Due to the low CBR value recorded, the above thickness assumes that he subgrade will be stabilised with 2% lime to a depth of 150mm.

5.3.5 Construction

The designs given above assume adequate provisions have been made for both surface and subsurface water.

The clayey site soils, which will make up the pavement subgrade are reactive. They will therefore be susceptible to shrinkage and swelling due to moisture content changes. If these subgrade soils are allowed to dry following compaction, it is probably that shrinkage will occur resulting in cracking. After placement of the pavement materials, the subgrade soils will moisten, resulting in swelling and partial loss of strength. It is therefore recommended that the subgrade be covered as soon as possible after completion of compaction in order to minimise the potential for evaporation and shrinkage to occur.

The subgrade materials should be compacted to a minimum density ratio of 100% of the Standard maximum dry density. Compaction should be verified by proof rolling and in-situ density tests. Base and subbase course materials should be compacted and tested to a minimum density ratio of 98% of the Modified maximum dry density. The level of compaction should be verified by in-situ density testing.

All pavement materials used should comply with the local council requirements.

5.4. Safe Batter Slopes

In the short term, dry cut slopes should remain stable at an angle of 1 to 1. In the long term dry cut slopes formed at an angle of 2(H) to 1(V) should remain stable. Slopes cut at this angle would be subject to erosion unless protected by topsoil and diversion drains at the crest of the slopes. In order to use mowers to maintain cut slopes, an angle of 4(H) to 1(V) or flatter should be used.

5.5. Retaining Wall Design

The parameters used to proportion the retaining walls depend on whether the walls can be permitted to deflect. For walls, which cannot be permitted to deflect, the “at rest” (K_o) conditions should be adopted. A value of 0.6 should be adopted. For walls that can be allowed to deflect, an active earth pressure coefficient (K_a) of 0.4 should be adopted. A passive earth pressure coefficient (K_p) of 2.5 may be used for the clays. A bulk density of 20 kN/m^3 may be used.

As with all retaining walls, the above coefficient must be adjusted for ground surface slope, groundwater and external loads, such as buildings and vehicles.

5.6. Site Preparation and Re-Grading

The performance of the slabs and pavements cannot be guaranteed unless the following procedures are adopted during the site earthworks:

- Remove any vegetation, topsoil and fill present. The exposed subgrade should be inspected by a geotechnical engineer who may wish to proof roll the exposed subgrade with a heavy, non-vibrating roller to detect soft or wet areas. These areas should be excavated to competent material and then filled as detailed below.

- Fill the site to the underside of slab or pavement level, in layers not exceeding 200 mm loose thickness, compacted to achieve a density ratio in the range of 98% to 102% of the Standard maximum dry density, at a moisture content within the range of -2% to +2% of the optimum for the material adopted.

The onsite silty clays can become untrafficable during periods of wet weather.

5.7. Soil Aggressiveness

The aggressiveness or erosion potential of an environment in building materials, particularly concrete and steel is dependent on the levels of soil pH and the types of salts present, generally sulphates. In order to determine the degree of aggressiveness, the test values obtained are compared to Tables 6.4.2 (C) and 6.5.2 (C) in AS2159 – 2009 Piling – Design and Installation and Tables 5.1 and 5.2 of AS2870-2011. In regards to the electrical conductivity, the laboratory test results have been multiplied by the appropriate factor to convert the results to EC_e. The test results are summarised in Table 5.6 below.

Table 5.6 – Soil Aggressiveness Summary Table

Sample No.	Location	Depth (m)	pH	Sulfate (mg/kg)	Electrical Conductivity (dS/m)	
					$EC_{1:5}$	EC_e
S2-3	BH2	1.0	5.2	180	0.640	4.480
S2-5	BH2	2.0	5.1	80	0.741	5.187
S2-6	BH2	2.5	5.4	160	0.790	5.530
S2-8	BH2	4.0	7.2	100	0.693	6.237
S8-2	BH8	0.5	6.2	10	0.155	1.085
S8-4	BH8	1.5	8.7	140	1.120	7.840
S8-5	BH8	2.0	8.7	120	0.944	6.608
S8-7	BH8	3.0	9.1	110	0.736	6.624
S15-2	BH15	0.5	6.4	90	0.112	0.784
S15-3	BH15	1.0	8.8	120	0.446	3.122

Table 5.6 – Soil Aggressiveness Summary Table (Cont.)

Sample No.	Location	Depth (m)	pH	Sulfate (mg/kg)	Electrical Conductivity (dS/m)	
					$EC_{1:5}$	EC_e
S15-5	BH15	2.0	8.7	10	0.192	1.728
S15-6	BH15	2.5	8.6	20	0.224	2.016

The report results range between:

- pH - 5.1 to 9.1
- soluble SO_4 - 10 to 180 mg/kg (ppm)
- EC_e - 0.784 to 7.840 dS/m

The soils on the site consist of low permeability silty clays. Therefore, the soil conditions B are considered appropriate.

A review of the durability aspects indicates that:

- pH : minimum value of 5.1
- SO_4 : maximum value of 180 mg/kg (ppm) < 5000 ppm
- EC_e : maximum value of 7.8 dS/m

The exposure classification for the onsite soils is non-aggressive for steel and mildly aggressive to concrete in accordance with AS2159-2009. The soils are classified as A2 in accordance with AS2870-2011.

6. SALINITY ASSESSMENT

6.1. Soil Test Results

The results of the soil sample analyses are provided in Tables 6.1 to Table 6.3. Table 6.1 also includes the appropriate multiplier factors used to convert results to EC_e (µS/cm) and the salinity class with which the soil sample falls according to Table 6.2: EC_e Values of Soil Salinity Classes in the publication entitled "Site Investigation for Urban Salinity (DLWC, 2002)".

Table 6.1 – Salinity Results

Sample ID	Sample Depth (m)	$EC_{1:5}$ (µS/cm)	Soil Type	Multiplier Factor	EC_e (µS/cm)	Salinity Class
S1-1	0.2	724	Silty Clay	7	5068	Moderately Saline
S2-2	0.5	437	Silty Clay	7	3059	Slightly Saline
S2-3	1.0	640	Silty Clay	7	4480	Moderately Saline
S2-4	1.5	780	Silty Clay	7	5460	Moderately Saline
S2-5	2.0	741	Silty Clay	7	5187	Moderately Saline
S2-6	2.5	790	Silty Clay	7	5530	Moderately Saline
S2-7	3.0	723	Silty Clay	7	5061	Moderately Saline
S2-8	4.0	693	Shale	9	6237	Moderately Saline
S4-1	0.2	226	Silty Clay	7	1582	Non Saline
S6-1	0.2	52	Silty Clay	7	364	Non Saline
S7-1	0.2	84	Silty Clay	7	588	Non Saline
S8-1	0.2	76	Silty Clay	7	532	Non Saline
S8-2	0.5	155	Silty Clay	7	1085	Non Saline
S8-3	1.0	997	Silty Clay	7	6979	Moderately Saline
S8-4	1.5	1120	Silty Clay	7	7840	Moderately Saline
S8-5	2.0	944	Silty Clay	7	6608	Moderately Saline
S8-6	2.5	666	Shale	9	5994	Moderately Saline
S8-7	3.0	736	Shale	9	6624	Moderately Saline
S8-8	4.0	570	Shale	9	5130	Moderately Saline
S9-1	0.2	430	Silty Clay	7	3010	Slightly Saline
S11-1	0.2	155	Silty Clay	7	1085	Non Saline
S12-1	0.2	87	Silty Clay	7	609	Non Saline
S13-1	0.2	58	Silty Clay	7	406	Non Saline
S14-1	0.2	100	Silty Clay	7	700	Non Saline
S15-1	0.2	87	Silty Clay	7	609	Non Saline
S15-2	0.5	112	Silty Clay	7	784	Non Saline
S15-3	1.0	446	Silty Clay	7	3122	Slightly Saline
S15-4	1.5	350	Sandstone	9	3150	Slightly Saline
S15-5	2.0	192	Sandstone	9	1728	Non Saline
S15-6	2.5	224	Sandstone	9	2016	Slightly Saline
S15-7	3.0	240	Sandstone	9	2160	Slightly Saline
S15-8	4.0	337	Sandstone	9	3033	Slightly Saline
S17-1	0.2	37	Silty Clay	7	259	Non Saline
S19-1	0.2	46	Silty Clay	7	322	Non Saline

Table 6.2 –Summary of ESP Results

Sample No.	Location	Depth (m)	ESP (%)	Sodicity
S2-3	BH2	1.0	21.5	Highly Sodic
S2-5	BH2	2.0	30.4	Highly Sodic
S2-6	BH2	2.5	29.9	Highly Sodic
S2-8	BH2	4.0	24.6	Highly Sodic
S8-2	BH8	0.5	10.3	Sodic
S8-4	BH8	1.5	6.6	Sodic
S8-5	BH8	2.0	13.4	Sodic
S8-7	BH8	3.0	9.0	Sodic
S13-1	BH13	0.2	1.4	Non-Sodic
S15-2	BH15	0.5	12.9	Sodic
S15-3	BH15	1.0	8.2	Sodic
S15-5	BH15	2.0	<0.2	Non-Sodic
S15-6	BH15	2.5	<0.2	Non-Sodic

Table 6.3 –Summary of Emerson Class Number Results

Sample No.	Location	Depth (m)	Emerson Class No.	Classification
8653/C1	BH2	0.5 – 1.1	6	Slaking, no dispersion
8653/C2	BH4	1.0 – 1.4	5	Slaking, no dispersion
8653/C3	BH8	0.3 – 0.8	3	Slaking, dispersion after remoulding
8653/C4	BH17	0.4 – 1.0	3	Slaking, dispersion after remoulding

EC_e is representative of the actual salinity level that the plant roots are exposed to and as such provides an indication of the toxicity of the soils to various plant species. Reported EC_e for the samples ranged from 259 µS/cm to 7840 µS/cm and may be classified as non-saline to moderately saline.

Sodicity is expressed as the amount of exchangeable sodium as a percentage of the Cation Exchange Capacity or ESP %. Soil with an ESP of less than 5% is considered non-sodic. Those with an ESP between 5 and 15% are considered sodic whereas those with an ESP greater than 15% are considered highly sodic. The ESP results indicate that the on-site soils which overly shale bedrock are sodic to highly sodic, whereas the soils which overly sandstone bedrock are non-sodic to sodic.

The results of the Emerson Class Number testing indicate that the on-site soils are Class 3 to Class 6. Soils of Class 3 are slaking and no dispersion before remoulding, dispersion after remoulding. Soils of Class 5 are slaking and no dispersion before remoulding, no dispersion after remoulding, no calcite or gypsum present and dispersion after slaking in a 1:5 soil/water suspension. Soils of Class 6 are as per Class 5, however experience flocculation after slaking in a 1:5 soil/water suspension. These results indicate that the soils are mostly non-dispersive.

6.2. Groundwater Salinity

As noted above, standpipe piezometers were installed in borehole BH2, BH8 and BH15. After installation, the piezometer was dewatered prior to sampling. Water samples were obtained six days later to ensure the sample was representative of the in-situ conditions. A description of salinity in water has been developed by Australia Water Resources Council and is given in Table 6.3.

Table 6.3 – Class of Groundwater Salinity

Class	Electrical Conductivity (µS/cm)
Fresh	0 – 800
Marginal	800 – 1600
Brackish	1600 – 4800
Saline	>4800

The electrical conductivity measured in SAL1 (BH8) is 35500 µS/cm, the electrical conductivity measured in SAL2 (BH2) is 33000 µS/cm. BH15 remained dry. This indicates the groundwater can be classified as saline.

6.3. Potential Impacts on Development

The general impacts that have the potential to occur may be summarised as:

- Damage to and subsequent reduction of the lifespan of buildings and associated infrastructure such as roads and underground services as a result of construction close to aggressive soil and groundwater. This may include:
    - Degradation of bricks, concrete, road base and curbing materials leading to expansion, cracking, strength and mass loss;

- Corrosion of reinforcement and loss of structural integrity;
- Rising/falling damp; and
- Non-structural impacts, such as efflorescence on bricks.

- Degradation of drainage infrastructure by a rise in the groundwater level. Damage to pipes has the potential to exacerbate the problem by further recharging the shallow groundwater; and

- Damage to or prevention of the cultivation of salt-sensitive vegetation in landscaped areas and gardens may arise across the site due to the salinity levels in surface soils.

The risks considered to be potentially posed to individual assets and activities and appropriate management options are detailed below.

The construction and maintenance stages of the proposed development have the potential to adversely affect salinity conditions on the site and in the surrounding area, mostly by altering the current hydrological cycle. Potential impacts include:

- A rise in the groundwater level due to increased water inputs associated with urban development. e.g. irrigation and leaking pipes. Reduced infiltration due to the construction of hardstand across the site may offset this to some extent;

- Altered flow and drainage patterns which may result in increased water accumulation and associated salinity issues in areas of impeded flow, as a consequence of e.g. the construction of drainage lines, footings and roads;

- Interception of groundwater should local groundwater levels be raised by prolonged periods of precipitation, creation of a perched water table, or increased recharge of the regional or localized aquifer may result from cutting or compaction within the perched or permanent aquifer;

- Excavation and redistribution of saline soil during excavation and filling operations around the site.

These impacts have the potential to lead to an increase in the surface expression of soil salinity and adversely affect downstream water quality.

6.4. Salinity Model

The testing results (provided in Table 6.1 to 6.3) indicates that the soils tested are classed as being mostly non saline to moderately saline. The majority of the near surface soils were non saline. Therefore, the soils are unlikely to present a risk of producing adverse salinity-based impacts. The groundwater below the site is saline and occurs at depths of approximately 2.0 to 2.5 metres below the land surface. Further, the results suggest that the soils on site are classed as sodic to highly sodic and non-dispersive. Sodic soils have the potential to lose structure and become dispersive when saturated, and therefore can be both poorly draining and susceptible to erosion. However, many Australian soils are sodic and sodicity is not necessarily a function of land salinity.

Therefore, the main mechanisms by which salts could potentially be mobilised, thereby amplifying salinity issues, include;

- raising of the groundwater table;
- impedance of groundwater flow or surface water drainage;

These mechanisms would result in an increased surface expression of salinity.

6.5. Salinity Risk Assessment and Conclusions

Based on the results of the salinity assessment, the following conclusions are made:

- Soil salinity is not expected to impact on the proposed site development, therefore a salinity management plan will not be required.
- The groundwater beneath the site should not be extracted for use as an irrigation source;
- Standard landscaping procedures for urban development sites would be sufficient to prevent any surface expression of salinity or impacts due to sodic soils. Such procedures would include the design and installation of appropriate drainage, covering landscaping zones in topsoil and revegetating.
- Selection of appropriate building designs and materials would also be necessary to ensure that the integrity of building foundations and floor slabs is not compromised due to the natural acidity, electrical conductivity and concentrations of key anions in the soils. Reference should be made to Section 5.7 of this report for advice regarding the aggressiveness of soils to buried steel and concrete.

7. WASTEWATER ASSESSMENT

7.1. Introduction

Climate data used to prepare the wastewater management plan for the site is that recorded by the Australian Government Bureau of Meteorology at Prospect Water Reservoir, Prospect, about 12.0km north east of the site. Details are given in Appendix A.

Table 7.1 – Monthly Rainfall and Evaporation Data

Month	Rainfall (Median) (mm)	Average Evaporation (mm)
January	73.2	170.5
February	73.1	131.6
March	78.3	120.9
April	57.2	87
May	38.4	62
June	50.0	48
July	32.9	52.7
August	30.9	77.5
September	40.2	108
October	43.1	136.4
November	60.1	150
December	58.0	173.6

Note: Data was obtained from the Prospect Water Reservoir (Prospect) weather station via the Bureau of Meteorology.

7.2. Laboratory Test Results

The physical soil parameters are summarised in Table 7.2 and the chemical parameters in Table 7.3.

Table 7.2 – Physical Soil Properties

Location	Depth (m)	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Material Description[1]
BH13	0.0 – 0.4	17	16	44	23	Loam
BH14	0.0 – 0.4	14	20	48	18	Loam

[1] = As given in AS/NZS 1547:2012

Table 7.3 – Soil Chemical Properties

Location	Depth (m)	pH	Electrical Conductivity (µS/cm)	CEC (meq/100g)	ESP (%)	Phosphorous Sorption Capacity (mgP)
BH13	0.2	6.7	58	17.1	1.4	766
BH14	0.9	6.9	100	17.7	11.5	1090

Based on the results in Table 2, the Design Irrigation Rate (DIR) has been determined using Table M1 in AS/NZ1547:2012. A DIR value of 21 mm/week (28 divided by a factor of safety of 1.3) has been adopted for a spray irrigation system.

7.3. Wastewater Assessment

Individual soil features are discussed below and a limitation rating is provided for each feature.

- Depth of soil – greater than the 0.4 m minimum required.
- Depth to water table – 2.0m.
- Soil permeability – DIR values of 21 mm/week are consistent with a soil of moderate permeability. This poses a minor limitation.
- Emerson Crumb – The soils are primarily Class 3, Class 5 and Class 6. These soils pose no limitation due to the soils potential to disperse.
- pH – The values of 6.7 and 6.9 pose no limitation.
- Electrical conductivity – this is a measure of soil salinity. Values below 4 dS/m (4000µS/cm) pose no limitations. The measured values are significantly less than this value.
- Sodicity – Exchangeable sodium percentage (ESP) is a measure of sodicity. Values less than 5 are considered non-sodic, whilst values greater than 15 are considered highly sodic. Values of 1.4 and 11.5 indicate non sodic to sodic soils are present. This poses a minor limitation.
- Cation Exchange Capacity (CEC) – A measure of the soil's ability to retain nutrients. Values in excess of 15 meq/100g pose no constraints. The measures values of 17.1 and 17.7 are in excess of 15 and therefore pose no limitation.

- Phosphorus Sorption – A measure of the soil's ability to immobilise excess phosphorus. Values in excess of 6000 kg/ha pose no constraints. Values of less than 2000 kg/ha pose a major limitation. The measured values are less than 2000kg/ha, and therefore pose a major limitation.

The above assessment indicates there are minor and major limitations on the soils

7.4. Site Constraints

Individual site features are discussed below and a limitation rating provided for each:

- Flood potential – It is unknown whether the site is above the 1 in 100-year flood contour.
- Exposure – The proposed disposal area has good wind and sun exposure.
- Slope – The slopes on the site are less than 5 degrees. Ensuring a good grass cover is maintained in the spray areas should ensure minimal if any erosion.
- Run on and up slope drainage – Where this is excessive, wastewater can be transported off site. The site has a gentle slope so run on drainage should not pose a limitation.
- Erosion potential - None visible on the site.
- Site drainage – No sign of surface dampness.
- Rock outcrops – None present on the site.
- Fill – No fill is present.
- Geology – There are no geological discontinuities in the area.
- Buffer distances – The buffer distances given in Table 7.4 should be adopted.

Table 7.4 – Recommended Buffer Distances

System	Recommended Buffer Distances
All land application systems	100 metres to permanent surface waters (e.g. river, streams, lakes, etc) 250 metres to domestic groundwater well 40 metres to other waters (e.g. farm dams, intermittent waterways and drainage channels, etc)
Surface spray irrigation	6 metres if area up-gradient and 3 metres if area down-gradient of driveways and property boundaries 15 metres to dwellings 3 metres to paths and walkways
Subsurface irrigation	6 metres if area up-gradient and 3 metres if area down-gradient of swimming pools, property boundaries, driveways and buildings.

7.5. Required Irrigation Area

The design criteria for sizing the required wastewater irrigation area are detailed in AS 1547. The required area for spray irrigation is calculated as follows:

$$A_i = q_w/DIR$$

Where

A_i = irrigation area required (m^2)

q_w = total quantity of effluent generated per week (L-litres)

DIR = design irrigation rate (litres/m^2/week)

The Australian Standard estimates a minimum design daily effluent flow of 180 litres per person per day for occupants. This assumes the office will be fitted with two toilets with hand basins, together with a kitchen area with sink. We have assumed the office will be accommodate up to 6 occupants. This equates to 7560 litres of weekly effluent.

For a DIR value of 21 litres/week, the minimum surface irrigation area required is:

$$A_i = 6300/21 = 360\ m^2$$

7.6. Hydraulic Loading

The hydraulic loading provides an indication of the potential periods when wet weather storage may be required. The hydraulic loading is given by the following relationships:

Hydraulic Loading = Precipitation - (Evapo transpiration + Percolation)

The monthly hydraulic loadings for the sites are determined from the water balance given in Appendix D. Hydraulic loads in excess of zero indicate wastewater storage is required. A minimum subsurface spray irrigation disposal area of 475 m^2 will be required if no storage is provided for 6 people.

7.7. Nutrient Balance

The amount of nutrient available can be determined by multiplying the effluent application note by the amount of nutrient in the effluent. The available nutrients are given below in Table 7.5.

Table 7.5 – Available Nutrients

Effluent Rate (litres per day)	Nitrogen[1] (kg/yr)	Phosphorous[2] (kg/yr)
1080	9.9	3.9

[1] = Assume a nominal rate of 30 mg/litre

[2] = Assume nominal rate of 12 mg/litre

In regards to the nitrogen, a nominal rate of 25 mg/m^2 /day has been assumed for the uptake of nitrogen into the soil. We have assumed that 50% of the nitrogen will be either lost to the atmosphere or taken up by the vegetation.

The area required is calculated as follows:

$$A = \frac{(0.5 \times 30) \times Q}{25} \qquad Q = \text{flow rate (L/d)}$$

$$= 648 m^2$$

The phosphorous sorption capacity of the onsite soils range between 766 and 1,090 mg/kg, with an average value of 928 mg/kg. Based on a bulk unit weight of 17kN/m^3 and an effective thickness of 0.4m, this equates to an uptake of 0.63 kg/m^2.

The area required for a 50-year life can be determined by multiplying the life required by the available phosphorous. This equates to

$$\text{Area} = \frac{P_{\text{generated}}}{P_{\text{uptake}}}$$

$$= \frac{50 \times 3.9}{0.63}$$

$$= 310\ m^2$$

7.8. Conclusion

Based on the above assessment the required area for the different criteria are given below in Table 7.6:

Table 7.6 – Summary Table

Criteria	Hydraulic	Nitrogen	Phosphorous
Area required (m^2)	475	648	310

The nitrogen requirements dictate the minimum disposal area required; i.e. 648 m^2.

The limitations associated with permeability have been addressed in the calculations given above.

8. PRELIMINARY ACID SULFATE SOILS ASSESSMENT

8.1. Introduction

ASS are the common name given to sediments and soils containing iron sulfides which, when exposed to oxygen generate sulfuric acid. Natural processes formed the majority of acid sulfate sediments when certain conditions existed in the Holocene geological period (the last 10,000 years). Formation conditions require the presence of iron-rich sediments, sulfate (usually from seawater), removal of reaction products such as bicarbonate, the presence of sulfate reducing bacteria and a plentiful supply of organic matter. It should be noted that these conditions exist in mangroves, salt marsh vegetation or tidal areas, and at the bottom of coastal rivers and lakes.

The relatively specific conditions under which acid sulfate soils are formed usually limit their occurrence to low lying parts of coastal floodplains, rivers and creeks. This includes areas with saline or brackish water such as deltas, coastal flats, backswamps and seasonal or permanent freshwater swamps that were formerly brackish. Due to flooding and stormwater erosion, these sulfidic sediments may continue to be re-distributed through the sands and sediments of the estuarine floodplain region. Sulfidic sediment may be found at any depth in suitable coastal sediments – usually beneath the water table.

Any lowering in the water table that covers and protects potential ASS will result in their aeration and the exposure of iron sulfide sediments to oxygen. The lowering in the water table can occur naturally due to seasonal fluctuations and drought or any human intervention, when carrying out any excavations during site development. Potential ASS can also be the exposed to air during physical disturbance with the material at the disturbance face, as well as the extracted material, both potentially being oxidised. The oxidation of iron sulfide sediments in potential ASS results in ASS soils.

Successful management of areas with ASS is possible but must take into account the specific nature of the site and the environmental consequences of development. While it is preferable that sites exhibiting acid sulfate characteristics not be disturbed, management techniques have been devised to minimise and manage impacts in certain circumstances.

When works involving the disturbance of soil or the change of groundwater levels are proposed in coastal areas, a preliminary assessment should be undertaken to determine whether acid sulfate soils are present and if the proposed works are likely to disturb these soils.

8.2. Presence of ASS

Reference to the Liverpool ASS Risk Map indicates the property is within an area where there are no known occurrences of ASS. It should be noted that maps are a guide only.

The following geomorphic or site criteria are normally used to determine if acid sulfate soils are likely to be present:

- sediments of recent geological age (Holocene)
- soil horizons less than 5 in AHD
- marine or estuarine sediments and tidal lakes
- in coastal wetlands or back swamp areas

8.3. Assessment

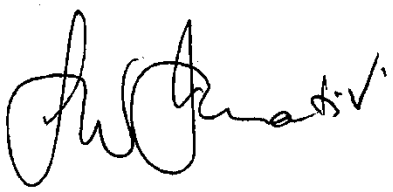
The property is at an elevation of about RL50 m AHD and is underlain by Bringelly Shale. This is not consistent with the geomorphic criteria necessary for the presence of ASS. Based on our onsite observations and the subsurface conditions exposed in the boreholes, it is our opinion that the proposed construction will not intercept any ASS. Based on the observations undertaken in the piezometers, it appears that any seepage into any excavations would be minor and as a consequence, construction will not result in the lowering of any groundwater that may be present in the area.

Our assessment is the proposed construction will not require the preparation of an Acid Sulfate Soil Management Plan

9. FINAL COMMENTS

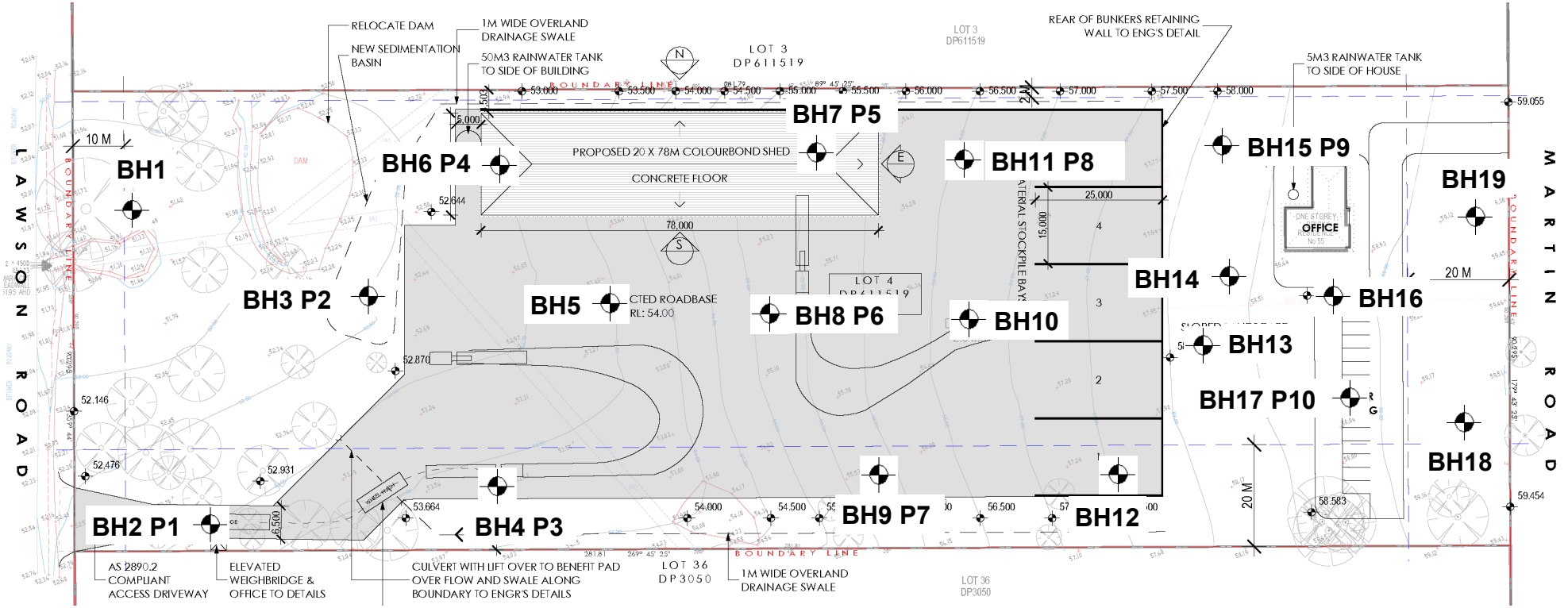
During construction, should the subsurface conditions vary from those inferred above, we would be contacted to determine if any changes should be made to our recommendations.

The exposed bearing surfaces for footings should be inspected by a geotechnical engineer to ensure the allowable pressure given has been achieved.



Matt Green
Senior Engineering Geologist

Laurie Ihnativ
Principal Geotechnical Engineer



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Client: AMJ DEMOLITION AND EXCAVATION		
GEOTECHNICAL INVESTIGATION **55 MARTIN ROAD, BADGERYS CREEK** **BOREHOLE AND PENETROMETER LOCATIONS**	Project No. 21649/8653C	
	Drawing No: 17/3905	

NOTES RELATING TO GEOTECHNICAL REPORTS

Introduction

These notes have been provided to outline the methodology and limitations inherent in geotechnical reporting. The issues discussed are not relevant to all reports and further advice should be sought if there are any queries regarding any advice or report.

When copies of reports are made, they should be reproduced in full.

Geotechnical Reports

Geotechnical reports are prepared by qualified personnel on the information supplied or obtained and are based on current engineering standards of interpretation and analysis.

Information may be gained from limited subsurface testing, surface observations, previous work and is supplemented by knowledge of the local geology and experience of the range of properties that may be exhibited by the materials present. For this reason, geotechnical reports should be regarded as interpretative rather than factual documents, limited to some extent by the scope of information on which they rely.

Where the report has been prepared for a specific purpose (eg. design of a three-storey building), the information and interpretation may not be appropriate if the design is changed (eg. a twenty storey building). In such cases, the report and the sufficiency of the existing work should be reviewed by SMEC Testing Services Pty Limited in the light of the new proposal.

Every care is taken with the report content, however, it is not always possible to anticipate or assume responsibility for the following conditions:

- Unexpected variations in ground conditions. The potential for this depends on the amount of investigative work undertaken.
- Changes in policy or interpretation by statutory authorities.
- The actions of contractors responding to commercial pressures.

If these occur, SMEC Testing Services Pty Limited would be pleased to resolve the matter through further investigation, analysis or advice.

Unforeseen Conditions

Should conditions encountered on site differ markedly from those anticipated from the information contained in the report, SMEC Testing Services Pty Limited should be notified immediately. Early identification of site anomalies generally results in any problems being more readily resolved and allows re-interpretation and assessment of the implications for future work.

Subsurface Information

Logs of a borehole, recovered core, test pit, excavated face or cone penetration test are an engineering and/or geological interpretation of the subsurface conditions. The reliability of the logged information depends on the drilling/testing method, sampling and/or observation spacings and the ground conditions. It is not always possible or economic to obtain continuous high quality data. It should also be recognised that the volume or material observed or tested is only a fraction of the total subsurface profile.

Interpretation of subsurface information and application to design and construction must take into consideration the spacing of the test locations, the frequency of observations and testing, and the possibility that geological boundaries may vary between observation points.

Groundwater observations and measurements outside of specially designed and constructed piezometers should be treated with care for the following reasons:

- In low permeability soils groundwater may not seep into an excavation or bore in the short time it is left open.
- A localised perched water table may not represent the true water table.
- Groundwater levels vary according to rainfall events or season.
- Some drilling and testing procedures mask or prevent groundwater inflow.

The installation of piezometers and long term monitoring of groundwater levels may be required to adequately identify groundwater conditions.

Supply of Geotechnical Information or Tendering Purposes

It is recommended tenderers are provided with as much geological and geotechnical information that is available and that where there are uncertainties regarding the ground conditions, prospective tenders should be provided with comments discussing the range of likely conditions in addition to the investigation data.

APPENDIX A – BOREHOLE LOGS AND EXPLANATION SHEETS

STS GeoEnvironmental Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: AMJ Demolition and Excavation P/L	Project / STS No.: 21649/8653C	**BOREHOLE NO.: BH 1**
Project: 55 Martin Road, Badgerys Creek	Date: December 12, 2017	
Location: Refer to Drawing No. 17/3905	Logged: DL Checked By: MG	Sheet 1 of 1

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
	S1/1 @ 0.2 m		SILTY CLAY: brown with dark brown, low to medium plasticity, trace of gravel TOPSOIL	CL		D-M
			BOREHOLE DISCONTINUED AT 0.3 M			
		1.0				
		2.0				
		3.0				
		4.0				
		5.0				

D - disturbed sample U - undisturbed tube sample B - bulk sample

WT - level of water table or free water N - Standard Penetration Test (SPT)

S - jar sample

Contractor: STS

Equipment: Christie

Hole Diameter (mm): 100/200/300

Angle from Vertical (^{o}):

Drill Bit: V/Spiral/Two Prong

NOTES: See explanation sheets for meaning of all descriptive terms and symbols

STS GeoEnvironmental Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: AMJ Demolition and Excavation P/L	Project / STS No.: 21649/8653C	**BOREHOLE NO.: BH 2**
Project: 55 Martin Road, Badgerys Creek	Date: December 12, 2017	
Location: Refer to Drawing No. 17/3905	Logged: JK Checked By: MG	Sheet 1 of 1

WATER	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
	S2-1/DUP/TRI @ 0.2 m S2-2 @ 0.5 m		SILTY CLAY: dark brown, medium plasticity TOPSOIL	CL	FIRM TO STIFF	D
	U50 0.5-0.8 m S2-3 @ 1.0 m B @ 0.5- 1.1 m	1.0	SILTY CLAY: red brown with orange brown and light grey, medium to high plasticity	CL/CH	STIFF	D-M M
WT 18/12/17	S2-4 @ 1.5 m S2-5 @ 2.0 m S2-6 @ 2.5 m S2-7 @ 3.0 m	2.0 3.0	SILTY CLAY: light grey with yellow brown/orange brown, medium to high plasticity	CL/CH	VERY STIFF	M M-D
	S2-8 @ 4.0 m	4.0 5.0	WEATHERED SHALE: dark grey with light grey, clay seams, trace of fine grained sand STANDPIPE PIEZOMETER INSTALLED BOREHOLE DISCONTINUED AT 6.0 M ON WEATHERED SHALE		EXTREMELY LOW STRENGTH	D D-M

D - disturbed sample U - undisturbed tube sample B - bulk sample

WT - level of water table or free water N - Standard Penetration Test (SPT)

S - jar sample

NOTES: See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS

Equipment: Edson RP70

Hole Diameter (mm): 100

Angle from Vertical (^{o}):

Drill Bit: Spiral

STS GeoEnvironmental Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: AMJ Demolition and Excavation P/L	Project / STS No.: 21649/8653C	**BOREHOLE NO.: BH 3**
Project: 55 Martin Road, Badgerys Creek	Date: December 12, 2017	
Location: Refer to Drawing No. 17/3905	Logged: DL Checked By: MG	Sheet 1 of 1

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
	S3/1 @ 0.2 m		SILTY CLAY: brown with light brown, low to medium plasticity, trace of gravel	CL	FIRM TO STIFF	D-M
			TOPSOIL			
	S3/2 @ 0.8 m		SILTY CLAY: light brown with light grey and some light orange, medium to high plasticity, trace of grave	CL/CH	STIFF	M
		1.0				
	S3/3 @ 1.6 m		SILTY CLAY: grey with light grey and some light brown, low to medium plasticity, trace of gravel	CL	VERY STIFF	D-M
		2.0				
		3.0				
			WEATHERED SHALE: grey with light grey		EXTREMELY LOW STRENGTH	
			AUGER REFUSAL AT 3.2 M ON WEATHERED SHALE			
		4.0				
		5.0				

D - disturbed sample U - undisturbed tube sample B - bulk sample

WT - level of water table or free water N - Standard Penetration Test (SPT)

S - jar sample

NOTES: See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS

Equipment: Christie

Hole Diameter (mm): 100/200/300

Angle from Vertical (^{o}):

Drill Bit: V/Spiral/Two Prong

STS GeoEnvironmental Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: AMJ Demolition and Excavation P/L	Project / STS No.: 21649/8653C	**BOREHOLE NO.: BH 4**
Project: 55 Martin Road, Badgerys Creek	Date: December 12, 2017	
Location: Refer to Drawing No. 17/3905	Logged: DL Checked By: MG	Sheet 1 of 1

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
	S4/1 @ 0.2 m		SILTY CLAY: brown with dark brown, low to medium plasticity, trace of gravel	CL	STIFF	D-M
			TOPSOIL			
	S4/2 @ 0.7 m		SILTY CLAY: light brown with orange brown, low to medium plasticity, trace of gravel, trace of fine grained sand	CL	STIFF	M
	S4/3 @ 0.9 m					
	B 1.0-1.4 m	1.0	SILTY CLAY: orange brown with light grey and some light brown, medium to high plasticity, trace of gravel	CL/CH	VERY STIFF	M
	S4/4 @ 1.4 m		SILTY CLAY: light grey with light brown, medium to high plasticity, trace of gravel	CL/CH	VERY STIFF	M
	S4/5 @ 2.1 m	2.0	SILTY CLAY: light brown with grey and some light grey, low to medium plasticity, trace of shale	CL	VERY STIFF	M
	S4/6 @ 3.0 m	3.0	SILTY CLAY: grey with light grey, low to medium plasticity, trace of shale	CL	VERY STIFF	M
			WEATHERED SHALE: grey with dark grey		EXTREMELY LOW STRENGTH	
		4.0	AUGER REFUSAL AT 3.8 M ON WEATHERED SHALE			
		5.0				

D - disturbed sample U - undisturbed tube sample B - bulk sample

WT - level of water table or free water N - Standard Penetration Test (SPT)

S - jar sample

Contractor: STS

Equipment: Christie

Hole Diameter (mm): 100/200/300

Angle from Vertical (^{o}):

Drill Bit: V/Spiral/Two Prong

NOTES: See explanation sheets for meaning of all descriptive terms and symbols

STS GeoEnvironmental Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: AMJ Demolition and Excavation P/L	Project / STS No.: 21649/8653C	**BOREHOLE NO.: BH 5**
Project: 55 Martin Road, Badgerys Creek	Date: December 12, 2017	
Location: Refer to Drawing No. 17/3905	Logged: DL Checked By: MG	Sheet 1 of 1

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
	S5/1 @ 0.2 m		SILTY CLAY: brown with dark brown, low to medium plasticity, trace of gravel TOPSOIL	CL		D
			BOREHOLE DISCONTINUED AT 0.3 M			
		1.0				
		2.0				
		3.0				
		4.0				
		5.0				

D - disturbed sample U - undisturbed tube sample B - bulk sample

WT - level of water table or free water N - Standard Penetration Test (SPT)

S - jar sample

Contractor: STS

Equipment: Christie

Hole Diameter (mm): 100/200/300

Angle from Vertical (^{o}):

Drill Bit: V/Spiral/Two Prong

NOTES: See explanation sheets for meaning of all descriptive terms and symbols

STS GeoEnvironmental Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: AMJ Demolition and Excavation P/L	Project / STS No.: 21649/8653C	**BOREHOLE NO.: BH 6**
Project: 55 Martin Road, Badgerys Creek	Date: December 12, 2017	
Location: Refer to Drawing No. 17/3905	Logged: DL Checked By: MG	Sheet 1 of 1

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
	S6/1 @ 0.2 m		SILTY CLAY: brown with dark brown, low to medium plasticity, trace of gravel	CL	STIFF	D
	S6/2 @ 0.6 m		TOPSOIL SILTY CLAY: light brown with light grey, low to medium plasticity, trace of gravel	CL	VERY STIFF	D-M
	U50	1.0				
	S6/3 @ 1.6 m		SILTY CLAY: light grey with grey, medium to high plasticity, trace of gravel	CL/CH	VERY STIFF	M
	S6/4 @ 2.4 m	2.0	SILTY CLAY: light brown with light grey, low to medium plasticity, trace of gravel	CL	VERY STIFF	D-M
		3.0	WEATHERED SHALE: light brown with brown		EXTREMELY LOW STRENGTH	
			AUGER REFUSAL AT 3.3 M ON WEATHERED SHALE			
		4.0				
		5.0				

D - disturbed sample U - undisturbed tube sample B - bulk sample

WT - level of water table or free water N - Standard Penetration Test (SPT)

S - jar sample

Contractor: STS

Equipment: Christie

Hole Diameter (mm): 100/200/300

NOTES: See explanation sheets for meaning of all descriptive terms and symbols

Angle from Vertical (^{o}):

Drill Bit: V/Spiral/Two Prong

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GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: AMJ Demolition and Excavation P/L	Project / STS No.: 21649/8653C	**BOREHOLE NO.: BH 7**
Project: 55 Martin Road, Badgerys Creek	Date: December 12, 2017	
Location: Refer to Drawing No. 17/3905	Logged: DL Checked By: MG	Sheet 1 of 1

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
	S7/1 @ 0.2 m		SILTY CLAY: brown with light brown, low to medium plasticity, trace of gravel	CL	STIFF	D-M
	S7/2 @ 0.7 m		TOPSOIL SILTY CLAY: light brown with light grey, low to medium plasticity, trace of gravel	CL	VERY STIFF	D-M
	U50	1.0				
	S7/3 @ 1.6 m	2.0	SILTY CLAY: light grey with light brown, medium to high plasticity, trace of gravel	CL/CH	VERY STIFF	M
	S7/4 @ 2.8 m	3.0	SILTY CLAY: grey with light grey and some orange brown, low to medium plasticity, trace of shale	CL	VERY STIFF	M
			WEATHERED SHALE: grey with dark grey		EXTREMELY LOW STRENGTH	
		4.0	AUGER REFUSAL AT 3.6 M ON WEATHERED SHALE			
		5.0				

D - disturbed sample U - undisturbed tube sample B - bulk sample

WT - level of water table or free water N - Standard Penetration Test (SPT)

S - jar sample

Contractor: STS

Equipment: Christie

Hole Diameter (mm): 100/200/300

NOTES: See explanation sheets for meaning of all descriptive terms and symbols

Angle from Vertical (^{o}):

Drill Bit: V/Spiral/Two Prong

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GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: AMJ Demolition and Excavation P/L	Project / STS No.: 21649/8653C	**BOREHOLE NO.: BH 8**
Project: 55 Martin Road, Badgerys Creek	Date: December 12, 2017	
Location: Refer to Drawing No. 17/3905	Logged: JK Checked By: MG	Sheet 1 of 1

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
	S1/DUP/TRI @ 0.2 m		SILTY CLAY: dark brown, low plasticity	CL	FIRM TO STIFF	D
	S8/2 @ 0.5 m		TOPSOIL			
	B @0.3-0.9m		SILTY CLAY: orange brown with light grey, medium to high plasticity	CL/CH	STIFF	M
	S8/3 @ 1.0m	1.0	SILTY CLAY: light grey with yellow brown/orange brown, medium to high plasticity	CL/CH	STIFF	M
	S8/4 @ 1.5 m					
	S8/5 @ 2.0 m	2.0			VERY STIFF	
	S8/6 @ 2.5 m					
WT 18/12/17			WEATHERED SHALE: dark grey with occasional light grey, trace of fine grained sand		EXTREMELY LOW STRENGTH	D
	S8/7 @ 3.0 m	3.0				
	S8/8 @ 4.0 m	4.0				
		5.0				
			STANDPIPE PIEZOMETER INSTALLED			
			BOREHOLE DISCONTINUED AT 6.0 M			

D - disturbed sample U - undisturbed tube sample B - bulk sample
WT - level of water table or free water N - Standard Penetration Test (SPT)
S - jar sample

NOTES: See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS
Equipment: Edson RP70
Hole Diameter (mm): 100
Angle from Vertical (^{o}):
Drill Bit: Spiral

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GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: AMJ Demolition and Excavation P/L	Project / STS No.: 21649/8653C	**BOREHOLE NO.: BH 9**
Project: 55 Martin Road, Badgerys Creek	Date: December 12, 2017	
Location: Refer to Drawing No. 17/3905	Logged: JK Checked By: MG	Sheet 1 of 1

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
	S9/1 @ 0.2 m		SILTY CLAY: dark brown, low plasticity TOPSOIL	CL	FIRM TO STIFF	D
		1.0	SILTY CLAY: orange brown with light grey, medium to high plasticity	CL/CH	STIFF	M-D
			SILTY CLAY: light grey with orange brown, medium to high plasticity	CL/CH	VERY STIFF	M
		2.0	WEATHERED SHALE: light grey with dark grey, fine grained, clay seams		EXTREMELY LOW STRENGTH	D
		3.0				
		4.0	AUGER REFUSAL AT 4.0 M ON WEATHERED SHALE			
		5.0				

D - disturbed sample U - undisturbed tube sample B - bulk sample

WT - level of water table or free water N - Standard Penetration Test (SPT)

S - jar sample

Contractor: STS

Equipment: Edson RP70

Hole Diameter (mm): 100/200/300

Angle from Vertical (^{o}):

Drill Bit: V/Spiral/Two Prong

NOTES: See explanation sheets for meaning of all descriptive terms and symbols

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GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: AMJ Demolition and Excavation P/L	Project / STS No.: 21649/8653C	**BOREHOLE NO.: BH 10**
Project: 55 Martin Road, Badgerys Creek	Date: December 12, 2017	
Location: Refer to Drawing No. 17/3905	Logged: DL Checked By: MG	Sheet 1 of 1

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
	S10/1 @ 0.2 m		SILTY CLAY: brown with dark brown, low to medium plasticity, trace of gravel TOPSOIL	CL		D
			BOREHOLE DISCONTINUED AT 0.3 M			
		1.0				
		2.0				
		3.0				
		4.0				
		5.0				

D - disturbed sample U - undisturbed tube sample B - bulk sample

WT - level of water table or free water N - Standard Penetration Test (SPT)

S - jar sample

Contractor: STS

Equipment: Christie

Hole Diameter (mm): 100/200/300

Angle from Vertical (^{o}):

Drill Bit: V/Spiral/Two Prong

NOTES: See explanation sheets for meaning of all descriptive terms and symbols

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GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: AMJ Demolition and Excavation P/L	Project / STS No.: 21649/8653C	**BOREHOLE NO.: BH 11**
Project: 55 Martin Road, Badgerys Creek	Date: December 12, 2017	
Location: Refer to Drawing No. 17/3905	Logged: JK Checked By: MG	Sheet 1 of 1

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
	S1/DUP/TRI @ 0.2 m		SILTY CLAY: dark brown/orange brown, medium plasticity TOPSOIL	CL	FIRM TO STIFF	D-M
		1.0	SILTY CLAY: orange brown with light grey, medium to high plasticity	CL/CH	STIFF	M
		2.0	SILTY CLAY: light grey with orange brown and yellow brown, medium plasticity, trace of fine grained sand	CL	VERY STIFF	M-D
		3.0				
		4.0	WEATHERED SHALE: light brown with orange brown and dark grey, fine grained, clay seams		EXTREMELY LOW STRENGTH	D
		5.0	AUGER REFUSAL AT 4.5 M ON WEATHERED SHALE			

D - disturbed sample U - undisturbed tube sample B - bulk sample

WT - level of water table or free water N - Standard Penetration Test (SPT)

S - jar sample

Contractor: STS

Equipment: Edson RP70

Hole Diameter (mm): 100

Angle from Vertical (^{o}):

Drill Bit: Spiral

NOTES: See explanation sheets for meaning of all descriptive terms and symbols

STS GeoEnvironmental Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: AMJ Demolition and Excavation P/L	Project / STS No.: 21649/8653C	**BOREHOLE NO.: BH 12**
Project: 55 Martin Road, Badgerys Creek	Date: December 12, 2017	
Location: Refer to Drawing No. 17/3905	Logged: DL Checked By: MG	Sheet 1 of 1

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
	S12/1 @ 0.2 m		SILTY CLAY: brown with dark brown, low to medium plasticity, trace of gravel TOPSOIL	CL		D
			BOREHOLE DISCONTINUED AT 0.3 M			
		1.0				
		2.0				
		3.0				
		4.0				
		5.0				

D - disturbed sample U - undisturbed tube sample B - bulk sample

WT - level of water table or free water N - Standard Penetration Test (SPT)

S - jar sample

Contractor: STS

Equipment: Christie

Hole Diameter (mm): 100/200/300

Angle from Vertical (^{o}):

Drill Bit: V/Spiral/Two Prong

NOTES: See explanation sheets for meaning of all descriptive terms and symbols

STS GeoEnvironmental Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: AMJ Demolition and Excavation P/L	Project / STS No.: 21649/8653C	**BOREHOLE NO.: BH 13**
Project: 55 Martin Road, Badgerys Creek	Date: December 12, 2017	
Location: Refer to Drawing No. 17/3905	Logged: DL Checked By: MG	Sheet 1 of 1

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
	S12/1 @ 0.2 m B1 @ 0.4 m		SILTY CLAY: brown with dark brown, low to medium plasticity, trace of gravel TOPSOIL	CL		D
		1.0	SILTY CLAY: light brown with orange brown, low to medium plasticity, trace of gravel	CL		D
		2.0	BOREHOLE DISCONTINUED AT 1.5 M			
		3.0				
		4.0				
		5.0				

D - disturbed sample U - undisturbed tube sample B - bulk sample

WT - level of water table or free water N - Standard Penetration Test (SPT)

S - jar sample

Contractor: STS

Equipment: Christie

Hole Diameter (mm): 100/200/300

Angle from Vertical (^{o}):

Drill Bit: V/Spiral/Two Prong

NOTES: See explanation sheets for meaning of all descriptive terms and symbols

STS GeoEnvironmental Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: AMJ Demolition and Excavation P/L	Project / STS No.: 21649/8653C	**BOREHOLE NO.: BH 14**
Project: 55 Martin Road, Badgerys Creek	Date: December 12, 2017	
Location: Refer to Drawing No. 17/3905	Logged: DL Checked By: MG	Sheet 1 of 1

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
	S14/1 @ 0.2 m B2 @ 0.4 m		SILTY CLAY: dark brown with brown, low to medium plasticity, trace of gravel TOPSOIL	CL		D
	S14/2 @ 0.9 m	1.0	SILTY CLAY: light brown with orange brown, low to medium plasticity, trace of gravel	CL		D
		2.0	BOREHOLE DISCONTINUED AT 1.5 M			
		3.0				
		4.0				
		5.0				

D - disturbed sample U - undisturbed tube sample B - bulk sample

WT - level of water table or free water N - Standard Penetration Test (SPT)

S - jar sample

Contractor: STS

Equipment: Christie

Hole Diameter (mm): 100/200/300

Angle from Vertical (^{o}):

Drill Bit: V/Spiral/Two Prong

NOTES: See explanation sheets for meaning of all descriptive terms and symbols

STS GeoEnvironmental Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: AMJ Demolition and Excavation P/L	Project / STS No.: 21649/8653C	**BOREHOLE NO.: BH 15**
Project: 55 Martin Road, Badgerys Creek	Date: December 12, 2017	
Location: Refer to Drawing No. 17/3905	Logged: JK Checked By: MG	Sheet 1 of 1

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
	B4/S15-1 @ 0.2 m		SILTY CLAY: dark brown, low plasticity TOPSOIL	CL	FIRM	D
	S15/2 @ 0.5 m		SILTY CLAY: orange brown with light grey, medium to high plasticity	CL/CH	FIRM TO STIFF	D-M
	U50				STIFF	
	S15/3 @ 1.0 m	1.0			VERY STIFF	
	S15/4 @ 1.5 m		WEATHERED SANDSTONE: dark grey with light grey and orange brown, fine grained, clay seams			D
	S15/5 @ 2.0 m	2.0				
	S15/6 @ 2.5 m					
	S15/7 @ 3.0 m	3.0				D-M
	S15/8 @ 4.0 m	4.0				D
			AUGER REFUSAL AT 4.3 M ON WEATHERD SANDSTONE STANDPIPE PIEZOMETER INSTALLED			
		5.0				

D - disturbed sample U - undisturbed tube sample B - bulk sample

WT - level of water table or free water N - Standard Penetration Test (SPT)

S - jar sample

Contractor: STS

Equipment: Edson RP70

Hole Diameter (mm): 100

Angle from Vertical (^{o}):

Drill Bit: Spiral

NOTES: See explanation sheets for meaning of all descriptive terms and symbols

STS GeoEnvironmental Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: AMJ Demolition and Excavation P/L	Project / STS No.: 21649/8653C	**BOREHOLE NO.: BH 16**
Project: 55 Martin Road, Badgerys Creek	Date: December 12, 2017	
Location: Refer to Drawing No. 17/3905	Logged: JK Checked By: MG	Sheet 1 of 1

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
	S16/1 @ 0.2 m		SILTY CLAY: dark brown, low plasticity TOPSOIL			
			BOREHOLE DISCONTINUED AT 0.2 M			
		1.0				
		2.0				
		3.0				
		4.0				
		5.0				

D - disturbed sample U - undisturbed tube sample B - bulk sample

WT - level of water table or free water N - Standard Penetration Test (SPT)

S - jar sample

Contractor: STS

Equipment: Edson RP70

Hole Diameter (mm): 100

Angle from Vertical (^{o}):

Drill Bit: Spiral

NOTES: See explanation sheets for meaning of all descriptive terms and symbols

STS GeoEnvironmental Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: AMJ Demolition and Excavation P/L	Project / STS No.: 21649/8653C	**BOREHOLE NO.: BH 17**
Project: 55 Martin Road, Badgerys Creek	Date: December 12, 2017	
Location: Refer to Drawing No. 17/3905	Logged: JK Checked By: MG	Sheet 1 of 1

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
	S17/1 @ 0.2 m B 0.4-1.0		SILTY CLAY: dark brown, low plasticity TOPSOIL	CL	FIRM TO STIFF	D
			SILTY CLAY: orange brown with light grey, medium to high plasticity	CL/CH	STIFF	M
		1.0	SANDY CLAY: light grey with orange brown, fine grained sand, medium plasticity	CL	STIFF	M-D
					VERY STIFF	
		2.0				M
		3.0				
			WEATHERED SHALE: light grey with orange brown and yellow brown, trace of fined grained sand		EXTREMELY LOW STRENGTH	D
		4.0				
		5.0	AUGER REFUSAL AT 5.0 M ON WEATHERED SHALE			

D - disturbed sample U - undisturbed tube sample B - bulk sample

WT - level of water table or free water N - Standard Penetration Test (SPT)

S - jar sample

Contractor: STS

Equipment: Edson RP70

Hole Diameter (mm): 100

Angle from Vertical (^{o}):

Drill Bit: Spiral

NOTES: See explanation sheets for meaning of all descriptive terms and symbols

STS GeoEnvironmental Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: AMJ Demolition and Excavation P/L	Project / STS No.: 21649/8653C	**BOREHOLE NO.: BH 18**
Project: 55 Martin Road, Badgerys Creek	Date: December 12, 2017	
Location: Refer to Drawing No. 17/3905	Logged: DL Checked By: MG	Sheet 1 of 1

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
	S18/1 @ 0.2 m		SILTY CLAY: brown with dark brown, low to medium plasticity, trace of gravel TOPSOIL			
			BOREHOLE DISCONTINUED AT 0.3 M			
		1.0				
		2.0				
		3.0				
		4.0				
		5.0				

D - disturbed sample U - undisturbed tube sample B - bulk sample

WT - level of water table or free water N - Standard Penetration Test (SPT)

S - jar sample

Contractor: STS

Equipment: Christie

Hole Diameter (mm): 100/200/300

Angle from Vertical (^{o}):

Drill Bit: V/Spiral/Two Prong

NOTES: See explanation sheets for meaning of all descriptive terms and symbols

STS GeoEnvironmental Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: AMJ Demolition and Excavation P/L	Project / STS No.: 21649/8653C	**BOREHOLE NO.: BH 19**
Project: 55 Martin Road, Badgerys Creek	Date: December 12, 2017	
Location: Refer to Drawing No. 17/3905	Logged: DL Checked By: MG	Sheet 1 of 1

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
	S19/1 @ 0.2 m		SILTY CLAY: brown with dark brown, low to medium plasticity, trace of gravel TOPSOIL	CL		D
			BOREHOLE DISCONTINUED AT 0.3M			
		1.0				
		2.0				
		3.0				
		4.0				
		5.0				

D - disturbed sample U - undisturbed tube sample B - bulk sample

WT - level of water table or free water N - Standard Penetration Test (SPT)

S - jar sample

Contractor: STS

Equipment: Christie

Hole Diameter (mm): 100/200/300

Angle from Vertical (^{o}):

Drill Bit: V/Spiral/Two Prong

NOTES: See explanation sheets for meaning of all descriptive terms and symbols

SMEC Testing Services Pty Ltd
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Phone: (02)9756 2166 Fax: (02)9756 1137 Email: enquiries@smectesting.com.au

Dynamic Cone Penetrometer Test Report

Project: No.55 Martin Road, Badgerys Creek
Client: AMJ Demolition and Excavation P/L
Address: No.44 Pearson Street, South Wentworthville 2145
Test Method: AS 1289.6.3.2

Project No.: 21649/8653C
Report No.: 17/3905
Report Date: 15/12/2017

Site No.	P1	P2	P3	P4		P1	P2	P3	P4
Location	Refer to Drawing No. 17/3905	Refer to Drawing No. 17/3905	Refer to Drawing No. 17/3905	Refer to Drawing No. 17/3905					
Starting Level	Surface Level	Surface Level	Surface Level	Surface Level					
Depth (m)	Penetration Resistance (blows / 150mm)				Depth (m)	Penetration Resistance (blows / 150mm)			
0.00 - 0.15	3	3	5	5	3.00 - 3.15			*	
0.15 - 0.30	5	5	8	10	3.15 - 3.30			*	
0.30 - 0.45	6	7	9	14	3.30 - 3.45			*	
0.45 - 0.60	6	6	10	16	3.45 - 3.60			*	
0.60 - 0.75	7	6	11	13	3.60 - 3.75			22	
0.75 - 0.90	5	9	12	11	3.75 - 3.90			Refusal	
0.90 - 1.05	5	16	12	15	3.90 - 4.05				
1.05 - 1.20	6	16	13	14	4.05 - 4.20				
1.20 - 1.35	8	20	22	22	4.20 - 4.35				
1.35 - 1.50	11	22	*	*	4.35 - 4.50				
1.50 - 1.65	11	*	*	*	4.50 - 4.65				
1.65 - 1.80	15	*	*	*	4.65 - 4.80				
1.80 - 1.95	19	*	*	*	4.80 - 4.95				
1.95 - 2.10	22	*	22	*	4.95 - 5.10				
2.10 - 2.25	Refusal	*	*	22	5.10 - 5.25				
2.25 - 2.40		22	*	Refusal	5.25 - 5.40				
2.40 - 2.55		Refusal	*		5.40 - 5.55				
2.55 - 2.70			*		5.55 - 5.70				
2.70 - 2.85			*		5.70 - 5.85				
2.85 - 3.00			22		5.85 - 6.00				

Remarks: * = Pre-drilled hole prior to testing

Technician: DL/JK

Approved Signatory.....
Laurie Ihnativ - Manager

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Dynamic Cone Penetrometer Test Report

Project: No.55 Martin Road, Badgerys Creek
Client: AMJ Demolition and Excavation P/L
Address: No.44 Pearson Street, South Wentworthville 2145
Test Method: AS 1289.6.3.2

Project No.: 21649/8653C
Report No.: 17/3905
Report Date: 15/12/2017

Site No.	P5	P6	P7	P8		P5	P6	P7	P8
Location	Refer to Drawing No. 17/3905	Refer to Drawing No. 17/3905	Refer to Drawing No. 17/3905	Refer to Drawing No. 17/3905					
Starting Level	Surface Level	Surface Level	Surface Level	Surface Level					
Depth (m)	Penetration Resistance (blows / 150mm)				Depth (m)	Penetration Resistance (blows / 150mm)			
0.00 - 0.15	6	2	2	2	3.00 - 3.15				
0.15 - 0.30	9	3	4	3	3.15 - 3.30				
0.30 - 0.45	13	3	4	5	3.30 - 3.45				
0.45 - 0.60	13	5	5	5	3.45 - 3.60				
0.60 - 0.75	13	7	6	6	3.60 - 3.75				
0.75 - 0.90	16	8	6	7	3.75 - 3.90				
0.90 - 1.05	15	8	10	5	3.90 - 4.05				
1.05 - 1.20	14	9	8	8	4.05 - 4.20				
1.20 - 1.35	12	11	17	12	4.20 - 4.35				
1.35 - 1.50	18	13	22	9	4.35 - 4.50				
1.50 - 1.65	16	9	Refusal	10	4.50 - 4.65				
1.65 - 1.80	22	9		13	4.65 - 4.80				
1.80 - 1.95	*	12		13	4.80 - 4.95				
1.95 - 2.10	*	22		10	4.95 - 5.10				
2.10 - 2.25	*	Refusal		17	5.10 - 5.25				
2.25 - 2.40	*			22	5.25 - 5.40				
2.40 - 2.55	18			Refusal	5.40 - 5.55				
2.55 - 2.70	19				5.55 - 5.70				
2.70 - 2.85	22				5.70 - 5.85				
2.85 - 3.00	Refusal				5.85 - 6.00				

Remarks: * = Pre-drilled hole prior to testing

Approved Signatory. ....
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Technician: DL/JK

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Dynamic Cone Penetrometer Test Report

Project: No.55 Martin Road, Badgerys Creek
Client: AMJ Demolition and Excavation P/L
Address: No.44 Pearson Street, South Wentworthville 2145
Test Method: AS 1289.6.3.2

Project No.: 21649/8653C
Report No.: 17/3905
Report Date: 15/12/2017

Site No.	P9	P10							
Location	Refer to Drawing No. 17/3905	Refer to Drawing No. 17/3905							
Starting Level	Surface Level	Surface Level							
Depth (m)	Penetration Resistance (blows / 150mm)				Depth (m)	Penetration Resistance (blows / 150mm)			
0.00 - 0.15	2	3			3.00 - 3.15				
0.15 - 0.30	1	4			3.15 - 3.30				
0.30 - 0.45	3	5			3.30 - 3.45				
0.45 - 0.60	4	5			3.45 - 3.60				
0.60 - 0.75	6	8			3.60 - 3.75				
0.75 - 0.90	10	10			3.75 - 3.90				
0.90 - 1.05	12	9			3.90 - 4.05				
1.05 - 1.20	15	9			4.05 - 4.20				
1.20 - 1.35	22	12			4.20 - 4.35				
1.35 - 1.50	Refusal	19			4.35 - 4.50				
1.50 - 1.65		22			4.50 - 4.65				
1.65 - 1.80		Refusal			4.65 - 4.80				
1.80 - 1.95					4.80 - 4.95				
1.95 - 2.10					4.95 - 5.10				
2.10 - 2.25					5.10 - 5.25				
2.25 - 2.40					5.25 - 5.40				
2.40 - 2.55					5.40 - 5.55				
2.55 - 2.70					5.55 - 5.70				
2.70 - 2.85					5.70 - 5.85				
2.85 - 3.00					5.85 - 6.00				

Remarks: * = Pre-drilled hole prior to testing

Technician: DL/JK

Approved Signatory..... .....
Laurie Ihnativ - Manager

E1. CLASSIFICATION OF SOILS

E1.1 Soil Classification and the Unified System

An assessment of the site conditions usually includes an appraisal of the data available by combining values of engineering properties obtained by the site investigation with descriptions, from visual observation of the materials present on site.

The system used by SMEC in the identification of soil is the Unified Soil Classification system (USC) which was developed by the US Army Corps of Engineers during World War II and has since gained international acceptance and has been adopted in its metricated form by the Standards Association of Australia.

The Australian Site Investigation Code (AS1726-1981, Appendix D) recommends that the description of a soil includes the USC group symbols which are an integral component of the system.

The soil description should contain the following information in order:

Soil composition

- SOIL NAME and USC classification symbol (IN BLOCK LETTERS)
- plasticity or particle characteristics
- colour
- secondary and minor constituents (name estimated proportion, plasticity or particle characteristics, colour

Soil condition

- moisture condition
- consistency or density index

Soil structure

- structure (zoning, defects, cementing)

Soil origin

interpretation based on observation eg FILL, TOPSOIL, RESIDUAL, ALLUVIUM.

E1.2 Soil Composition

(a) Soil Name and Classification Symbol

The USC system is summarised in Figure E1.2.1. The primary division separates soil types on the basis of particle size into:

- Coarse grained soils - more than 50% of the material less than 60 mm is larger than 0.06 mm (60 µm).
- Fine grained soils - more than 50% of the material less than 60 mm is smaller than 0.06 mm (60 µm).

Initial classification is by particle size as shown in Table E1.2.1. Further classification of fine grained soils is based on plasticity.

TABLE E1.2.1 - CLASSIFICATION BY PARTICLE SIZE

NAME	SUB-DIVISION	SIZE
Clay (1)		< 2 µm
Silt (2)		2 µm to 60 µm
Sand	Fine Medium Coarse	60 µm to 200 µm 200 µm to 600 µm 600 µm to 2 mm
Gravel (3)	Fine Medium Coarse	2 mm to 6 mm 6 mm to 20 mm 20 mm to 60 mm
Cobbles (3)		60 mm to 200 mm
Boulders (3)		> 200 mm

Where a soil contains an appropriate amount of secondary material, the name includes each of the secondary components (greater than 12%) in increasing order of significance, eg sandy silty clay.

Minor components of a soil are included in the description by means of the terms “some” and “trace” as defined in Table E1.2.2.

TABLE E1.2.2 - MINOR SOIL COMPONENTS

TERM	DESCRIPTION	APPROXIMATE PROPORTION (%)
Trace	presence just detectable, little or no influence on soil properties	0-5
Some	presence easily detectable, little influence on soil properties	5-12

The USC group symbols should be included with each soil description as shown in Table E1.2.3

TABLE E1.2.3 - SOIL GROUP SYMBOLS

SOIL TYPE	PREFIX
Gravel	G
Sand	S
Silt	M
Clay	C
Organic	O
Peat	Pt

The group symbols are combined with qualifiers which indicate grading, plasticity or secondary components as shown on Table E1.2.4

TABLE E1.2.4 - SOIL GROUP QUALIFIERS

SUBGROUP	SUFFIX
Well graded	W
Poorly Graded	P
Silty	M
Clayey	C
Liquid Limit <50% - low to medium plasticity	L
Liquid Limit >50% - medium to high plasticity	H

(b) Grading

"Well graded" Good representation of all particle sizes from the largest to the smallest.

"Poorly graded" One or more intermediate sizes poorly represented

"Gap graded" One or more intermediate sizes absent

"Uniformly graded" Essentially single size material.

(c) Particle shape and texture

The shape and surface texture of the coarse grained particles should be described.

Angularity may be expressed as "rounded", "sub-rounded", "sub-angular" or "angular".

Particle **form** can be "equidimensional", "flat" or elongate".

Surface texture can be "glassy", "smooth", "rough", pitted" or striated".

(d) Colour

The colour of the soil should be described in the moist condition using simple terms such as:

Black White Grey Red
Brown Orange Yellow Green
Blue

These may be modified as necessary by "light" or "dark". Borderline colours may be described as a combination of two colours, eg red-brown.

For soils that contain more than one colour terms such as:

- Speckled Very small (<10 mm dia) patches
- Mottled Irregular
- Blotched Large irregular (>75 mm dia)
- Streaked Randomly oriented streaks

(e) Minor Components

Secondary and minor components should be individually described in a similar manner to the dominant component.

E1.3 ***S****oil Condition*

(a) Moisture

Soil moisture condition is described as "dry", "moist" or "wet".

The moisture categories are defined as:
Dry (D) - Little or no moisture evident. Soils are running.
Moist (M) - Darkened in colour with cool feel. Granular soil particles tend to adhere. No free water evident upon remoulding of cohesive soils.

In addition the moisture content of cohesive soils can be estimated in relation to their liquid or plastic limit.

(b) Consistency

Estimates of the consistency of a clay or silt soil may be made from manual examination, hand penetrometer test, SPT results or from laboratory tests to determine undrained shear or unconfined compressive strengths. The classification of consistency is defined in Table E1.3.1.

TABLE E1.3.1 - CONSISTENCY OF FINE-GRAINED SOILS

TERM	UNCONFINED STRENGTH (kPa)	FIELD IDENTIFICATION
Very Soft	<25	Easily penetrated by fist. Sample exudes between fingers when squeezed in the fist.
Soft	25 - 50	Easily moulded in fingers. Easily penetrated 50 mm by thumb.
Firm	50 - 100	Can be moulded by strong pressure in the fingers. Penetrated only with great effort.
Stiff	100 - 200	Cannot be moulded in fingers. Indented by thumb but penetrated only with great effort.
Very Stiff	200 - 400	Very tough. Difficult to cut with knife. Readily indented with thumb nail.
Hard	>400	Brittle, can just be scratched with thumb nail. Tends to break into fragments.

Unconfined compressive strength as derived by a hand penetrometer can be taken as approximately double the undrained shear strength ($q_u = 2\ c_u$).

(c) Density Index

The insitu density index of granular soils can be assessed from the results of SPT or cone penetrometer tests. Density index should not be estimated visually.

TABLE E1.3.2 - DENSITY OF GRANULAR SOILS

TERM	SPT N VALUE	STATIC CONE VALUE q_c (MPa)	DENSITY INDEX (%)
Very Loose	0 - 3	0 - 2	0 - 15
Loose	3 - 8	2 - 5	15 - 35
Medium Dense	8 - 25	5 - 15	35 - 65
Dense	25 - 42	15 - 20	65 - 85
Very Dense	>42	>20	>85

E1.4 Soil Structure

(a) Zoning

A sample may consist of several zones differing in colour, grain size or other properties. Terms to classify these zones are:

Layer - continuous across exposure or sample
Lens - discontinuous with lenticular shape
Pocket - irregular inclusion
Each zone should be described, their distinguishing features, and the nature of the interzone boundaries.

(b) Defects

Defects which are present in the sample can include:

- fissures
- roots (containing organic matter)
- tubes (hollow)
- casts (infilled)

Defects should be described giving details of dimensions and frequency. Fissure orientation, planarity, surface condition and infilling should be noted. If there is a tendency to break into blocks, block dimensions should be recorded

E1.5 Soil Origin

Information which may be interpretative but which may contribute to the usefulness of the material description should be included. The most common interpreted feature is the origin of the soil. The assessment of the probable origin is based on the soil material description, soil structure and its relationship to other soil and rock materials.

Common terms used are:

“Residual Soil” - Material which appears to have been derived by weathering from the underlying rock. There is no evidence of transport.

“Colluvium” - Material which appears to have been transported from its original location. The method of movement is usually the combination of gravity and erosion.

“Landslide Debris” - An extreme form of colluvium where the soil has been transported by mass movement. The material is obviously distributed and contains distinct defects related to the slope failure.

“Alluvium” - Material which has been transported essentially by water. usually associated with former stream activity.

“Fill” - Material which has been transported and placed by man. This can range from natural soils which have been placed in a controlled manner in engineering construction to dumped waste material. A description of the constituents should include an assessment of the method of placement.

E1.6 Fine Grained Soils

The physical properties of fine grained soils are dominated by silts and clays.

The definition of clay and silt soils is governed by their Atterberg Limits. Clay soils are characterised by the properties of cohesion and plasticity with cohesion defines as the ability to deform without rupture. Silts exhibit cohesion but have low plasticity or are non-plastic.

The field characteristics of clay soils include:

- dry lumps have appreciable dry strength and cannot be powdered
- volume changes occur with moisture content variation
- feels smooth when moist with a greasy appearance when cut.

The field characteristics of silt soils include:

- dry lumps have negligible dry strength and can be powdered easily
- dilatancy - an increase in volume due to shearing - is indicted by the presence of a shiny film of water after a hand sample is shaken. The water disappears upon remoulding. Very fine grained sands may also exhibit dilatancy.
- low plasticity index
- feels gritty to the teeth

E1.7 Organic Soils

Organic soils are distinguished from other soils by their appreciable content of vegetable matter, usually derived from plant remains.

The soil usually has a distinctive smell and low bulk density.

The USC system uses the symbol Pt for partly decomposed organic material. The O symbol is combined with suffixes “O” or “H” depending on plasticity.

Where roots or root fibres are present their frequency and the depth to which they are encountered should be recorded. The presence of roots or root fibres does not necessarily mean the material is an “organic material” by classification.

Coal and lignite should be described as such and not simply as organic matter.

APPENDIX B – LABORATORY TEST RESULTS

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Shrink Swell Index Report

Project: No.55 Martin Road, Badgerys Creek — Project No.: 21649
Client: AMJ Demolition and Excavation P/L — Report No.: 17/3920
Address: No.44 Pearson Street, South Wentworthville 2145 — Report Date: 18/12/2017
Test Method: AS 1289.7.1.1 — Page: 1 of 1

Sampling Procedure: AS 1289.1.3.1 Clause 3.1.3.2 - Thin Walled Sampler

STS / Sample No.		8653C/1	8653C/2	8653C/3			
Sample Location		Borehole 6 Refer to Drawing	Borehole 7 Refer to Drawing	Borehole 15 Refer to Drawing			
Material Description		SILTY CLAY: light brown with light grey, trace of gravel	SILTY CLAY: light brown with light grey, trace of gravel	SILTY CLAY: orange brown with light grey			
Depth (m)		0.7 - 1.0	0.6 - 0.9	0.5 - 0.8			
Sample Date		12/12/2017	12/12/2017	12/12/2017			
Shrink	Moisture Content (%)	16.3	10.6	15.2			
	Soil Crumbling	Nil	Nil	Nil			
	Extent of Cracking	Fine Cracks	Open Cracks	Open Cracks			
	Strain (%)	2.5	1.8	3.1			
Swell	Moisture Content Initial (%)	14.0	10.0	16.2			
	Moisture Content Final (%)	34.7	20.0	35.3			
	Strain (%)	1.7	3.1	0.0			
Inert Inclusions (%)		<5	<10	<5			
Shrink Swell Index (%)		**1.9**	**1.8**	**1.7**			

Remarks:

Approved Signatory.....

Technician: NP

Orlando Mendoza - Laboratory Manager

SMEC Testing Services Pty Ltd
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California Bearing Ratio Determination Report

Project: 55 MARTIN ROAD, BADGERYS CREEK — Project No.: 21649
Client: AMJ Demolition and Excavation P/L — Report No.: 17/3960
Address: No.44 Pearson Street, South Wentworthville 2145 — Report Date: 20/12/2017
Test Method: AS 1289.6.1.1, 2.1.1 — Page: 1 of 1
No. of Days Soaked: 4 — Compactive Effort: Standard
Target Compaction (%): 100
Surcharge (Kg): 4.5
Sampling Procedure: AS 1289.1.2.1 Clause 6.5.3 - Power Auger Drilling (Not covered under NATA Scope of Accreditation)

STS / Sample No.		8653C/1	8653C/2	8653C/3	8653C/4		
Sample Location		Borehole 2 Refer to Drawing No. 17/3905	Borehole 4 Refer to Drawing No. 17/3905	Borehole 8 Refer to Drawing No. 17/3905	Borehole 17 Refer to Drawing No. 17/3905		
Material Description		Silty Gravelly Clay, red brown	Silty Clay, orange brown/light grey/light brown, trace of gravel	Slity Clay: light grey with yellow brown/orange brown	Silty Gravelly Clay, red brown		
Depth of Sample (m)		0.5-1.1	1.0-1.4	0.3-0.9	0.4-1.0		
Sample Date		13/12/2017	13/12/2017	13/12/2017	13/12/2017		
Oversize on Wet Basis +19mm (%)		0.0	0.0	0.0	0.0		
Field Moisture Content (%)		19	12.4	13.1	13		
Optimum Moisture Content (%)		22.9	20.5	17.3	17		
Maximum Dry Density (t/m³)		1.648	1.581	1.691	1.74		
Dry Density (t/m³)	Before Soaking	1.65	1.582	1.679	1.743		
	After Soaking	1.641	1.515	1.606	1.672		
Relative Compaction (%)	Before Soaking	100.1	100.1	99.3	100.2		
	After Soaking	99.6	95.9	94.9	96.1		
Moisture Content (%)	Before Soaking	22.7	20.0	17.6	16.9		
	After Soaking	25.6	26.1	23	21.5		
Moisture Ratio Before Soaking (%)		99	98	101.8	99.3		
Moisture Content after test (%)	Top 30mm	27.0	30.2	27.9	27.9		
	Entire Depth	24.5	24.2	25.2	25.2		
Swell after Soaking (%)		0.6	4.4	4.6	4.3		
CBR Value (%)		**1.5**	**2.5**	**1.5**	**1.5**		
Penetration (mm)		**2.0**	**2.5**	**2.5**	**2.5**		

Remarks: +19mm material excluded from test

NATA Accredited Laboratory Number 2750
Accredited for compliance with ISO/IEC 17025
The results of tests, calibrations and / or measurements included in this document are traceable to Australian / national standards

Approved Signatory.....
Orlando Mendoza - Laboratory Manager

Technician: NP

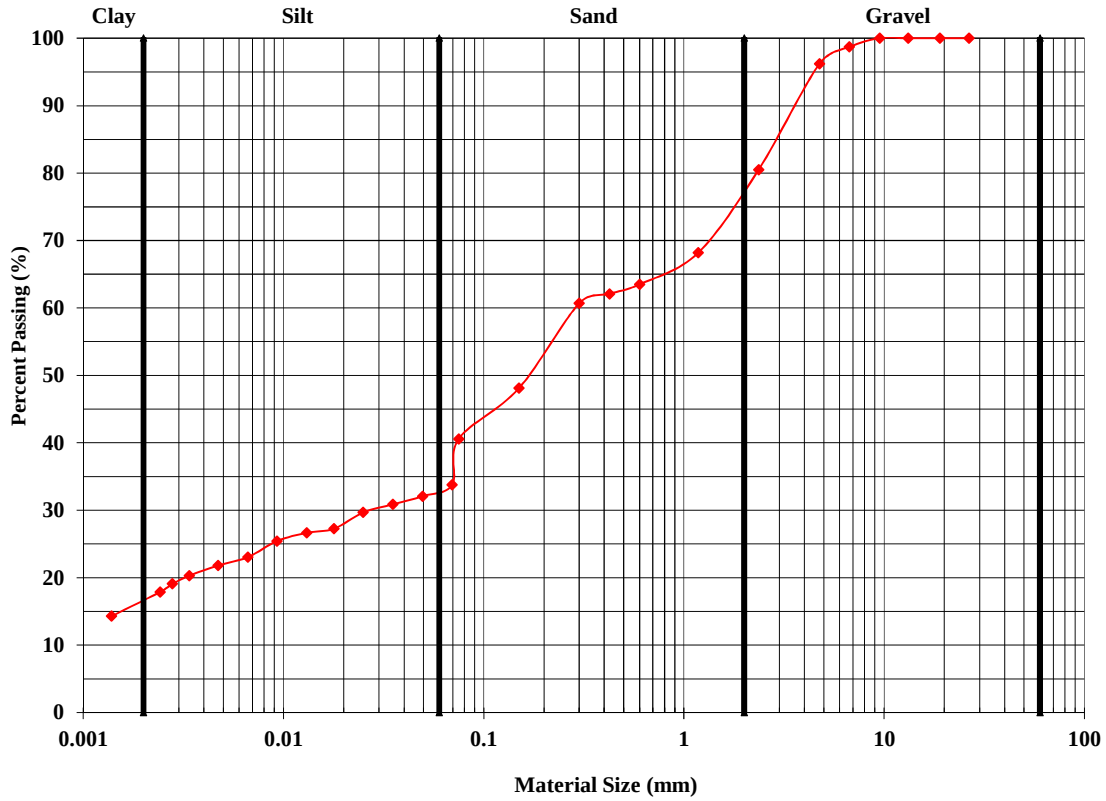
SMEC Testing Services Pty Ltd
14/1 Cowpasture Place, Wetherill Park NSW 2164
Phone: (02)9756 2166 Fax: (02)9756 1137 Email: enquiries@smectesting.com.au

Particle Size Distribution

Project: 55 MARTIN ROAD, BADGERYS CREEK
Client: AMJ Demolition and Excavation P/L
Address: No.44 Pearson Street, South Wentworthville 2145
Test Method: AS 1289.3.6.3
Sampling Procedure: AS 1289.1.2.1 Clause 6.5.3 - Power Auger Drilling (Not covered under NATA Scope of Accreditation)
Material Description: Sand, brown, with clay/gravel, trace of silt

STS / Sample No.: 8653C/1
Sample Location: Borehole 13
Depth (m): 0.0 - 0.4
Method of Despersion: Mechanical Stirrer

Project No.: 21649
Report No.: 17/3969
Report Date: 21/12/2017
Page: 1 of 2
Client Project No: N/A



Sieve Size (mm)	Percent Passing (%)
26.5	100
19.0	100
13.2	100
9.5	100
6.7	98.7
4.75	96.2
2.36	80.5
1.18	68.2
0.60	63.5
0.425	62.1
0.30	60.7
0.15	48.1
0.075	40.6
*Particle Size (mm)	Percent Passing (%)
0.0696	33.8
0.0496	32.1
0.0352	30.9
0.0250	29.7
0.0179	27.3
0.0131	26.7
0.0093	25.5
0.0066	23.0
0.0047	21.8
0.0034	20.3
0.0028	19.1
0.0024	17.9
0.0014	14.3

*Particle Size obtained by Hydrometer Analysis.
Hydrometer Type: g/L

Remarks:

Technician: BV

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Approved Signatory.....
Orlando Mendoza - Laboratory Manager

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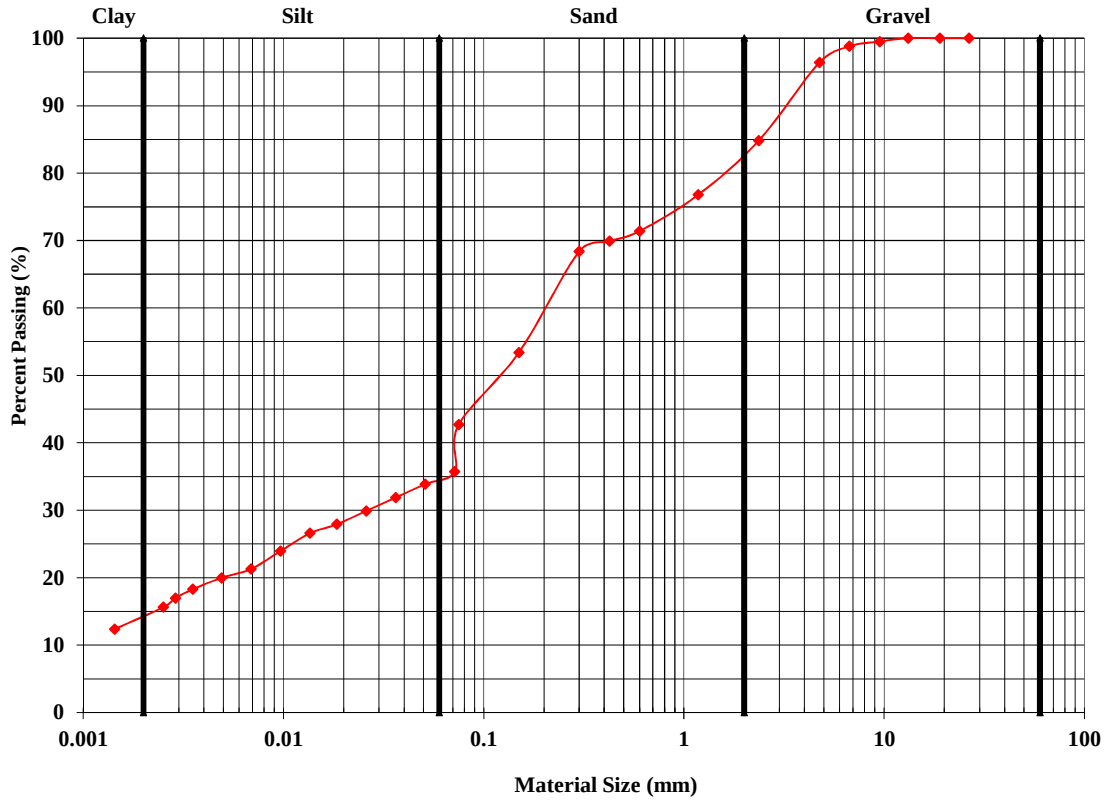
Phone: (02)9756 2166 Fax: (02)9756 1137 Email: enquiries@smectesting.com.au

Particle Size Distribution

Project: 55 MARTIN ROAD, BADGERYS CREEK
Client: AMJ Demolition and Excavation P/L
Address: No.44 Pearson Street, South Wentworthville 2145
Test Method: AS 1289.3.6.3
Sampling Procedure: AS 1289.1.2.1 Clause 6.5.3 - Power Auger Drilling (Not covered under NATA Scope of Accreditation)
Material Description: Sand, brown, with silt/gravel, trace of clay

STS / Sample No.: 8653C/2
Sample Location: Borehole 14
Depth (m): 0.0 - 0.4
Method of Despersion: Mechanical Stirrer

Project No.: 21649
Report No.: 17/3969
Report Date: 21/12/2017
Page: 2 OF 2
Client Project No: N/A



Sieve Size (mm)	Percent Passing (%)
26.5	100
19.0	100
13.2	100
9.5	99.5
6.7	98.8
4.75	96.4
2.36	84.8
1.18	76.8
0.60	71.4
0.425	69.9
0.30	68.4
0.15	53.4
0.075	42.7
*Particle Size (mm)	Percent Passing (%)
0.0717	35.7
0.0510	33.9
0.0364	31.9
0.0259	29.9
0.0185	27.9
0.0135	26.6
0.0097	24.0
0.0069	21.3
0.0049	20.0
0.0035	18.3
0.0029	17.0
0.0025	15.7
0.0014	12.4

*Particle Size obtained by Hydrometer Analysis.
Hydrometer Type: g/L

Remarks:

Technician: BV

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Approved Signatory.....
Orlando Mendoza - Laboratory Manager

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Phone: (02)9756 2166 Fax: (02)9756 1137 Email: enquiries@smectesting.com.au

Emerson Class No.

Project: NO.6 EDWARD STREET, NELSON — Project No.: 21825
Client: THE SALVATION ARMY PROPERTY TRUST — Report No.: 18/0101
Address: 265 CHALMERS STREET, REDFERN NSW 2016 — Report Date: 16/01/2018
Test Method: AS 1289.3.8.1 — Page: 1 OF 1

Sampling Procedure: AS 1289.1.2.1 Clause 6.5.3 - Power Auger Drilling (Not covered under NATA Scope of Accreditation)

STS / Sample No.	8653C/1	8653C/2	8653C/3	8653C/4		
Sample Location	Borehole 2	Borehole 4	Borehole 8	Borehole 17		
Material Description	SILTY CLAY: red brown with orange brown and light grey	SILTY CLAY: orange brown with light grey and some light brown, trace of fine grained sand	SILTY CLAY: orange brown with light grey	SILTY CLAY: orange brown with light grey		
Depth (mm)	0.5 - 1.1	1.0 - 1.4	0.3 - 0.9	0.4 - 1.0		
Sample Date	12/12/2017	12/12/2017	12/12/2017	12/12/2017		
Date Tested	11/01/2018	11/01/2018	11/01/2018	11/01/2018		
Source of Material	Disturbed	Disturbed	Disturbed	Disturbed		
Water Temperature (°)	20	20	20	20		
Emerson Class No.	**6**	**5**	**3**	**3**		

Emerson Classification

Class 1: Slaking and complete dispersion before remoulding

Class 2: Slaking and some dispersion before remoulding

Class 3: Slaking and no dispersion before remoulding, dispersion after remoulding

Class 4: Slaking and no despersion before remoulding, no dispersion after remoulding, calcite or gypsum present

Class 5: Slaking and no dispersion before remoulding, no dispersion after remoulding, no calcite or gypsum present, dispersion after slaking in a 1:5 soil / water suspension

Class 6: Slaking and no dispersion before remoulding, no dispersion after remoulding, no calcite or gypsum present, flocculation after shaking in a 1:5 soil / water suspension

Class 7: No slaking, swelling occurs

Class 8: No slaking, swelling does not occur

Remarks:

Approved Signatory..... .....

Technician: FV — Orlando Mendoza - Laboratory Manager

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES1731937**	Page	: 1 of 15
Client	: **SMEC TESTING SERVICES PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: SMEC TESTING ALL RESULTS	Contact	: Customer Services ES
Address	: P O BOX 6989 WETHERILL PARK NSW, AUSTRALIA 2164	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: ----	Telephone	: +61-2-8784 8555
Project	: 21649	Date Samples Received	: 14-Dec-2017 16:02
Order number	: E-2017-713	Date Analysis Commenced	: 19-Dec-2017
C-O-C number	: ----	Issue Date	: 27-Dec-2017 13:42
Sampler	: ----		
Site	: ----		
Quote number	: ----		
No. of samples received	: 24		
No. of samples analysed	: 18		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Descriptive Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Dian Dao		Sydney Inorganics, Smithfield, NSW
Edwandy Fadjar	Organic Coordinator	Sydney Inorganics, Smithfield, NSW
Edwandy Fadjar	Organic Coordinator	Sydney Organics, Smithfield, NSW
Raymond Commodore	Instrument Chemist	Sydney Inorganics, Smithfield, NSW
Shaun Spooner	Asbestos Identifier	Newcastle - Asbestos, Mayfield West, NSW

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EA200N: Asbestos weights and percentages are not covered under the Scope of NATA Accreditation.
  Weights of Asbestos are based on extracted bulk asbestos, fibre bundles, and/or ACM and do not include respirable fibres (if present)
  The Asbestos (Fines and Fibrous) weight is calculated from the extracted Fibrous Asbestos and Asbestos Fines as an equivalent weight of 100% Asbestos
  Percentages for Asbestos content in ACM are based on the 2013 NEPM default values.
  All calculations of percentage Asbestos under this method are approximate and should be used as a guide only.
- EA200 'Am' Amosite (brown asbestos)
- EA200 'Cr' Crocidolite (blue asbestos)
- EA200 'Trace' - Asbestos fibres ("Free Fibres") detected by trace analysis per AS4964. The result can be interpreted that the sample contains detectable 'respirable' asbestos fibres
- EA200: Asbestos Identification Samples were analysed by Polarised Light Microscopy including dispersion staining.
- EA200 Legend
- EA200 'Ch' Chrysotile (white asbestos)
- EA200: 'UMF' Unknown Mineral Fibres. "-" indicates fibres detected may or may not be asbestos fibres. Confirmation by alternative techniques is recommended.
- EA200: Negative results for vinyl tiles should be confirmed by an independent analytical technique.
- EA200N: ALS laboratory procedures and methods used for the identification and quantitation of asbestos are consistent with AS4964-2004 and the requirements of the 2013 NEPM for Assessment of Site Contamination
- EA200: For samples larger than 30g, the <2mm fraction may be sub-sampled prior to trace analysis as outlined in ISO23909:2008(E) Sect 6.3.2-2
- ED007 and ED008: When Exchangeable Al is reported from these methods, it should be noted that Rayment & Lyons (2011) suggests Exchange Acidity by 1M KCl - Method 15G1 (ED005) is a more suitable method for the determination of exchange acidity (H+ + Al3+).
- EA200: 'Yes' - Asbestos detected by polarised light microscopy including dispersion staining.
- EA200: 'No*' - No asbestos found, at the reporting limit of 0.1g/kg, by polarised light microscopy including dispersion staining. Asbestos material was detected and positively identified at concentrations estimated to be below 0.1g/kg.
- EA200: 'No' - No asbestos found at the reporting limit 0.1g/kg, by polarised light microscopy including dispersion staining.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	21649/S1/1-1	21649/S2-1	21649/S2-2	21649/S2-3	21649/S2-4
			Client sampling date / time	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00
Compound	CAS Number	LOR	Unit	ES1731937-001	ES1731937-002	ES1731937-003	ES1731937-004	ES1731937-005
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	5.4	----	5.0	5.2	5.1
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	724	----	437	640	780
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	15.0	10.8	17.8	15.2	----
EA200: AS 4964 - 2004 Identification of Asbestos in Soils								
Asbestos Detected	1332-21-4	0.1	g/kg	No	No	----	----	----
Asbestos (Trace)	1332-21-4	5	Fibres	No	No	----	----	----
Asbestos Type	1332-21-4	-	--	-	-	----	----	----
Sample weight (dry)	----	0.01	g	320	152	----	----	----
APPROVED IDENTIFIER:	----	-	--	S.SPOONER	S.SPOONER	----	----	----
EA200N: Asbestos Quantification (non-NATA)								
ø Asbestos (Fines and Fibrous <7mm)	1332-21-4	0.0004	g	<0.0004	<0.0004	----	----	----
ø Asbestos (Fines and Fibrous FA+AF)	----	0.001	% (w/w)	<0.001	<0.001	----	----	----
ø Weight Used for % Calculation	----	0.0001	kg	0.320	0.152	----	----	----
ø Fibrous Asbestos >7mm	----	0.0004	g	<0.0004	<0.0004	----	----	----
ED008: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	----	----	----	1.0	----
Exchangeable Magnesium	----	0.1	meq/100g	----	----	----	10.1	----
Exchangeable Potassium	----	0.1	meq/100g	----	----	----	0.1	----
Exchangeable Sodium	----	0.1	meq/100g	----	----	----	3.1	----
Cation Exchange Capacity	----	0.1	meq/100g	----	----	----	14.2	----
Exchangeable Sodium Percent	----	0.1	%	----	----	----	21.5	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	----	----	----	180	----
EG005T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5	----	12	----	----
Cadmium	7440-43-9	1	mg/kg	<1	----	<1	----	----
Chromium	7440-47-3	2	mg/kg	8	----	26	----	----
Copper	7440-50-8	5	mg/kg	11	----	15	----	----
Lead	7439-92-1	5	mg/kg	16	----	13	----	----
Nickel	7440-02-0	2	mg/kg	5	----	3	----	----
Zinc	7440-66-6	5	mg/kg	18	----	7	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	21649/S1/1-1	21649/S2-1	21649/S2-2	21649/S2-3	21649/S2-4
				Client sampling date / time	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00
Compound	CAS Number	LOR	Unit		ES1731937-001	ES1731937-002	ES1731937-003	ES1731937-004	ES1731937-005
					Result	Result	Result	Result	Result
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		<0.1	----	<0.1	----	----
EP068A: Organochlorine Pesticides (OC)									
alpha-BHC	319-84-6	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
beta-BHC	319-85-7	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
gamma-BHC	58-89-9	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
delta-BHC	319-86-8	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
Heptachlor	76-44-8	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
Aldrin	309-00-2	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
Heptachlor epoxide	1024-57-3	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
^ Total Chlordane (sum)	----	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
trans-Chlordane	5103-74-2	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
alpha-Endosulfan	959-98-8	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
cis-Chlordane	5103-71-9	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
Dieldrin	60-57-1	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
4.4`-DDE	72-55-9	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
Endrin	72-20-8	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
beta-Endosulfan	33213-65-9	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
^ Endosulfan (sum)	115-29-7	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
4.4`-DDD	72-54-8	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
Endrin aldehyde	7421-93-4	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
Endosulfan sulfate	1031-07-8	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
4.4`-DDT	50-29-3	0.2	mg/kg		<0.2	<0.2	<0.2	----	----
Endrin ketone	53494-70-5	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
Methoxychlor	72-43-5	0.2	mg/kg		<0.2	<0.2	<0.2	----	----
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
^ Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-29-3	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
EP068B: Organophosphorus Pesticides (OP)									
Dichlorvos	62-73-7	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
Demeton-S-methyl	919-86-8	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
Monocrotophos	6923-22-4	0.2	mg/kg		<0.2	<0.2	<0.2	----	----
Dimethoate	60-51-5	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
Diazinon	333-41-5	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
Chlorpyrifos-methyl	5598-13-0	0.05	mg/kg		<0.05	<0.05	<0.05	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	21649/S1/1-1	21649/S2-1	21649/S2-2	21649/S2-3	21649/S2-4
				Client sampling date / time	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00
Compound	CAS Number	LOR	Unit		ES1731937-001	ES1731937-002	ES1731937-003	ES1731937-004	ES1731937-005
					Result	Result	Result	Result	Result
EP068B: Organophosphorus Pesticides (OP) - Continued									
Parathion-methyl	298-00-0	0.2	mg/kg		<0.2	<0.2	<0.2	----	----
Malathion	121-75-5	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
Fenthion	55-38-9	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
Chlorpyrifos	2921-88-2	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
Parathion	56-38-2	0.2	mg/kg		<0.2	<0.2	<0.2	----	----
Pirimphos-ethyl	23505-41-1	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
Chlorfenvinphos	470-90-6	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
Bromophos-ethyl	4824-78-6	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
Fenamiphos	22224-92-6	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
Prothiofos	34643-46-4	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
Ethion	563-12-2	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
Carbophenothion	786-19-6	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
Azinphos Methyl	86-50-0	0.05	mg/kg		<0.05	<0.05	<0.05	----	----
EP068S: Organochlorine Pesticide Surrogate									
Dibromo-DDE	21655-73-2	0.05	%		**81.4**	**82.1**	**85.2**	----	----
EP068T: Organophosphorus Pesticide Surrogate									
DEF	78-48-8	0.05	%		**79.0**	**76.0**	**79.0**	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	21649/S2-5	21649/S2-6	21649/S2-7	21649/S2-8	21649/S3/1-1
			Client sampling date / time	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00
Compound	CAS Number	LOR	Unit	ES1731937-006	ES1731937-007	ES1731937-008	ES1731937-009	ES1731937-010
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	5.1	5.4	6.2	7.2	----
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	741	790	723	693	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	12.7	14.6	----	9.6	12.7
EA200: AS 4964 - 2004 Identification of Asbestos in Soils								
Asbestos Detected	1332-21-4	0.1	g/kg	----	----	----	----	No
Asbestos (Trace)	1332-21-4	5	Fibres	----	----	----	----	No
Asbestos Type	1332-21-4	-	--	----	----	----	----	-
Sample weight (dry)	----	0.01	g	----	----	----	----	427
APPROVED IDENTIFIER:	----	-	--	----	----	----	----	S.SPOONER
EA200N: Asbestos Quantification (non-NATA)								
ø Asbestos (Fines and Fibrous <7mm)	1332-21-4	0.0004	g	----	----	----	----	<0.0004
ø Asbestos (Fines and Fibrous FA+AF)	----	0.001	% (w/w)	----	----	----	----	<0.001
ø Weight Used for % Calculation	----	0.0001	kg	----	----	----	----	0.427
ø Fibrous Asbestos >7mm	----	0.0004	g	----	----	----	----	<0.0004
ED008: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	0.2	0.3	----	0.3	----
Exchangeable Magnesium	----	0.1	meq/100g	9.0	6.2	----	3.2	----
Exchangeable Potassium	----	0.1	meq/100g	0.2	0.2	----	0.1	----
Exchangeable Sodium	----	0.1	meq/100g	4.2	2.9	----	1.2	----
Cation Exchange Capacity	----	0.1	meq/100g	13.7	9.7	----	4.8	----
Exchangeable Sodium Percent	----	0.1	%	30.4	29.9	----	24.6	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	80	160	----	100	----
EG005T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	----	----	----	----	5
Cadmium	7440-43-9	1	mg/kg	----	----	----	----	<1
Chromium	7440-47-3	2	mg/kg	----	----	----	----	16
Copper	7440-50-8	5	mg/kg	----	----	----	----	28
Lead	7439-92-1	5	mg/kg	----	----	----	----	19
Nickel	7440-02-0	2	mg/kg	----	----	----	----	9
Zinc	7440-66-6	5	mg/kg	----	----	----	----	22

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	21649/S2-5	21649/S2-6	21649/S2-7	21649/S2-8	21649/S3/1-1
			Client sampling date / time	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00
Compound	CAS Number	LOR	Unit	ES1731937-006	ES1731937-007	ES1731937-008	ES1731937-009	ES1731937-010
				Result	Result	Result	Result	Result
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	----	----	----	----	<0.1
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	319-84-6	0.05	mg/kg	----	----	----	----	<0.05
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	----	----	----	----	<0.05
beta-BHC	319-85-7	0.05	mg/kg	----	----	----	----	<0.05
gamma-BHC	58-89-9	0.05	mg/kg	----	----	----	----	<0.05
delta-BHC	319-86-8	0.05	mg/kg	----	----	----	----	<0.05
Heptachlor	76-44-8	0.05	mg/kg	----	----	----	----	<0.05
Aldrin	309-00-2	0.05	mg/kg	----	----	----	----	<0.05
Heptachlor epoxide	1024-57-3	0.05	mg/kg	----	----	----	----	<0.05
^ Total Chlordane (sum)	----	0.05	mg/kg	----	----	----	----	<0.05
trans-Chlordane	5103-74-2	0.05	mg/kg	----	----	----	----	<0.05
alpha-Endosulfan	959-98-8	0.05	mg/kg	----	----	----	----	<0.05
cis-Chlordane	5103-71-9	0.05	mg/kg	----	----	----	----	<0.05
Dieldrin	60-57-1	0.05	mg/kg	----	----	----	----	<0.05
4.4`-DDE	72-55-9	0.05	mg/kg	----	----	----	----	<0.05
Endrin	72-20-8	0.05	mg/kg	----	----	----	----	<0.05
beta-Endosulfan	33213-65-9	0.05	mg/kg	----	----	----	----	<0.05
^ Endosulfan (sum)	115-29-7	0.05	mg/kg	----	----	----	----	<0.05
4.4`-DDD	72-54-8	0.05	mg/kg	----	----	----	----	<0.05
Endrin aldehyde	7421-93-4	0.05	mg/kg	----	----	----	----	<0.05
Endosulfan sulfate	1031-07-8	0.05	mg/kg	----	----	----	----	<0.05
4.4`-DDT	50-29-3	0.2	mg/kg	----	----	----	----	<0.2
Endrin ketone	53494-70-5	0.05	mg/kg	----	----	----	----	<0.05
Methoxychlor	72-43-5	0.2	mg/kg	----	----	----	----	<0.2
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.05	mg/kg	----	----	----	----	<0.05
^ Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-29-3	0.05	mg/kg	----	----	----	----	<0.05
EP068B: Organophosphorus Pesticides (OP)								
Dichlorvos	62-73-7	0.05	mg/kg	----	----	----	----	<0.05
Demeton-S-methyl	919-86-8	0.05	mg/kg	----	----	----	----	<0.05
Monocrotophos	6923-22-4	0.2	mg/kg	----	----	----	----	<0.2
Dimethoate	60-51-5	0.05	mg/kg	----	----	----	----	<0.05
Diazinon	333-41-5	0.05	mg/kg	----	----	----	----	<0.05
Chlorpyrifos-methyl	5598-13-0	0.05	mg/kg	----	----	----	----	<0.05

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	21649/S2-5	21649/S2-6	21649/S2-7	21649/S2-8	21649/S3/1-1
				Client sampling date / time	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00
Compound	CAS Number	LOR	Unit		ES1731937-006	ES1731937-007	ES1731937-008	ES1731937-009	ES1731937-010
					Result	Result	Result	Result	Result
EP068B: Organophosphorus Pesticides (OP) - Continued									
Parathion-methyl	298-00-0	0.2	mg/kg		----	----	----	----	<0.2
Malathion	121-75-5	0.05	mg/kg		----	----	----	----	<0.05
Fenthion	55-38-9	0.05	mg/kg		----	----	----	----	<0.05
Chlorpyrifos	2921-88-2	0.05	mg/kg		----	----	----	----	<0.05
Parathion	56-38-2	0.2	mg/kg		----	----	----	----	<0.2
Pirimphos-ethyl	23505-41-1	0.05	mg/kg		----	----	----	----	<0.05
Chlorfenvinphos	470-90-6	0.05	mg/kg		----	----	----	----	<0.05
Bromophos-ethyl	4824-78-6	0.05	mg/kg		----	----	----	----	<0.05
Fenamiphos	22224-92-6	0.05	mg/kg		----	----	----	----	<0.05
Prothiofos	34643-46-4	0.05	mg/kg		----	----	----	----	<0.05
Ethion	563-12-2	0.05	mg/kg		----	----	----	----	<0.05
Carbophenothion	786-19-6	0.05	mg/kg		----	----	----	----	<0.05
Azinphos Methyl	86-50-0	0.05	mg/kg		----	----	----	----	<0.05
EP068S: Organochlorine Pesticide Surrogate									
Dibromo-DDE	21655-73-2	0.05	%		----	----	----	----	**94.3**
EP068T: Organophosphorus Pesticide Surrogate									
DEF	78-48-8	0.05	%		----	----	----	----	**88.2**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	21649/S3/2-1	21649/S4/1-1	21649/S4/2-1	21649/S4/5-1	21649/S4/6-1
			Client sampling date / time	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00
Compound	CAS Number	LOR	Unit	ES1731937-011	ES1731937-013	ES1731937-014	ES1731937-017	ES1731937-018
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	----	6.9	----	----	----
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	----	226	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	14.4	11.5	12.8	11.0	10.3
EA200: AS 4964 - 2004 Identification of Asbestos in Soils								
Asbestos Detected	1332-21-4	0.1	g/kg	----	----	----	No	No
Asbestos (Trace)	1332-21-4	5	Fibres	----	----	----	No	No
Asbestos Type	1332-21-4	-	--	----	----	----	-	-
Sample weight (dry)	----	0.01	g	----	----	----	25.2	22.1
APPROVED IDENTIFIER:	----	-	--	----	----	----	S.SPOONER	S.SPOONER
EA200N: Asbestos Quantification (non-NATA)								
ø Asbestos (Fines and Fibrous <7mm)	1332-21-4	0.0004	g	----	----	----	<0.0004	<0.0004
ø Asbestos (Fines and Fibrous FA+AF)	----	0.001	% (w/w)	----	----	----	<0.001	<0.001
ø Weight Used for % Calculation	----	0.0001	kg	----	----	----	0.0252	0.0221
ø Fibrous Asbestos >7mm	----	0.0004	g	----	----	----	<0.0004	<0.0004
EG005T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5	10	10	<5	7
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	13	19	18	13	12
Copper	7440-50-8	5	mg/kg	33	14	16	36	31
Lead	7439-92-1	5	mg/kg	19	19	9	14	13
Nickel	7440-02-0	2	mg/kg	14	8	4	22	21
Zinc	7440-66-6	5	mg/kg	40	32	7	65	47
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	319-84-6	0.05	mg/kg	<0.05	<0.05	----	<0.05	----
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	<0.05	<0.05	----	<0.05	----
beta-BHC	319-85-7	0.05	mg/kg	<0.05	<0.05	----	<0.05	----
gamma-BHC	58-89-9	0.05	mg/kg	<0.05	<0.05	----	<0.05	----
delta-BHC	319-86-8	0.05	mg/kg	<0.05	<0.05	----	<0.05	----
Heptachlor	76-44-8	0.05	mg/kg	<0.05	<0.05	----	<0.05	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	21649/S3/2-1	21649/S4/1-1	21649/S4/2-1	21649/S4/5-1	21649/S4/6-1
			Client sampling date / time	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00
Compound	CAS Number	LOR	Unit	ES1731937-011	ES1731937-013	ES1731937-014	ES1731937-017	ES1731937-018
				Result	Result	Result	Result	Result
EP068A: Organochlorine Pesticides (OC) - Continued								
Aldrin	309-00-2	0.05	mg/kg	<0.05	<0.05	----	<0.05	----
Heptachlor epoxide	1024-57-3	0.05	mg/kg	<0.05	<0.05	----	<0.05	----
^ Total Chlordane (sum)	----	0.05	mg/kg	<0.05	<0.05	----	<0.05	----
trans-Chlordane	5103-74-2	0.05	mg/kg	<0.05	<0.05	----	<0.05	----
alpha-Endosulfan	959-98-8	0.05	mg/kg	<0.05	<0.05	----	<0.05	----
cis-Chlordane	5103-71-9	0.05	mg/kg	<0.05	<0.05	----	<0.05	----
Dieldrin	60-57-1	0.05	mg/kg	<0.05	<0.05	----	<0.05	----
4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	<0.05	----	<0.05	----
Endrin	72-20-8	0.05	mg/kg	<0.05	<0.05	----	<0.05	----
beta-Endosulfan	33213-65-9	0.05	mg/kg	<0.05	<0.05	----	<0.05	----
^ Endosulfan (sum)	115-29-7	0.05	mg/kg	<0.05	<0.05	----	<0.05	----
4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	<0.05	----	<0.05	----
Endrin aldehyde	7421-93-4	0.05	mg/kg	<0.05	<0.05	----	<0.05	----
Endosulfan sulfate	1031-07-8	0.05	mg/kg	<0.05	<0.05	----	<0.05	----
4.4`-DDT	50-29-3	0.2	mg/kg	<0.2	<0.2	----	<0.2	----
Endrin ketone	53494-70-5	0.05	mg/kg	<0.05	<0.05	----	<0.05	----
Methoxychlor	72-43-5	0.2	mg/kg	<0.2	<0.2	----	<0.2	----
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.05	mg/kg	<0.05	<0.05	----	<0.05	----
^ Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-2	0.05	mg/kg	<0.05	<0.05	----	<0.05	----
EP068B: Organophosphorus Pesticides (OP)								
Dichlorvos	62-73-7	0.05	mg/kg	<0.05	<0.05	----	<0.05	----
Demeton-S-methyl	919-86-8	0.05	mg/kg	<0.05	<0.05	----	<0.05	----
Monocrotophos	6923-22-4	0.2	mg/kg	<0.2	<0.2	----	<0.2	----
Dimethoate	60-51-5	0.05	mg/kg	<0.05	<0.05	----	<0.05	----
Diazinon	333-41-5	0.05	mg/kg	<0.05	<0.05	----	<0.05	----
Chlorpyrifos-methyl	5598-13-0	0.05	mg/kg	<0.05	<0.05	----	<0.05	----
Parathion-methyl	298-00-0	0.2	mg/kg	<0.2	<0.2	----	<0.2	----
Malathion	121-75-5	0.05	mg/kg	<0.05	<0.05	----	<0.05	----
Fenthion	55-38-9	0.05	mg/kg	<0.05	<0.05	----	<0.05	----
Chlorpyrifos	2921-88-2	0.05	mg/kg	<0.05	<0.05	----	<0.05	----
Parathion	56-38-2	0.2	mg/kg	<0.2	<0.2	----	<0.2	----
Pirimphos-ethyl	23505-41-1	0.05	mg/kg	<0.05	<0.05	----	<0.05	----
Chlorfenvinphos	470-90-6	0.05	mg/kg	<0.05	<0.05	----	<0.05	----
Bromophos-ethyl	4824-78-6	0.05	mg/kg	<0.05	<0.05	----	<0.05	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	21649/S3/2-1	21649/S4/1-1	21649/S4/2-1	21649/S4/5-1	21649/S4/6-1
				Client sampling date / time	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00
Compound	CAS Number	LOR	Unit		ES1731937-011	ES1731937-013	ES1731937-014	ES1731937-017	ES1731937-018
					Result	Result	Result	Result	Result
EP068B: Organophosphorus Pesticides (OP) - Continued									
Fenamiphos	22224-92-6	0.05	mg/kg		<0.05	<0.05	----	<0.05	----
Prothiofos	34643-46-4	0.05	mg/kg		<0.05	<0.05	----	<0.05	----
Ethion	563-12-2	0.05	mg/kg		<0.05	<0.05	----	<0.05	----
Carbophenothion	786-19-6	0.05	mg/kg		<0.05	<0.05	----	<0.05	----
Azinphos Methyl	86-50-0	0.05	mg/kg		<0.05	<0.05	----	<0.05	----
EP068S: Organochlorine Pesticide Surrogate									
Dibromo-DDE	21655-73-2	0.05	%		**119**	**92.8**	----	**88.7**	----
EP068T: Organophosphorus Pesticide Surrogate									
DEF	78-48-8	0.05	%		**97.4**	**85.3**	----	**78.1**	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	21649/S6/1-1	21649/S6/2-1	21649/S7/1-1	----	----
			Client sampling date / time	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	----	----
Compound	CAS Number	LOR	Unit	ES1731937-020	ES1731937-021	ES1731937-024	--------	--------
				Result	Result	Result	----	----
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	**7.0**	----	**6.8**	----	----
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	**52**	----	**84**	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	**11.3**	**13.2**	**10.6**	----	----
EA200: AS 4964 - 2004 Identification of Asbestos in Soils								
Asbestos Detected	1332-21-4	0.1	g/kg	**No**	----	**No**	----	----
Asbestos (Trace)	1332-21-4	5	Fibres	**No**	----	**No**	----	----
Asbestos Type	1332-21-4	-	--	**-**	----	**-**	----	----
Sample weight (dry)	----	0.01	g	**324**	----	**311**	----	----
APPROVED IDENTIFIER:	----	-	--	**S.SPOONER**	----	**S.SPOONER**	----	----
EA200N: Asbestos Quantification (non-NATA)								
ø Asbestos (Fines and Fibrous <7mm)	1332-21-4	0.0004	g	<0.0004	----	<0.0004	----	----
ø Asbestos (Fines and Fibrous FA+AF)	----	0.001	% (w/w)	<0.001	----	<0.001	----	----
ø Weight Used for % Calculation	----	0.0001	kg	**0.324**	----	**0.311**	----	----
ø Fibrous Asbestos >7mm	----	0.0004	g	<0.0004	----	<0.0004	----	----
EG005T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	**7**	**10**	**8**	----	----
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	----	----
Chromium	7440-47-3	2	mg/kg	**19**	**16**	**16**	----	----
Copper	7440-50-8	5	mg/kg	**25**	**44**	**15**	----	----
Lead	7439-92-1	5	mg/kg	**18**	**17**	**14**	----	----
Nickel	7440-02-0	2	mg/kg	**17**	**18**	**12**	----	----
Zinc	7440-66-6	5	mg/kg	**38**	**50**	**26**	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	----	----
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	319-84-6	0.05	mg/kg	<0.05	----	<0.05	----	----
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	<0.05	----	<0.05	----	----
beta-BHC	319-85-7	0.05	mg/kg	<0.05	----	<0.05	----	----
gamma-BHC	58-89-9	0.05	mg/kg	<0.05	----	<0.05	----	----
delta-BHC	319-86-8	0.05	mg/kg	<0.05	----	<0.05	----	----
Heptachlor	76-44-8	0.05	mg/kg	<0.05	----	<0.05	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	21649/S6/1-1	21649/S6/2-1	21649/S7/1-1	----	----
				Client sampling date / time	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	----	----
Compound	CAS Number	LOR	Unit		ES1731937-020	ES1731937-021	ES1731937-024	--------	--------
					Result	Result	Result	----	----
EP068A: Organochlorine Pesticides (OC) - Continued									
Aldrin	309-00-2	0.05	mg/kg		<0.05	----	<0.05	----	----
Heptachlor epoxide	1024-57-3	0.05	mg/kg		<0.05	----	<0.05	----	----
^ Total Chlordane (sum)	----	0.05	mg/kg		<0.05	----	<0.05	----	----
trans-Chlordane	5103-74-2	0.05	mg/kg		<0.05	----	<0.05	----	----
alpha-Endosulfan	959-98-8	0.05	mg/kg		<0.05	----	<0.05	----	----
cis-Chlordane	5103-71-9	0.05	mg/kg		<0.05	----	<0.05	----	----
Dieldrin	60-57-1	0.05	mg/kg		<0.05	----	<0.05	----	----
4.4`-DDE	72-55-9	0.05	mg/kg		<0.05	----	<0.05	----	----
Endrin	72-20-8	0.05	mg/kg		<0.05	----	<0.05	----	----
beta-Endosulfan	33213-65-9	0.05	mg/kg		<0.05	----	<0.05	----	----
^ Endosulfan (sum)	115-29-7	0.05	mg/kg		<0.05	----	<0.05	----	----
4.4`-DDD	72-54-8	0.05	mg/kg		<0.05	----	<0.05	----	----
Endrin aldehyde	7421-93-4	0.05	mg/kg		<0.05	----	<0.05	----	----
Endosulfan sulfate	1031-07-8	0.05	mg/kg		<0.05	----	<0.05	----	----
4.4`-DDT	50-29-3	0.2	mg/kg		<0.2	----	<0.2	----	----
Endrin ketone	53494-70-5	0.05	mg/kg		<0.05	----	<0.05	----	----
Methoxychlor	72-43-5	0.2	mg/kg		<0.2	----	<0.2	----	----
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.05	mg/kg		<0.05	----	<0.05	----	----
^ Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-2	0.05	mg/kg		<0.05	----	<0.05	----	----
EP068B: Organophosphorus Pesticides (OP)									
Dichlorvos	62-73-7	0.05	mg/kg		<0.05	----	<0.05	----	----
Demeton-S-methyl	919-86-8	0.05	mg/kg		<0.05	----	<0.05	----	----
Monocrotophos	6923-22-4	0.2	mg/kg		<0.2	----	<0.2	----	----
Dimethoate	60-51-5	0.05	mg/kg		<0.05	----	<0.05	----	----
Diazinon	333-41-5	0.05	mg/kg		<0.05	----	<0.05	----	----
Chlorpyrifos-methyl	5598-13-0	0.05	mg/kg		<0.05	----	<0.05	----	----
Parathion-methyl	298-00-0	0.2	mg/kg		<0.2	----	<0.2	----	----
Malathion	121-75-5	0.05	mg/kg		<0.05	----	<0.05	----	----
Fenthion	55-38-9	0.05	mg/kg		<0.05	----	<0.05	----	----
Chlorpyrifos	2921-88-2	0.05	mg/kg		<0.05	----	<0.05	----	----
Parathion	56-38-2	0.2	mg/kg		<0.2	----	<0.2	----	----
Pirimphos-ethyl	23505-41-1	0.05	mg/kg		<0.05	----	<0.05	----	----
Chlorfenvinphos	470-90-6	0.05	mg/kg		<0.05	----	<0.05	----	----
Bromophos-ethyl	4824-78-6	0.05	mg/kg		<0.05	----	<0.05	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	21649/S6/1-1	21649/S6/2-1	21649/S7/1-1	----	----
				Client sampling date / time	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	----	----
Compound	CAS Number	LOR	Unit		ES1731937-020	ES1731937-021	ES1731937-024	--------	--------
					Result	Result	Result	----	----
EP068B: Organophosphorus Pesticides (OP) - Continued									
Fenamiphos	22224-92-6	0.05	mg/kg		<0.05	----	<0.05	----	----
Prothiofos	34643-46-4	0.05	mg/kg		<0.05	----	<0.05	----	----
Ethion	563-12-2	0.05	mg/kg		<0.05	----	<0.05	----	----
Carbophenothion	786-19-6	0.05	mg/kg		<0.05	----	<0.05	----	----
Azinphos Methyl	86-50-0	0.05	mg/kg		<0.05	----	<0.05	----	----
EP068S: Organochlorine Pesticide Surrogate									
Dibromo-DDE	21655-73-2	0.05	%		**77.0**	----	**90.5**	----	----
EP068T: Organophosphorus Pesticide Surrogate									
DEF	78-48-8	0.05	%		**70.0**	----	**83.8**	----	----

Analytical Results

Descriptive Results

Sub-Matrix: **SOIL**

Method: Compound	Client sample ID - Client sampling date / time	Analytical Results
EA200: AS 4964 - 2004 Identification of Asbestos in Soils		
EA200: Description	21649/S1/1-1 - 14-Dec-2017 00:00	Mid brown clay soil.
EA200: Description	21649/S2-1 - 14-Dec-2017 00:00	Mid brown clay soil.
EA200: Description	21649/S3/1-1 - 14-Dec-2017 00:00	Mid brown clay soil.
EA200: Description	21649/S4/5-1 - 14-Dec-2017 00:00	Mid brown clay soil.
EA200: Description	21649/S4/6-1 - 14-Dec-2017 00:00	Mid brown clay soil.
EA200: Description	21649/S6/1-1 - 14-Dec-2017 00:00	Mid brown clay soil.
EA200: Description	21649/S7/1-1 - 14-Dec-2017 00:00	Mid brown clay soil.

Surrogate Control Limits

Sub-Matrix: **SOIL**		Recovery Limits (%)	
Compound	*CAS Number*	*Low*	*High*
EP068S: Organochlorine Pesticide Surrogate			
Dibromo-DDE	21655-73-2	49	147
EP068T: Organophosphorus Pesticide Surrogate			
DEF	78-48-8	35	143

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES1731925**	Page	: 1 of 24
Client	: **SMEC TESTING SERVICES PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: SMEC TESTING ALL RESULTS	Contact	: Customer Services ES
Address	: P O BOX 6989 WETHERILL PARK NSW, AUSTRALIA 2164	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: ----	Telephone	: +61-2-8784 8555
Project	: 21649	Date Samples Received	: 14-Dec-2017 16:02
Order number	: E-2017-713	Date Analysis Commenced	: 18-Dec-2017
C-O-C number	: ----	Issue Date	: 02-Jan-2018 17:24
Sampler	: ----		
Site	: ----		
Quote number	: ----		
No. of samples received	: 36		
No. of samples analysed	: 33		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Descriptive Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW
Dian Dao		Sydney Inorganics, Smithfield, NSW
Edwandy Fadjar	Organic Coordinator	Sydney Inorganics, Smithfield, NSW
Edwandy Fadjar	Organic Coordinator	Sydney Organics, Smithfield, NSW
Greg Vogel	Laboratory Manager	Brisbane Inorganics, Stafford, QLD
Matt Frost	Senior Organic Chemist	Brisbane Inorganics, Stafford, QLD
Matt Frost	Senior Organic Chemist	Brisbane Organics, Stafford, QLD
Raymond Commodore	Instrument Chemist	Sydney Inorganics, Smithfield, NSW
Shaun Spooner	Asbestos Identifier	Newcastle - Asbestos, Mayfield West, NSW

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EA200N: Asbestos weights and percentages are not covered under the Scope of NATA Accreditation.
  Weights of Asbestos are based on extracted bulk asbestos, fibre bundles, and/or ACM and do not include respirable fibres (if present)
  The Asbestos (Fines and Fibrous) weight is calculated from the extracted Fibrous Asbestos and Asbestos Fines as an equivalent weight of 100% Asbestos
  Percentages for Asbestos content in ACM are based on the 2013 NEPM default values.
  All calculations of percentage Asbestos under this method are approximate and should be used as a guide only.
- EA200 'Am' Amosite (brown asbestos)
- EA200 'Cr' Crocidolite (blue asbestos)
- EA200 'Trace' - Asbestos fibres ("Free Fibres") detected by trace analysis per AS4964. The result can be interpreted that the sample contains detectable 'respirable' asbestos fibres
- EA200: Asbestos Identification Samples were analysed by Polarised Light Microscopy including dispersion staining.
- EA200 Legend
- EA200 'Ch' Chrysotile (white asbestos)
- EA200: 'UMF' Unknown Mineral Fibres. "-" indicates fibres detected may or may not be asbestos fibres. Confirmation by alternative techniques is recommended.
- EA200: Negative results for vinyl tiles should be confirmed by an independent analytical technique.
- EA200N: ALS laboratory procedures and methods used for the identification and quantitation of asbestos are consistent with AS4964-2004 and the requirements of the 2013 NEPM for Assessment of Site Contamination
- Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero, for 'TEQ 1/2LOR' are treated as half the reported LOR, and for 'TEQ LOR' are treated as being equal to the reported LOR.
  Note: TEQ 1/2LOR and TEQ LOR will calculate as 0.6mg/Kg and 1.2mg/Kg respectively for samples with non-detects for all of the eight TEQ PAHs.
- EA200: For samples larger than 30g, the <2mm fraction may be sub-sampled prior to trace analysis as outlined in ISO23909:2008(E) Sect 6.3.2-2
- ED007 and ED008: When Exchangeable Al is reported from these methods, it should be noted that Rayment & Lyons (2011) suggests Exchange Acidity by 1M KCl - Method 15G1 (ED005) is a more suitable method for the determination of exchange acidity (H+ + Al3+).
- EA200: 'Yes' - Asbestos detected by polarised light microscopy including dispersion staining.
- EA200: 'No*' - No asbestos found, at the reporting limit of 0.1g/kg, by polarised light microscopy including dispersion staining. Asbestos material was detected and positively identified at concentrations estimated to be below 0.1g/kg.
- EA200: 'No' - No asbestos found at the reporting limit 0.1g/kg, by polarised light microscopy including dispersion staining.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	21649/S7/2-1	21649/S8-1	21649/S8-2	21649/S8-3	21649/S8-4
			Client sampling date / time	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00
Compound	CAS Number	LOR	Unit	ES1731925-001	ES1731925-004	ES1731925-005	ES1731925-006	ES1731925-007
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	----	6.1	6.2	8.7	8.7
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	----	76	155	997	1120
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	9.6	8.8	10.5	----	14.8
EA200: AS 4964 - 2004 Identification of Asbestos in Soils								
Asbestos Detected	1332-21-4	0.1	g/kg	----	No	----	----	----
Asbestos (Trace)	1332-21-4	5	Fibres	----	No	----	----	----
Asbestos Type	1332-21-4	-	--	----	-	----	----	----
Sample weight (dry)	----	0.01	g	----	218	----	----	----
APPROVED IDENTIFIER:	----	-	--	----	S.SPOONER	----	----	----
EA200N: Asbestos Quantification (non-NATA)								
ø Asbestos (Fines and Fibrous <7mm)	1332-21-4	0.0004	g	----	<0.0004	----	----	----
ø Asbestos (Fines and Fibrous FA+AF)	----	0.001	% (w/w)	----	<0.001	----	----	----
ø Weight Used for % Calculation	----	0.0001	kg	----	0.218	----	----	----
ø Fibrous Asbestos >7mm	----	0.0004	g	----	<0.0004	----	----	----
ED006: Exchangeable Cations on Alkaline Soils								
Exchangeable Calcium	----	0.2	meq/100g	----	----	----	----	10.9
Exchangeable Magnesium	----	0.2	meq/100g	----	----	----	----	10.8
Exchangeable Potassium	----	0.2	meq/100g	----	----	----	----	<0.2
Exchangeable Sodium	----	0.2	meq/100g	----	----	----	----	1.5
Cation Exchange Capacity	----	0.2	meq/100g	----	----	----	----	23.3
Exchangeable Sodium Percent	----	0.2	%	----	----	----	----	6.6
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	----	----	9.6	----	----
Exchangeable Magnesium	----	0.1	meq/100g	----	----	7.0	----	----
Exchangeable Potassium	----	0.1	meq/100g	----	----	0.2	----	----
Exchangeable Sodium	----	0.1	meq/100g	----	----	1.9	----	----
Cation Exchange Capacity	----	0.1	meq/100g	----	----	18.7	----	----
Exchangeable Sodium Percent	----	0.1	%	----	----	10.3	----	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	----	----	10	----	140
EG005T: Total Metals by ICP-AES								

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	21649/S7/2-1	21649/S8-1	21649/S8-2	21649/S8-3	21649/S8-4
				Client sampling date / time	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00
Compound	CAS Number	LOR	Unit		ES1731925-001	ES1731925-004	ES1731925-005	ES1731925-006	ES1731925-007
					Result	Result	Result	Result	Result
EG005T: Total Metals by ICP-AES - Continued									
Arsenic	7440-38-2	5	mg/kg		<5	**10**	**11**	----	----
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	----	----
Chromium	7440-47-3	2	mg/kg		**11**	**14**	**18**	----	----
Copper	7440-50-8	5	mg/kg		**24**	**13**	**14**	----	----
Lead	7439-92-1	5	mg/kg		**14**	**17**	**15**	----	----
Nickel	7440-02-0	2	mg/kg		**11**	**7**	**8**	----	----
Zinc	7440-66-6	5	mg/kg		**29**	**22**	**18**	----	----
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		<0.1	<0.1	<0.1	----	----
EP068A: Organochlorine Pesticides (OC)									
alpha-BHC	319-84-6	0.05	mg/kg		<0.05	<0.05	----	----	----
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg		<0.05	<0.05	----	----	----
beta-BHC	319-85-7	0.05	mg/kg		<0.05	<0.05	----	----	----
gamma-BHC	58-89-9	0.05	mg/kg		<0.05	<0.05	----	----	----
delta-BHC	319-86-8	0.05	mg/kg		<0.05	<0.05	----	----	----
Heptachlor	76-44-8	0.05	mg/kg		<0.05	<0.05	----	----	----
Aldrin	309-00-2	0.05	mg/kg		<0.05	<0.05	----	----	----
Heptachlor epoxide	1024-57-3	0.05	mg/kg		<0.05	<0.05	----	----	----
^ Total Chlordane (sum)	----	0.05	mg/kg		<0.05	<0.05	----	----	----
trans-Chlordane	5103-74-2	0.05	mg/kg		<0.05	<0.05	----	----	----
alpha-Endosulfan	959-98-8	0.05	mg/kg		<0.05	<0.05	----	----	----
cis-Chlordane	5103-71-9	0.05	mg/kg		<0.05	<0.05	----	----	----
Dieldrin	60-57-1	0.05	mg/kg		<0.05	<0.05	----	----	----
4.4`-DDE	72-55-9	0.05	mg/kg		<0.05	<0.05	----	----	----
Endrin	72-20-8	0.05	mg/kg		<0.05	<0.05	----	----	----
beta-Endosulfan	33213-65-9	0.05	mg/kg		<0.05	<0.05	----	----	----
^ Endosulfan (sum)	115-29-7	0.05	mg/kg		<0.05	<0.05	----	----	----
4.4`-DDD	72-54-8	0.05	mg/kg		<0.05	<0.05	----	----	----
Endrin aldehyde	7421-93-4	0.05	mg/kg		<0.05	<0.05	----	----	----
Endosulfan sulfate	1031-07-8	0.05	mg/kg		<0.05	<0.05	----	----	----
4.4`-DDT	50-29-3	0.2	mg/kg		<0.2	<0.2	----	----	----
Endrin ketone	53494-70-5	0.05	mg/kg		<0.05	<0.05	----	----	----
Methoxychlor	72-43-5	0.2	mg/kg		<0.2	<0.2	----	----	----
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.05	mg/kg		<0.05	<0.05	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	21649/S7/2-1	21649/S8-1	21649/S8-2	21649/S8-3	21649/S8-4
			Client sampling date / time	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00
Compound	CAS Number	LOR	Unit	ES1731925-001	ES1731925-004	ES1731925-005	ES1731925-006	ES1731925-007
				Result	Result	Result	Result	Result
EP068A: Organochlorine Pesticides (OC) - Continued								
^ Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-29-3	0.05	mg/kg	<0.05	<0.05	----	----	----
EP068B: Organophosphorus Pesticides (OP)								
Dichlorvos	62-73-7	0.05	mg/kg	<0.05	<0.05	----	----	----
Demeton-S-methyl	919-86-8	0.05	mg/kg	<0.05	<0.05	----	----	----
Monocrotophos	6923-22-4	0.2	mg/kg	<0.2	<0.2	----	----	----
Dimethoate	60-51-5	0.05	mg/kg	<0.05	<0.05	----	----	----
Diazinon	333-41-5	0.05	mg/kg	<0.05	<0.05	----	----	----
Chlorpyrifos-methyl	5598-13-0	0.05	mg/kg	<0.05	<0.05	----	----	----
Parathion-methyl	298-00-0	0.2	mg/kg	<0.2	<0.2	----	----	----
Malathion	121-75-5	0.05	mg/kg	<0.05	<0.05	----	----	----
Fenthion	55-38-9	0.05	mg/kg	<0.05	<0.05	----	----	----
Chlorpyrifos	2921-88-2	0.05	mg/kg	<0.05	<0.05	----	----	----
Parathion	56-38-2	0.2	mg/kg	<0.2	<0.2	----	----	----
Pirimphos-ethyl	23505-41-1	0.05	mg/kg	<0.05	<0.05	----	----	----
Chlorfenvinphos	470-90-6	0.05	mg/kg	<0.05	<0.05	----	----	----
Bromophos-ethyl	4824-78-6	0.05	mg/kg	<0.05	<0.05	----	----	----
Fenamiphos	22224-92-6	0.05	mg/kg	<0.05	<0.05	----	----	----
Prothiofos	34643-46-4	0.05	mg/kg	<0.05	<0.05	----	----	----
Ethion	563-12-2	0.05	mg/kg	<0.05	<0.05	----	----	----
Carbophenothion	786-19-6	0.05	mg/kg	<0.05	<0.05	----	----	----
Azinphos Methyl	86-50-0	0.05	mg/kg	<0.05	<0.05	----	----	----
EP068S: Organochlorine Pesticide Surrogate								
Dibromo-DDE	21655-73-2	0.05	%	**74.4**	**119**	----	----	----
EP068T: Organophosphorus Pesticide Surrogate								
DEF	78-48-8	0.05	%	**70.5**	**84.1**	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	21649/S8-5	21649/S8-6	21649/S8-7	21649/S8-8	21649/S9-1
			Client sampling date / time	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00
Compound	CAS Number	LOR	Unit	ES1731925-008	ES1731925-009	ES1731925-010	ES1731925-011	ES1731925-012
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	8.7	9.2	9.1	8.8	5.4
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	944	666	736	570	430
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	16.3	----	11.1	----	11.9
ED006: Exchangeable Cations on Alkaline Soils								
Exchangeable Calcium	----	0.2	meq/100g	5.4	----	4.4	----	----
Exchangeable Magnesium	----	0.2	meq/100g	10.2	----	7.8	----	----
Exchangeable Potassium	----	0.2	meq/100g	0.2	----	<0.2	----	----
Exchangeable Sodium	----	0.2	meq/100g	2.4	----	1.2	----	----
Cation Exchange Capacity	----	0.2	meq/100g	18.2	----	13.5	----	----
Exchangeable Sodium Percent	----	0.2	%	13.4	----	9.0	----	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	120	----	110	----	----
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	319-84-6	0.05	mg/kg	----	----	----	----	<0.05
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	----	----	----	----	<0.05
beta-BHC	319-85-7	0.05	mg/kg	----	----	----	----	<0.05
gamma-BHC	58-89-9	0.05	mg/kg	----	----	----	----	<0.05
delta-BHC	319-86-8	0.05	mg/kg	----	----	----	----	<0.05
Heptachlor	76-44-8	0.05	mg/kg	----	----	----	----	<0.05
Aldrin	309-00-2	0.05	mg/kg	----	----	----	----	<0.05
Heptachlor epoxide	1024-57-3	0.05	mg/kg	----	----	----	----	<0.05
^ Total Chlordane (sum)	----	0.05	mg/kg	----	----	----	----	<0.05
trans-Chlordane	5103-74-2	0.05	mg/kg	----	----	----	----	<0.05
alpha-Endosulfan	959-98-8	0.05	mg/kg	----	----	----	----	<0.05
cis-Chlordane	5103-71-9	0.05	mg/kg	----	----	----	----	<0.05
Dieldrin	60-57-1	0.05	mg/kg	----	----	----	----	<0.05
4.4`-DDE	72-55-9	0.05	mg/kg	----	----	----	----	<0.05
Endrin	72-20-8	0.05	mg/kg	----	----	----	----	<0.05
beta-Endosulfan	33213-65-9	0.05	mg/kg	----	----	----	----	<0.05
^ Endosulfan (sum)	115-29-7	0.05	mg/kg	----	----	----	----	<0.05
4.4`-DDD	72-54-8	0.05	mg/kg	----	----	----	----	<0.05
Endrin aldehyde	7421-93-4	0.05	mg/kg	----	----	----	----	<0.05

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	21649/S8-5	21649/S8-6	21649/S8-7	21649/S8-8	21649/S9-1
				Client sampling date / time	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00
Compound	CAS Number	LOR	Unit		ES1731925-008	ES1731925-009	ES1731925-010	ES1731925-011	ES1731925-012
					Result	Result	Result	Result	Result
EP068A: Organochlorine Pesticides (OC) - Continued									
Endosulfan sulfate	1031-07-8	0.05	mg/kg		----	----	----	----	<0.05
4.4`-DDT	50-29-3	0.2	mg/kg		----	----	----	----	<0.2
Endrin ketone	53494-70-5	0.05	mg/kg		----	----	----	----	<0.05
Methoxychlor	72-43-5	0.2	mg/kg		----	----	----	----	<0.2
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.05	mg/kg		----	----	----	----	<0.05
^ Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-2	0.05	mg/kg		----	----	----	----	<0.05
EP068B: Organophosphorus Pesticides (OP)									
Dichlorvos	62-73-7	0.05	mg/kg		----	----	----	----	<0.05
Demeton-S-methyl	919-86-8	0.05	mg/kg		----	----	----	----	<0.05
Monocrotophos	6923-22-4	0.2	mg/kg		----	----	----	----	<0.2
Dimethoate	60-51-5	0.05	mg/kg		----	----	----	----	<0.05
Diazinon	333-41-5	0.05	mg/kg		----	----	----	----	<0.05
Chlorpyrifos-methyl	5598-13-0	0.05	mg/kg		----	----	----	----	<0.05
Parathion-methyl	298-00-0	0.2	mg/kg		----	----	----	----	<0.2
Malathion	121-75-5	0.05	mg/kg		----	----	----	----	<0.05
Fenthion	55-38-9	0.05	mg/kg		----	----	----	----	<0.05
Chlorpyrifos	2921-88-2	0.05	mg/kg		----	----	----	----	<0.05
Parathion	56-38-2	0.2	mg/kg		----	----	----	----	<0.2
Pirimphos-ethyl	23505-41-1	0.05	mg/kg		----	----	----	----	<0.05
Chlorfenvinphos	470-90-6	0.05	mg/kg		----	----	----	----	<0.05
Bromophos-ethyl	4824-78-6	0.05	mg/kg		----	----	----	----	<0.05
Fenamiphos	22224-92-6	0.05	mg/kg		----	----	----	----	<0.05
Prothiofos	34643-46-4	0.05	mg/kg		----	----	----	----	<0.05
Ethion	563-12-2	0.05	mg/kg		----	----	----	----	<0.05
Carbophenothion	786-19-6	0.05	mg/kg		----	----	----	----	<0.05
Azinphos Methyl	86-50-0	0.05	mg/kg		----	----	----	----	<0.05
EP068S: Organochlorine Pesticide Surrogate									
Dibromo-DDE	21655-73-2	0.05	%		----	----	----	----	**119**
EP068T: Organophosphorus Pesticide Surrogate									
DEF	78-48-8	0.05	%		----	----	----	----	**82.5**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	21649/S10-1-1	21649/S11-1	21649/S12/1-1	21649/S13/1-1	21649/S14/1-1
			Client sampling date / time	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00
Compound	CAS Number	LOR	Unit	ES1731925-013	ES1731925-014	ES1731925-015	ES1731925-016	ES1731925-018
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	----	6.3	6.0	6.7	----
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	----	155	87	58	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	8.4	11.6	8.1	----	7.8
EA200: AS 4964 - 2004 Identification of Asbestos in Soils								
Asbestos Detected	1332-21-4	0.1	g/kg	----	No	----	----	No
Asbestos (Trace)	1332-21-4	5	Fibres	----	No	----	----	No
Asbestos Type	1332-21-4	-	--	----	-	----	----	-
Sample weight (dry)	----	0.01	g	----	156	----	----	137
APPROVED IDENTIFIER:	----	-	--	----	S.SPOONER	----	----	S.SPOONER
EA200N: Asbestos Quantification (non-NATA)								
ø Asbestos (Fines and Fibrous <7mm)	1332-21-4	0.0004	g	----	<0.0004	----	----	<0.0004
ø Asbestos (Fines and Fibrous FA+AF)	----	0.001	% (w/w)	----	<0.001	----	----	<0.001
ø Weight Used for % Calculation	----	0.0001	kg	----	0.156	----	----	0.137
ø Fibrous Asbestos >7mm	----	0.0004	g	----	<0.0004	----	----	<0.0004
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	----	----	----	13.0	----
Exchangeable Magnesium	----	0.1	meq/100g	----	----	----	3.6	----
Exchangeable Potassium	----	0.1	meq/100g	----	----	----	0.2	----
Exchangeable Sodium	----	0.1	meq/100g	----	----	----	0.2	----
Cation Exchange Capacity	----	0.1	meq/100g	----	----	----	17.1	----
Exchangeable Sodium Percent	----	0.1	%	----	----	----	1.4	----
EG005T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	----	9	8	----	16
Cadmium	7440-43-9	1	mg/kg	----	<1	<1	----	<1
Chromium	7440-47-3	2	mg/kg	----	13	23	----	24
Copper	7440-50-8	5	mg/kg	----	16	13	----	26
Lead	7439-92-1	5	mg/kg	----	24	21	----	41
Nickel	7440-02-0	2	mg/kg	----	6	7	----	12
Zinc	7440-66-6	5	mg/kg	----	39	37	----	110
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	----	<0.1	<0.1	----	<0.1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	21649/S10-1-1	21649/S11-1	21649/S12/1-1	21649/S13/1-1	21649/S14/1-1
			Client sampling date / time	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00
Compound	CAS Number	LOR	Unit	ES1731925-013	ES1731925-014	ES1731925-015	ES1731925-016	ES1731925-018
				Result	Result	Result	Result	Result
EK072: Phosphate Sorption Capacity								
Phosphate Sorption Capacity	----	250	mg P sorbed/kg	----	----	----	766	----
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	319-84-6	0.05	mg/kg	<0.05	----	----	----	----
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	<0.05	----	----	----	----
beta-BHC	319-85-7	0.05	mg/kg	<0.05	----	----	----	----
gamma-BHC	58-89-9	0.05	mg/kg	<0.05	----	----	----	----
delta-BHC	319-86-8	0.05	mg/kg	<0.05	----	----	----	----
Heptachlor	76-44-8	0.05	mg/kg	<0.05	----	----	----	----
Aldrin	309-00-2	0.05	mg/kg	<0.05	----	----	----	----
Heptachlor epoxide	1024-57-3	0.05	mg/kg	<0.05	----	----	----	----
^ Total Chlordane (sum)	----	0.05	mg/kg	<0.05	----	----	----	----
trans-Chlordane	5103-74-2	0.05	mg/kg	<0.05	----	----	----	----
alpha-Endosulfan	959-98-8	0.05	mg/kg	<0.05	----	----	----	----
cis-Chlordane	5103-71-9	0.05	mg/kg	<0.05	----	----	----	----
Dieldrin	60-57-1	0.05	mg/kg	<0.05	----	----	----	----
4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	----	----	----	----
Endrin	72-20-8	0.05	mg/kg	<0.05	----	----	----	----
beta-Endosulfan	33213-65-9	0.05	mg/kg	<0.05	----	----	----	----
^ Endosulfan (sum)	115-29-7	0.05	mg/kg	<0.05	----	----	----	----
4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	----	----	----	----
Endrin aldehyde	7421-93-4	0.05	mg/kg	<0.05	----	----	----	----
Endosulfan sulfate	1031-07-8	0.05	mg/kg	<0.05	----	----	----	----
4.4`-DDT	50-29-3	0.2	mg/kg	<0.2	----	----	----	----
Endrin ketone	53494-70-5	0.05	mg/kg	<0.05	----	----	----	----
Methoxychlor	72-43-5	0.2	mg/kg	<0.2	----	----	----	----
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.05	mg/kg	<0.05	----	----	----	----
^ Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-29-3	0.05	mg/kg	<0.05	----	----	----	----
EP068B: Organophosphorus Pesticides (OP)								
Dichlorvos	62-73-7	0.05	mg/kg	<0.05	----	----	----	----
Demeton-S-methyl	919-86-8	0.05	mg/kg	<0.05	----	----	----	----
Monocrotophos	6923-22-4	0.2	mg/kg	<0.2	----	----	----	----
Dimethoate	60-51-5	0.05	mg/kg	<0.05	----	----	----	----
Diazinon	333-41-5	0.05	mg/kg	<0.05	----	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	21649/S10-1-1	21649/S11-1	21649/S12/1-1	21649/S13/1-1	21649/S14/1-1
				Client sampling date / time	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00
Compound	CAS Number	LOR	Unit		ES1731925-013	ES1731925-014	ES1731925-015	ES1731925-016	ES1731925-018
					Result	Result	Result	Result	Result
EP068B: Organophosphorus Pesticides (OP) - Continued									
Chlorpyrifos-methyl	5598-13-0	0.05	mg/kg		<0.05	----	----	----	----
Parathion-methyl	298-00-0	0.2	mg/kg		<0.2	----	----	----	----
Malathion	121-75-5	0.05	mg/kg		<0.05	----	----	----	----
Fenthion	55-38-9	0.05	mg/kg		<0.05	----	----	----	----
Chlorpyrifos	2921-88-2	0.05	mg/kg		<0.05	----	----	----	----
Parathion	56-38-2	0.2	mg/kg		<0.2	----	----	----	----
Pirimphos-ethyl	23505-41-1	0.05	mg/kg		<0.05	----	----	----	----
Chlorfenvinphos	470-90-6	0.05	mg/kg		<0.05	----	----	----	----
Bromophos-ethyl	4824-78-6	0.05	mg/kg		<0.05	----	----	----	----
Fenamiphos	22224-92-6	0.05	mg/kg		<0.05	----	----	----	----
Prothiofos	34643-46-4	0.05	mg/kg		<0.05	----	----	----	----
Ethion	563-12-2	0.05	mg/kg		<0.05	----	----	----	----
Carbophenothion	786-19-6	0.05	mg/kg		<0.05	----	----	----	----
Azinphos Methyl	86-50-0	0.05	mg/kg		<0.05	----	----	----	----
EP068S: Organochlorine Pesticide Surrogate									
Dibromo-DDE	21655-73-2	0.05	%		**118**	----	----	----	----
EP068T: Organophosphorus Pesticide Surrogate									
DEF	78-48-8	0.05	%		**83.9**	----	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	21649/S14/1-2	21649/S15-1	21649/S15-2	21649/S15-3	21649/S15-4
			Client sampling date / time	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00
Compound	CAS Number	LOR	Unit	ES1731925-019	ES1731925-020	ES1731925-021	ES1731925-022	ES1731925-023
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	6.9	6.4	6.4	8.8	8.5
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	100	87	112	446	350
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	10.3	11.8	16.2	13.7	----
EA200: AS 4964 - 2004 Identification of Asbestos in Soils								
Asbestos Detected	1332-21-4	0.1	g/kg	----	No	----	----	----
Asbestos (Trace)	1332-21-4	5	Fibres	----	No	----	----	----
Asbestos Type	1332-21-4	-	--	----	-	----	----	----
Sample weight (dry)	----	0.01	g	----	126	----	----	----
APPROVED IDENTIFIER:	----	-	--	----	S.SPOONER	----	----	----
EA200N: Asbestos Quantification (non-NATA)								
ø Asbestos (Fines and Fibrous <7mm)	1332-21-4	0.0004	g	----	<0.0004	----	----	----
ø Asbestos (Fines and Fibrous FA+AF)	----	0.001	% (w/w)	----	<0.001	----	----	----
ø Weight Used for % Calculation	----	0.0001	kg	----	0.126	----	----	----
ø Fibrous Asbestos >7mm	----	0.0004	g	----	<0.0004	----	----	----
ED006: Exchangeable Cations on Alkaline Soils								
Exchangeable Calcium	----	0.2	meq/100g	----	----	----	16.9	----
Exchangeable Magnesium	----	0.2	meq/100g	----	----	----	13.4	----
Exchangeable Potassium	----	0.2	meq/100g	----	----	----	<0.2	----
Exchangeable Sodium	----	0.2	meq/100g	----	----	----	2.7	----
Cation Exchange Capacity	----	0.2	meq/100g	----	----	----	33.0	----
Exchangeable Sodium Percent	----	0.2	%	----	----	----	8.2	----
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	6.2	----	10.5	----	----
Exchangeable Magnesium	----	0.1	meq/100g	9.4	----	9.4	----	----
Exchangeable Potassium	----	0.1	meq/100g	0.1	----	0.2	----	----
Exchangeable Sodium	----	0.1	meq/100g	2.0	----	3.0	----	----
Cation Exchange Capacity	----	0.1	meq/100g	17.7	----	23.1	----	----
Exchangeable Sodium Percent	----	0.1	%	11.5	----	12.9	----	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	----	----	90	120	----
EG005T: Total Metals by ICP-AES								

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	21649/S14/1-2	21649/S15-1	21649/S15-2	21649/S15-3	21649/S15-4
				Client sampling date / time	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00
Compound	CAS Number	LOR	Unit		ES1731925-019	ES1731925-020	ES1731925-021	ES1731925-022	ES1731925-023
					Result	Result	Result	Result	Result
EG005T: Total Metals by ICP-AES - Continued									
Arsenic	7440-38-2	5	mg/kg		**15**	**12**	----	----	----
Cadmium	7440-43-9	1	mg/kg		<1	<1	----	----	----
Chromium	7440-47-3	2	mg/kg		**19**	**18**	----	----	----
Copper	7440-50-8	5	mg/kg		**31**	**21**	----	----	----
Lead	7439-92-1	5	mg/kg		**20**	**68**	----	----	----
Nickel	7440-02-0	2	mg/kg		**52**	**14**	----	----	----
Zinc	7440-66-6	5	mg/kg		**124**	**55**	----	----	----
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		<0.1	<0.1	----	----	----
EK072: Phosphate Sorption Capacity									
Phosphate Sorption Capacity	----	250	mg P sorbed/kg		**1090**	----	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	21649/S15-5	21649/S15-6	21649/S15-7	21649/S15-8	21649/S16/1-1
			Client sampling date / time	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00
Compound	CAS Number	LOR	Unit	ES1731925-024	ES1731925-025	ES1731925-026	ES1731925-027	ES1731925-028
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	8.7	8.6	9.1	9.5	----
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	192	224	240	337	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	9.6	10.6	----	----	7.7
EA200: AS 4964 - 2004 Identification of Asbestos in Soils								
Asbestos Detected	1332-21-4	0.1	g/kg	----	----	----	----	No
Asbestos (Trace)	1332-21-4	5	Fibres	----	----	----	----	No
Asbestos Type	1332-21-4	-	--	----	----	----	----	-
Sample weight (dry)	----	0.01	g	----	----	----	----	317
APPROVED IDENTIFIER:	----	-	--	----	----	----	----	S.SPOONER
EA200N: Asbestos Quantification (non-NATA)								
ø Asbestos (Fines and Fibrous <7mm)	1332-21-4	0.0004	g	----	----	----	----	<0.0004
ø Asbestos (Fines and Fibrous FA+AF)	----	0.001	% (w/w)	----	----	----	----	<0.001
ø Weight Used for % Calculation	----	0.0001	kg	----	----	----	----	0.317
ø Fibrous Asbestos >7mm	----	0.0004	g	----	----	----	----	<0.0004
ED006: Exchangeable Cations on Alkaline Soils								
Exchangeable Calcium	----	0.2	meq/100g	21.1	18.0	----	----	----
Exchangeable Magnesium	----	0.2	meq/100g	9.8	8.4	----	----	----
Exchangeable Potassium	----	0.2	meq/100g	<0.2	<0.2	----	----	----
Exchangeable Sodium	----	0.2	meq/100g	<0.2	<0.2	----	----	----
Cation Exchange Capacity	----	0.2	meq/100g	30.9	26.5	----	----	----
Exchangeable Sodium Percent	----	0.2	%	<0.2	<0.2	----	----	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	10	20	----	----	----
EG005T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	----	----	----	----	16
Cadmium	7440-43-9	1	mg/kg	----	----	----	----	<1
Chromium	7440-47-3	2	mg/kg	----	----	----	----	26
Copper	7440-50-8	5	mg/kg	----	----	----	----	15
Lead	7439-92-1	5	mg/kg	----	----	----	----	28
Nickel	7440-02-0	2	mg/kg	----	----	----	----	8
Zinc	7440-66-6	5	mg/kg	----	----	----	----	40

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	21649/S15-5	21649/S15-6	21649/S15-7	21649/S15-8	21649/S16/1-1
			Client sampling date / time	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00
Compound	CAS Number	LOR	Unit	ES1731925-024	ES1731925-025	ES1731925-026	ES1731925-027	ES1731925-028
				Result	Result	Result	Result	Result
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	----	----	----	----	<0.1
EP066: Polychlorinated Biphenyls (PCB)								
Total Polychlorinated biphenyls	----	0.1	mg/kg	----	----	----	----	<0.1
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	319-84-6	0.05	mg/kg	----	----	----	----	<0.05
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	----	----	----	----	<0.05
beta-BHC	319-85-7	0.05	mg/kg	----	----	----	----	<0.05
gamma-BHC	58-89-9	0.05	mg/kg	----	----	----	----	<0.05
delta-BHC	319-86-8	0.05	mg/kg	----	----	----	----	<0.05
Heptachlor	76-44-8	0.05	mg/kg	----	----	----	----	<0.05
Aldrin	309-00-2	0.05	mg/kg	----	----	----	----	<0.05
Heptachlor epoxide	1024-57-3	0.05	mg/kg	----	----	----	----	<0.05
^ Total Chlordane (sum)	----	0.05	mg/kg	----	----	----	----	<0.05
trans-Chlordane	5103-74-2	0.05	mg/kg	----	----	----	----	<0.05
alpha-Endosulfan	959-98-8	0.05	mg/kg	----	----	----	----	<0.05
cis-Chlordane	5103-71-9	0.05	mg/kg	----	----	----	----	<0.05
Dieldrin	60-57-1	0.05	mg/kg	----	----	----	----	<0.05
4.4`-DDE	72-55-9	0.05	mg/kg	----	----	----	----	<0.05
Endrin	72-20-8	0.05	mg/kg	----	----	----	----	<0.05
beta-Endosulfan	33213-65-9	0.05	mg/kg	----	----	----	----	<0.05
^ Endosulfan (sum)	115-29-7	0.05	mg/kg	----	----	----	----	<0.05
4.4`-DDD	72-54-8	0.05	mg/kg	----	----	----	----	<0.05
Endrin aldehyde	7421-93-4	0.05	mg/kg	----	----	----	----	<0.05
Endosulfan sulfate	1031-07-8	0.05	mg/kg	----	----	----	----	<0.05
4.4`-DDT	50-29-3	0.2	mg/kg	----	----	----	----	<0.2
Endrin ketone	53494-70-5	0.05	mg/kg	----	----	----	----	<0.05
Methoxychlor	72-43-5	0.2	mg/kg	----	----	----	----	<0.2
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.05	mg/kg	----	----	----	----	<0.05
^ Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-29-3	0.05	mg/kg	----	----	----	----	<0.05
EP068B: Organophosphorus Pesticides (OP)								
Dichlorvos	62-73-7	0.05	mg/kg	----	----	----	----	<0.05
Demeton-S-methyl	919-86-8	0.05	mg/kg	----	----	----	----	<0.05
Monocrotophos	6923-22-4	0.2	mg/kg	----	----	----	----	<0.2

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	21649/S15-5	21649/S15-6	21649/S15-7	21649/S15-8	21649/S16/1-1
				Client sampling date / time	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00
Compound	CAS Number	LOR	Unit		ES1731925-024	ES1731925-025	ES1731925-026	ES1731925-027	ES1731925-028
					Result	Result	Result	Result	Result
EP068B: Organophosphorus Pesticides (OP) - Continued									
Dimethoate	60-51-5	0.05	mg/kg		----	----	----	----	<0.05
Diazinon	333-41-5	0.05	mg/kg		----	----	----	----	<0.05
Chlorpyrifos-methyl	5598-13-0	0.05	mg/kg		----	----	----	----	<0.05
Parathion-methyl	298-00-0	0.2	mg/kg		----	----	----	----	<0.2
Malathion	121-75-5	0.05	mg/kg		----	----	----	----	<0.05
Fenthion	55-38-9	0.05	mg/kg		----	----	----	----	<0.05
Chlorpyrifos	2921-88-2	0.05	mg/kg		----	----	----	----	<0.05
Parathion	56-38-2	0.2	mg/kg		----	----	----	----	<0.2
Pirimphos-ethyl	23505-41-1	0.05	mg/kg		----	----	----	----	<0.05
Chlorfenvinphos	470-90-6	0.05	mg/kg		----	----	----	----	<0.05
Bromophos-ethyl	4824-78-6	0.05	mg/kg		----	----	----	----	<0.05
Fenamiphos	22224-92-6	0.05	mg/kg		----	----	----	----	<0.05
Prothiofos	34643-46-4	0.05	mg/kg		----	----	----	----	<0.05
Ethion	563-12-2	0.05	mg/kg		----	----	----	----	<0.05
Carbophenothion	786-19-6	0.05	mg/kg		----	----	----	----	<0.05
Azinphos Methyl	86-50-0	0.05	mg/kg		----	----	----	----	<0.05
EP075(SIM)A: Phenolic Compounds									
Phenol	108-95-2	0.5	mg/kg		----	----	----	----	<0.5
2-Chlorophenol	95-57-8	0.5	mg/kg		----	----	----	----	<0.5
2-Methylphenol	95-48-7	0.5	mg/kg		----	----	----	----	<0.5
3- & 4-Methylphenol	1319-77-3	1	mg/kg		----	----	----	----	<1
2-Nitrophenol	88-75-5	0.5	mg/kg		----	----	----	----	<0.5
2.4-Dimethylphenol	105-67-9	0.5	mg/kg		----	----	----	----	<0.5
2.4-Dichlorophenol	120-83-2	0.5	mg/kg		----	----	----	----	<0.5
2.6-Dichlorophenol	87-65-0	0.5	mg/kg		----	----	----	----	<0.5
4-Chloro-3-methylphenol	59-50-7	0.5	mg/kg		----	----	----	----	<0.5
2.4.6-Trichlorophenol	88-06-2	0.5	mg/kg		----	----	----	----	<0.5
2.4.5-Trichlorophenol	95-95-4	0.5	mg/kg		----	----	----	----	<0.5
Pentachlorophenol	87-86-5	2	mg/kg		----	----	----	----	<2
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	0.5	mg/kg		----	----	----	----	<0.5
Acenaphthylene	208-96-8	0.5	mg/kg		----	----	----	----	<0.5
Acenaphthene	83-32-9	0.5	mg/kg		----	----	----	----	<0.5
Fluorene	86-73-7	0.5	mg/kg		----	----	----	----	<0.5

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	21649/S15-5	21649/S15-6	21649/S15-7	21649/S15-8	21649/S16/1-1
				Client sampling date / time	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00
Compound	CAS Number	LOR	Unit		ES1731925-024	ES1731925-025	ES1731925-026	ES1731925-027	ES1731925-028
					Result	Result	Result	Result	Result
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued									
Phenanthrene	85-01-8	0.5	mg/kg		----	----	----	----	<0.5
Anthracene	120-12-7	0.5	mg/kg		----	----	----	----	<0.5
Fluoranthene	206-44-0	0.5	mg/kg		----	----	----	----	<0.5
Pyrene	129-00-0	0.5	mg/kg		----	----	----	----	<0.5
Benz(a)anthracene	56-55-3	0.5	mg/kg		----	----	----	----	<0.5
Chrysene	218-01-9	0.5	mg/kg		----	----	----	----	<0.5
Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg		----	----	----	----	<0.5
Benzo(k)fluoranthene	207-08-9	0.5	mg/kg		----	----	----	----	<0.5
Benzo(a)pyrene	50-32-8	0.5	mg/kg		----	----	----	----	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg		----	----	----	----	<0.5
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg		----	----	----	----	<0.5
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg		----	----	----	----	<0.5
^ **Sum of polycyclic aromatic hydrocarbons**	----	0.5	mg/kg		----	----	----	----	<0.5
^ **Benzo(a)pyrene TEQ (zero)**	----	0.5	mg/kg		----	----	----	----	<0.5
^ **Benzo(a)pyrene TEQ (half LOR)**	----	0.5	mg/kg		----	----	----	----	**0.6**
^ **Benzo(a)pyrene TEQ (LOR)**	----	0.5	mg/kg		----	----	----	----	**1.2**
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	10	mg/kg		----	----	----	----	<10
C10 - C14 Fraction	----	50	mg/kg		----	----	----	----	<50
C15 - C28 Fraction	----	100	mg/kg		----	----	----	----	<100
C29 - C36 Fraction	----	100	mg/kg		----	----	----	----	<100
^ **C10 - C36 Fraction (sum)**	----	50	mg/kg		----	----	----	----	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	10	mg/kg		----	----	----	----	<10
^ **C6 - C10 Fraction minus BTEX (F1)**	C6_C10-BTEX	10	mg/kg		----	----	----	----	<10
>C10 - C16 Fraction	----	50	mg/kg		----	----	----	----	<50
>C16 - C34 Fraction	----	100	mg/kg		----	----	----	----	<100
>C34 - C40 Fraction	----	100	mg/kg		----	----	----	----	<100
^ **>C10 - C40 Fraction (sum)**	----	50	mg/kg		----	----	----	----	<50
^ **>C10 - C16 Fraction minus Naphthalene (F2)**	----	50	mg/kg		----	----	----	----	<50
EP080: BTEXN									
Benzene	71-43-2	0.2	mg/kg		----	----	----	----	<0.2
Toluene	108-88-3	0.5	mg/kg		----	----	----	----	<0.5

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	21649/S15-5	21649/S15-6	21649/S15-7	21649/S15-8	21649/S16/1-1
				Client sampling date / time	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00
Compound	CAS Number	LOR	Unit		ES1731925-024	ES1731925-025	ES1731925-026	ES1731925-027	ES1731925-028
					Result	Result	Result	Result	Result
EP080: BTEXN - Continued									
Ethylbenzene	100-41-4	0.5	mg/kg		----	----	----	----	<0.5
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg		----	----	----	----	<0.5
ortho-Xylene	95-47-6	0.5	mg/kg		----	----	----	----	<0.5
^ Sum of BTEX	----	0.2	mg/kg		----	----	----	----	<0.2
^ Total Xylenes	----	0.5	mg/kg		----	----	----	----	<0.5
Naphthalene	91-20-3	1	mg/kg		----	----	----	----	<1
EP066S: PCB Surrogate									
Decachlorobiphenyl	2051-24-3	0.1	%		----	----	----	----	114
EP068S: Organochlorine Pesticide Surrogate									
Dibromo-DDE	21655-73-2	0.05	%		----	----	----	----	116
EP068T: Organophosphorus Pesticide Surrogate									
DEF	78-48-8	0.05	%		----	----	----	----	120
EP075(SIM)S: Phenolic Compound Surrogates									
Phenol-d6	13127-88-3	0.5	%		----	----	----	----	83.8
2-Chlorophenol-D4	93951-73-6	0.5	%		----	----	----	----	84.0
2.4.6-Tribromophenol	118-79-6	0.5	%		----	----	----	----	87.6
EP075(SIM)T: PAH Surrogates									
2-Fluorobiphenyl	321-60-8	0.5	%		----	----	----	----	94.5
Anthracene-d10	1719-06-8	0.5	%		----	----	----	----	99.2
4-Terphenyl-d14	1718-51-0	0.5	%		----	----	----	----	91.0
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	0.2	%		----	----	----	----	116
Toluene-D8	2037-26-5	0.2	%		----	----	----	----	125
4-Bromofluorobenzene	460-00-4	0.2	%		----	----	----	----	120

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	21649/S17/1	21649/S18/1-1	21649/S19/1-1	TRIP 1	TRIP 2
			Client sampling date / time	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00
Compound	CAS Number	LOR	Unit	ES1731925-029	ES1731925-030	ES1731925-031	ES1731925-032	ES1731925-033
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	5.9	----	6.0	----	----
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	37	----	46	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	----	8.6	----	9.5	9.0
EA200: AS 4964 - 2004 Identification of Asbestos in Soils								
Asbestos Detected	1332-21-4	0.1	g/kg	----	No	----	----	----
Asbestos (Trace)	1332-21-4	5	Fibres	----	No	----	----	----
Asbestos Type	1332-21-4	-	--	----	-	----	----	----
Sample weight (dry)	----	0.01	g	----	223	----	----	----
APPROVED IDENTIFIER:	----	-	--	----	S.SPOONER	----	----	----
EA200N: Asbestos Quantification (non-NATA)								
ø Asbestos (Fines and Fibrous <7mm)	1332-21-4	0.0004	g	----	<0.0004	----	----	----
ø Asbestos (Fines and Fibrous FA+AF)	----	0.001	% (w/w)	----	<0.001	----	----	----
ø Weight Used for % Calculation	----	0.0001	kg	----	0.223	----	----	----
ø Fibrous Asbestos >7mm	----	0.0004	g	----	<0.0004	----	----	----
EG005T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	----	11	----	----	11
Cadmium	7440-43-9	1	mg/kg	----	<1	----	----	<1
Chromium	7440-47-3	2	mg/kg	----	28	----	----	17
Copper	7440-50-8	5	mg/kg	----	15	----	----	16
Lead	7439-92-1	5	mg/kg	----	26	----	----	22
Nickel	7440-02-0	2	mg/kg	----	7	----	----	10
Zinc	7440-66-6	5	mg/kg	----	38	----	----	35
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	----	<0.1	----	----	<0.1
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	319-84-6	0.05	mg/kg	----	----	----	<0.05	<0.05
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	----	----	----	<0.05	<0.05
beta-BHC	319-85-7	0.05	mg/kg	----	----	----	<0.05	<0.05
gamma-BHC	58-89-9	0.05	mg/kg	----	----	----	<0.05	<0.05
delta-BHC	319-86-8	0.05	mg/kg	----	----	----	<0.05	<0.05
Heptachlor	76-44-8	0.05	mg/kg	----	----	----	<0.05	<0.05

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	21649/S17/1	21649/S18/1-1	21649/S19/1-1	TRIP 1	TRIP 2
				Client sampling date / time	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00
Compound	CAS Number	LOR	Unit		ES1731925-029	ES1731925-030	ES1731925-031	ES1731925-032	ES1731925-033
					Result	Result	Result	Result	Result
EP068A: Organochlorine Pesticides (OC) - Continued									
Aldrin	309-00-2	0.05	mg/kg		----	----	----	<0.05	<0.05
Heptachlor epoxide	1024-57-3	0.05	mg/kg		----	----	----	<0.05	<0.05
^ Total Chlordane (sum)	----	0.05	mg/kg		----	----	----	<0.05	<0.05
trans-Chlordane	5103-74-2	0.05	mg/kg		----	----	----	<0.05	<0.05
alpha-Endosulfan	959-98-8	0.05	mg/kg		----	----	----	<0.05	<0.05
cis-Chlordane	5103-71-9	0.05	mg/kg		----	----	----	<0.05	<0.05
Dieldrin	60-57-1	0.05	mg/kg		----	----	----	<0.05	<0.05
4.4`-DDE	72-55-9	0.05	mg/kg		----	----	----	<0.05	<0.05
Endrin	72-20-8	0.05	mg/kg		----	----	----	<0.05	<0.05
beta-Endosulfan	33213-65-9	0.05	mg/kg		----	----	----	<0.05	<0.05
^ Endosulfan (sum)	115-29-7	0.05	mg/kg		----	----	----	<0.05	<0.05
4.4`-DDD	72-54-8	0.05	mg/kg		----	----	----	<0.05	<0.05
Endrin aldehyde	7421-93-4	0.05	mg/kg		----	----	----	<0.05	<0.05
Endosulfan sulfate	1031-07-8	0.05	mg/kg		----	----	----	<0.05	<0.05
4.4`-DDT	50-29-3	0.2	mg/kg		----	----	----	<0.2	<0.2
Endrin ketone	53494-70-5	0.05	mg/kg		----	----	----	<0.05	<0.05
Methoxychlor	72-43-5	0.2	mg/kg		----	----	----	<0.2	<0.2
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.05	mg/kg		----	----	----	<0.05	<0.05
^ Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-2	0.05	mg/kg		----	----	----	<0.05	<0.05
EP068B: Organophosphorus Pesticides (OP)									
Dichlorvos	62-73-7	0.05	mg/kg		----	----	----	<0.05	<0.05
Demeton-S-methyl	919-86-8	0.05	mg/kg		----	----	----	<0.05	<0.05
Monocrotophos	6923-22-4	0.2	mg/kg		----	----	----	<0.2	<0.2
Dimethoate	60-51-5	0.05	mg/kg		----	----	----	<0.05	<0.05
Diazinon	333-41-5	0.05	mg/kg		----	----	----	<0.05	<0.05
Chlorpyrifos-methyl	5598-13-0	0.05	mg/kg		----	----	----	<0.05	<0.05
Parathion-methyl	298-00-0	0.2	mg/kg		----	----	----	<0.2	<0.2
Malathion	121-75-5	0.05	mg/kg		----	----	----	<0.05	<0.05
Fenthion	55-38-9	0.05	mg/kg		----	----	----	<0.05	<0.05
Chlorpyrifos	2921-88-2	0.05	mg/kg		----	----	----	<0.05	<0.05
Parathion	56-38-2	0.2	mg/kg		----	----	----	<0.2	<0.2
Pirimphos-ethyl	23505-41-1	0.05	mg/kg		----	----	----	<0.05	<0.05
Chlorfenvinphos	470-90-6	0.05	mg/kg		----	----	----	<0.05	<0.05
Bromophos-ethyl	4824-78-6	0.05	mg/kg		----	----	----	<0.05	<0.05

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	21649/S17/1	21649/S18/1-1	21649/S19/1-1	TRIP 1	TRIP 2
				Client sampling date / time	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00
Compound	CAS Number	LOR	Unit		ES1731925-029	ES1731925-030	ES1731925-031	ES1731925-032	ES1731925-033
					Result	Result	Result	Result	Result
EP068B: Organophosphorus Pesticides (OP) - Continued									
Fenamiphos	22224-92-6	0.05	mg/kg		----	----	----	<0.05	<0.05
Prothiofos	34643-46-4	0.05	mg/kg		----	----	----	<0.05	<0.05
Ethion	563-12-2	0.05	mg/kg		----	----	----	<0.05	<0.05
Carbophenothion	786-19-6	0.05	mg/kg		----	----	----	<0.05	<0.05
Azinphos Methyl	86-50-0	0.05	mg/kg		----	----	----	<0.05	<0.05
EP068S: Organochlorine Pesticide Surrogate									
Dibromo-DDE	21655-73-2	0.05	%		----	----	----	**81.0**	**96.8**
EP068T: Organophosphorus Pesticide Surrogate									
DEF	78-48-8	0.05	%		----	----	----	**79.5**	**89.1**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	DUP 1	DUP 2	DUP 3	----	----
			Client sampling date / time	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	----	----
Compound	CAS Number	LOR	Unit	ES1731925-035	ES1731925-036	ES1731925-037	--------	--------
				Result	Result	Result	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	**10.4**	**10.1**	**14.0**	----	----
EG005T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	----	**10**	**13**	----	----
Cadmium	7440-43-9	1	mg/kg	----	<1	<1	----	----
Chromium	7440-47-3	2	mg/kg	----	**21**	**20**	----	----
Copper	7440-50-8	5	mg/kg	----	**18**	**18**	----	----
Lead	7439-92-1	5	mg/kg	----	**20**	**18**	----	----
Nickel	7440-02-0	2	mg/kg	----	**10**	**9**	----	----
Zinc	7440-66-6	5	mg/kg	----	**43**	**44**	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	----	<0.1	<0.1	----	----
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	319-84-6	0.05	mg/kg	<0.05	<0.05	----	----	----
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	<0.05	<0.05	----	----	----
beta-BHC	319-85-7	0.05	mg/kg	<0.05	<0.05	----	----	----
gamma-BHC	58-89-9	0.05	mg/kg	<0.05	<0.05	----	----	----
delta-BHC	319-86-8	0.05	mg/kg	<0.05	<0.05	----	----	----
Heptachlor	76-44-8	0.05	mg/kg	<0.05	<0.05	----	----	----
Aldrin	309-00-2	0.05	mg/kg	<0.05	<0.05	----	----	----
Heptachlor epoxide	1024-57-3	0.05	mg/kg	<0.05	<0.05	----	----	----
^ Total Chlordane (sum)	----	0.05	mg/kg	<0.05	<0.05	----	----	----
trans-Chlordane	5103-74-2	0.05	mg/kg	<0.05	<0.05	----	----	----
alpha-Endosulfan	959-98-8	0.05	mg/kg	<0.05	<0.05	----	----	----
cis-Chlordane	5103-71-9	0.05	mg/kg	<0.05	<0.05	----	----	----
Dieldrin	60-57-1	0.05	mg/kg	<0.05	<0.05	----	----	----
4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	<0.05	----	----	----
Endrin	72-20-8	0.05	mg/kg	<0.05	<0.05	----	----	----
beta-Endosulfan	33213-65-9	0.05	mg/kg	<0.05	<0.05	----	----	----
^ Endosulfan (sum)	115-29-7	0.05	mg/kg	<0.05	<0.05	----	----	----
4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	<0.05	----	----	----
Endrin aldehyde	7421-93-4	0.05	mg/kg	<0.05	<0.05	----	----	----
Endosulfan sulfate	1031-07-8	0.05	mg/kg	<0.05	<0.05	----	----	----
4.4`-DDT	50-29-3	0.2	mg/kg	<0.2	<0.2	----	----	----
Endrin ketone	53494-70-5	0.05	mg/kg	<0.05	<0.05	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	DUP 1	DUP 2	DUP 3	----	----
				Client sampling date / time	14-Dec-2017 00:00	14-Dec-2017 00:00	14-Dec-2017 00:00	----	----
Compound	CAS Number	LOR	Unit		ES1731925-035	ES1731925-036	ES1731925-037	--------	--------
					Result	Result	Result	----	----
EP068A: Organochlorine Pesticides (OC) - Continued									
Methoxychlor	72-43-5	0.2	mg/kg		<0.2	<0.2	----	----	----
^ **Sum of Aldrin + Dieldrin**	309-00-2/60-57-1	0.05	mg/kg		<0.05	<0.05	----	----	----
^ **Sum of DDD + DDE + DDT**	72-54-8/72-55-9/50-2	0.05	mg/kg		<0.05	<0.05	----	----	----
EP068B: Organophosphorus Pesticides (OP)									
Dichlorvos	62-73-7	0.05	mg/kg		<0.05	<0.05	----	----	----
Demeton-S-methyl	919-86-8	0.05	mg/kg		<0.05	<0.05	----	----	----
Monocrotophos	6923-22-4	0.2	mg/kg		<0.2	<0.2	----	----	----
Dimethoate	60-51-5	0.05	mg/kg		<0.05	<0.05	----	----	----
Diazinon	333-41-5	0.05	mg/kg		<0.05	<0.05	----	----	----
Chlorpyrifos-methyl	5598-13-0	0.05	mg/kg		<0.05	<0.05	----	----	----
Parathion-methyl	298-00-0	0.2	mg/kg		<0.2	<0.2	----	----	----
Malathion	121-75-5	0.05	mg/kg		<0.05	<0.05	----	----	----
Fenthion	55-38-9	0.05	mg/kg		<0.05	<0.05	----	----	----
Chlorpyrifos	2921-88-2	0.05	mg/kg		<0.05	<0.05	----	----	----
Parathion	56-38-2	0.2	mg/kg		<0.2	<0.2	----	----	----
Pirimphos-ethyl	23505-41-1	0.05	mg/kg		<0.05	<0.05	----	----	----
Chlorfenvinphos	470-90-6	0.05	mg/kg		<0.05	<0.05	----	----	----
Bromophos-ethyl	4824-78-6	0.05	mg/kg		<0.05	<0.05	----	----	----
Fenamiphos	22224-92-6	0.05	mg/kg		<0.05	<0.05	----	----	----
Prothiofos	34643-46-4	0.05	mg/kg		<0.05	<0.05	----	----	----
Ethion	563-12-2	0.05	mg/kg		<0.05	<0.05	----	----	----
Carbophenothion	786-19-6	0.05	mg/kg		<0.05	<0.05	----	----	----
Azinphos Methyl	86-50-0	0.05	mg/kg		<0.05	<0.05	----	----	----
EP068S: Organochlorine Pesticide Surrogate									
Dibromo-DDE	21655-73-2	0.05	%		**119**	**98.6**	----	----	----
EP068T: Organophosphorus Pesticide Surrogate									
DEF	78-48-8	0.05	%		**119**	**116**	----	----	----

Analytical Results

Descriptive Results

Sub-Matrix: **SOIL**

Method: Compound	Client sample ID - Client sampling date / time	Analytical Results
EA200: AS 4964 - 2004 Identification of Asbestos in Soils		
EA200: Description	21649/S8-1 - 14-Dec-2017 00:00	Mid brown clay soil.
EA200: Description	21649/S11-1 - 14-Dec-2017 00:00	Mid brown clay soil.
EA200: Description	21649/S14/1-1 - 14-Dec-2017 00:00	Mid brown clay soil.
EA200: Description	21649/S15-1 - 14-Dec-2017 00:00	Mid brown clay soil.
EA200: Description	21649/S16/1-1 - 14-Dec-2017 00:00	Mid brown clay soil.
EA200: Description	21649/S18/1-1 - 14-Dec-2017 00:00	Mid brown clay soil.

Surrogate Control Limits

Sub-Matrix: **SOIL**

Compound	CAS Number	Recovery Limits (%) Low	High
EP066S: PCB Surrogate			
Decachlorobiphenyl	2051-24-3	39	149
EP068S: Organochlorine Pesticide Surrogate			
Dibromo-DDE	21655-73-2	49	147
EP068T: Organophosphorus Pesticide Surrogate			
DEF	78-48-8	35	143
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	63	123
2-Chlorophenol-D4	93951-73-6	66	122
2.4.6-Tribromophenol	118-79-6	40	138
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	70	122
Anthracene-d10	1719-06-8	66	128
4-Terphenyl-d14	1718-51-0	65	129
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	73	133
Toluene-D8	2037-26-5	74	132
4-Bromofluorobenzene	460-00-4	72	130

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES1732087**	Page	: 1 of 5
Client	: **SMEC TESTING SERVICES PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: SMEC TESTING ALL RESULTS	Contact	: Customer Services ES
Address	: P O BOX 6989 WETHERILL PARK NSW, AUSTRALIA 2164	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: ----	Telephone	: +61-2-8784 8555
Project	: ----	Date Samples Received	: 18-Dec-2017 11:30
Order number	: ----	Date Analysis Commenced	: 18-Dec-2017
C-O-C number	: ----	Issue Date	: 22-Dec-2017 17:03
Sampler	: ----		
Site	: ----		
Quote number	: EN/222/17		
No. of samples received	: 9		
No. of samples analysed	: 9		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW
Edwandy Fadjar	Organic Coordinator	Sydney Inorganics, Smithfield, NSW

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	19161/3850-S1	19161/3827-S1	19161/3851-S1	19161/3811-S1	19161/3824-S1
				Client sampling date / time	15-Dec-2017 09:30	15-Dec-2017 00:00	15-Dec-2017 00:00	15-Dec-2017 00:00	15-Dec-2017 00:00
Compound	CAS Number	LOR	Unit		ES1732087-003	ES1732087-004	ES1732087-005	ES1732087-006	ES1732087-007
					Result	Result	Result	Result	Result
EA002 : pH (Soils)									
pH Value	----	0.1	pH Unit		**5.5**	**8.4**	**8.3**	**9.0**	**7.4**
EA010: Conductivity									
Electrical Conductivity @ 25°C	----	1	µS/cm		**182**	**285**	**497**	**111**	**311**
EA055: Moisture Content									
Moisture Content	----	1.0	%		**14.2**	**9.0**	**11.3**	**5.2**	**10.1**
ED040S : Soluble Sulfate by ICPAES									
Sulfate as SO4 2-	14808-79-8	10	mg/kg		<10	**20**	**280**	<10	**80**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	19710/610-S1	20463/137-S1	----	----	----
				Client sampling date / time	15-Dec-2017 00:00	15-Dec-2017 00:00	----	----	----
Compound	CAS Number	LOR	Unit		ES1732087-008	ES1732087-009	--------	--------	--------
					Result	Result	----	----	----
EA002 : pH (Soils)									
pH Value	----	0.1	pH Unit		**5.8**	**5.5**	**----**	**----**	**----**
EA010: Conductivity									
Electrical Conductivity @ 25°C	----	1	µS/cm		**95**	**82**	**----**	**----**	**----**
EA055: Moisture Content									
Moisture Content	----	1.0	%		**13.2**	**15.7**	**----**	**----**	**----**
ED040S : Soluble Sulfate by ICPAES									
Sulfate as SO4 2-	14808-79-8	10	mg/kg		<10	**70**	**----**	**----**	**----**

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)				Client sample ID	**21649-SAL1**	**21649-SAL2**	**----**	**----**	**----**
				Client sampling date / time	18-Dec-2017 09:20	18-Dec-2017 09:30	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*		**ES1732087-001**	**ES1732087-002**	**--------**	**--------**	**--------**
					Result	Result	----	----	----
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit		**7.54**	**7.10**	**----**	**----**	**----**
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm		**35500**	**33000**	**----**	**----**	**----**

APPENDIX C – BUREAU OF METEOROLOGY DATA

Australian Government
Bureau of Meteorology

Climate statistics for Australian locations

Monthly climate statistics

All years of record

Note: Many statistics are updated quarterly and recent weather events may not be represented in the statistics below. For more current information on recent extreme values, please refer to the corresponding Daily rainfall, Maximum temperature and Minimum temperature data tables for this site, and our Australian Climate and Weather Extremes Monitoring System. Missing observations associated with the observer being unavailable (where observations are undertaken manually), a failure in the observing equipment, or when an event has produced suspect data may result in an extreme event not being recorded.

Site name: PROSPECT RESERVOIR **Site number:** 067019 **Commenced:** 1887 Map
Latitude: 33.82° S **Longitude:** 150.91° E **Elevation:** 61 m **Operational status:** Open

View: Main statistics / All available **Period:** Use all years of data **Text size:** Normal / Large

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years	
Temperature															
Maximum temperature															
Mean maximum temperature (°C)	28.5	28.0	26.4	23.7	20.4	17.4	16.9	18.8	21.5	24.0	25.6	27.5	23.2	52	1965 2017
Highest temperature (°C)	45.1	43.3	39.5	37.1	29.4	25.6	27.1	29.4	35.0	39.0	42.0	42.7	45.1	52	1965 2017
Date	18 Jan 2013	11 Feb 2017	13 Mar 1998	04 Apr 1986	10 May 1967	06 Jun 1997	30 Jul 2017	26 Aug 1995	25 Sep 1972	21 Oct 1988	20 Nov 2009	21 Dec 1994	18 Jan 2013		
Lowest maximum temperature (°C)	17.5	18.0	16.0	14.3	12.5	10.0	7.8	10.5	11.7	12.0	12.5	11.7	7.8	52	1965 2017
Date	28 Jan 1978	24 Feb 1992	09 Mar 1980	17 Apr 1983	31 May 1977	12 Jun 1975	23 Jul 1968	11 Aug 1973	05 Sep 1967	06 Oct 1978	16 Nov 1988	08 Dec 1966	23 Jul 1968		
Decile 1 maximum temperature (°C)	22.5	22.5	21.8	19.6	17.0	14.6	14.2	15.4	16.7	18.3	19.7	21.6		52	1965 2017
Decile 9 maximum temperature(°C)	35.4	34.0	31.1	27.9	23.8	20.0	19.8	22.7	27.1	31.0	32.5	34.0		52	1965 2017
Mean number of days ≥ 30 °C	11.0	8.4	5.5	0.9	0.0	0.0	0.0	0.0	1.1	3.9	5.7	9.3	45.8	52	1965 2017
Mean number of days ≥ 35 °C	3.6	2.3	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.4	2.4	10.6	52	1965 2017
Mean number of days ≥ 40 °C	0.7	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	1.4	52	1965 2017
Minimum temperature															
Mean minimum temperature (°C)	17.7	17.8	16.2	13.0	9.9	7.5	6.1	6.8	9.4	12.1	14.4	16.4	12.3	52	1965 2017

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years	
Lowest temperature (°C)	10.0	10.8	7.9	3.6	1.2	-0.8	-0.6	-0.5	1.7	4.5	6.8	7.8	-0.8	52	1965 2017
Date	16 Jan 1996	18 Feb 1998	30 Mar 1970	23 Apr 2006	29 May 1987	30 Jun 2010	17 Jul 2007	13 Aug 2005	01 Sep 2012	08 Oct 1998	03 Nov 2003	18 Dec 1969	30 Jun 2010		
Highest minimum temperature (°C)	26.7	26.5	23.3	21.9	17.4	15.8	16.3	17.2	19.8	24.0	24.7	25.3	26.7	52	1965 2017
Date	22 Jan 1967	06 Feb 2011	03 Mar 1968	05 Apr 1986	02 May 2000	10 Jun 1995	25 Jul 1990	18 Aug 1988	24 Sep 2003	03 Oct 1981	22 Nov 2006	23 Dec 2000	22 Jan 1967		
Decile 1 minimum temperature (°C)	14.6	15.0	13.0	9.6	6.0	3.9	2.7	3.5	5.7	8.3	10.6	13.0		52	1965 2017
Decile 9 minimum temperature (°C)	20.8	20.6	19.0	16.3	13.6	11.4	9.7	10.5	13.2	15.8	18.0	19.5		52	1965 2017
Mean number of days ≤ 2 °C	0.0	0.0	0.0	0.0	0.0	0.6	1.8	0.8	0.0	0.0	0.0	0.0	3.2	52	1965 2017
Mean number of days ≤ 0 °C	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	52	1965 2017
Ground surface temperature															
Mean daily ground minimum temperature (°C)															
Lowest ground temperature (°C)															
Date															
Mean number of days ground min. temp. ≤ -1 °C															

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years	
Rainfall															
Mean rainfall (mm)	95.8	96.5	98.0	76.6	69.9	77.2	55.7	50.4	46.0	58.1	72.8	75.9	875.0	129	1887 2017
Highest rainfall (mm)	426.7	519.1	380.7	425.0	556.0	531.3	323.7	458.5	186.3	269.0	391.3	338.1	1900.0	131	1887 2017
Date	1951	1956	1890	2015	1889	1950	1904	1986	1892	1916	1961	1920	1950		
Lowest rainfall (mm)	3.9	2.8	5.1	2.0	1.8	1.0	0.0	0.0	0.0	0.0	0.8	2.2	394.6	131	1887 2017
Date	1929	1902	1940	1997	1957	2001	1977	1995	1957	1988	1915	1979	1944		
Decile 1 rainfall (mm)	22.3	12.5	20.7	15.1	10.0	8.9	6.4	5.9	7.4	12.5	15.9	19.9	574.7	131	1887 2017
Decile 5 (median) rainfall (mm)	73.2	73.1	78.3	57.2	38.4	50.0	32.9	30.9	40.2	43.1	60.1	58.0	861.7	131	1887 2017
Decile 9 rainfall (mm)	193.7	197.7	201.7	170.5	169.9	181.0	128.1	129.6	100.5	130.7	141.7	159.4	1178.0	131	1887 2017
Highest daily rainfall (mm)	161.2	164.6	153.9	163.1	314.2	163.4	143.5	321.0	96.5	102.1	126.2	154.9	321.0	131	1887 2018
Date	31 Jan 2001	11 Feb 1956	20 Mar 1892	16 Apr 1946	28 May 1889	11 Jun 1991	10 Jul 1904	06 Aug 1986	02 Sep 1970	05 Oct 1916	14 Nov 1969	13 Dec 1910	06 Aug 1986		
Mean number of days of rain	10.7	10.7	11.0	9.4	8.9	9.5	7.8	7.9	8.4	9.2	9.6	10.0	113.1	131	1887 2017
Mean number of days of rain ≥ 1 mm	8.1	8.1	8.4	7.0	6.4	7.0	5.6	5.7	6.1	6.8	7.3	7.6	84.1	131	1887 2018
Mean number of days of rain ≥ 10 mm	2.6	2.6	2.6	2.1	1.7	2.0	1.4	1.4	1.3	1.7	2.3	2.3	24.0	131	1887 2018
Mean number of days of rain ≥ 25 mm	0.9	1.1	1.0	0.7	0.7	0.7	0.5	0.4	0.3	0.5	0.6	0.7	8.1	131	1887 2018

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years	
Other daily elements															
Mean daily wind run (km)															
Maximum wind gust speed (km/h)															
Date															
Mean daily sunshine (hours)															
Mean daily solar exposure (MJ/m^2)	22.3	19.2	16.5	13.6	10.4	8.7	9.9	13.2	16.8	19.8	21.2	22.7	16.2	28	1990 2018
Mean number of clear days	6.6	5.0	6.7	8.8	9.0	10.0	11.3	13.2	11.4	8.3	6.8	7.1	104.2	33	1968 2001
Mean number of cloudy days	12.6	11.7	11.7	8.0	9.5	8.3	6.6	6.3	7.1	9.2	10.6	10.5	112.1	33	1968 2001
Mean daily evaporation (mm)	5.5	4.7	3.9	2.9	2.0	1.6	1.7	2.5	3.6	4.4	5.0	5.6	3.6	44	1965 2017

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years	
9 am conditions															
Mean 9am temperature (°C)	21.3	21.0	19.6	16.9	13.5	10.7	9.6	11.1	14.5	17.4	18.4	20.6	16.2	42	1968 2010
Mean 9am wet-bulb temperature (°C)	18.5	18.6	17.3	14.7	11.8	9.0	7.7	8.7	11.3	13.7	15.3	17.2	13.6	39	1968 2010
Mean 9am dew-point temperature (°C)	16.4	17.0	15.6	12.6	10.0	7.0	5.3	5.6	7.8	10.1	12.5	14.5	11.2	37	1974 2010
Mean 9am relative humidity (%)	75	79	79	77	80	79	76	70	65	65	70	70	74	37	1974 2010
Mean 9am cloud cover (oktas)	4.8	4.9	4.5	3.7	3.8	3.6	3.2	2.9	3.2	4.0	4.4	4.5	4.0	45	1965 2010
Mean 9am wind speed (km/h)	7.5	7.0	7.3	8.0	7.7	8.0	8.1	9.2	9.6	10.0	8.5	8.2	8.3	44	1965 2010

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years	
3 pm conditions															
Mean 3pm temperature (°C)	26.8	26.3	24.8	22.4	19.2	16.5	15.9	17.4	19.6	22.1	23.4	25.9	21.7	33	1968 2001
Mean 3pm wet-bulb temperature (°C)	20.0	20.0	18.8	16.4	14.4	12.0	10.8	11.5	13.2	15.3	16.9	18.8	15.7	31	1968 2001
Mean 3pm dew-point temperature (°C)	15.3	15.7	14.4	11.3	9.9	6.9	4.8	4.5	6.3	8.8	11.5	13.5	10.2	28	1974 2001
Mean 3pm relative humidity (%)	52	54	55	52	57	55	50	45	45	46	50	49	51	28	1974 2001
Mean 3pm cloud cover (oktas)	4.8	5.0	4.8	4.2	4.3	4.2	3.9	3.8	3.9	4.4	4.8	4.6	4.4	33	1968 2001
Mean 3pm wind speed (km/h)	12.7	12.4	12.0	11.5	10.3	12.3	12.4	14.3	15.3	15.4	14.4	14.5	13.1	30	1968 2001

red = highest value blue = lowest value

Product IDCJCM0037 Prepared at Thu 11 Jan 2018 02:39:03 AM EST

Monthly statistics are only included if there are more than 10 years of data. The number of years (provided in the 2nd last column of the table) may differ between elements if the observing program at the site changed. More detailed data for individual sites can be obtained by contacting the Bureau.

Related Links

- This page URL: http://www.bom.gov.au/climate/averages/tables/cw_067019_All.shtml
- Summary statistics and locational map for this site:
  http://www.bom.gov.au/climate/averages/tables/cw_067019.shtml
- About climate averages: http://www.bom.gov.au/climate/cdo/about/about-stats.shtml
- Data file (csv): http://www.bom.gov.au/clim_data/cdio/tables/text/IDCJCM0037_067019.csv
- Climate averages home page URL: http://www.bom.gov.au/climate/data/index.shtml
- Bureau of Meteorology website: http://www.bom.gov.au

Page created: Thu 11 Jan 2018 02:39:03 AM EST

This page was created at **on**

APPENDIX D -WATER BALANCE CALCULATIONS

MONTHLY WATER BALANCE USED TO DETERMINE WET WEATHER STORAGE

Design Wastewater Flow	Q	l/day	1080
Design Percolation Rate	R	mm/wk	21
Land Area	L	m^2	475

Paramters	**Symbol**	**Formula**	**Units**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
Days in Month	D	-	days	31	28	31	30	31	30	31	31	30	31	30	31	365
Precipitation	P	-	mm/month	73.2	73.1	78.3	57.2	38.4	50	32.9	30.9	40.2	43.1	60.1	58	635.4
Evaporation	E	-	mm/month	170.5	131.6	120.9	87	62	48	52.7	77.5	108	136.4	150	173.6	1318.2
Crop Factor	C	-	-	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	-
Inputs																
Precipitation	P	-	mm/month	73.2	73.1	78.3	57.2	38.4	50	32.9	30.9	40.2	43.1	60.1	58	635.4
Effluent Irrigation	W	(Q x D) / L	mm/month	70.5	63.7	70.5	68.2	70.5	68.2	70.5	70.5	68.2	70.5	68.2	70.5	829.9
Inputs		P + W	mm/month	143.7	136.8	148.8	125.4	108.9	118.2	103.4	101.4	108.4	113.6	128.3	128.5	1465.3
Outputs																
Evapotranspiration	ET	E x C	mm/month	102.30	78.96	72.54	52.20	37.20	28.80	31.62	46.50	64.80	81.84	90.00	104.16	790.92
Percolation	B	(R / 7) x D	mm/month	93.0	84.0	93.0	90.0	93.0	90.0	93.0	93.0	90.0	93.0	90.0	93.0	1095.0
Outputs		ET + B	mm/month	195.3	163.0	165.5	142.2	130.2	118.8	124.6	139.5	154.8	174.8	180.0	197.2	1885.9
Storage	S	(P + W) - (ET + B)	mm/month	-51.6	-26.2	-16.8	-16.8	-21.3	-0.6	-21.2	-38.1	-46.4	-61.3	-51.7	-68.7	-

Job No: 2017-01

6 March 2018

Claron Consulting Pty Ltd
PO Box 115 Castle Hill
SUBURB NSW 1765

Attention: Brent Winning

RE: 55 MARTIN ROAD BADGERYS CREEK – STORMWATER WATER MANAGEMENT

Introduction

This Stormwater Water Management Plan & Report has been prepared to support the Development Application for the proposed industrial development at 55 Martin Road, Badgerys Creek.

The scope of this report includes an assessment of the stormwater management requirements for the proposed development. Accordingly, this report includes findings of the assessment and proposes a best practice stormwater management strategy.

Site

The site is 55 Martin Road (Lot 4 DP 611519) Badgerys Creek and is located between Martin Road and Lawson Road. The site is located in the Badgerys Creek catchment and Martin Road is at the top of the catchment with the properties on the eastern side of the road draining to South Creek. An engineering survey of the site was undertaken by Revolution Surveys (Ref 3330-1B) on 31 May 2017 and is shown in *Appendix A.*

The site falls evenly from RL 59.5m AHD at the eastern boundary of the site to RL 51.6m AHD on the western boundary. The site area is 2.54 Ha. The site drains to the existing sag in Lawson Road, which is drained by an existing 450mm diameter concrete pipe. The upstream invert level of this pipe is RL 51.23m AHD. The site is impacted by drainage easements on the western portion of the site.

There is an existing residence located on the site in the upper eastern part of the property and is proposed to be repurposed as a site office and staff amenities. The site has been previously used for rural purposes; it is currently being used for agistment.

The site has mainly been cleared and is well covered with grasses with the majority of the trees located at the lower western end of the site fronting Lawson Road. There is one dam located on the property at the western end of the site; the trees have been identified as remnant stand of Cumberland Plain vegetation.

Ultramark Pty Ltd

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24 Meckiff Avenue, North Rocks, NSW 2153
E-mail ultramark15@outlook.com

It is proposed that this dam will remain on the site to maintain the current conditions within the Cumberland Plain vegetation but is not part of the stormwater management of the site.

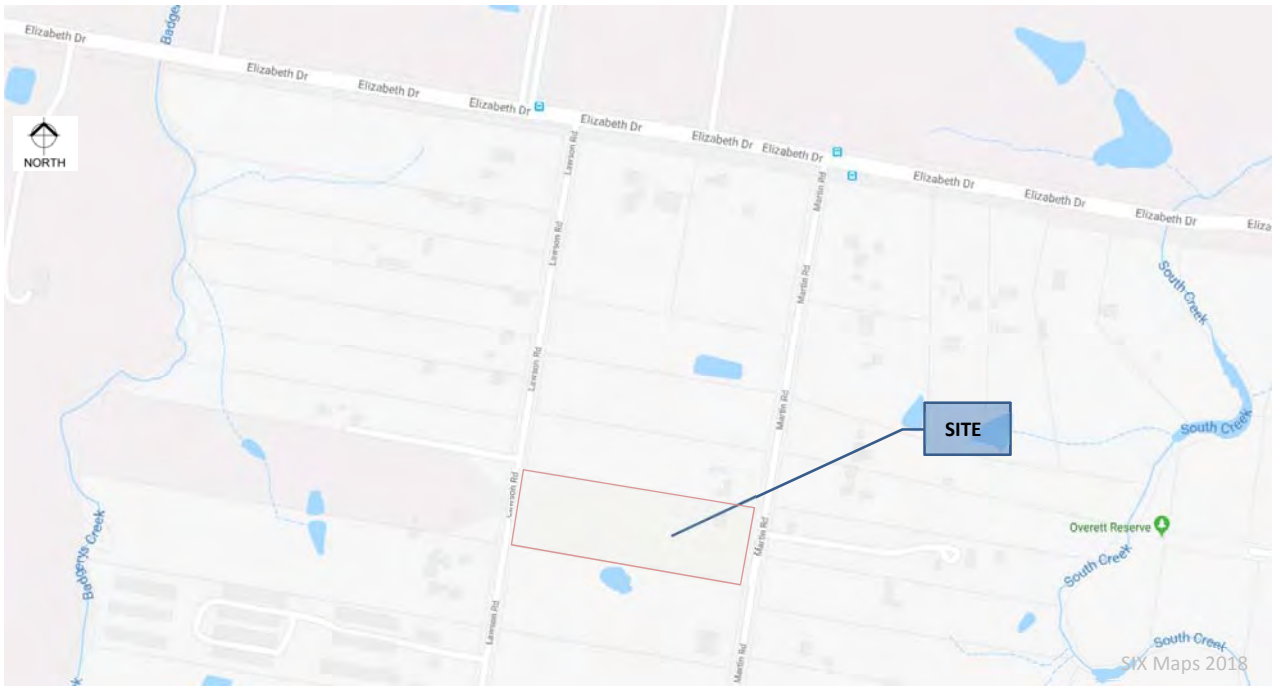


Figure 1 Locality Map

The site is located clear of the Badgerys Creek floodplain; however, it is subject to local overland flow from the surrounding properties.

The design of the site will be undertaken to ensure that there is no impact on the local overland flow.

Proposed Development

The proposed development for a resource recovery and associated facilities. The project comprises of a large shed, several covered storage bins and a hardstand manoeuvring area. The existing house on the site is to be reconfigured as the site office and a carpark will be provided adjacent to the office. The lower portion of the site, fronting Lawson Road, is not to be developed to protect the remnant Cumberland Plain vegetation.

To address Council's stormwater management requirements for on-site detention and stormwater treatment a combined tank is proposed to be constructed under the hardstand. The tank will contain a rainwater tank, detention tank and a *Stormwater 360 Stormfilter* (or equivalent) for treatment within the detention tank.

Further details on the proposed stormwater drainage system are provided below.

Council Requirements

The site is located within the Liverpool City Council LGA and as such the following specific requirements and guidelines have been adopted:

- Liverpool Development Control Plan 2008
- Water Management Policy 2016
- On-Site Stormwater Detention Technical Specification 2003
- Erosion And Sediment Control Policy 2003
- Guidelines For Development And Subdivision Of Land 2003

A Pre Application meeting (PL-85/2017) on the 19 July 2017 between Council and the Proponent noted the following requirements:

- Stormwater drainage for the site must be in accordance with Council's Development Control Plan.
- A stormwater concept plan shall be submitted with the application.
- The stormwater concept plan shall be accompanied by a supporting report and calculations.
- On-site detention is required to be provided for the site.
- The on-site detention system must be within common property and accessible from the street without going through dwellings or private courtyards.
- A water quality treatment device shall be provided in accordance with Council's Development Control Plan. Provide MUSIC Model

Stormwater Analysis Overview

In order to determine the appropriate discharge control for the site and external flows the DRAINS hydrological/hydraulic computer software was used. The total flow from the catchment was calibrated against the probability rational method to ensure that the flows were of the correct magnitude.

To analyse the stormwater quality treatment train for the site the MUSIC model was developed for the site. These models are discussed in further detail below.

Hydrological Analysis

Hydrological Model Setup

The DRAINS model used the following input data:

- Soil Type 3
- AMC 4
- Depression Storage Paved 1mm Supplementary 1mm Grassed 5mm

The IFD data was obtained from the BOM website for the following coordinates; 33.875 S and 150.75 E. (raw data: 29.83, 6.42, 1.89, 59.14.00, 12.57, 4.17, skew 0.01, F2 4.3, F50 15.8)

The model was constructed using nodes and overland flow routes. Detailed information on the existing case model is provided in *Appendix B*.

Catchment Areas

A combination of orthophoto map imagery, GIS information, detail around survey and confirmation by a site inspection was used to determine the catchment areas for the existing site conditions.

The total area draining to the outlet (Node A/1) is 19.90 Ha and this is broken up as follows:

- Site Area 2.54 Ha
- Northern External Catchment 9.23 Ha
- Southern External Catchment 8.13 Ha

The existing catchment plan is shown in Figure 2.

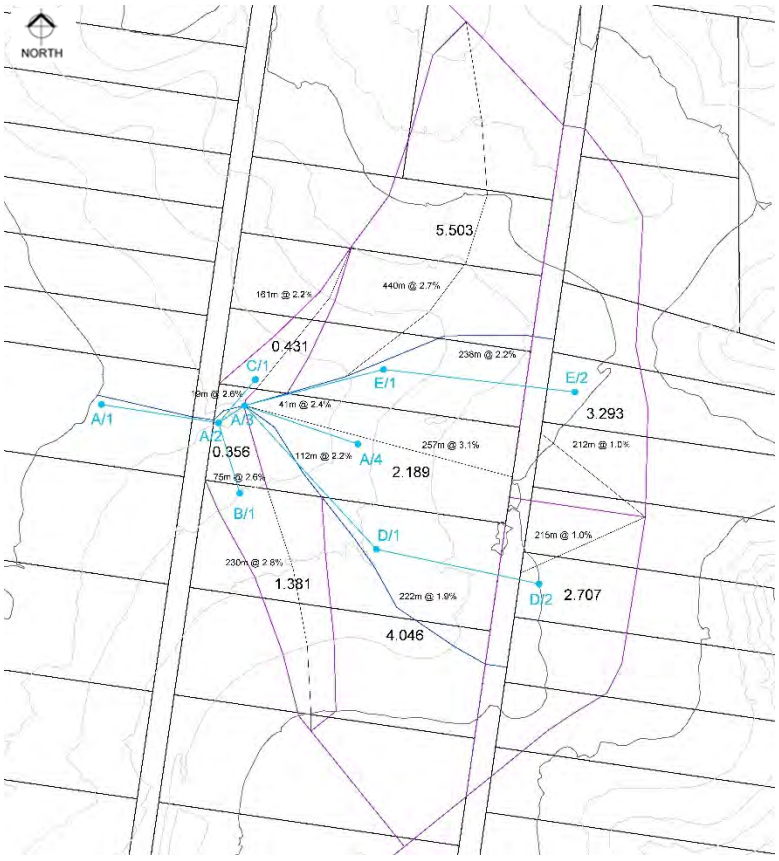


Figure 2 Existing Catchment Plan

Existing Flows

The existing flows, at the critical locations and the adopted permitted site discharge (PSD) for the site is summarised below:

Catchment	Node	Q100 (m^3/s)	Q50 (m^3/s)	Q20 (m^3/s)	Q10 (m^3/s)	Q5 (m^3/s)	Q2 (m^3/s)
Outlet (DRAINS)	A/1	4.44	3.68	2.86	2.21	1.69	0.84
Outlet (PRM)	A/1	4.28	3.45	2.58	1.99	1.55	1.00
Northern External	E/1	1.98	1.65	1.28	0.99	0.75	0.37
Southern External	D/1	1.46	1.22	0.94	0.73	0.55	0.27
Site - PSD		0.66	0.54	0.42	0.32	0.24	0.12

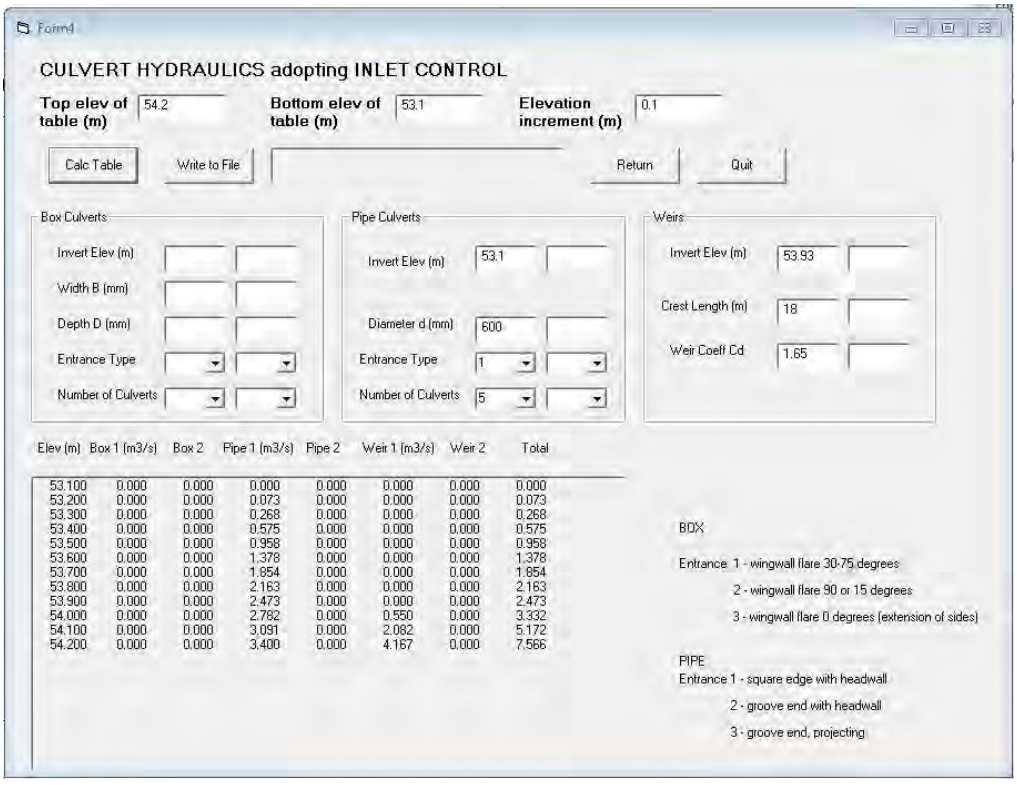
Detailed information on the existing case results is provided in *Appendix C*.

Overland Flow Management

The external overland flows are to be managed by the following methods:

- For the northern catchment the shed and retaining wall have been set back from the low point and easement, so as to not obstruct the flow.
- With the southern catchment, the overland flowpath is obstructed by the access driveway and ramp to the hardstand. To convey the flows under the accessway a 5 cell 600 diameter piped culvert is proposed.

Once the flow is past these points it will flow unchanged through the site.



On Site Detention Design

Given the configuration of the site, the lower portion of the site will bypass the detention tank. The area of this bypass is 0.65 Ha with the remaining 1.89 Ha to be drained to the tank. The design of the tank has considered this bypass as part of the sizing process, to ensure that the site PSD is met.

The detention tank is to be located at the western end of the hardstand area and as described earlier will also include a rainwater tank and the stormwater quality treatment. For the sizing of the detention tank both the rainwater tank and treatment system are considered to be full.

The roof areas of the shed and bins are to be directed to the rainwater tank, with the remainder of the site directed to the treatment system and detention tank.

The developed case DRAINS model has been structured to simulate the post development flows off the site only with a simplified model to simplify the pre development model. That is there has been no modelling of the stormwater reticulation within the site and all the flows are assumed to be captured and directed to the detention tank. Whilst this model is of a uncomplicated structure, it provides a robust indication of the stormwater runoff and storage requirements, as well as readily comparing the pre and post development flows from the site. The design DRAINS model layout is shown in Figure 3

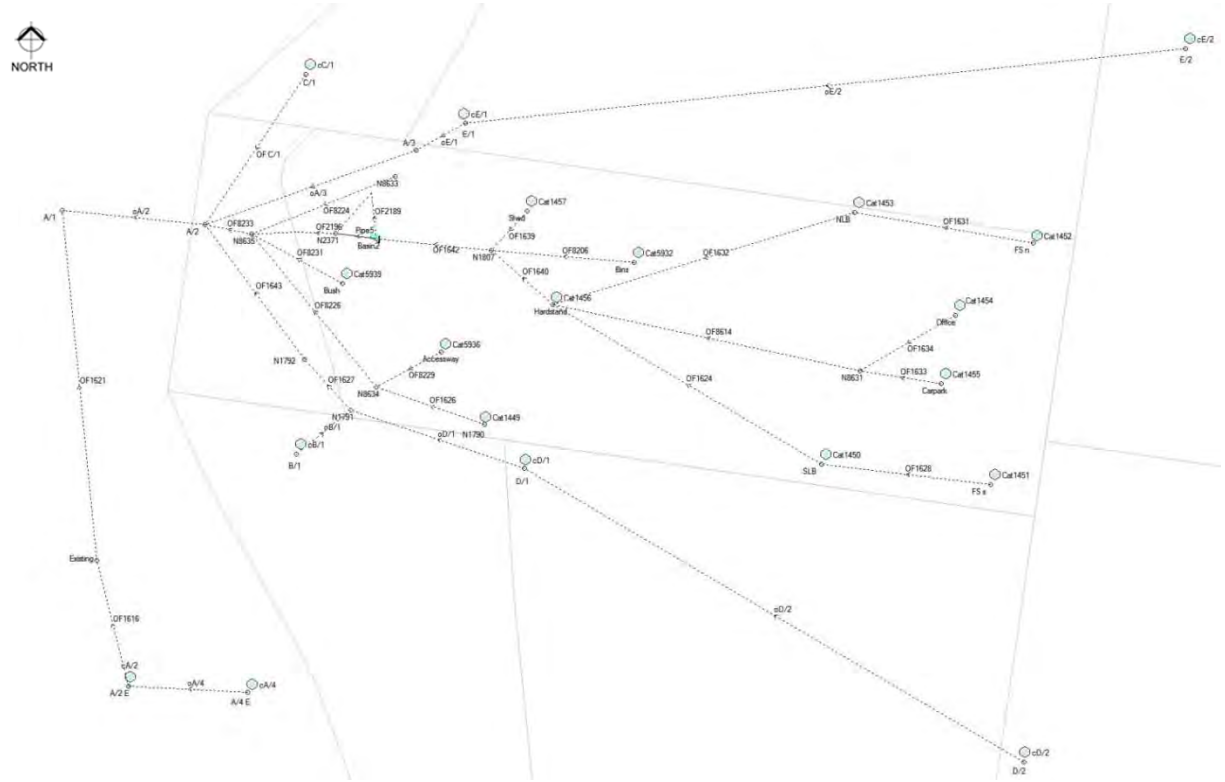


Figure 3 DRAINS model design layout

To determine compliance with the OSD requirement which is to compare the total peak post development flow rates with the predevelopment for a range of storm events, the basin's outlets will need to be capable of detaining the range of flows for all these events.

In the event of total blockage of the outlet pipe from the basin, an emergency overflow weir is provided and it will drain into the open space at the bottom of the site and into the existing watercourse.

Detailed information on the developed case model is provided in *Appendix D*.

The table below summarises the peak flow from the developed site compared to the PSD:

ARI	Pre Development Q (m^3/s)	Post Development Q (m^3/s)	Volume (m^3)
100	0.658	0.342	721
50	0.543	0.306	628
20	0.418	0.27	529
10	0.322	0.224	443
5	0.244	0.173	383
2	0.121	0.121	271

To detain the post development flows to pre development conditions a tank with a minimum capacity of 633 m^3 is required. The modelling has also shown that a low 175mm (invert RL 52.6m AHD) and a higher 200mm (invert RL 53.7m AHD) diameter outlet pipes will satisfactorily detain the flows to meet the PSD requirements.

Detailed information on the developed case results is provided in *Appendix E*.

Stormwater Quality Treatment

This WSUD strategy has been developed in accordance with Council's requirements and guidelines, as well as industry best practice. The proposed treatment train consists of rainwater tanks for all roof areas, pit insert filers for the pits within the hardstand area and a treatment tank for a proprietary system, a Stormwater 360 *Stormfilter* (or approved equivalent), located within the detention tank. This system has been designed to manage the pollutant loads from the site to meet the required targets.

The in tank system was chosen over a more traditional bioretention basin as the basin would need to be located downstream of the tank and this would impact on the Cumberland Plan vegetation in this area. In addition the bioretention basin would also need to be carefully sited to ensure the upstream overland flows are directed around the basin.

The treatment train for the site has been modelled using the MUSIC stormwater quality modelling software, as required by Council. The modelling parameters have been adopted tom the Sydney Catchment Management Authority (SCMA) and other local guidelines for all inputs including rainfall and evaporation, rainfall-runoff, pollution generation and treatment node parameters.

The objective of the WSUD strategy is to capture the following percentage of the following pollutant loadings, as per Council's DCP 2008:

- Total Suspended Solids 80 %
- Total Phosphorus 45 %
- Total Nitrogen 45 %

Proposed Treatment Measures

This WSUD strategy prescribes the use of 2 major components, as described below.

Rainwater Tanks

There 2 tanks proposed for the site a small 3KL tank located near the existing building and a large 100KL tank located adjacent to the detention tank.

The tank located near the office is to be connected to the toilets and local irrigation. Overflow from this tank is to be connected to the line running to the main rainwater tank.

The yearly water demand is estimated at 4.0 ML for dust suppression for an area of 2.5 ha. This includes stockpiling of materials, processing of materials, landscaping and vegetation

Stormfilter System

As previously described the proposed Stormfilter system is to be co-located within the detention tank. The filter is located in a 8.5 x 8.5 m square tank with a 790mm wall around the tank. There is no internal roof to this tank and flows that pond greater than this height will overflow on to the filter tanks. This will only occur in storm events greater than the 0.5EY storm. The sizing of the Stormfilter is shown in Figure 4.

In addition to the above a wheel wash is also provided for all vehicles entering and leaving the site. The impact of the wheel wash has not been included the modelling.

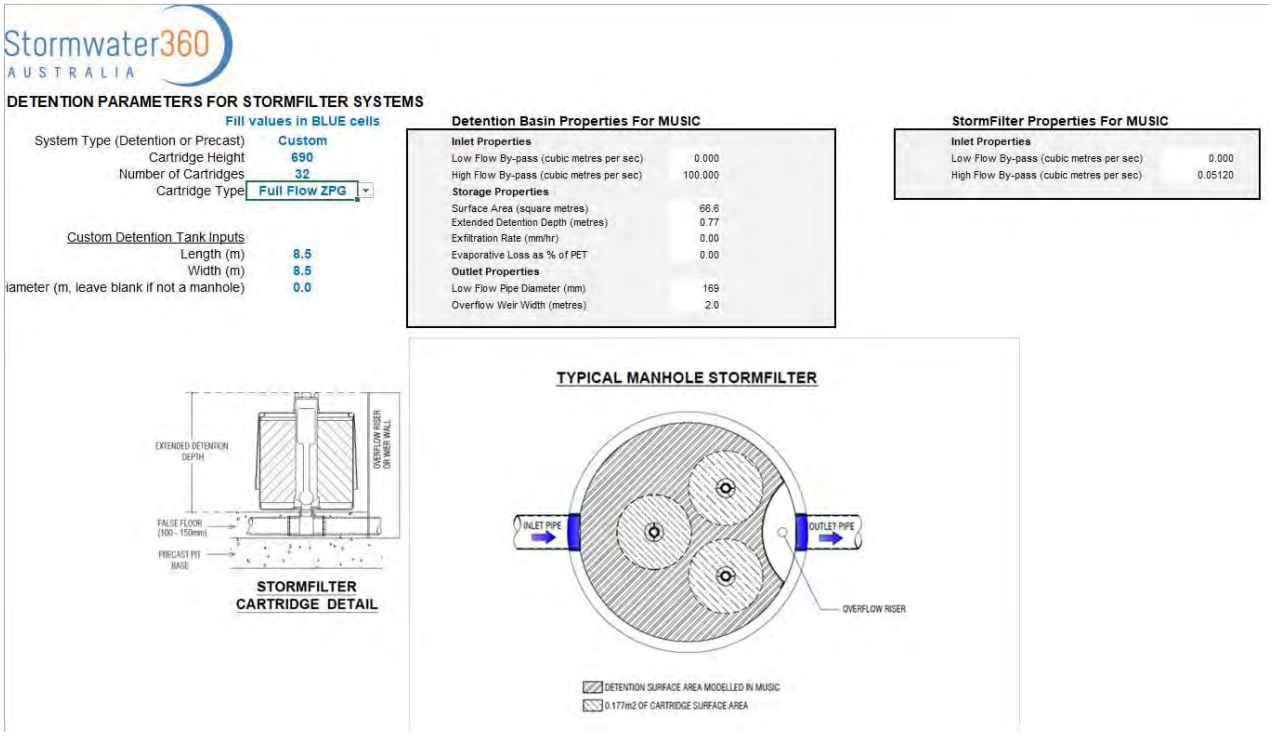
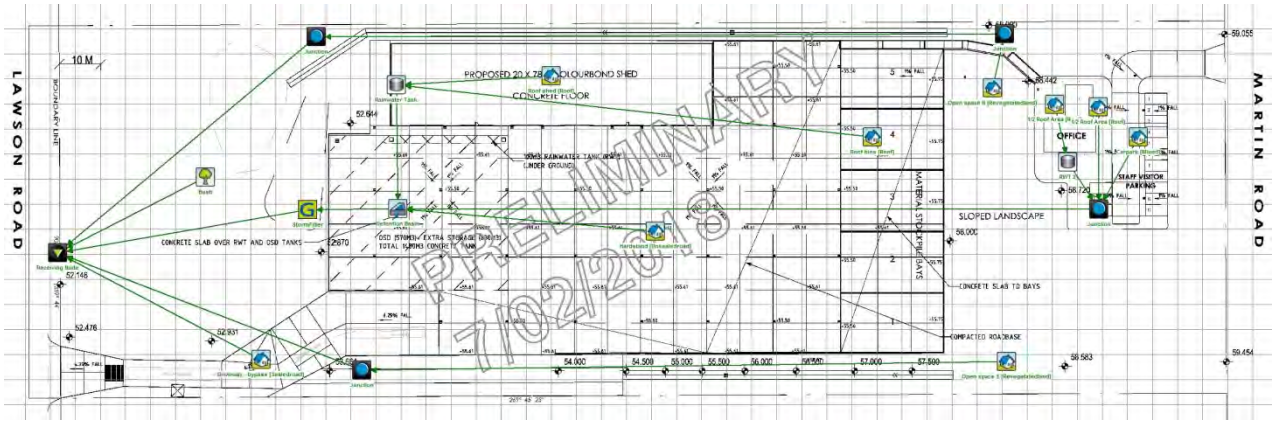


Figure 4 Stormfilter Sizing

The MUSIC model layout is shown in Figure 5 below.



Results

The estimated treatment train effectiveness is summarised in the table below:

	Sources	Residual Load	Reduction (%)
Treatment Train Effectiveness at Stormfilter			
Flow (ML/yr)	9.53	6.75	29.2
Total Suspended Solids (kg/yr)	7870	600	92.4
Total Phosphorus (kg/yr)	4.14	0.807	80.5
Total Nitrogen (kg/yr)	22.1	10.2	54
Gross Pollutants (kg/yr)	253	0	100
Treatment Train Effectiveness at Receiving Node			
Flow (ML/yr)	12.4	9.6	22.5
Total Suspended Solids (kg/yr)	8220	951	88.4
Total Phosphorus (kg/yr)	4.76	1.43	69.9
Total Nitrogen (kg/yr)	26.4	14.4	45.2
Gross Pollutants (kg/yr)	298	45.2	84.8

Erosion and Sediment Control

A Soil and Water Management Plan (SWMP) will be prepared and implemented to minimise potential impacts on hydrology and water quality during the construction period and ongoing operation of the site. This Plan will incorporate the design and installation of erosion controls in accordance with the requirements Managing Urban Stormwater: Soils and Construction published by Landcom (colloquially known as the "Blue Book").

The Plan will include the following:

1. At the vegetation clearing stage, cleared vegetation will be mulched and spread over disturbed area to provide a natural erosion barrier

2. Prior to commencement of earthworks, a range of measures will be put in place including:

- Construction of cut-off drains to prevent clean water from upstream of the corridor flowing onto and eroding disturbed areas
- The diversion of site discharge points to erosion control measures such as silt fences and sedimentation basins in order to control dirty water areas
- The stabilisation of exposed areas as soon as practical following the construction of each section of works

3. Controls outside the specific work area would be put in place including:

- Refuelling of plant and machinery within bunded areas or off site in appropriate locations
- Minimisation of disturbed areas so that the potential export of sediment is minimised
- The establishment and maintenance of stabilised construction compounds to reduce the overall disturbance area for the Project.

4. Temporary sediment basins will be constructed to capture water and sediment before it can leave the site or enter the receiving water bodies. Conceptual design of the temporary sediment basins will be included in the SWMP and follow the methodology outlined in the "Blue Book" with the following features:

- Sediment basins are to be located at points near where dirty water would discharge to receiving waters or leave the site
- Basins are to be designed for Type F/D soils, as outlined in Section 6.3.4 of the Blue Book, in accordance with the soil type classifications
- The minimum depth of the basins will be 0.6 metres with an average depth of 1 metre.

A surface water quality monitoring program for the construction and operational periods will be developed to monitor water quality upstream and downstream of the construction areas. Construction period monitoring will be carried out periodically and after rainfall events as part of the assessment of the operation of water quality mitigation measures. Monitoring during the construction phase of the project would examine the following indicators:

- pH
- Electrical conductivity
- Turbidity
- Dissolved oxygen

- Total Suspended Solids
- Oil and Grease

Conclusion

This report is submitted for Council's review and approval and should be read in conjunction with the engineering drawings submitted for the development application for the proposed works.

Based on the proposed stormwater drainage concept the key features are:

- Post development flows will be attenuated to at least pre development rates for the range of events up to the 100 Year ARI event.
- An underground OSD tank will be provided with a minimum detention volume of 633m^3.
- Rainwater tanks will capture the runoff from the roof areas and reused onsite.
- A Stormwater 360 *Stormfilter* will be co-located within the detention tank.
- Erosion and sediment control measures will be implemented during the construction phase.

It is therefore concluded that the drainage design for the site addresses Council's watercycle management requirements for the development.

Yours faithfully,

ULTRAMARK PTY LTD

ROBERT PETERSON
Director

Appendices

Appendix A Site Survey Plan

Appendix B Existing Case DRAINS model layout

Appendix C Existing Case Results

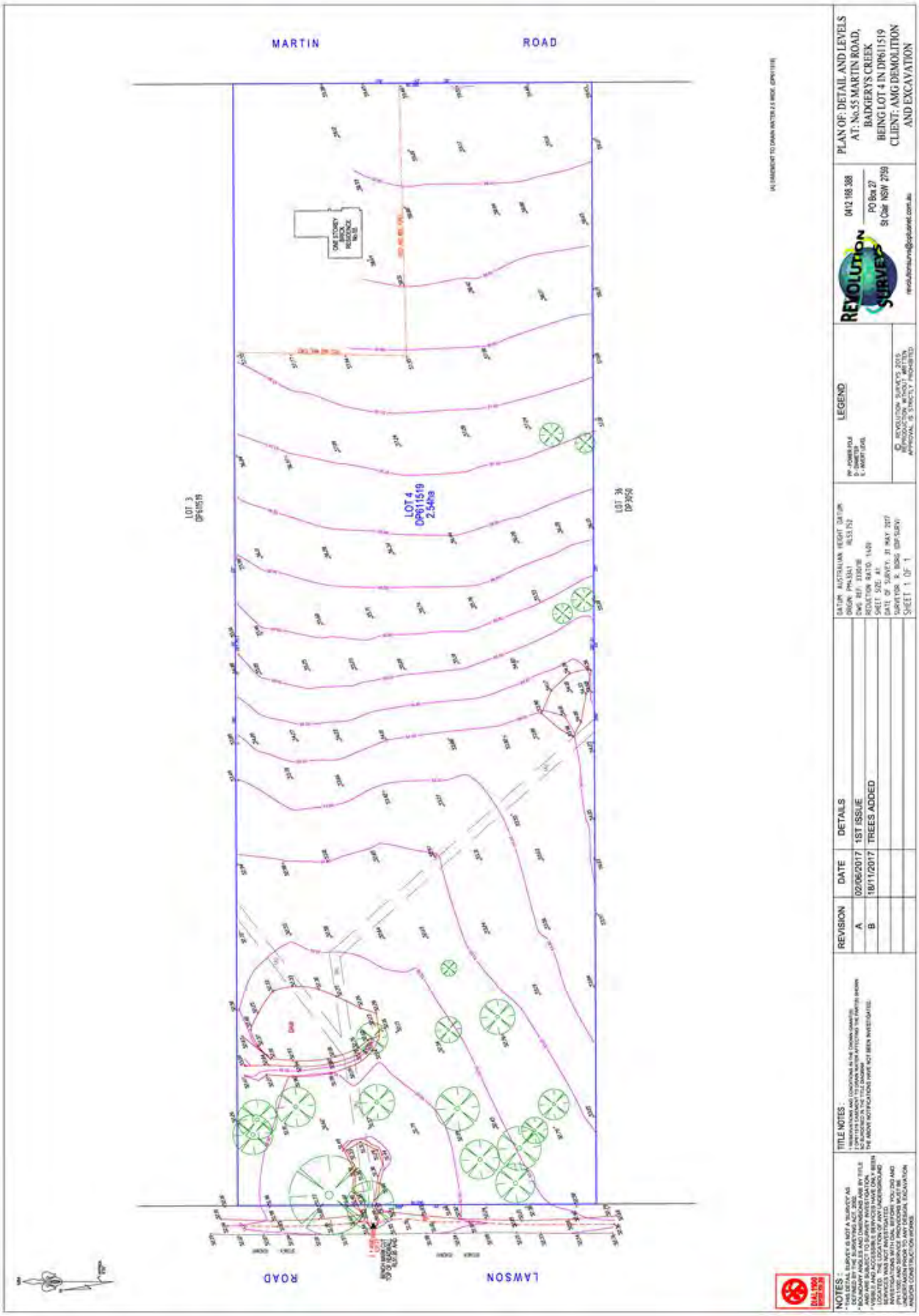
Appendix D Developed Case DRAINS model layout

Appendix E Developed Case DRAINS Results

Appendix F MUSIC model layout and results

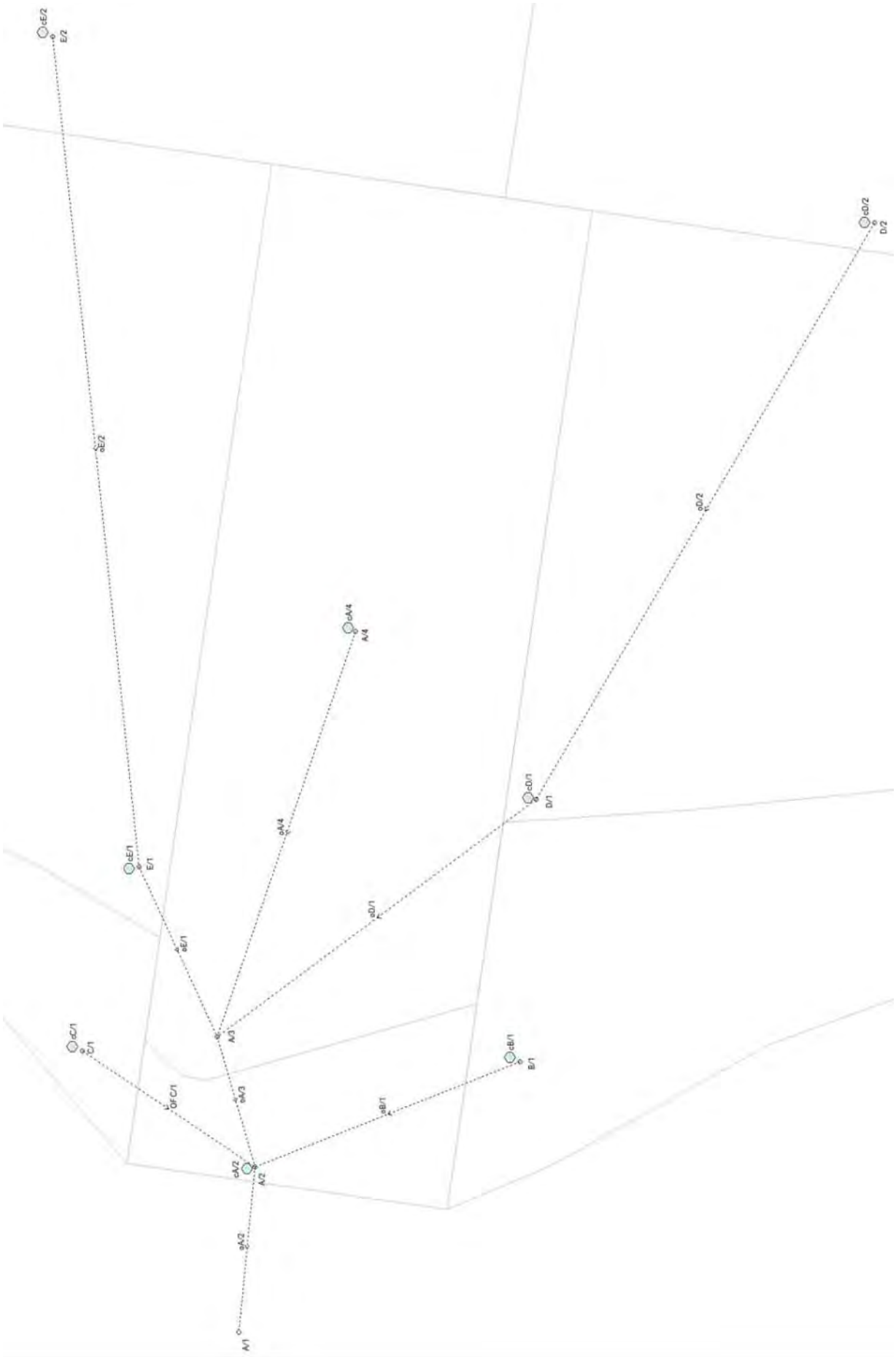
Appendix G Stormwater Water Concept Plan

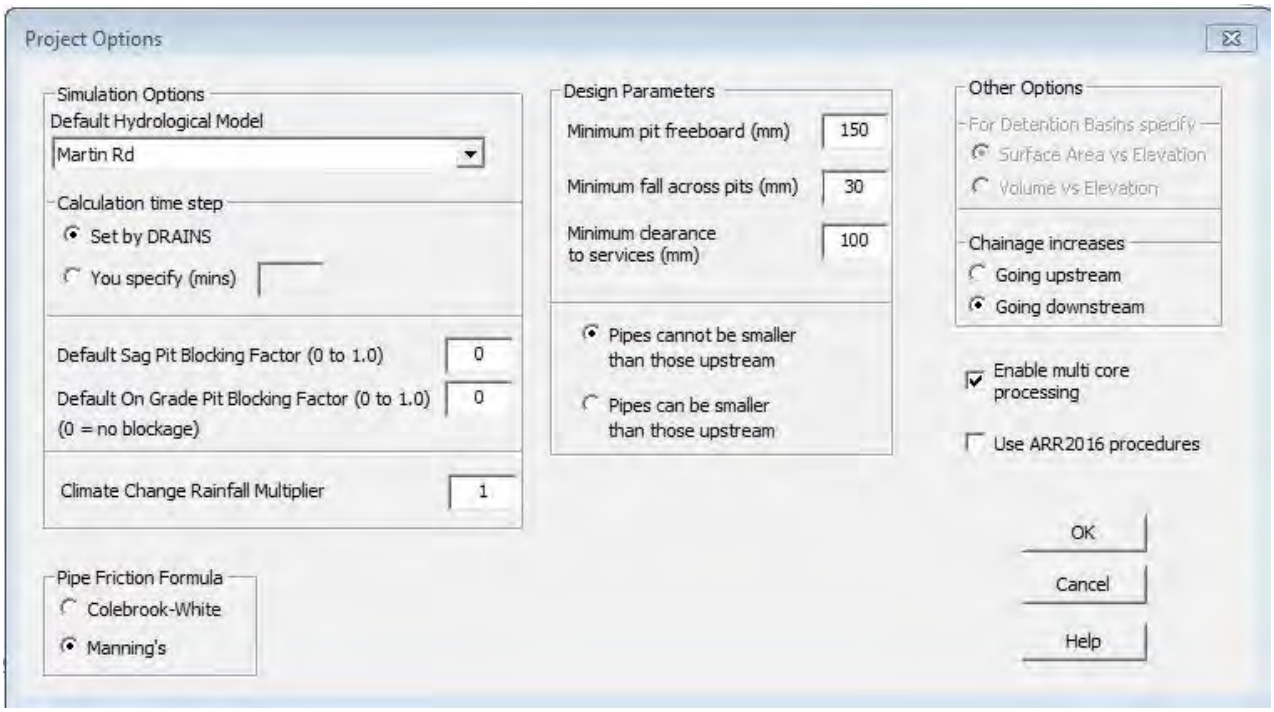
Appendix A Site Survey Plan

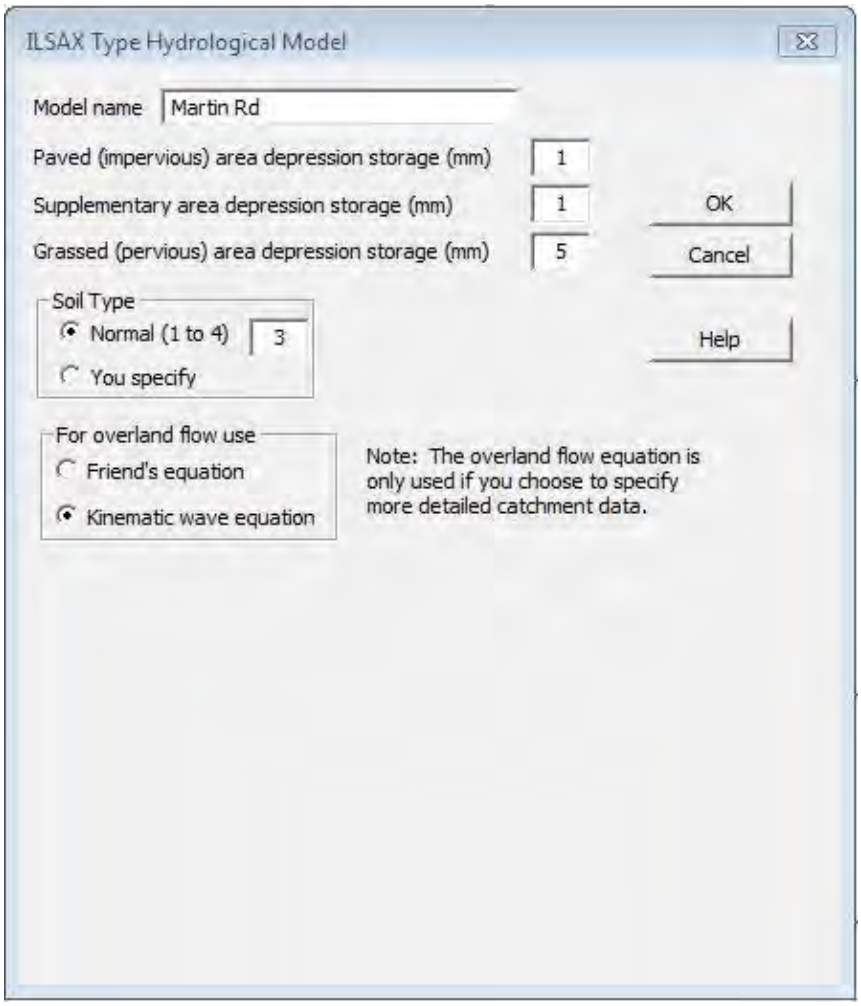

MARTIN
ROAD
LOT 3
DP611519
LOT 4
DP611519
2.545ha
LOT 36
DP3950
ONE STORY
BRICK
RESIDENCE
No.55
ROAD
LAWSON
LEGEND
PLAN OF: DETAIL AND LEVELS
AT : No.55 MARTIN ROAD,
BADGERYS CREEK
BEING LOT 4 IN DP611519
CLIENT: AMG DEMOLITION
AND EXCAVATION
REVOLUTION SURVEYS
0412 188 388
PO Box 27
St Clair NSW 2759
REVISION
DATE
DETAILS
A
02/06/2017
1ST ISSUE
B
18/11/2017
TREES ADDED
DATUM: AUSTRALIAN HEIGHT DATUM
ORIGIN: PM-5341
AHD
DWG REF: 33507B
REDUCTION RATIO: 1:400
SHEET SIZE: A1
DATE OF SURVEY: 31 MAY 2017
SURVEYOR: R. BORG (DP-SURV)
SHEET 1 OF 1
TITLE NOTES:
NOTES:
1 BEFORE YOU DIG
1100

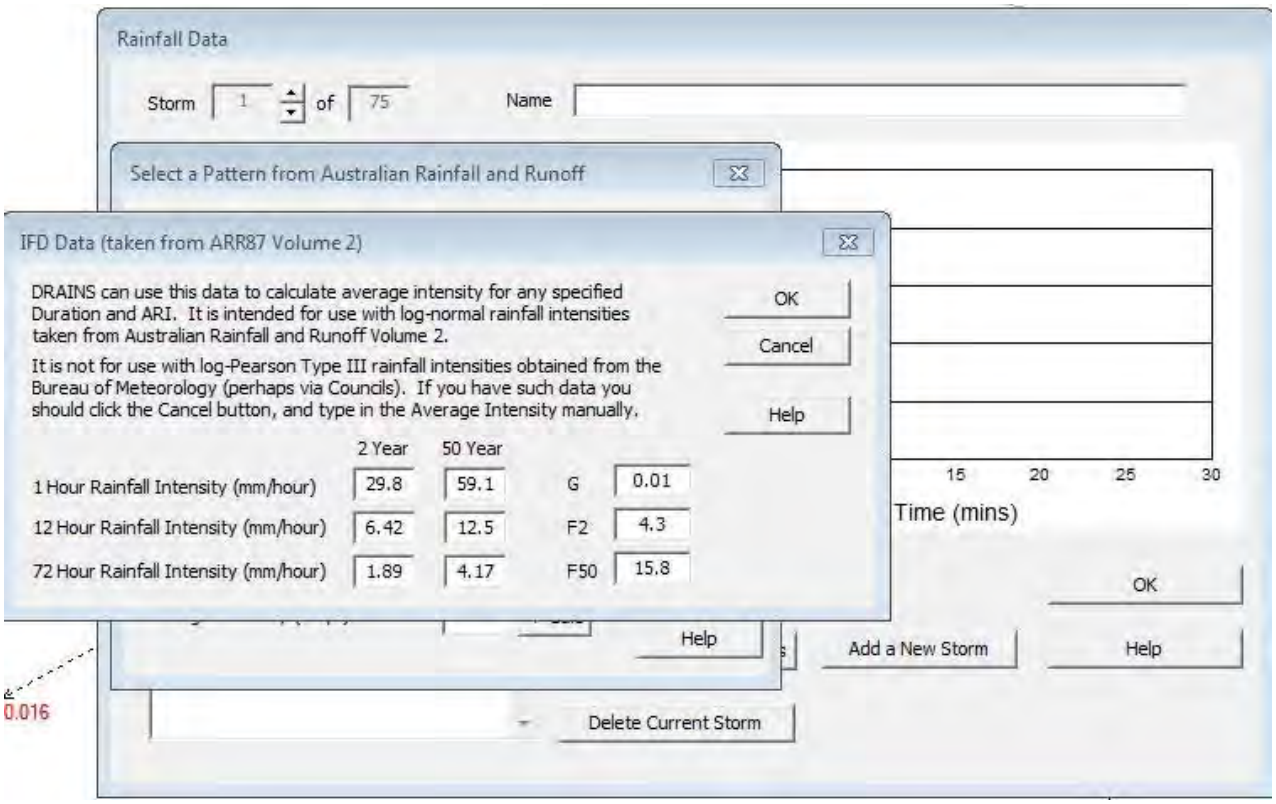
Appendix B Existing Case DRAINS model layout

Existing Case Model Layout



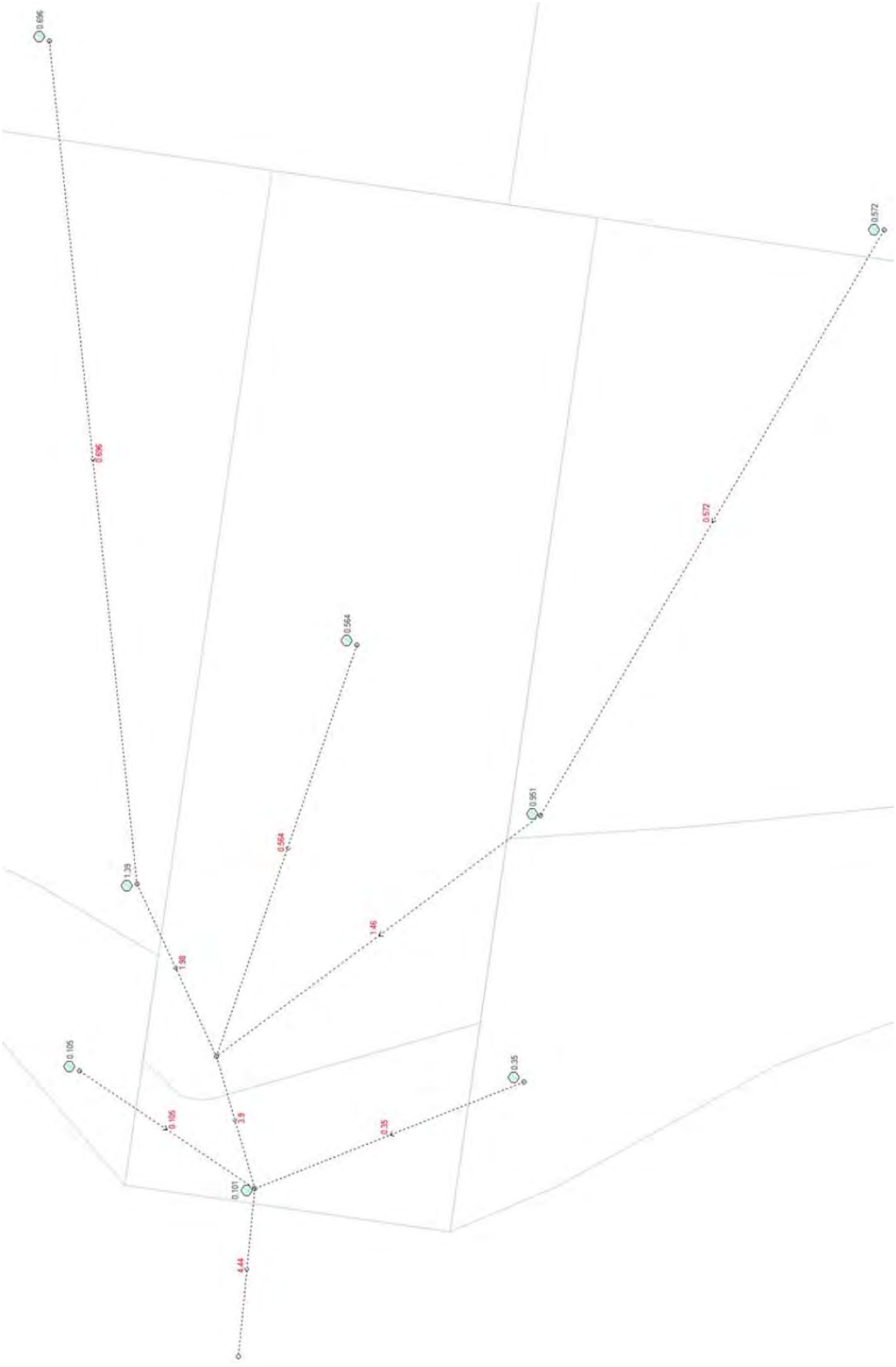

Project Options
Simulation Options
Default Hydrological Model
Martin Rd
Calculation time step
Set by DRAINS
You specify (mins)
Default Sag Pit Blocking Factor (0 to 1.0)
0
Default On Grade Pit Blocking Factor (0 to 1.0)
(0 = no blockage)
0
Climate Change Rainfall Multiplier
1
Pipe Friction Formula
Colebrook-White
Manning's
Design Parameters
Minimum pit freeboard (mm)
150
Minimum fall across pits (mm)
30
Minimum clearance to services (mm)
100
Pipes cannot be smaller than those upstream
Pipes can be smaller than those upstream
Other Options
For Detention Basins specify
Surface Area vs Elevation
Volume vs Elevation
Chainage increases
Going upstream
Going downstream
Enable multi core processing
Use ARR2016 procedures
OK
Cancel
Help


ILSAX Type Hydrological Model
Model name
Martin Rd
Paved (impervious) area depression storage (mm)
1
Supplementary area depression storage (mm)
1
Grassed (pervious) area depression storage (mm)
5
OK
Cancel
Help
Soil Type
Normal (1 to 4)
3
You specify
For overland flow use
Friend's equation
Kinematic wave equation
Note: The overland flow equation is only used if you choose to specify more detailed catchment data.

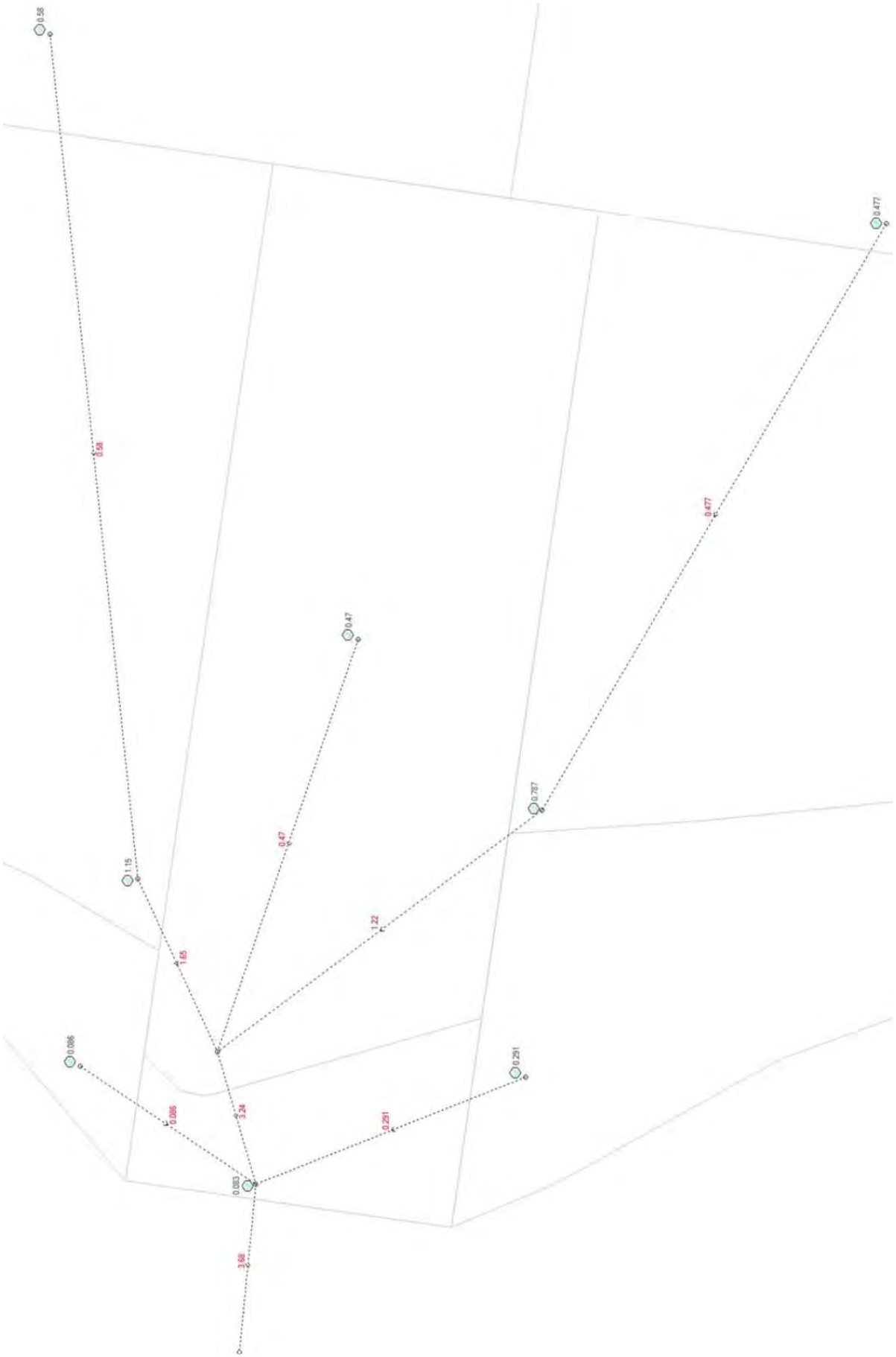

Rainfall Data
Storm 1 of 75
Name
Select a Pattern from Australian Rainfall and Runoff
IFD Data (taken from ARR87 Volume 2)
DRAINS can use this data to calculate average intensity for any specified Duration and ARI. It is intended for use with log-normal rainfall intensities taken from Australian Rainfall and Runoff Volume 2.
It is not for use with log-Pearson Type III rainfall intensities obtained from the Bureau of Meteorology (perhaps via Councils). If you have such data you should click the Cancel button, and type in the Average Intensity manually.
OK
Cancel
Help
2 Year
50 Year
1 Hour Rainfall Intensity (mm/hour) 29.8 59.1
12 Hour Rainfall Intensity (mm/hour) 6.42 12.5
72 Hour Rainfall Intensity (mm/hour) 1.89 4.17
G 0.01
F2 4.3
F50 15.8
15
20
25
30
Time (mins)
OK
Help
Add a New Storm
Help
0.016
Delete Current Storm

Appendix C Existing Case Results

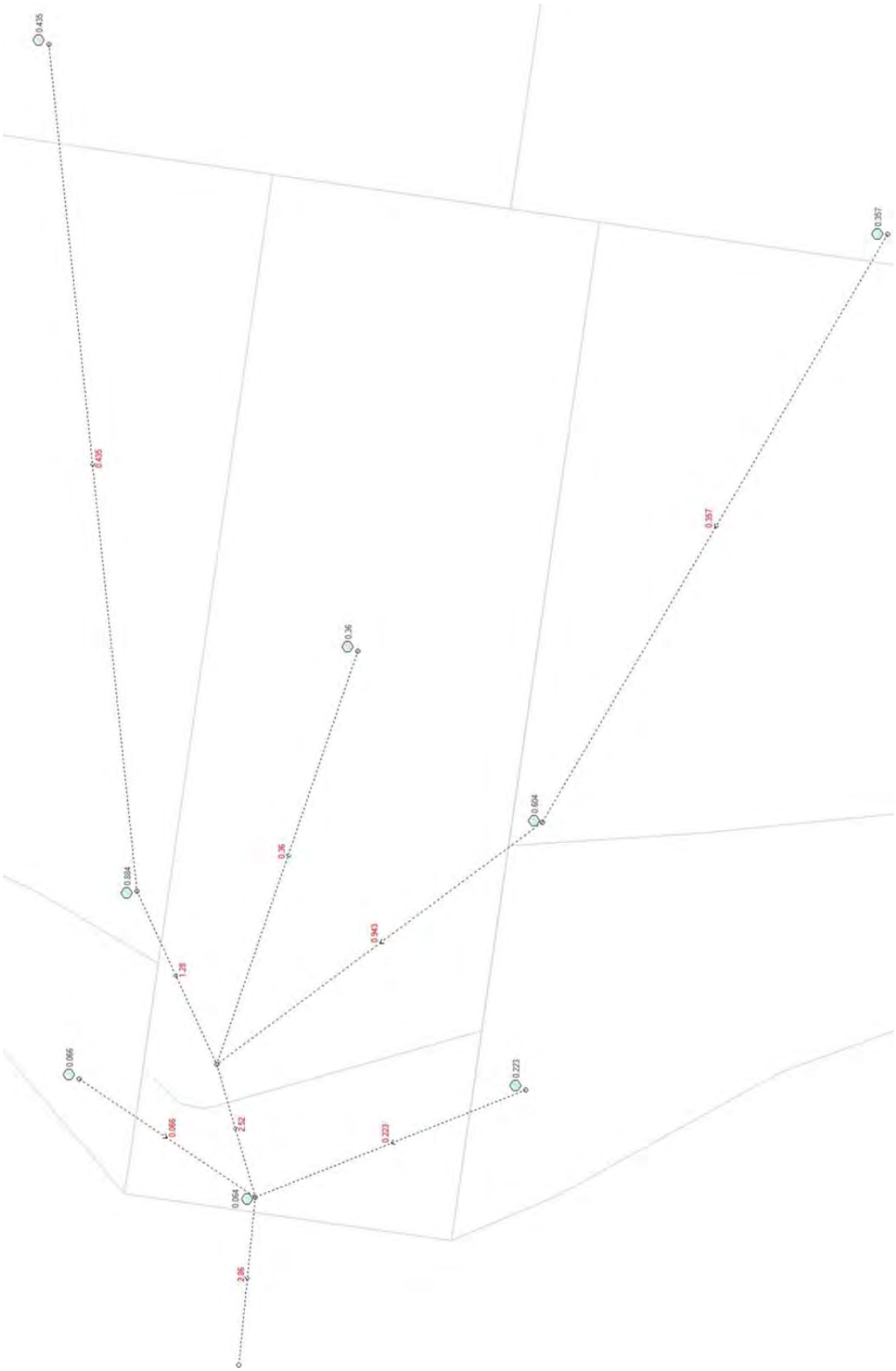
100 Year ARI Existing Case Peak Flows



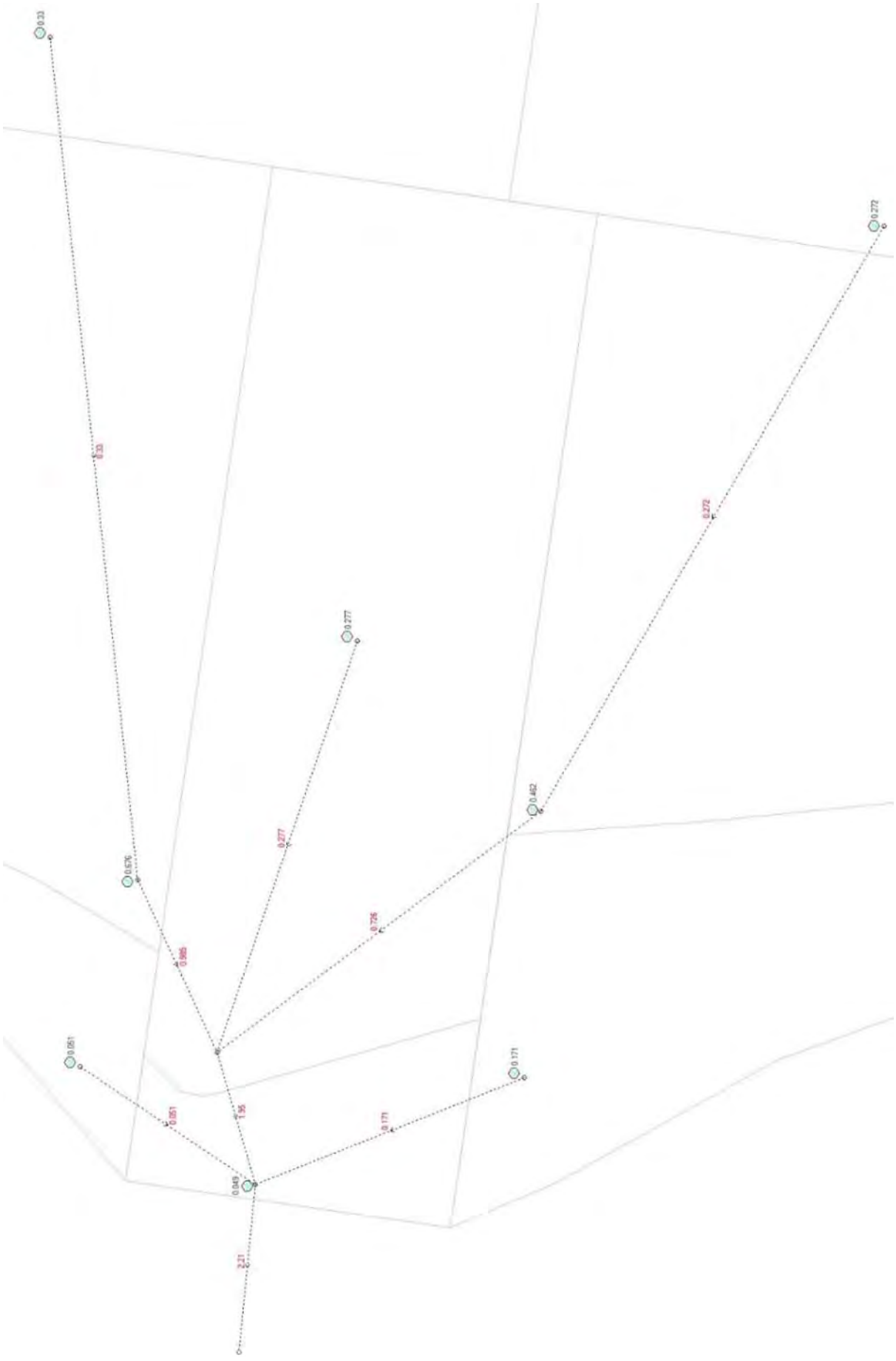
50 Year ARI Existing Case Peak Flows



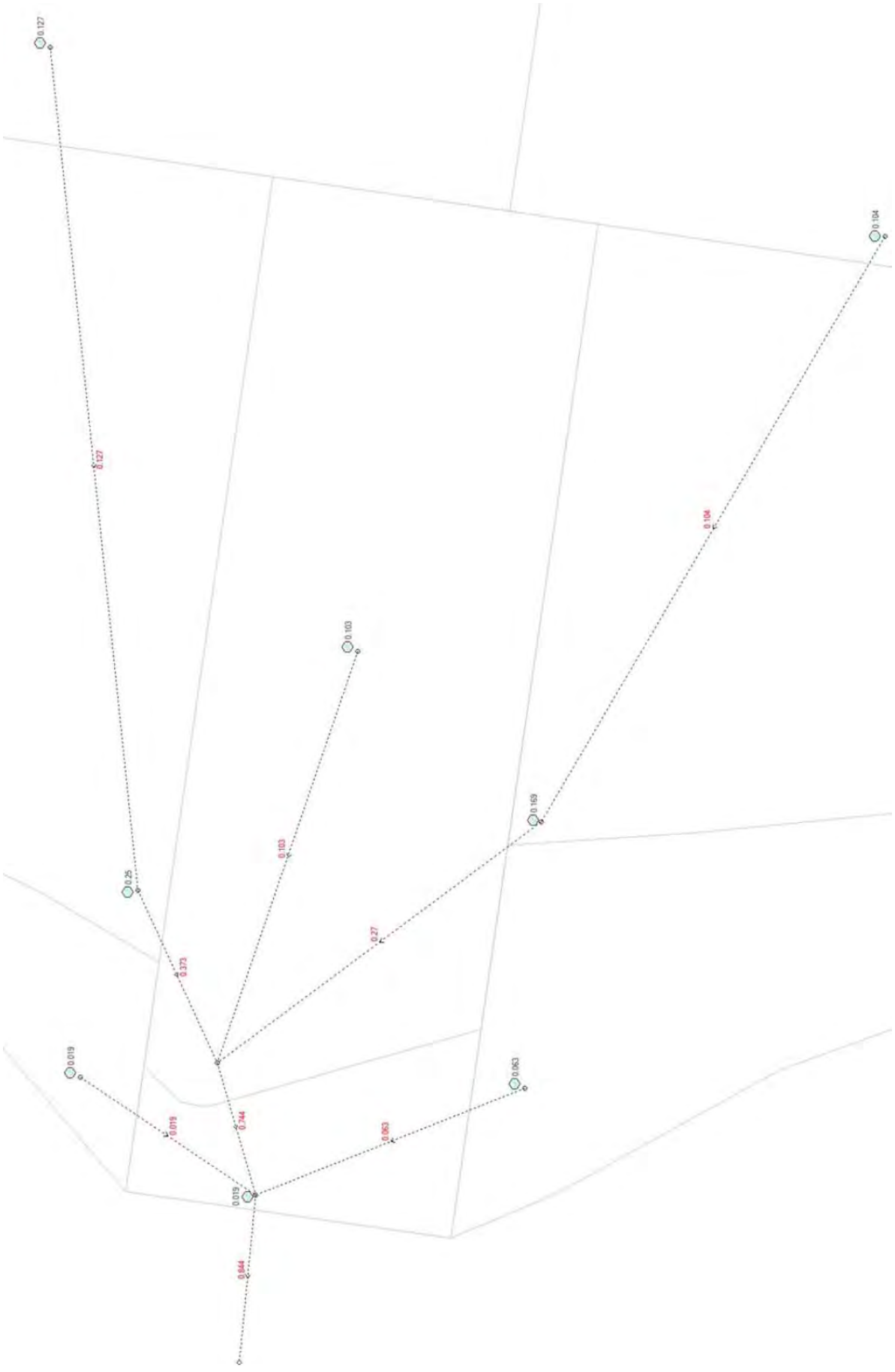
20 Year ARI Existing Case Peak Flows



10 Year ARI Existing Case Peak Flows

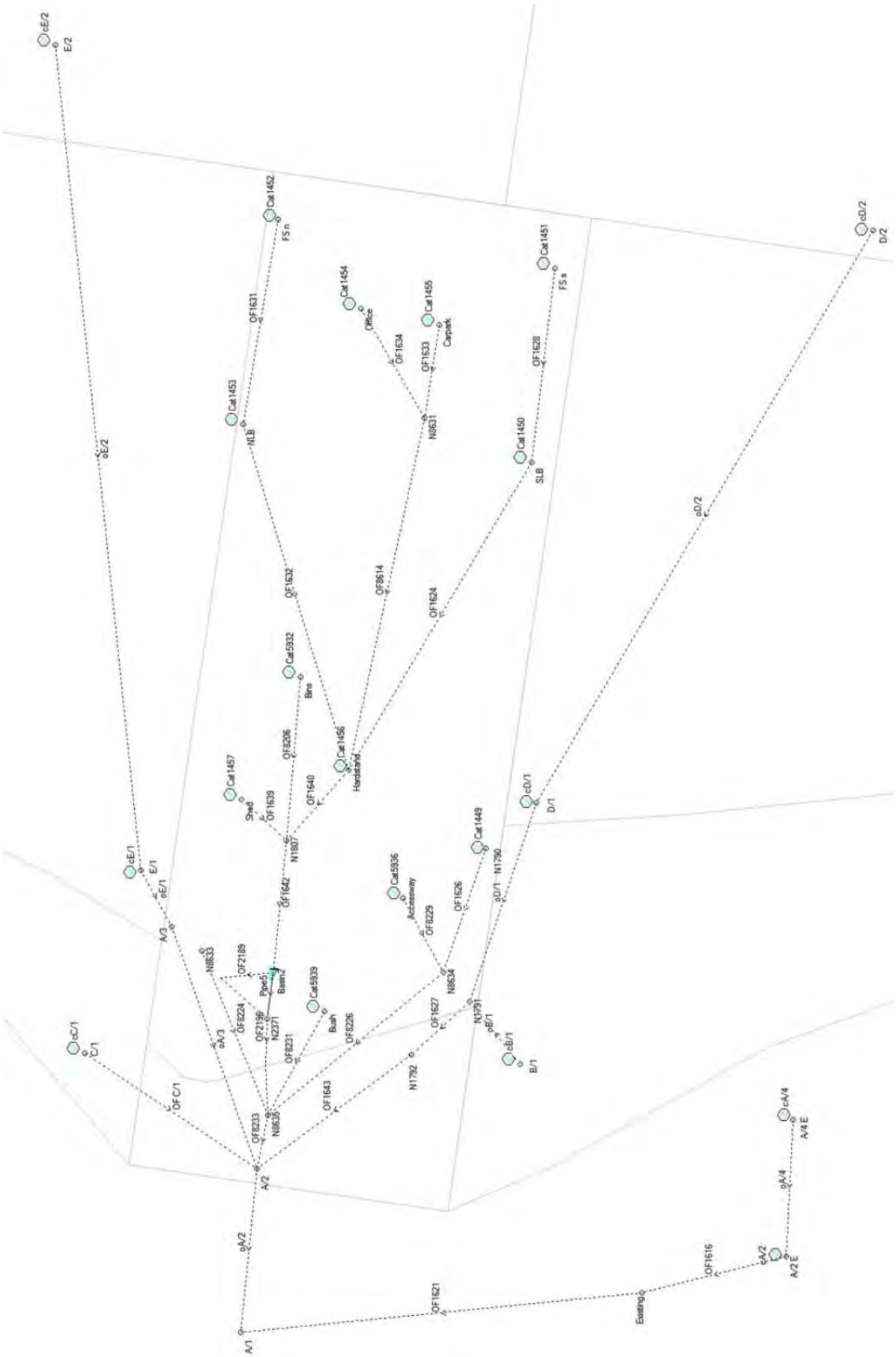


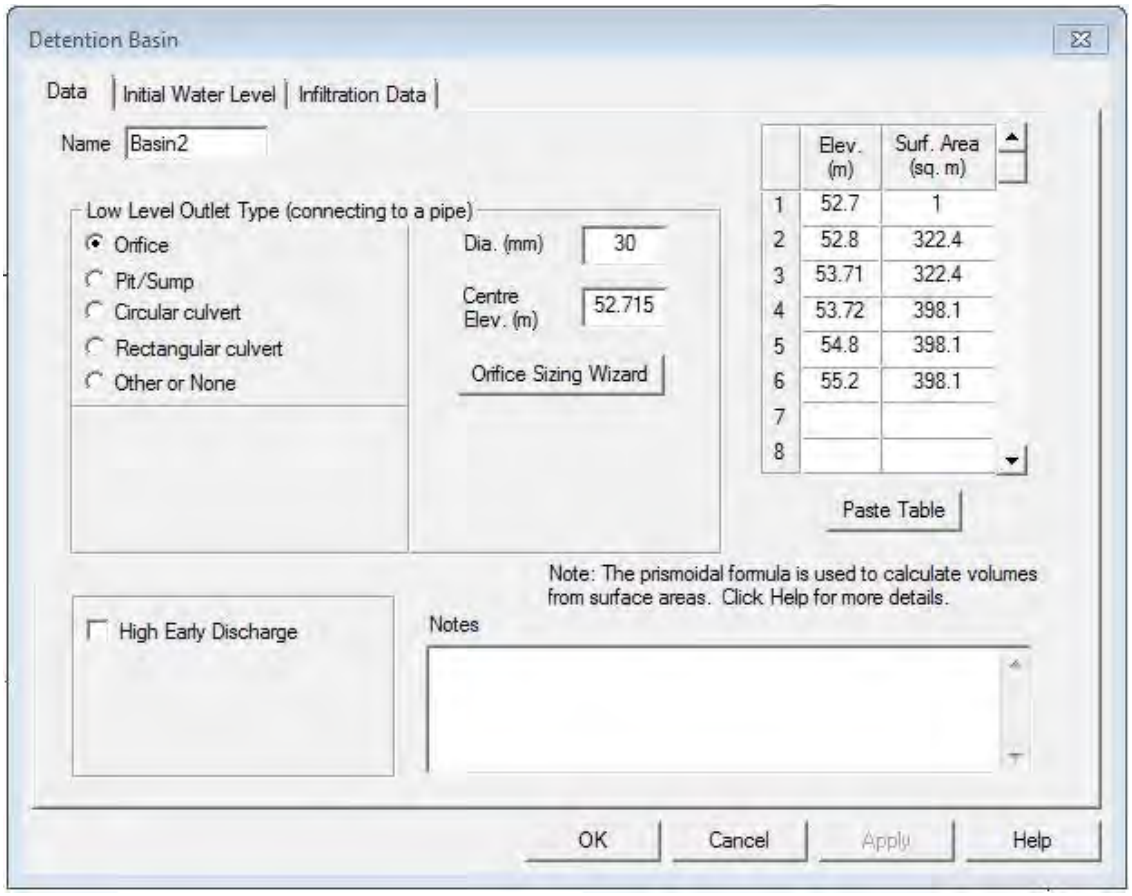
5 Year ARI Existing Case Peak Flows

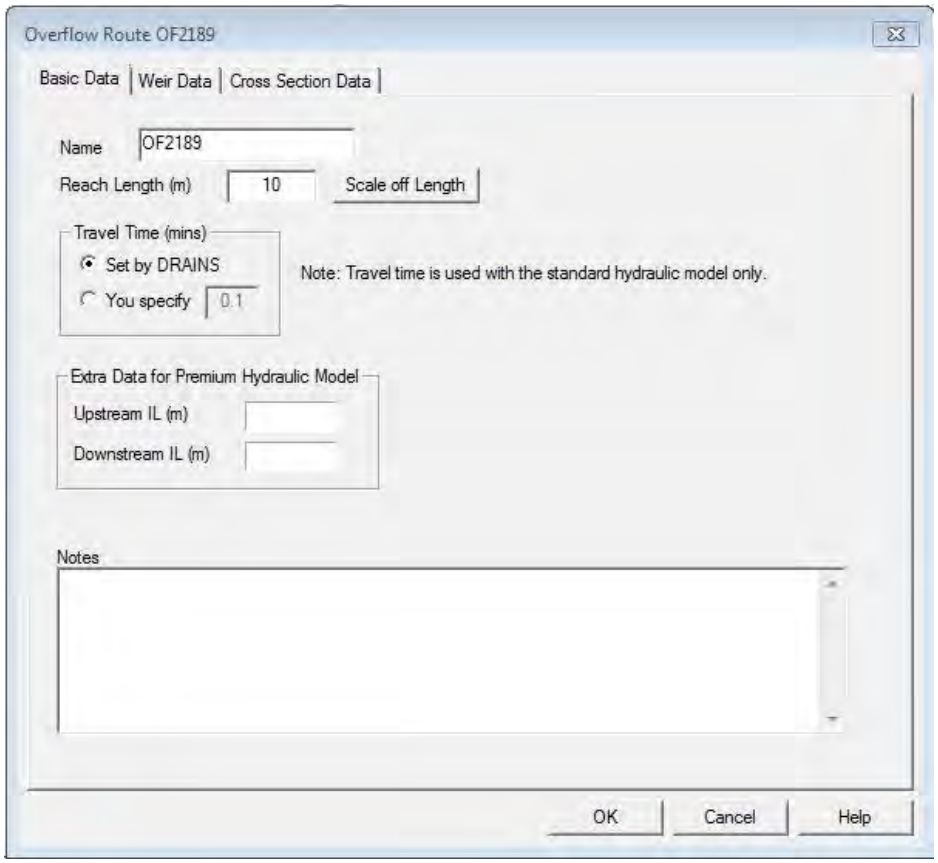


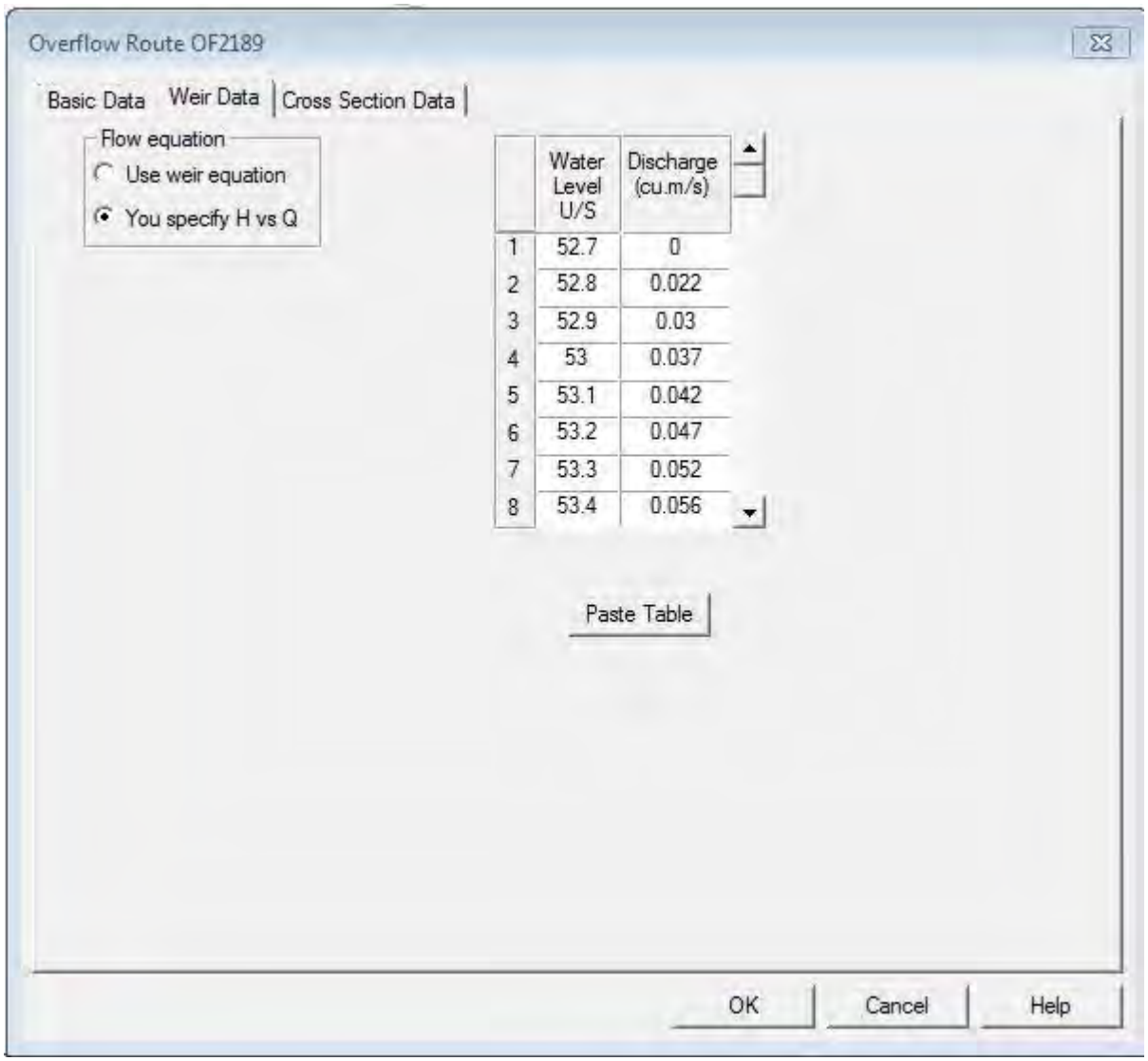
Appendix D Developed Case DRAINS model layout

Developed Case Model Layout



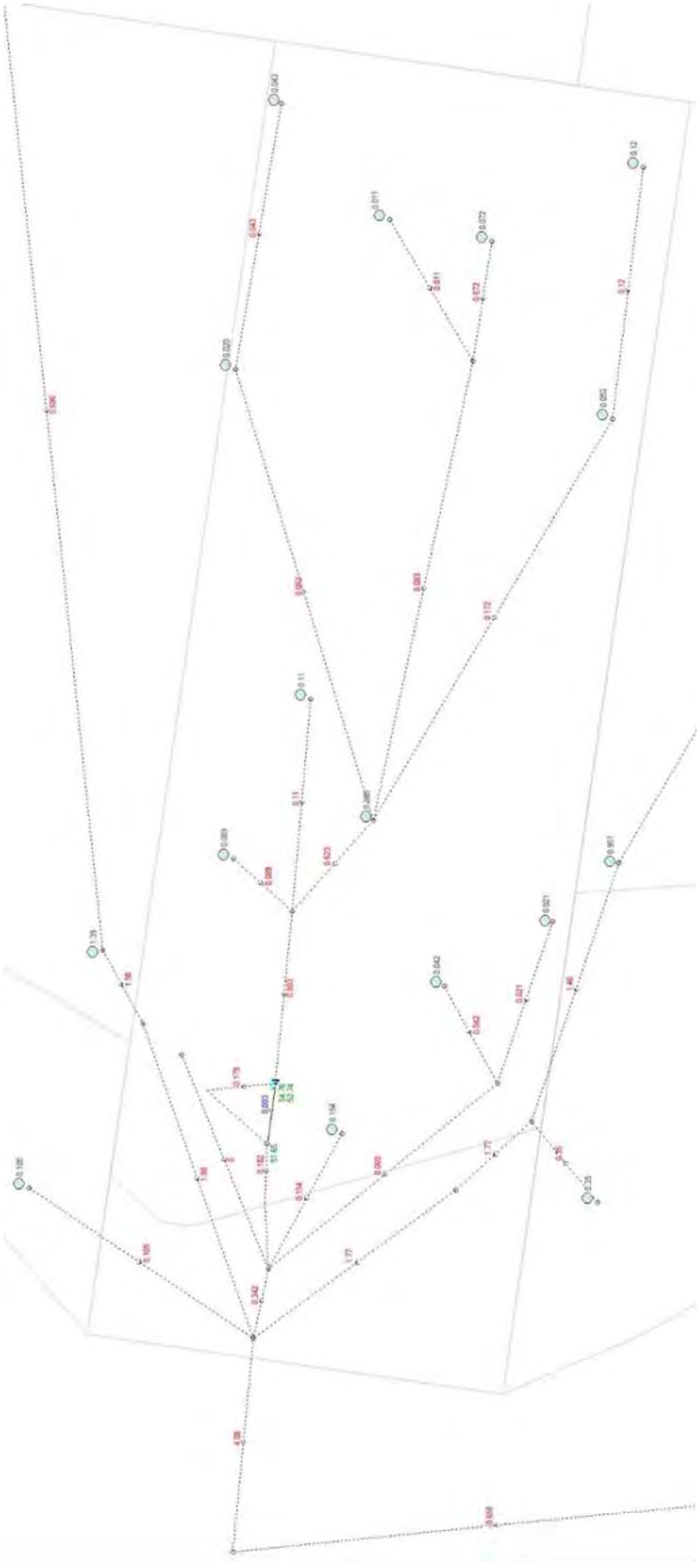

Detention Basin
Data
Initial Water Level
Infiltration Data
Name
Basin2
Low Level Outlet Type (connecting to a pipe)
Orifice
Pit/Sump
Circular culvert
Rectangular culvert
Other or None
Dia. (mm)
30
Centre Elev. (m)
52.715
Orifice Sizing Wizard
Elev. (m)
Surf. Area (sq. m)
1 52.7 1
2 52.8 322.4
3 53.71 322.4
4 53.72 398.1
5 54.8 398.1
6 55.2 398.1
7
8
Paste Table
Note: The prismoidal formula is used to calculate volumes from surface areas. Click Help for more details.
High Early Discharge
Notes
OK
Cancel
Apply
Help


Overflow Route OF2189
Basic Data
Weir Data
Cross Section Data
Name
OF2189
Reach Length (m)
10
Scale off Length
Travel Time (mins)
Set by DRAINS
You specify
0.1
Note: Travel time is used with the standard hydraulic model only.
Extra Data for Premium Hydraulic Model
Upstream IL (m)
Downstream IL (m)
Notes
OK
Cancel
Help

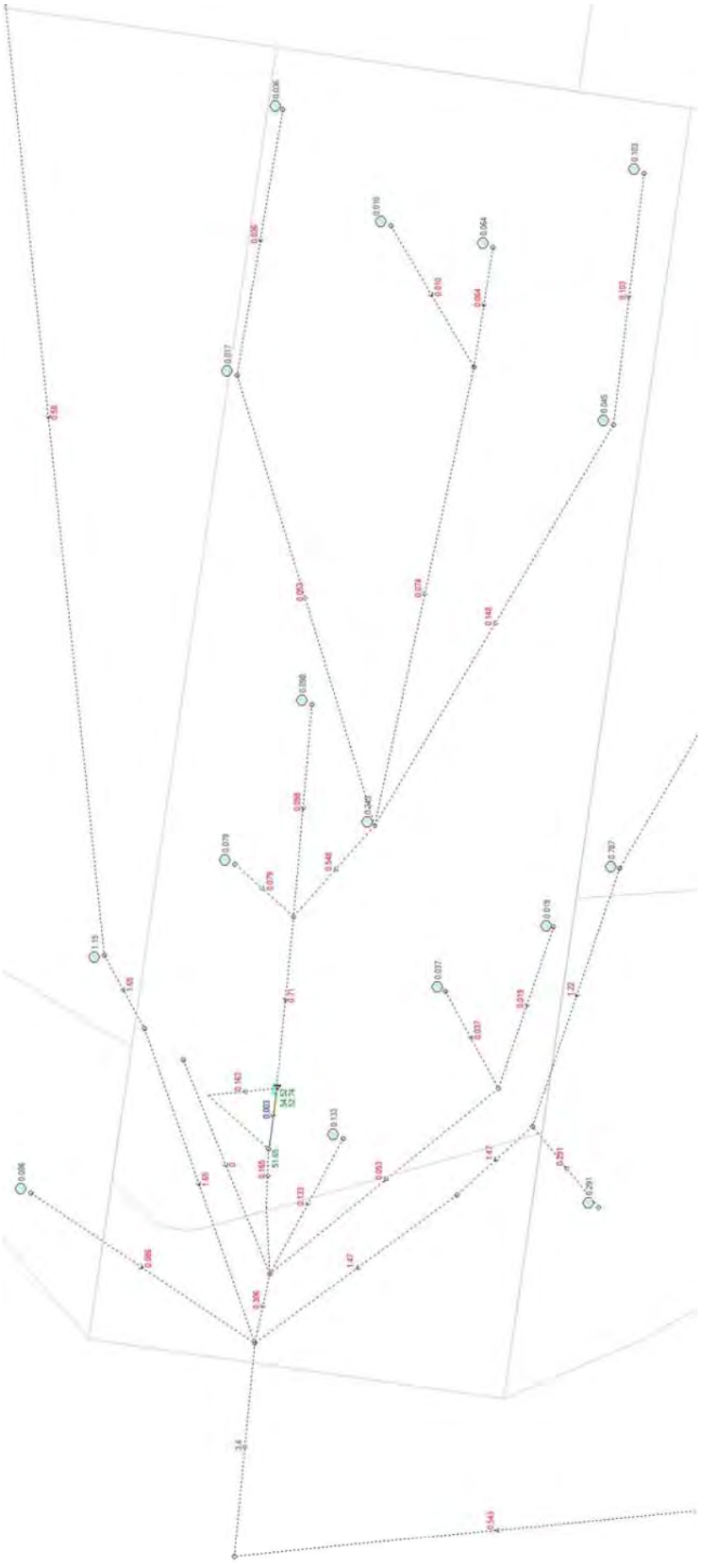

Overflow Route OF2189
Basic Data
Weir Data
Cross Section Data
Flow equation
Use weir equation
You specify H vs Q
Water Level U/S
Discharge (cu.m/s)
1 52.7 0
2 52.8 0.022
3 52.9 0.03
4 53 0.037
5 53.1 0.042
6 53.2 0.047
7 53.3 0.052
8 53.4 0.056
Paste Table
OK
Cancel
Help

Appendix E Developed Case DRAINS Results

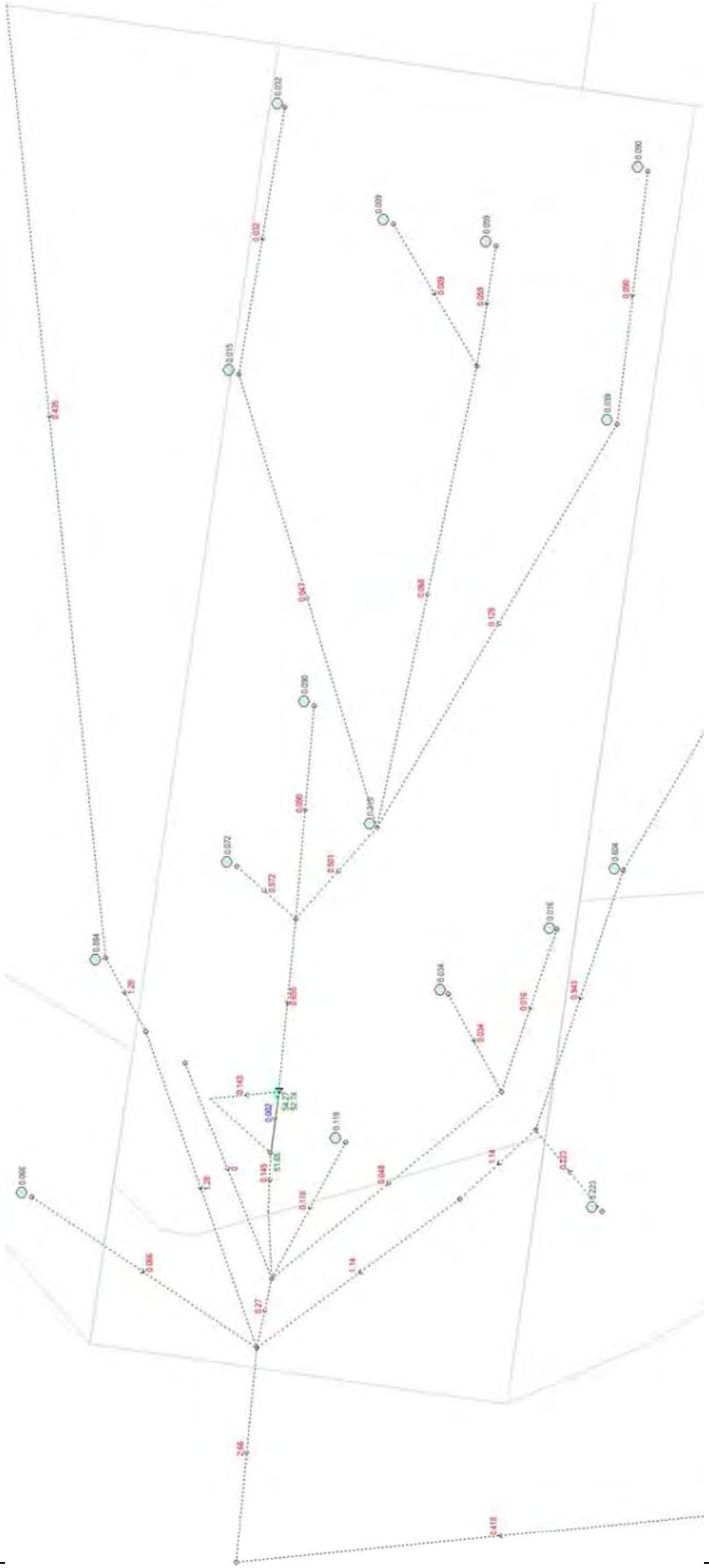
100 Year ARI Developed Case Peak Flows



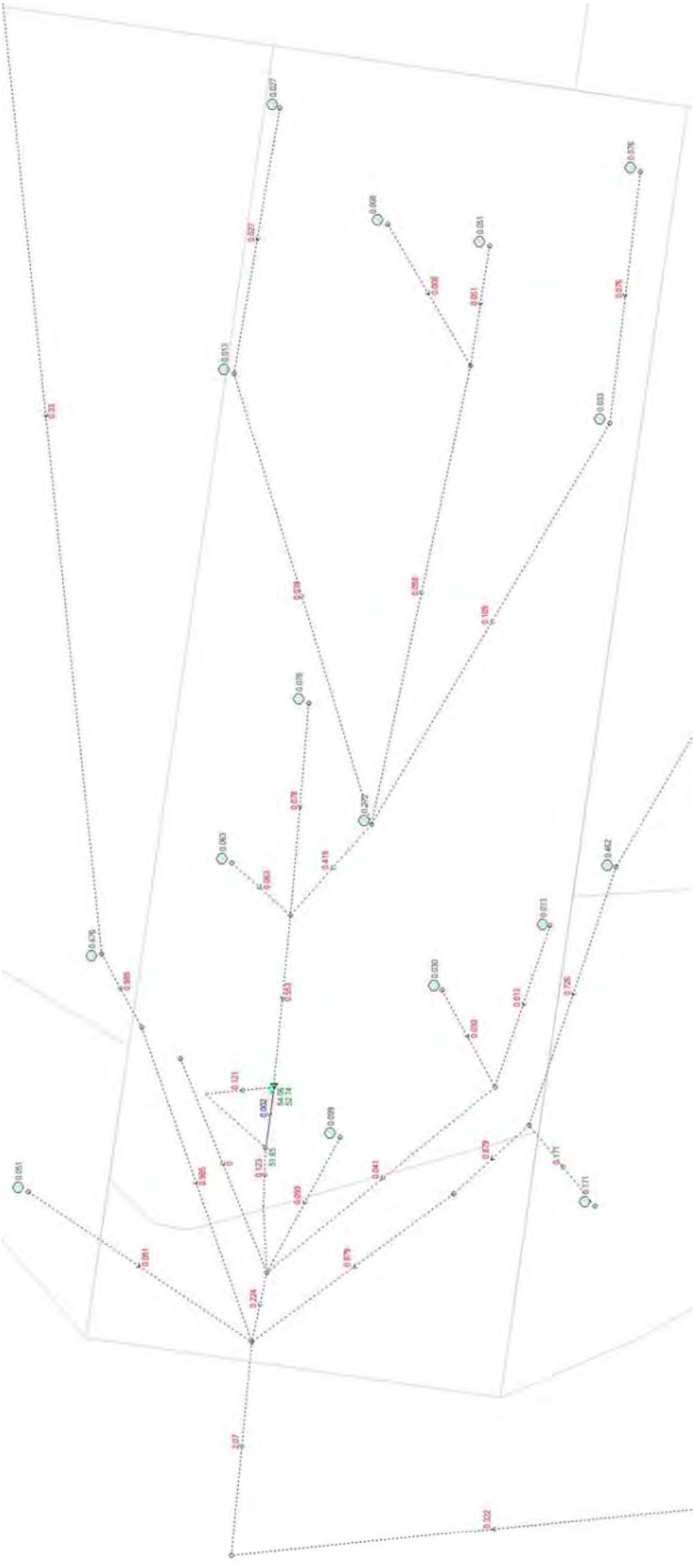
50 Year ARI Developed Case Peak Flows



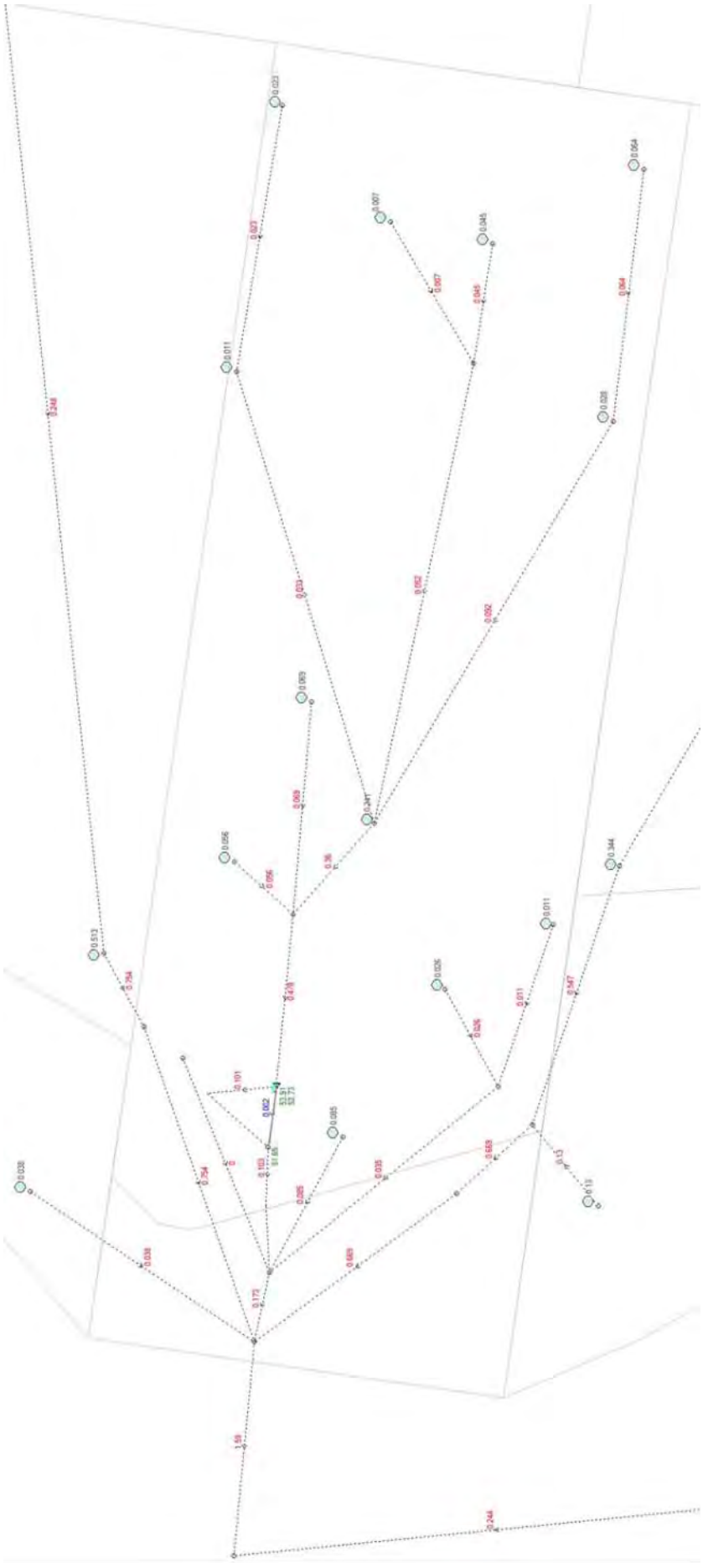
20 Year ARI Developed Case Peak Flows



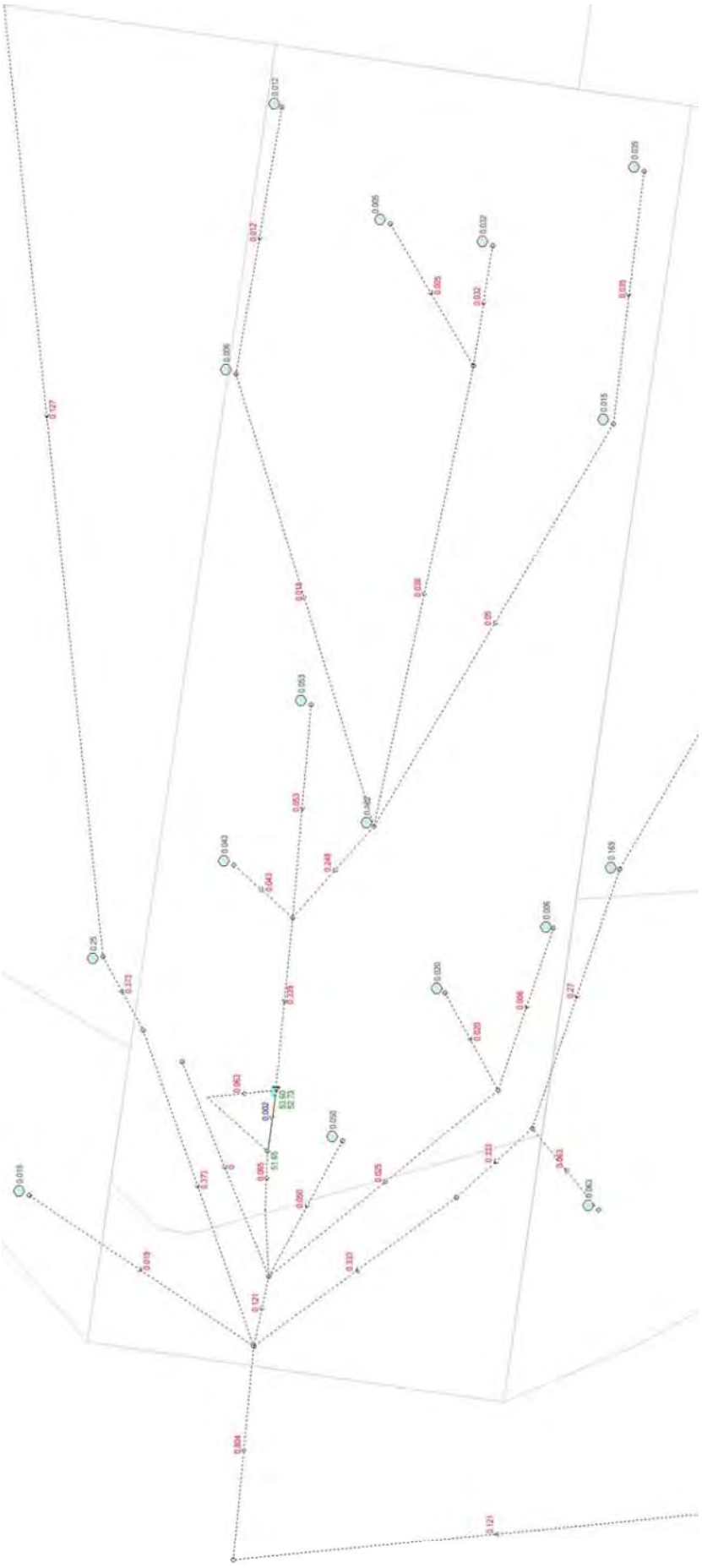
10 Year ARI Developed Case Peak Flows



5 Year ARI Developed Case Peak Flows

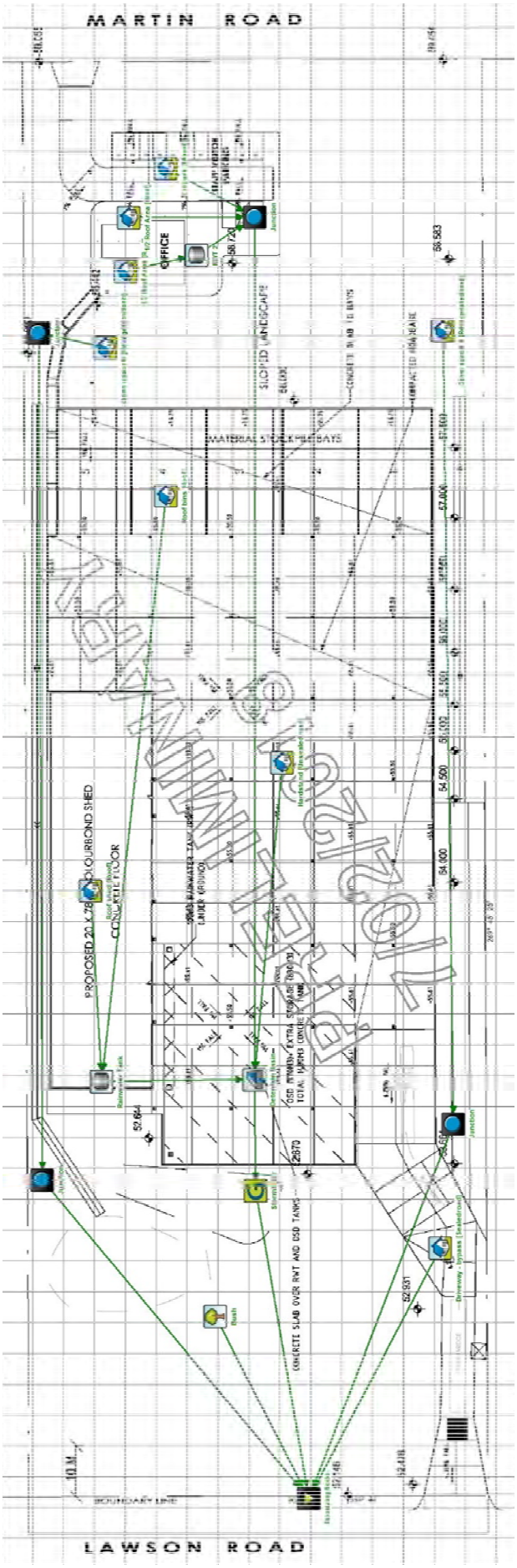


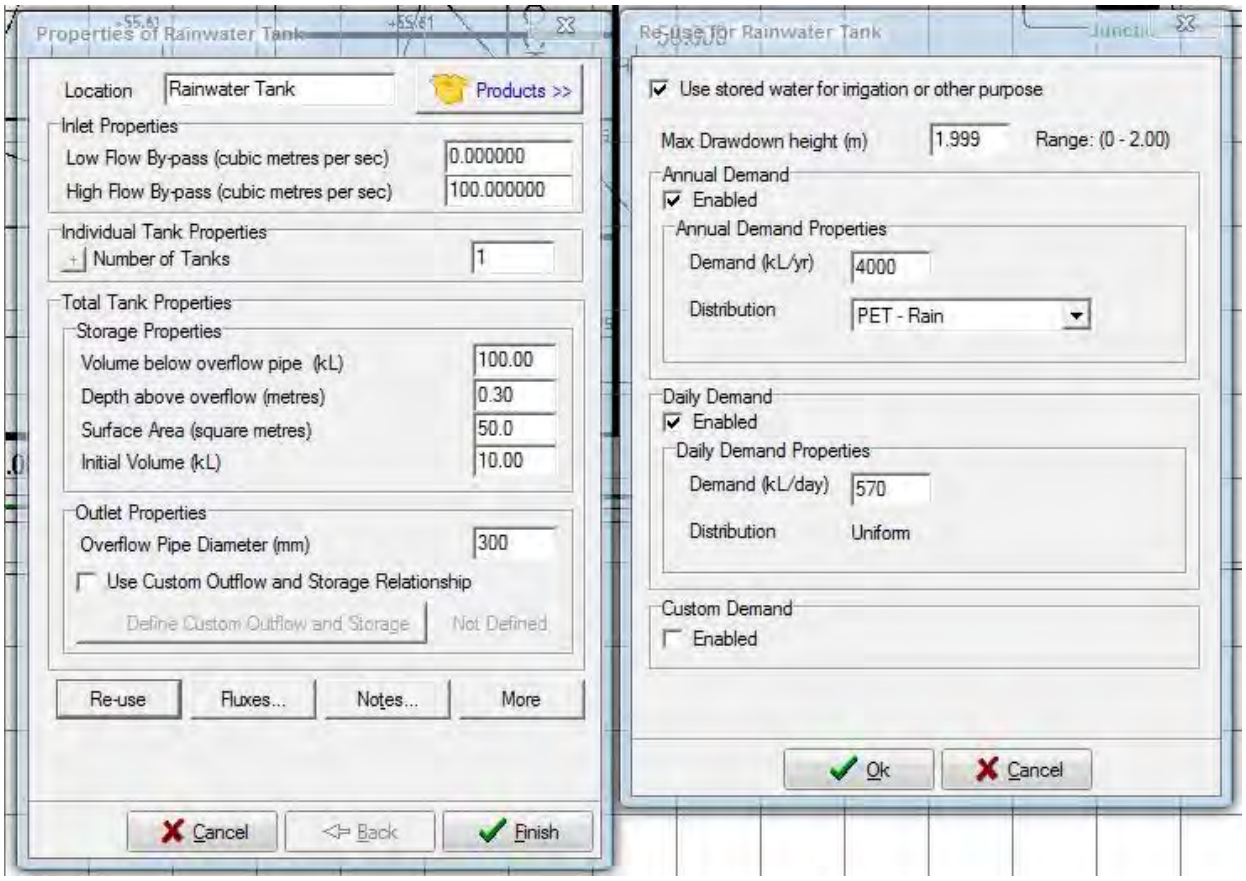
2 Year ARI Developed Case Peak Flows

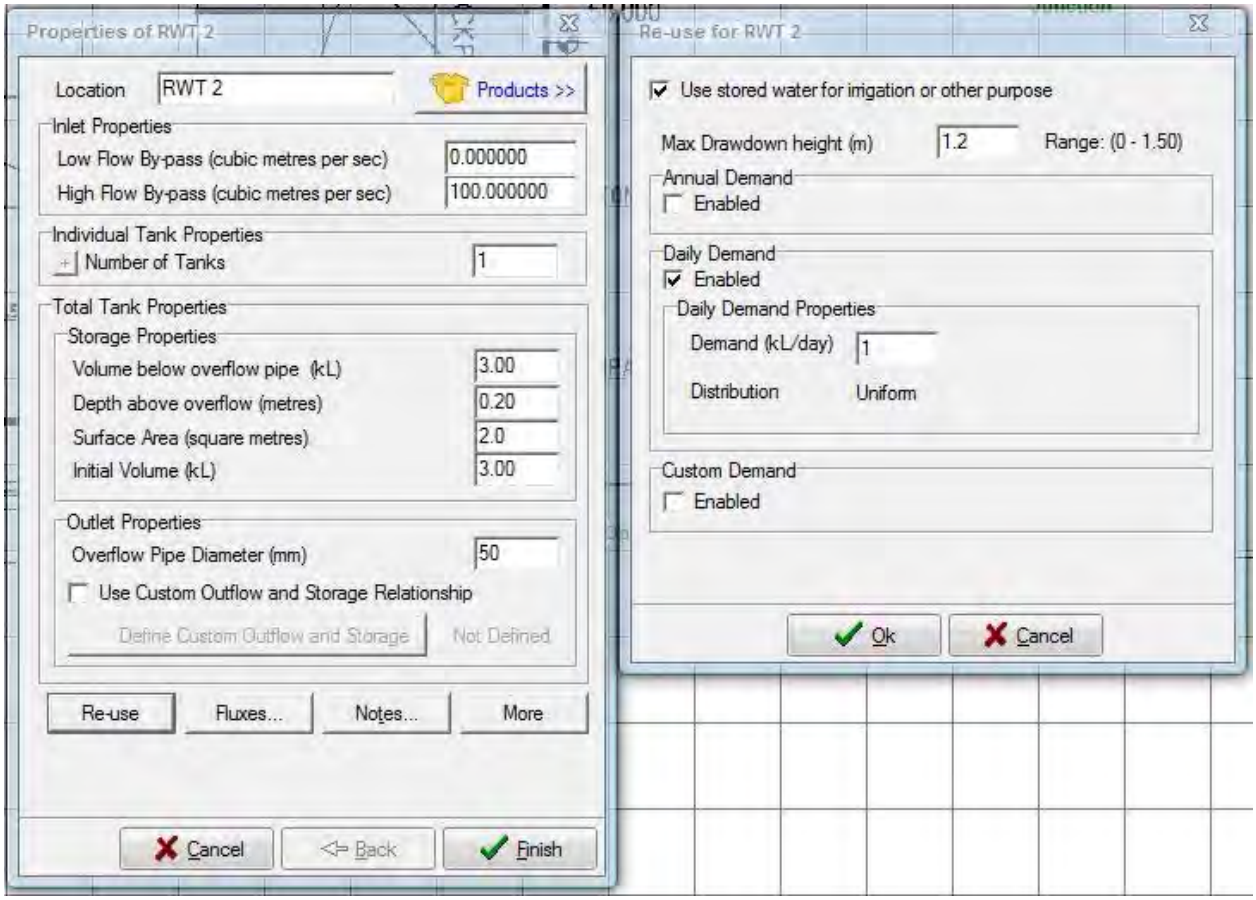


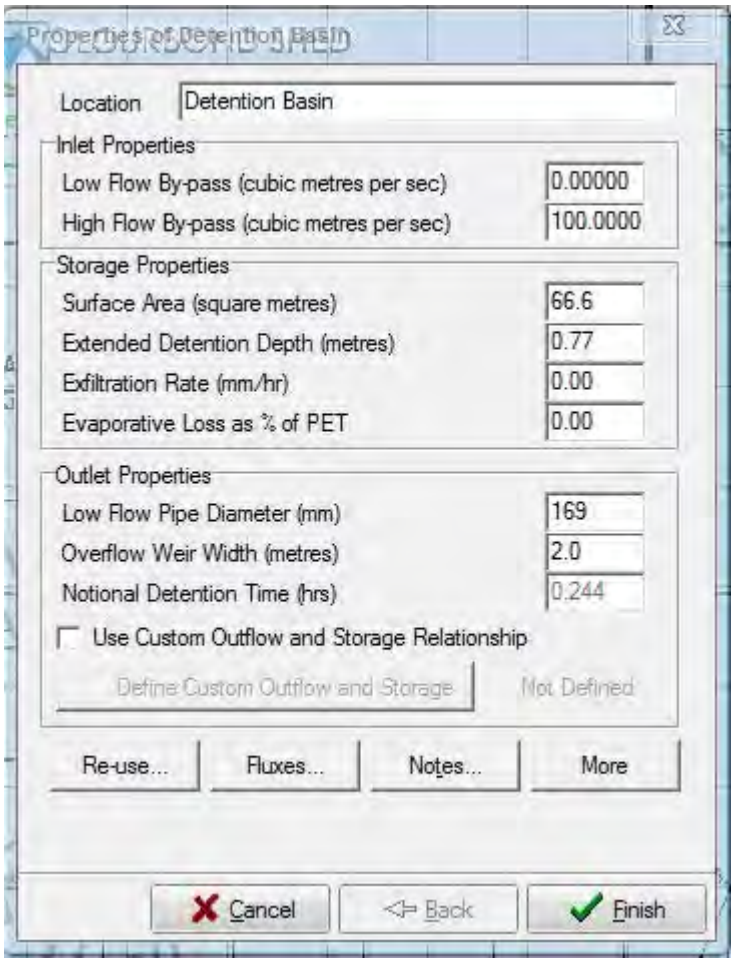
Appendix F MUSIC model layout and results

MUSIC Model Layout




Properties of Rainwater Tank
Location
Rainwater Tank
Products >>
Inlet Properties
Low Flow By-pass (cubic metres per sec)
0.000000
High Flow By-pass (cubic metres per sec)
100.000000
Individual Tank Properties
Number of Tanks
1
Total Tank Properties
Storage Properties
Volume below overflow pipe (kL)
100.00
Depth above overflow (metres)
0.30
Surface Area (square metres)
50.0
Initial Volume (kL)
10.00
Outlet Properties
Overflow Pipe Diameter (mm)
300
Use Custom Outflow and Storage Relationship
Define Custom Outflow and Storage
Not Defined
Re-use
Fluxes...
Notes...
More
Cancel
Back
Finish
Re-use for Rainwater Tank
Use stored water for irrigation or other purpose
Max Drawdown height (m)
1.999
Range: (0 - 2.00)
Annual Demand
Enabled
Annual Demand Properties
Demand (kL/yr)
4000
Distribution
PET - Rain
Daily Demand
Enabled
Daily Demand Properties
Demand (kL/day)
570
Distribution
Uniform
Custom Demand
Enabled
Ok
Cancel


Properties of RWT 2
Location
RWT 2
Products >>
Inlet Properties
Low Flow By-pass (cubic metres per sec)
0.000000
High Flow By-pass (cubic metres per sec)
100.000000
Individual Tank Properties
Number of Tanks
1
Total Tank Properties
Storage Properties
Volume below overflow pipe (kL)
3.00
Depth above overflow (metres)
0.20
Surface Area (square metres)
2.0
Initial Volume (kL)
3.00
Outlet Properties
Overflow Pipe Diameter (mm)
50
Use Custom Outflow and Storage Relationship
Define Custom Outflow and Storage
Not Defined
Re-use
Fluxes...
Notes...
More
Cancel
Back
Finish
Re-use for RWT 2
Use stored water for irrigation or other purpose
Max Drawdown height (m)
1.2
Range: (0 - 1.50)
Annual Demand
Enabled
Daily Demand
Enabled
Daily Demand Properties
Demand (kL/day)
1
Distribution
Uniform
Custom Demand
Enabled
Ok
Cancel



Stormwater360
AUSTRALIA

DETENTION PARAMETERS FOR STORMFILTER SYSTEMS

Fill values in BLUE cells

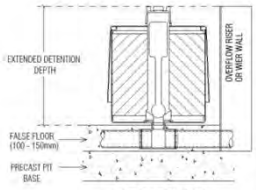
System Type (Detention or Precast)	Custom
Cartridge Height	690
Number of Cartridges	32
Cartridge Type	Full Flow ZPG
Custom Detention Tank Inputs	
Length (m)	8.5
Width (m)	8.5
Diameter (m, leave blank if not a manhole)	0.0

Detention Basin Properties For MUSIC

Inlet Properties	
Low Flow By-pass (cubic metres per sec)	0.000
High Flow By-pass (cubic metres per sec)	100.000
Storage Properties	
Surface Area (square metres)	66.6
Extended Detention Depth (metres)	0.77
Exfiltration Rate (mm/hr)	0.00
Evaporative Loss as % of PET	0.00
Outlet Properties	
Low Flow Pipe Diameter (mm)	169
Overflow Weir Width (metres)	2.0

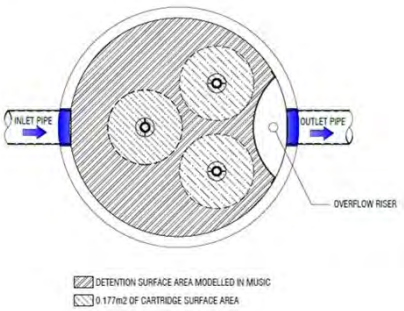
StormFilter Properties For MUSIC

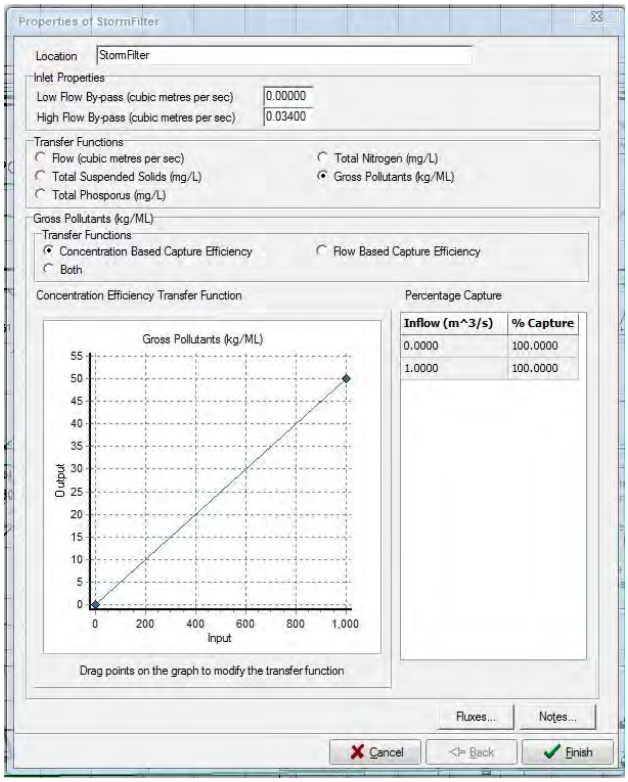
Inlet Properties	
Low Flow By-pass (cubic metres per sec)	0.000
High Flow By-pass (cubic metres per sec)	0.05120

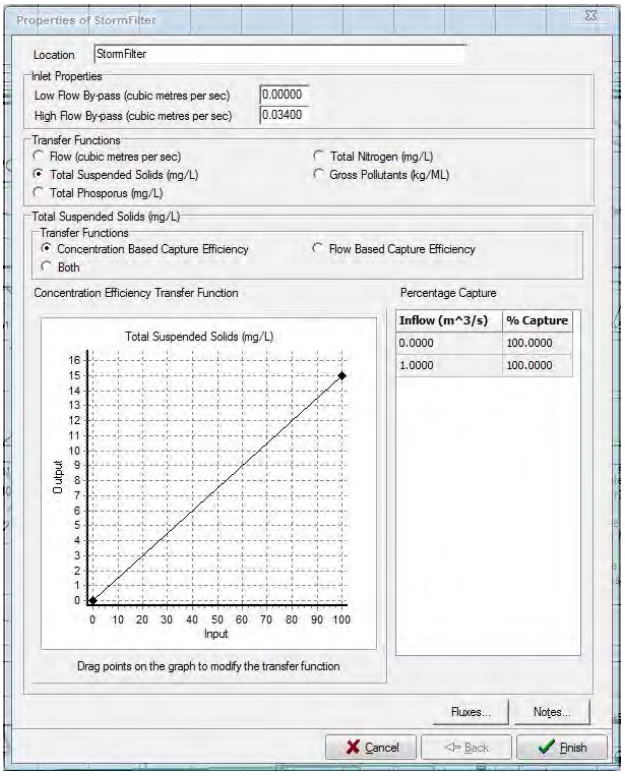


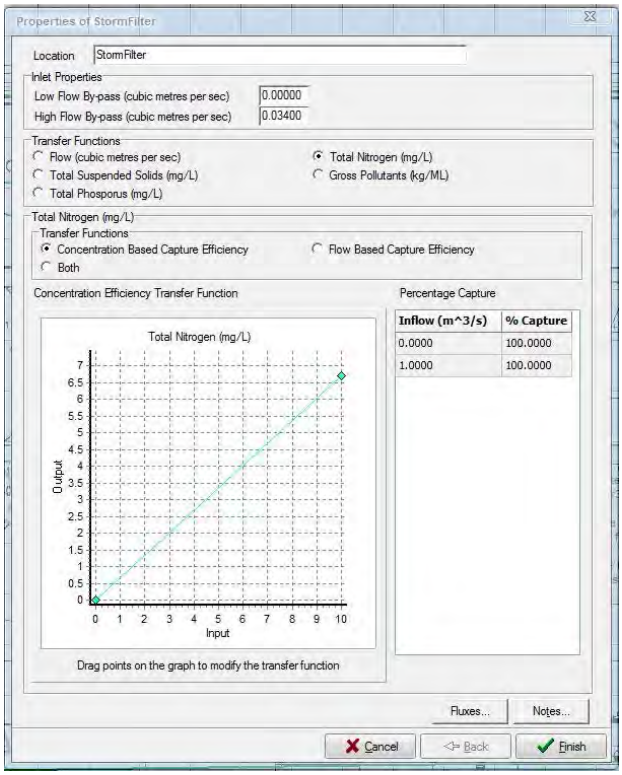
STORMFILTER CARTRIDGE DETAIL

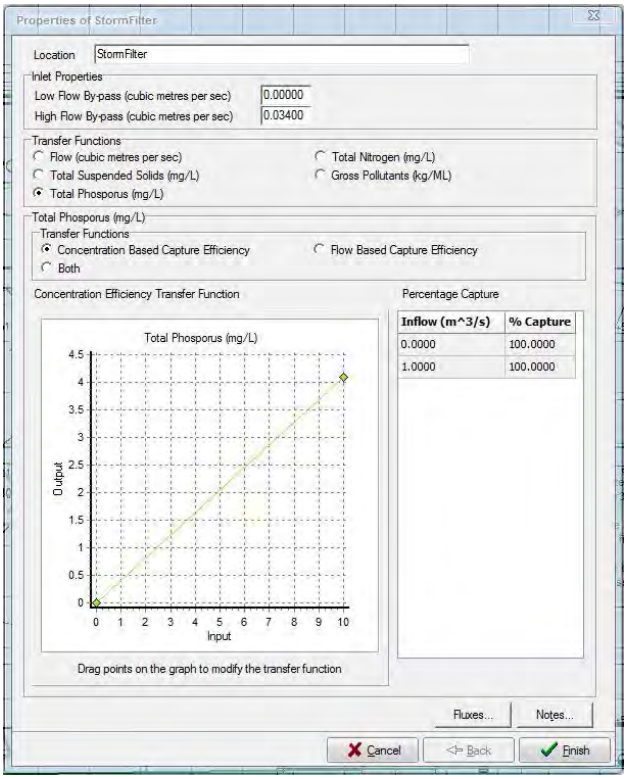
TYPICAL MANHOLE STORMFILTER



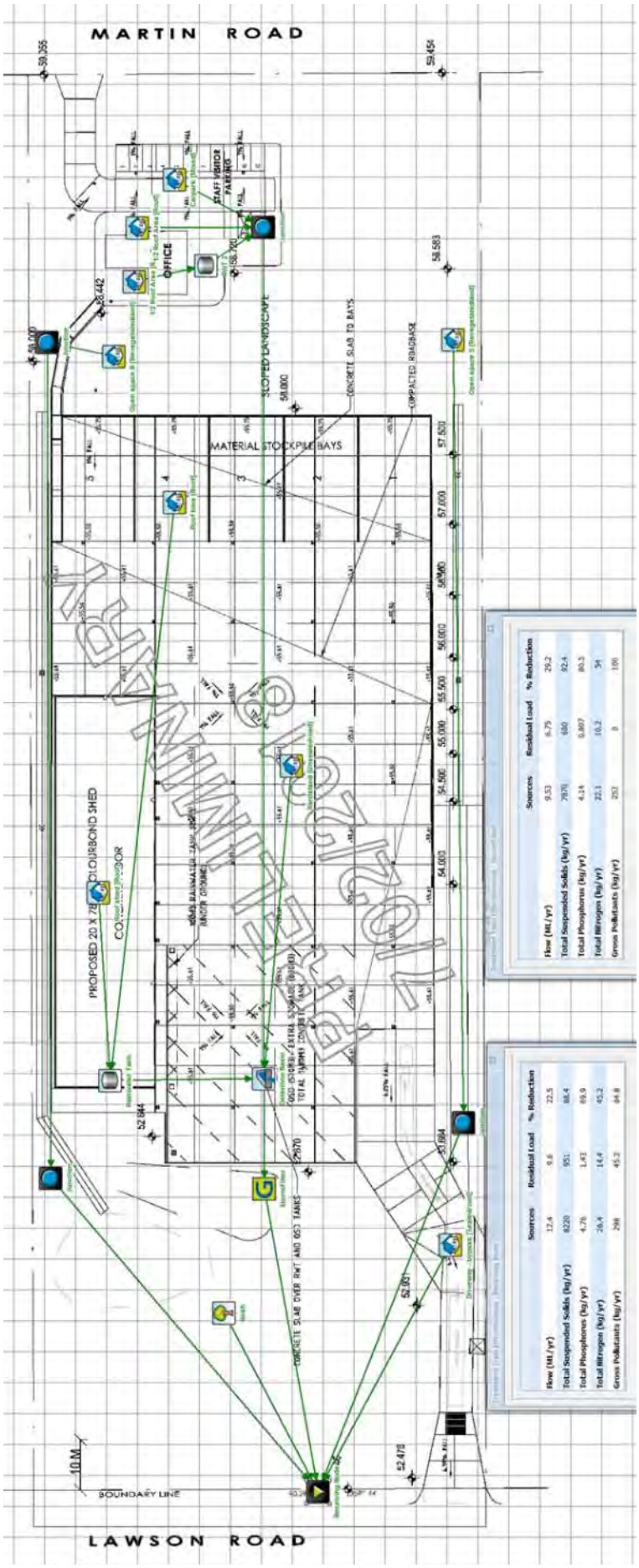

Properties of StormFilter
Location StormFilter
Inlet Properties
Low Flow By-pass (cubic metres per sec) 0.00000
High Flow By-pass (cubic metres per sec) 0.03400
Transfer Functions
Flow (cubic metres per sec)
Total Nitrogen (mg/L)
Total Suspended Solids (mg/L)
Gross Pollutants (kg/ML)
Total Phosporus (mg/L)
Gross Pollutants (kg/ML)
Transfer Functions
Concentration Based Capture Efficiency
Flow Based Capture Efficiency
Both
Concentration Efficiency Transfer Function
Gross Pollutants (kg/ML)
Output
Input
Percentage Capture
Inflow (m^3/s) % Capture
0.0000 100.0000
1.0000 100.0000
Drag points on the graph to modify the transfer function
Fluxes...
Notes...
Cancel
Back
Finish


Properties of StormFilter
Location StormFilter
Inlet Properties
Low Flow By-pass (cubic metres per sec) 0.00000
High Flow By-pass (cubic metres per sec) 0.03400
Transfer Functions
Flow (cubic metres per sec)
Total Nitrogen (mg/L)
Total Suspended Solids (mg/L)
Gross Pollutants (kg/ML)
Total Phosporus (mg/L)
Total Suspended Solids (mg/L)
Transfer Functions
Concentration Based Capture Efficiency
Flow Based Capture Efficiency
Both
Concentration Efficiency Transfer Function
Total Suspended Solids (mg/L)
Output
Input
Percentage Capture
Inflow (m^3/s) % Capture
0.0000 100.0000
1.0000 100.0000
Drag points on the graph to modify the transfer function
Fluxes...
Notes...
Cancel
Back
Finish


Properties of StormFilter
Location StormFilter
Inlet Properties
Low Flow By-pass (cubic metres per sec) 0.00000
High Flow By-pass (cubic metres per sec) 0.03400
Transfer Functions
Flow (cubic metres per sec)
Total Nitrogen (mg/L)
Total Suspended Solids (mg/L)
Gross Pollutants (kg/ML)
Total Phosporus (mg/L)
Total Nitrogen (mg/L)
Transfer Functions
Concentration Based Capture Efficiency
Flow Based Capture Efficiency
Both
Concentration Efficiency Transfer Function
Total Nitrogen (mg/L)
Output
Input
Percentage Capture
Inflow (m^3/s) % Capture
0.0000 100.0000
1.0000 100.0000
Drag points on the graph to modify the transfer function
Fluxes...
Notes...
Cancel
Back
Finish


Properties of StormFilter
Location StormFilter
Inlet Properties
Low Flow By-pass (cubic metres per sec) 0.00000
High Flow By-pass (cubic metres per sec) 0.03400
Transfer Functions
Flow (cubic metres per sec)
Total Nitrogen (mg/L)
Total Suspended Solids (mg/L)
Gross Pollutants (kg/ML)
Total Phosporus (mg/L)
Total Phosporus (mg/L)
Transfer Functions
Concentration Based Capture Efficiency
Flow Based Capture Efficiency
Both
Concentration Efficiency Transfer Function
Total Phosporus (mg/L)
Output
Input
Percentage Capture
Inflow (m^3/s) % Capture
0.0000 100.0000
1.0000 100.0000
Drag points on the graph to modify the transfer function
Fluxes...
Notes...
Cancel
Back
Finish

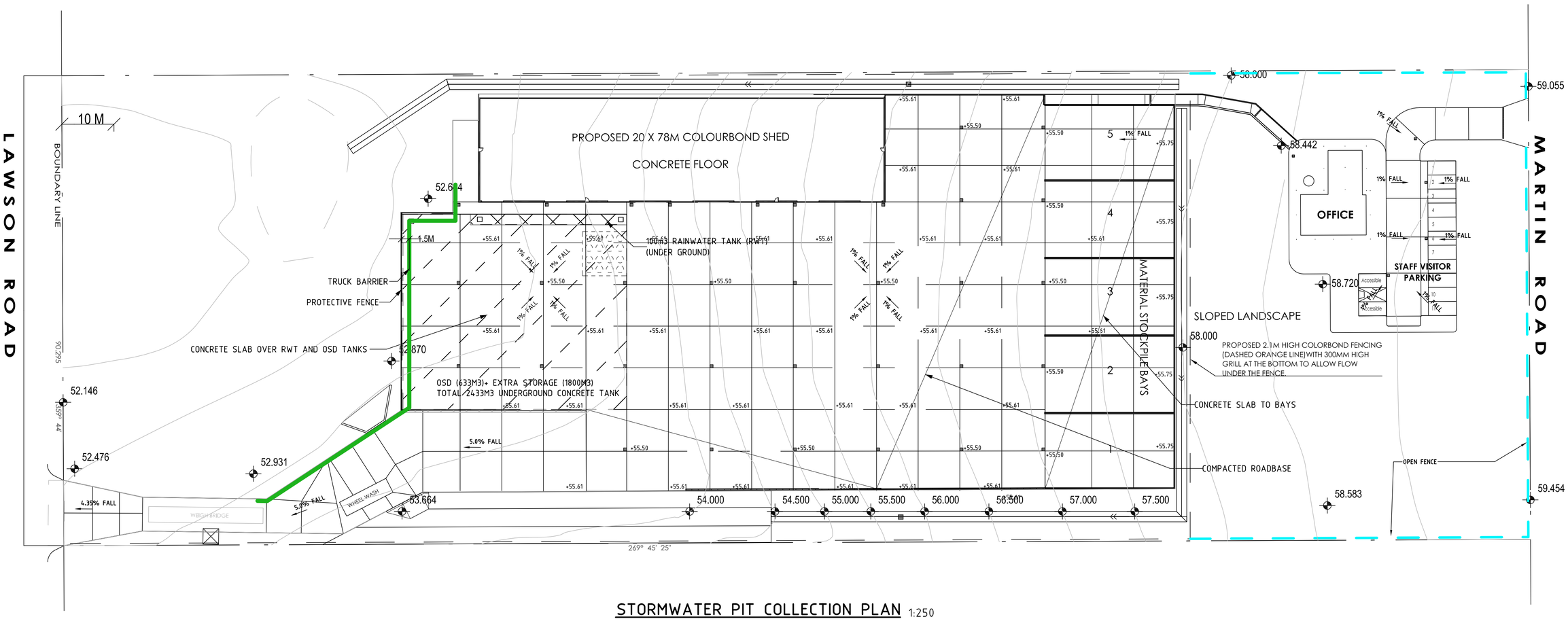
MUSIC Model Results



Appendix G Stormwater Water Concept Plan

LINE TYPES

- DIRECTION OF PIPE FLOW
- DIRECTION OF ROOF FLOW
- DIRECTION OF OVERLAND FLOW



STORMWATER PIT COLLECTION PLAN 1:250

Concept Storwater plan and detail

AMENDMENTS

preliminary	7/02/18	Issue for review	L Y
A	8/03/18	Issue for DA	L Y

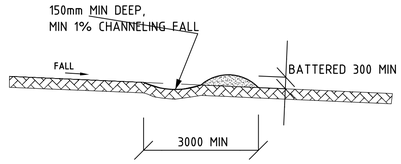
ARCHITECT

PROJECT
Proposed stormwater plan
for A M J
at 55 Martin Rd, Badgery Creek

T.O.P. Consulting Group (NSW) Pty. Ltd
A.B.N. 76 156 071 706
Structural and Civil Engineers
Shop 1, 13-19 Hogben St, Kogarah, NSW 2217
Ph. (02)9588-9966 Fax. (02)9588-9977
Email: office@topconsulting.com.au

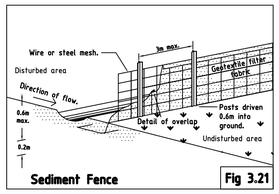
SCALE	DATE	ISSUE	DRAWN	L Y	SHEET
AS SHOWN	17/01/18	A	CHECKED		D2
			APPR'D		JOB NUMBER 17-040

8/03/2018 12:08:40 PM



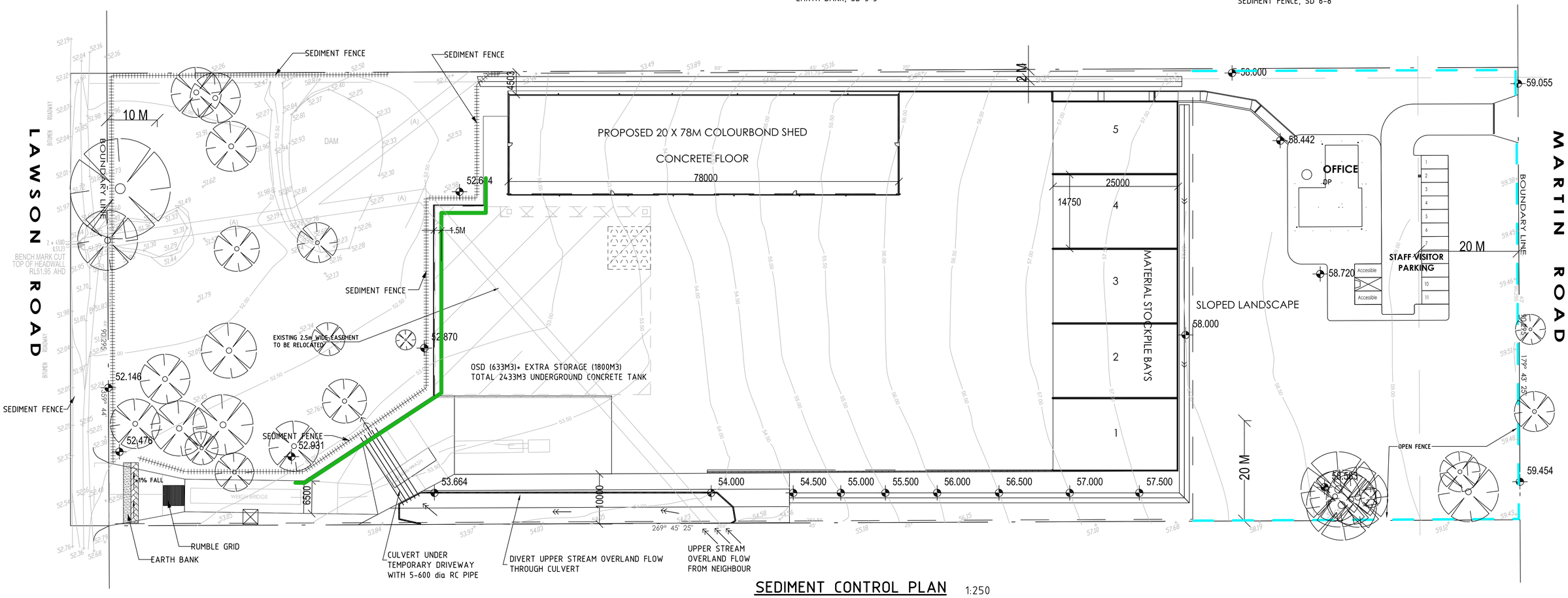
EARTH BANK DETAIL N T S

MORE DETAILS REFER TO COUNCIL'S
Erosion & Sediment Control Policy,
EARTH BANK, SD 5-5



SEDIMENT FENCE DETAIL N T S

MORE DETAILS REFER TO COUNCIL'S
Erosion & Sediment Control Policy,
SEDIMENT FENCE, SD 6-8



SEDIMENT CONTROL PLAN 1:250

Erosion and sediment plan and detail

AMENDMENTS

preliminary	7/02/18	Issue for review	L Y
A	8/03/18	Issue for DA	L Y

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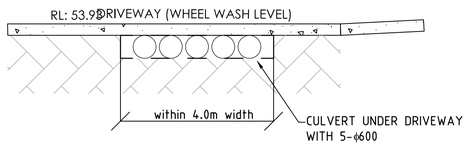
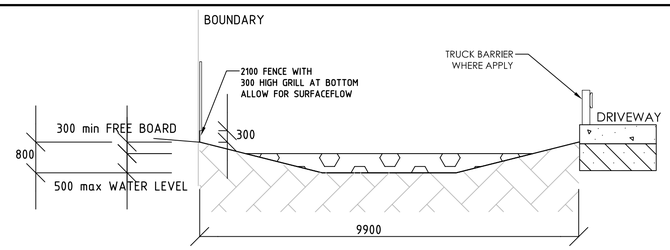
SCALE	DATE	ISSUE	DRAWN	CHECKED	APPR'D	SHEET	JOB NUMBER
AS SHOWN (1:100)	17/01/18	A	L Y			D1	17-040

LINE TYPES

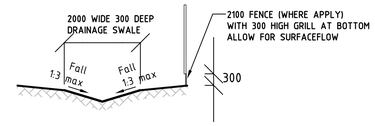
- DIRECTION OF PIPE FLOW
- DIRECTION OF ROOF FLOW
- DIRECTION OF OVERLAND FLOW



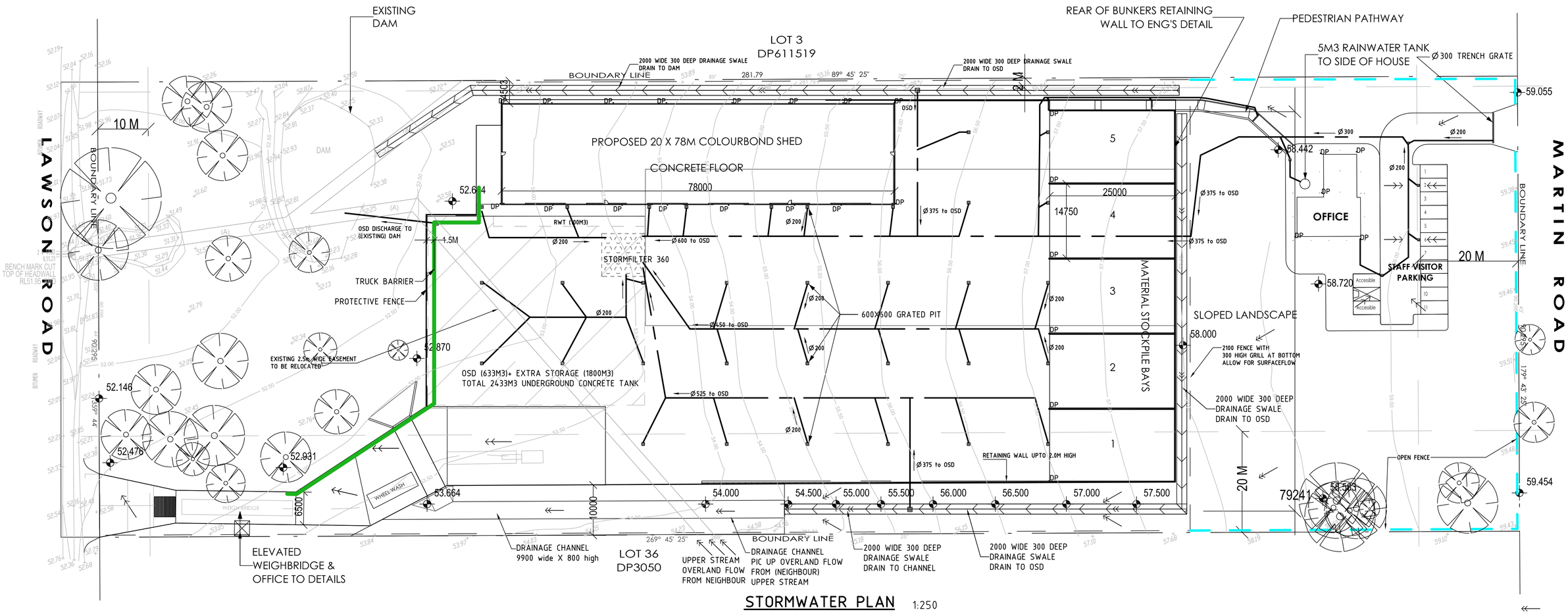
UNDER DRIVEWAY CULVERT SECTION N T S



DRAINAGE CHANNEL SECTION (TYPICAL) N T S



DRAINAGE SWALE SECTION (TYPICAL) N T S



STORMWATER PLAN 1:250

ALL PIPES ARE DEFINED AS CLASS 4,
SUBJECT TO CHECK WITH MAXIMUM TRUCK/MACHINARY LOAD

THE PLANS TO READ IN CONJUCTION WITH REPORT DATED 6 MARCH 2018
- STORMWATER WATER MANAGEMENT - BY ROBERT PETERSON, ULTRAMARK PTY LTD

TYPICAL SECTION 1:250

Concept Storwater plan and detail

AMENDMENTS

preliminary	7/02/18	Issue for review	L Y
A	8/03/18	Issue for DA	L Y

ARCHITECT

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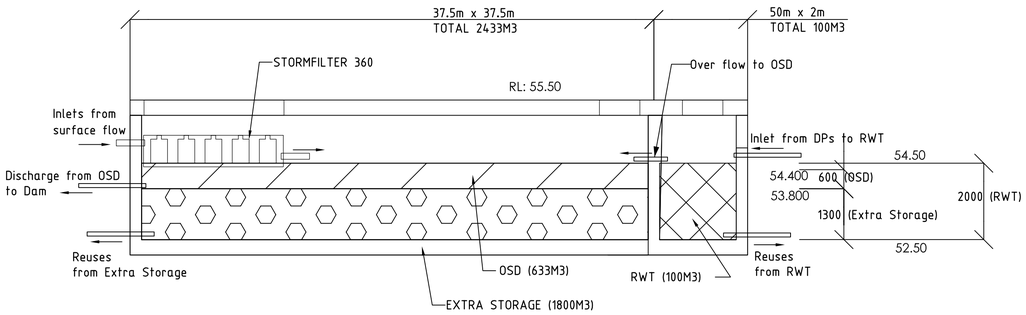
SCALE	DATE	ISSUE	DRAWN	L Y	SHEET
AS SHOWN	17/01/18	A	CHECKED		D3
			APPR'D		JOB NUMBER 17-040

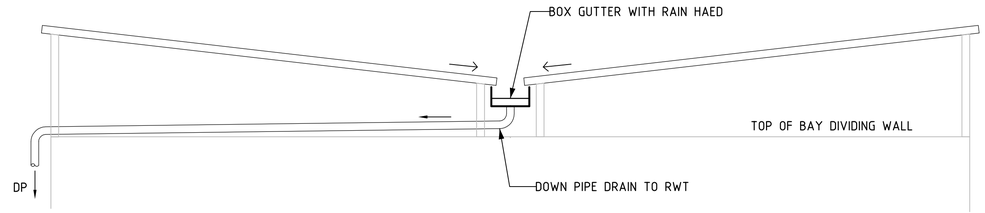
8/03/2018 12:16:58 PM

LINE TYPES

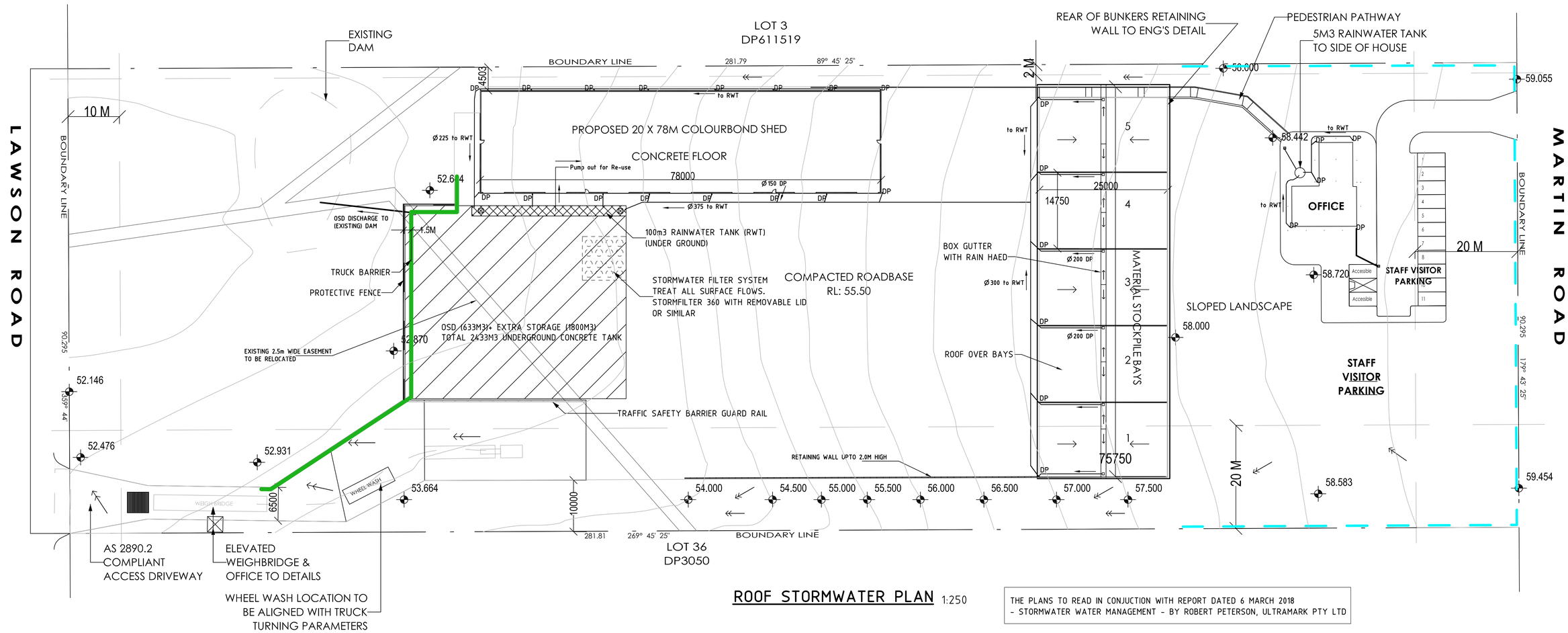
- DIRECTION OF PIPE FLOW
- DIRECTION OF ROOF FLOW
- DIRECTION OF OVERLAND FLOW



RWT, OSD, EXTRA STORAGE AND STORMWATER TREATMENT UNIT SECTION N T S



ROOF BOX GUTTER SECTION (TYPICAL) N T S



ROOF STORMWATER PLAN 1:250

THE PLANS TO READ IN CONJUCTION WITH REPORT DATED 6 MARCH 2018
- STORMWATER WATER MANAGEMENT - BY ROBERT PETERSON, ULTRAMARK PTY LTD

Concept Storwater plan and detail

AMENDMENTS

preliminary	7/02/18	Issue for review	L Y
A	8/03/18	Issue for DA	L Y

ARCHITECT

PROJECT
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for A M J
at 55 Martin Rd, Badgery Creek

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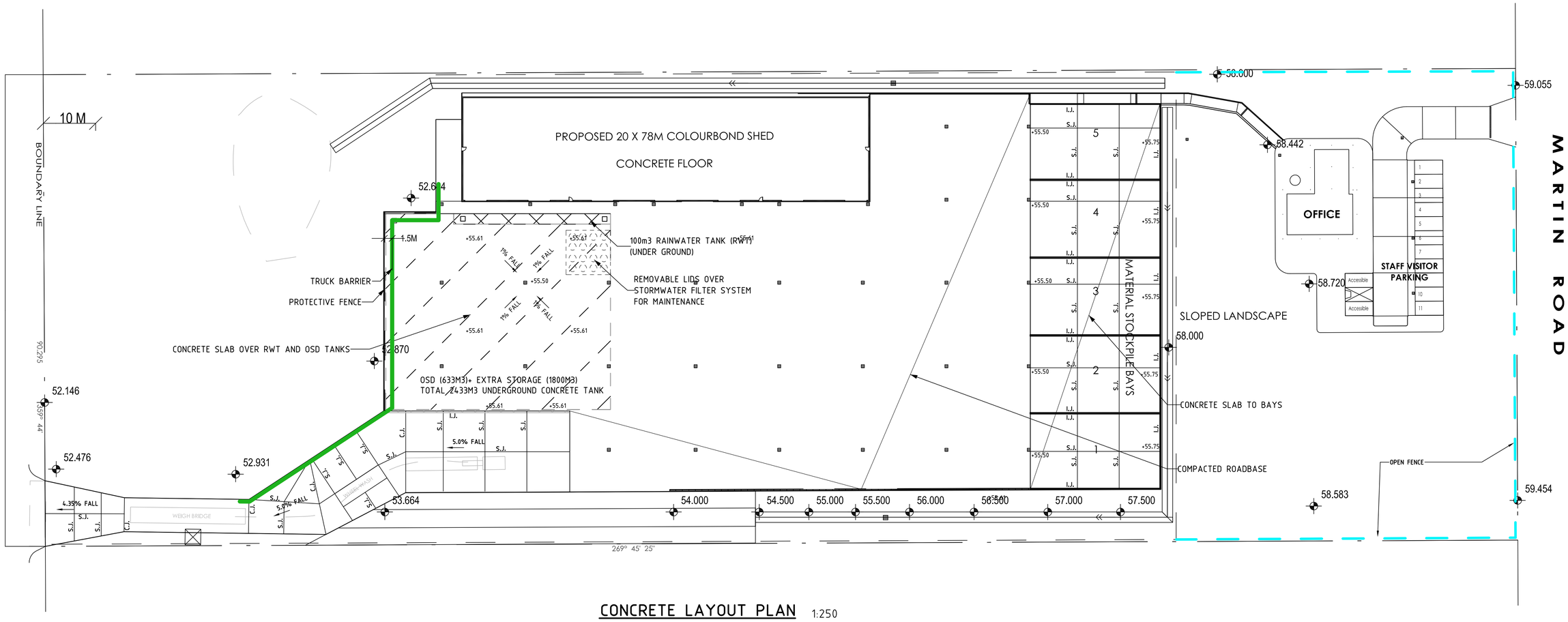
Email: office@topconsulting.com.au

SCALE	DATE	ISSUE			SHEET	JOB NUMBER
AS SHOWN	17/01/18	A	DRAWN	L Y	D4	17-040
			CHECKED			
			APPR'D			

8/03/2018 12:17:16 PM



CONCRETE LAYOUT PLAN 1:250

C.J. - CONSTRUCTION JOINT

I.J. - ISOLATION JOINT

S.J. - SAW CUT JOINT

Pavement plan and detail

AMENDMENTS

preliminary	7/02/18	Issue for review	L Y
A	8/03/18	Issue for DA	L Y

ARCHITECT

PROJECT
Proposed stormwater plan
for A M J
at 55 Martin Rd, Badgery Creek

T.O.P. Consulting Group (NSW) Pty. Ltd
A.B.N. 76 156 071 706
Structural and Civil Engineers
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SCALE	DATE	ISSUE	DRAWN	CHECKED	APPR'D	SHEET	JOB NUMBER
AS SHOWN (1:100)	7/02/18	A	L Y			S1	17-040

8/03/2018 12:11:02 PM

TRAFFIC IMPACT ASSESSMENT REPORT

FOR

A PROPOSED RESOURCE RECOVERY FACILITY

AT

55 MARTIN ROAD, BADGERYS CREEK

Ref. 17149r

February 2018

Prepared By

TRANSPORT & URBAN PLANNING PTY LTD
Traffic Engineering, Transport Planning
Road Safety & Project Management Consultants
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CONTENTS

1.0 INTRODUCTION

Transport and Urban Planning Pty Ltd has been engaged to prepare this Traffic Impact Assessment report on behalf of AMJ Demolition and Excavation Pty Ltd, for a proposed new resource recovery facility at 55 Martin Road, Badgerys Creek.

The facility is planned to process up to 95,000 tonnes per annum (tpa) of non-putrescible construction and demolition materials, including soil and green garden waste. The development will be built on a parcel of land which contains one residential dwelling on a cleared but otherwise undeveloped property.

The site is shown on **Figures 1** and **2.**

This report provides an assessment of the site access including its key access intersection, the expected traffic generation of the development and its impact on the surrounding road network, and the proposed internal traffic circulation. The report is arranged as follows:

- Section 2 describes the site and its location;
- Section 3 details the proposed development, and identifies its traffic generation, access, parking and internal circulation;
- Section 4 identifies the surrounding road network and traffic conditions;
- Section 5 calculates the traffic impact of the proposal on the surrounding road network;
- Section 6 assesses the construction traffic impact;
- Section 7 provides conclusions.

This assessment has been prepared in accordance with the provisions of the Infrastructure SEPP, the RMS Guide to Traffic Generating Developments and Liverpool City Council DCP. It addresses the Secretary's Environmental Assessment Requirements (SEARs) for traffic impacts of the development and its construction.

2.0 THE SITE

The site is located on 55 Martins Road Badgerys Creek, Lot 4 DP611519. The property is rectangular with frontages to two parallel roads, Martin Road and Lawson Road. Each road frontage is 90.3m wide, and the length on each side is 281.8m. The site has an area of 2.54 hectares.

The site location is 450m south of Elizabeth Drive, west of South Creek. It is 15km west of Liverpool CBD, and is within the Liverpool City LGA.

The existing development on the site consists of one residential house on a cleared but otherwise undeveloped property. Surrounding properties contain a mix of agricultural and material stockpiling and processing activities.

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N

NOT TO SCALE

FIGURE 1

55 MARTIN ROAD
BADGERYS CREEK

SITE LOCATION

JOB NO. 17149 22/02/18

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N

NOT TO SCALE

FIGURE 2

55 MARTIN ROAD
BADGERYS CREEK

SUBJECT SITE

JOB NO. 17149

22/02/18

3.0 THE PROPOSED DEVELOPMENT

The proposed development is shown on plans attached as **Appendix A** and involves modifying the existing dwelling into a site office with a car park for 12 vehicles plus 2 spaces for the disabled, with a single driveway to Martin Road; plus construction of a new Colorbond shed 20m x 78m with a concrete floor, 5 large covered material storage bays, a large vehicle manoeuvring area, with a weighbridge, wheel wash and new heavy vehicle driveway to Lawson Road.

All heavy vehicle access to and from the site will be via Lawson Road and Elizabeth Drive. Only light vehicles associated with staff and visitors will use Martin Road to access the site.

3.1 Proposed Use

The site will be used as a resource recovery facility, processing up to 95,000tpa of construction and demolition materials, including soil and green garden waste. The operation will involve;

- Unloading of materials into the large shed;
- Material handling and sorting;
- Crushing and screening of concrete, bricks, untreated timber and similar construction and demolition materials;
- Shredding of green garden waste;
- Storage of processed materials;
- Sale of processed materials to trade clients or transfer to an off site landscape supply outlet.

Although no retail sales will occur from the site, the site office is expected to cater for business clients and the car park has been designed to accommodate a peak day's operation.

3.2 Hours of Operation

The proposed facility is planned to operate:

- 7am – 6pm Monday to Friday;
- 7am – 5pm Saturday;
- No works – Sunday or Public Holidays

3.3 Staffing

The peak number of staff on site is planned to be 6, plus up to 3 truck drivers who would operate from the site. The 6 staff will be made up of management, administration and material processing staff.

3.4 Site Access and Parking

Driveway access will be provided to both Martin Road and Lawson Road. The Martin Road driveway will be used by light vehicles only and will be 9m wide at the property boundary, leading to a 6m wide internal access road. The driveway will be located on a straight, level section of Martin Road and has excellent sight lines. The driveway design and location meets or exceeds all standard traffic design requirements.

The Martin Road driveway will lead to a car park with 12 spaces plus 2 spaces for the disabled. The car park design and space dimensions fully satisfy the requirements of AS2890 Parts 1 and 6. The total of 14 car spaces is assessed as sufficient for all potential staff and visitor parking demands.

There will be no vehicular connection from the Martin Road driveway further west than the site office, so no heavy vehicles can access the operational section of the site from Martin Road.

The Lawson Road driveway is designed for heavy vehicle use in accordance with Figure 3.1 and Section 3.4 of AS2890 Part 2, for truck access up to and including articulated vehicles. All dimensions, grades and manoeuvring space are compliant with AS2890 Part 2. The driveway will be located on a straight, level section of Lawson Road, and sight distances exceed standard traffic design requirements.

The heavy vehicle driveway leads to a 6.5m wide internal access road, a weighbridge and a wheel wash facility. The access road widens to a large operational manoeuvring area, approximately 120m x 50m, the main processing shed and storage bays. The manoeuvring area will provide generous space for all trucks to turn around onsite, with minimal reversing movements required.

A pedestrian access pathway between the site office and the facility operations area is well located at the north eastern corner of the operations area, which will be well separated from truck manoeuvres.

3.5 Truck Volumes

The site operation will involve large trucks visiting the site regularly throughout each day, some operated by the site operator and some independent. A typical daily profile of truck trips is expected to be:

Incoming Materials

8 HRV trucks x 15 t/day	=	120 t/day
6 AV trucks x 32 t/day	=	192 t/day
Total	**=**	**312 t/day**

300 operating days x 312 t/day = 93,600 tpa

Approximately 20% of these 14 trucks will backload, so the typical additional truck trips for outgoing materials will be 11 trucks:

Outgoing Materials

6 HRV trucks

5 AV trucks

The total truck trips per day will typically be 14 HRV trucks and 12 AV trucks, totalling 26 truck trips per day. This equates to 26 truck movements into the site and 26 truck movements out of the site per day. Over a 10 hour day there will be an average of 2.6 trucks entering and 2.6 trucks leaving the site each hour. Because truck operations are planned to occur regularly throughout each day, the peak hour volumes are expected to be up to three trucks per hour in and out of the site.

3.6 Truck Routes

All trucks to and from the site will use Lawson Road and Elizabeth Drive. The expected east/west split along Elizabeth Drive will be approximately one third west, two thirds east.

Elizabeth Drive is a classified main road well designed to carry heavy vehicles. Lawson Road is an unclassified road but it is a designated B-double route between the site and Elizabeth Drive. Full details of these roads will be provided in Section 4.

3.7 Light Vehicle Volumes

During normal AM and PM road network peak hours, up to 9 staff will drive to or from the site. Staff are expected to arrive and depart at different times due to various hours of office administration and operational duties.

A peak hourly volume of up to 5 cars is expected to travel to the site along Martin Road in one AM peak hour, and also from the site in one PM peak hour. This equates to a very low average of one additional car trip every 12 minutes, in one direction only, at peak.

4.0 SURROUNDING ROAD NETWORK

The site will have light vehicle access to Martin Road and heavy vehicle access to Lawson Road, both of which are local roads under the control of Liverpool City Council. These roads lead to Elizabeth Drive, a classified main road, which is designated to carry heavy vehicles. It provides a link to the arterial road network across western Sydney.

Due to the very low volume of light vehicular traffic that the proposed development will generate on Martin Road, the key access intersection to the site will be Lawson Road at Elizabeth Drive.

4.1 Lawson Road

Lawson Road is a local road running north/south from Elizabeth Drive, 450m north of the site, to a termination point 1.4km south of the site. It provides local access to adjacent agricultural properties.

Near the site, Lawson Road has an approximately 6.5m wide bitumen sealed surface in good condition, with unsealed narrow shoulders and grass verges. The road is straight and level and has no linemarking or street lighting. The road has no

intersections between the site and Elizabeth Drive, and has local driveways approximately every 50-100m.

The road carries low vehicle volumes and traffic conditions are very good.

4.2 Martin Road

Martin Road is a local road running north/south from Elizabeth Drive, 450m north of the site, to a termination point 1.6km south of the site. It provides local access to agricultural properties and also to several large commercial businesses (eg. Australian Native Landscapes).

Near the site, Martin Road has an approximate width of 7.5m of bitumen with unsealed shoulders and grass verges. The road is straight and level and has no linemarking or street lighting.

Martin Road carries low to moderate traffic volumes and traffic conditions are good, noting that volumes of heavy vehicles currently using Martin Road are significantly higher than volumes using Lawson Road.

4.3 Elizabeth Drive

Elizabeth Drive is a classified main road under the control of RMS. It is designated as an arterial road and is designed to accommodate high volumes of vehicles, including trucks. It runs east/west from the M7 Motorway 8kms east of the site, to The Northern Road 6kms west of the site.

At its intersection with Lawson Road, Elizabeth Drive consists of a 15 to 17m wide bitumen carriageway, with one through traffic lane in each direction, plus a 100m long right turn lane and a 150m long left turn lane for traffic entering Lawson Road. Left turning vehicles out of Lawson Road also have a 50m acceleration lane to merge with Elizabeth Drive traffic.

At its intersection with Martin Road, Elizabeth Drive has a 17 to 20m carriageway width, with a similar lane configuration as its intersection with Lawson Road.

Elizabeth Drive has an 80km/h speed limit, is straight and level with a high standard of delineation. Sight distances at both intersections with Martin Road and Lawson Road are very good and exceed the RMS guideline requirements.

4.4 Key Access Intersection

The key access intersection for the proposed development is Lawson Road at Elizabeth Drive. It is a T-junction with Lawson Road terminating at Elizabeth Drive, and traffic on Lawson Road must give way.

In addition to the details provided in Section 4.3, it should be noted that edgelines on the Lawson Road approach to Elizabeth Drive restrict its width to approximately 5.6m. While the width of Lawson Road splays widely on approach to Elizabeth Drive so that trucks can turn safely, it is recommended that widening of Lawson Road for a short distance south of the intersection be considered due to the expected increase in two way truck volumes.

The capacity of the intersection will be analysed in Section 5, however site observations show current traffic conditions at the intersection are good, with low delays, no congestion and safe operation.

5.0 TRAFFIC IMPACT OF DEVELOPMENT

The traffic impact of the forecast additional light and heavy vehicle volumes identified in Sections 3.5 and 3.7 will be assessed in this section.

Firstly, the additional light vehicle traffic is expected to be very low, up to five car trips per peak hour, in one direction only. At an average movement of up to one car every 12 minutes, the traffic impact on Martin Road and Elizabeth Drive will be very low and there will be no measurable change to traffic conditions on the surrounding road network.

The impact of trucks to and from the site will be more significant, and SIDRA intersection modelling will be carried out at the key access intersection to calculate this impact. SIDRA will be used to model existing operation of Lawson Road at Elizabeth Drive, and the additional development generated truck traffic will then be added to the model to calculate future operation. Comparison of the existing and future intersection operation results will identify the traffic impact of the development.

5.1 Existing Traffic Volumes

A traffic count was carried out at the intersection of Lawson Road and Elizabeth Drive on Thursday 31 August, 2017. The AM and PM peak hour volumes were identified and are provided in **Figure 3**. The full count data is provided in **Appendix B**.

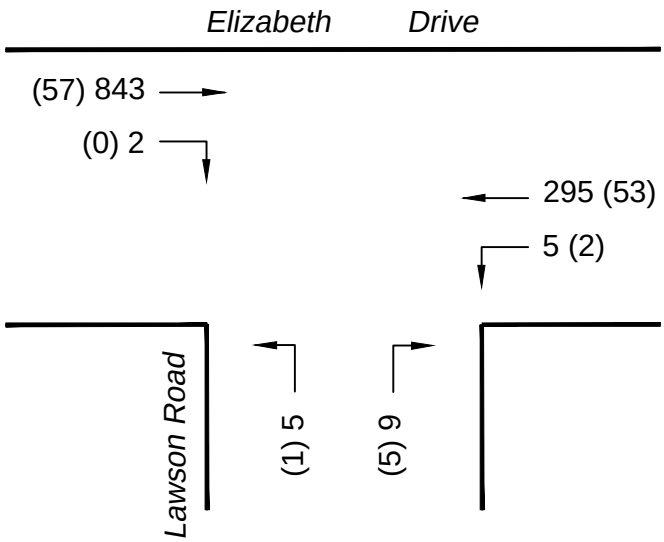
The count shows that the peak hour two way volume on Lawson Road is currently up to 33 vehicles. This is a very low volume and verifies that Lawson Road has capacity to easily accommodate the expected additional three truck movements in each direction.

5.2 SIDRA Modelling Details

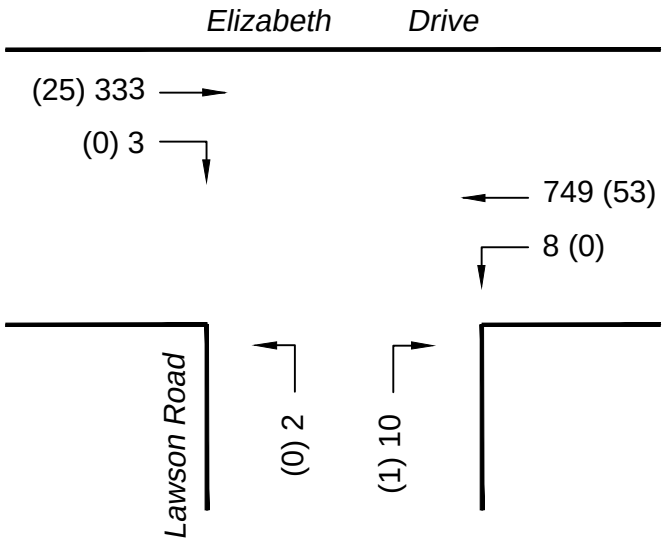
SIDRA was initially developed by the Australian Road and Research Board during the 1970's. It has continued to be developed and used for traffic analysis throughout Australia and internationally. SIDRA is endorsed in the RMS Guide to Traffic Generating Developments (Section 4.2.2, page 4-3) to determine measures of effectiveness of intersection operation.

SIDRA modelling calculates the intersection's operation and produces outputs to assess intersection capacity and efficiency. The key SIDRA outputs are Degree of Saturation, Average Delay and Level of Service (LoS). Degree of Saturation (DoS) is the ratio of demand flow to capacity, or volume/capacity (v/c). For intersections controlled by signals, satisfactory operation is indicated by a DoS of up to about 0.9. Full saturation is 1.

Table 3.1 shows for each Level of Service, the range of Average Delay to vehicles using the intersection and a description of operational efficiency. Levels of Service range from "A" (Good Operation) to "E" (at capacity).



AM PEAK HOUR
0715 - 0815



PM PEAK HOUR
1615 - 1715

KEY
344 LIGHT VEHICLES
(27) HEAVY VEHICLES

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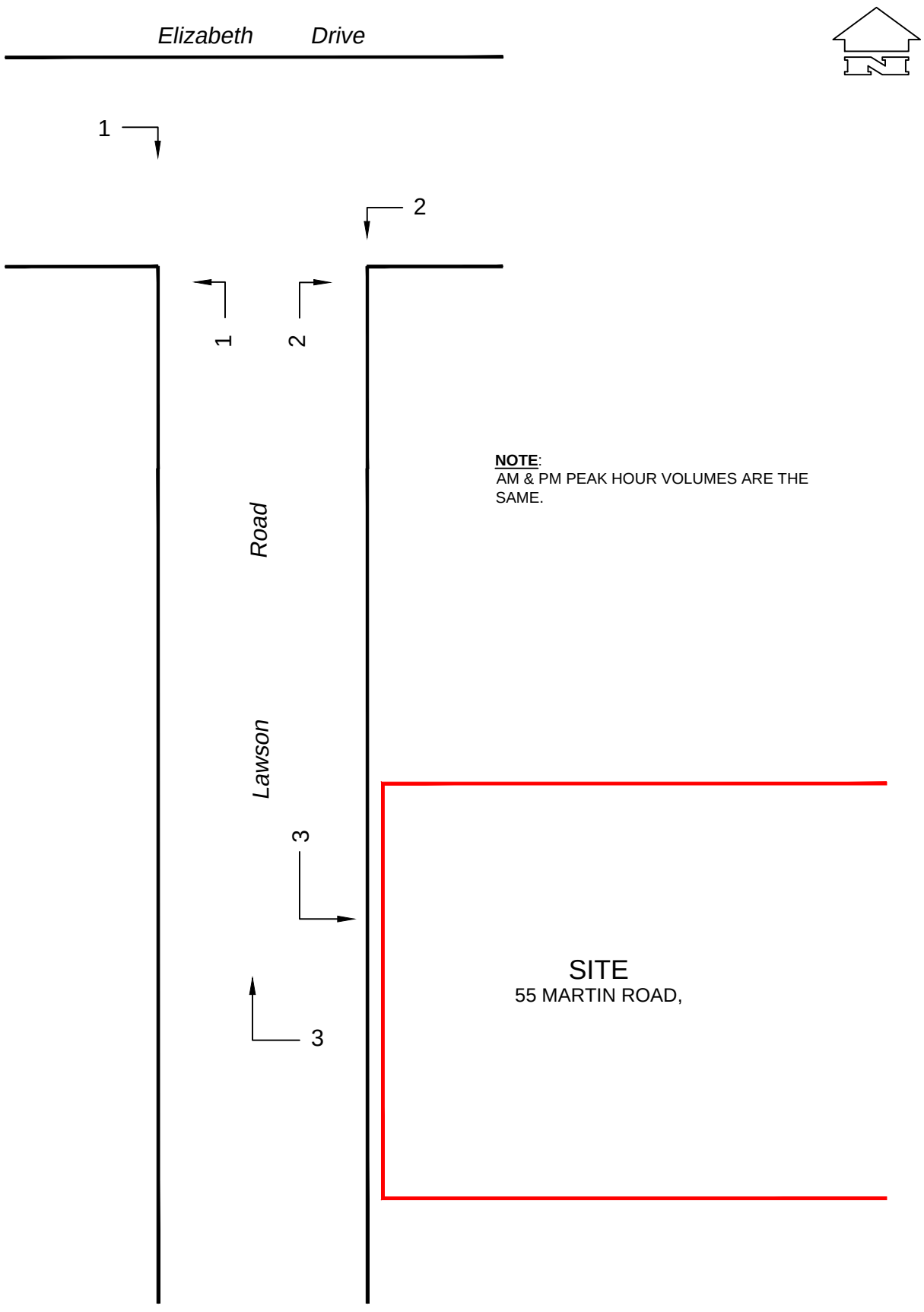
FIGURE 3

55 MARTIN ROAD,
BADGERYS CREEK

EXISTING TRAFFIC VOLUMES
ELIZABETH DR & LAWSON RD INTERSECTION

JOB NO.17149 22/02/18



NOTE:
AM & PM PEAK HOUR VOLUMES ARE THE SAME.

KEY
12 ADDITIONAL TRUCKS

Not to Scale

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FIGURE 4

55 MARTIN ROAD,
BADGERYS CREEK

ADDITIONAL TRUCK TRAFFIC DISTRIBUTION

JOB NO.17149

22/02/18

TABLE 3.1

LEVEL OF SERVICE CRITERIA FOR INTERSECTIONS

Level of Service	Average Delay (seconds/vehicle)	Stop/Give Way Signs
A	<14	Good Operation
B	15 to 28	Acceptable delays and spare capacity
C	29 to 42	Satisfactory, but accident study required
D	43 to 56	Near capacity and accident study required
E	57 to 70	At capacity, requites other control mode

Source: Table 4.2 RTA Guide to Traffic Generating Developments October 2002

Note that operation of unsignalised intersections is assessed by only reviewing the delays on the minor approach and the right turn into the minor approach, because delays for through movements on the major road are negligible.

5.3 SIDRA Results

TABLE 3.2

LAWSON ROAD AT ELIZABETH DRIVE
EXISTING OPERATION

Movement	AM Peak			PM Peak		
	DoS	Avg Delay (sec)	LoS	DoS	Avg Delay (sec)	LoS
Right turn into Lawson Road	0.002	8.4	A	0.007	12.8	A
Lawson Road Exit	0.097	20.7	B	0.053	19.5	B

The above results show very low levels of saturation and low delays. The right turn into Lawson Road operates at Level of Service A (good operation) at all times. The Lawson Road approach operates at Level of Service B (acceptable with spare capacity).

TABLE 3.3

LAWSON ROAD AT ELIZABETH DRIVE
FUTURE OPERATION WITH DEVELOPMENT

Movement	AM Peak			PM Peak		
	DoS	Avg Delay (sec)	LoS	DoS	Avg Delay (sec)	LoS
Right turn into Lawson Road	0.004	9.3	A	0.010	14.2	A
Lawson Road Exit	0.117	21.6	B	0.067	21.0	B

The above results show that during future operation, the degree of saturation remains at very low levels and there is only an increase of 0.9 second to average delay in the AM peak and up to 1.5 seconds in the PM peak. This indicates that the intersection has a large amount of spare capacity and will experience low traffic impact from the proposed development. The Level of Service will remain unchanged. The traffic impact of the development is therefore assessed as low and acceptable.

6.0 CONSTRUCTION TRAFFIC IMPACT

The construction of the proposed development will involve delivery to the site of construction plant and equipment that will remain on site for the duration of construction. Regular daily vehicular activity will comprise of light vehicles owned by construction workers to and from the site and material deliveries by trucks up to HRV size.

The typical daily truck volumes are expected to be less than 10, and the number of onsite workers will be 5 to 10.

This means that the daily heavy and light vehicle construction traffic will not exceed the volumes of vehicles expected during ongoing operation of the development. Because this report has identified that the traffic impact of the development when complete will be low and acceptable, the same assessment is made for the construction phase of the development.

7.0 CONCLUSION

Transport and Urban Planning Pty Ltd has prepared this Traffic Impact Assessment for a proposed resource recovery facility at 55 Martin Road, Badgerys Creek. The facility is planned to process up to 95,000tpa of construction and demolition materials, including green garden waste.

The traffic generation of the proposal has been identified. Light vehicle movements only will occur on Martin Road. Up to five light vehicle movements in each peak hour, in one direction only, will be generated by staff, which equates to one movement every 12 minutes. Martin Road and Elizabeth Drive have adequate capacity to accommodate this low volume of light vehicles.

All heavy vehicle traffic will access the site via Lawson Road and Elizabeth Drive. Up to three truck movements per hour in each direction will occur on Lawson Road. SIDRA analysis of the key access intersection of Lawson Road at Elizabeth Drive shows that the intersection currently operates at Level of Service B (acceptable with spare capacity). The modelling shows that with the additional truck volumes added to the intersection, its operation will continue to be Level of Service B, with only minor changes to average delays. The traffic impact of the proposed development is therefore assessed as low and acceptable.

The site access driveways are well designed and are fully in accordance with AS2890 Parts 1 and 2, for light and heavy vehicles. Sight distances at the driveways exceed the minimum requirements contained in Austroad and RMS guidelines.

The internal traffic circulation provides generous room for trucks to manoeuvre on site, and all vehicles will be able to enter and leave the site in a forward direction. The car park is designed fully in accordance with AS2890 Parts 1 and 6, and provides parking for 12 cars plus two spaces for the disabled. This amount of parking is assessed as sufficient to meet peak demand.

The traffic impact during construction of the development has been identified to be of a lower level than when the development is completed and is operating. Construction traffic impact is therefore also assessed as low and acceptable.

In summary, the proposed development will be a low traffic generator and will have a low traffic impact on surrounding roads. It will have good access from both Lawson Road and Martin Road, and good access to the arterial classified road network at Elizabeth Drive. All access and internal traffic arrangements are designed fully in accordance with relevant Australian Standards. The development is assessed as acceptable in all aspects of its traffic design.

Appendix A

Design Plans

EXISTING DAM TO REMAIN

1M WIDE OVERLAND DRAINAGE SWALE

50M3 RAINWATER TANK TO SIDE OF BUILDING

N

BOUNDARY LINE

53.000 53.500 54.000 54.500 55.

4,503

52.714

5,000

W

20,000

52.677

20 X 78M COLOURBOND SHED

78,000

S

ROAD

LAWSON

10 M

BOUNDARY LINE

2 * 450D
IL51.23

BENCH MARK SET
TOP OF HEADWALL
RL51.95 AHD

DAM

(A)

COMPACTED ROADBASE

55.500

38,150

INDICATIVE OUTLINE OF OSD
TANK UNDER BY ENGR

359° 44' 90.295

52.146

53.077

30,853

54.100 GRAD 1:16 1.4M RISE ACROSS 22.4M 55.500

15,205 23,814

52.500

52.724 53.048 54.100

WHEEL WASH

53.661

CULVERT WITH LIFT OVER TO BENEFIT
PAD OVER FLOW AND SWALE ALONG
BOUNDARY TO ENGR'S DETAILS

52.613 GRAD 1:23 0.637M RISE ACROSS 15.2M 53.250

WEIGH BRIDGE 6,500

53.250 GRAD 1:16 0.85M RISE ACROSS 13.7M 54.100

10,000

54.000 54.50

52.925 53.327 53.796

281.81 269° 45' 25" BOUNDARY LINE 45"

AS 2890.2 COMPLIANT
ACCESS DRIVEWAY

ELEVATED WEIGHBRIDGE &
OFFICE TO DETAILS

WHEEL WASH LOCATION TO BE ALIGNED
WITH TRUCK TURNING PARAMETERS

1M 4M 10M 15M 20M
SCALE BAR

NOTE
1. Contractors to verify all dimensions on site before any shop drawings or work is commenced.
2. Figured dimensions to be taken in preference to scaled dwgs.
3. This drawing is to be read in conjunction with the specification and engineers drawings.

REV	DESCRIPTION	BY	CHK	DATE
A	ISSUE FOR INFORMATION	VW	PI	14.11.2017
B	ISSUE FOR INFORMATION	VW	PI	15.11.2017
C	ISSUE FOR INFORMATION	VW	PI	27.11.2017
D	ISSUE FOR INFORMATION	VW	PI	29.11.2017
E	ISSUE FOR INFORMATION	VW	PI	01.12.2017
F	ISSUE FOR INFORMATION	VW	PI	14.12.2017
G	REVISED SURVEY WITH ADDITIONAL TREES ON MARTIN AND LAWSON ROAD	VW	PI	17.01.2018
H	ISSUE FOR RESIZING TO 1:200 SCALE @ A1	VW	PI	22.01.2018
I	ISSUE FOR INFORMATION	VW	PI	30.01.2018
J	ISSUE FOR INFORMATION	VW	PI	30.01.2018

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Nominated Registered Architect: Peter Israel (reg no. 5064)

CLIENT
MICHAEL ANTOUN

PROJECT
PROPOSED WASTE RESOURCE RECOVERY FACILITY

DRAWING
SITE PLAN (PART A) - LAWSON RD WEST

NORTH N

DRAWN VW | CHECKED PI

PROJECT No P513 | SCALE 1:200 @ A1, 1:400 @ A3

A SK 02 J
disc stage. dwg no. revision

Printed: 30/01/2018 K:\P\P513\P513 - 55 Martin Road, Bardgrove, Orwell\DRAWINGS\00_STAGE 1\01_PLN\P513 - 55 Martin Rd, Bardgrove, Orwell V03.pln

LOT 3
DP611519

PEDESTRIAN PATHWAY

5M3 RAINWATER TANK TO SIDE OF HOUSE

281.79

89° 45' 25"

BOUNDARY LINE

59.055

EXISTING RL OF SLAB TBC ON-SITE; PEDESTRIAN ACCESS GRADIENT TO SUIT.

55.000 | 55.500 | 56.000 | 56.500 | 2 M | 57.000 | 57.500 | 58.000 | 58.500

55.500

BAY 5

BAY 4

BAY 3

BAY 2

BAY 1

14,500

14,600

14,750

14,750

14,750

14,350

600

25,000

26,600

1,000 | 12,300 | 12,700 | 600

400

E

12 DEG COLOURBOND ROOF SHED OVER CONCRETE FLOOR

CONCRETE PAD TO ENGR'S DTL

LOT 4
DP611519
2.54ha

LOT 4
DP611519
2.54ha

REAR OF BUNKERS RETAINING WALL TO ENG'S DETAIL

S1

S1

BUTTERFLY ROOF WITH BOX GUTTER RWDP

BOX GUTTER

58.500

ONE STOREY BRICK RESIDENCE No.55

OFFICE

58.640

58.720

ACCESSIBLE SPOT

ACCESSIBLE SPOT

STAFF VISITOR PARKING

1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 12

SLOPED LANDSCAPE

58.000

20 M

20 M

179° 43' 25"

BOUNDARY LINE

90.295

59.454

MARTIN ROAD

54.500 | 55.000 | 55.500 | 56.000 | 56.500 | 57.000 | 57.500 | 58.000 | 58.500 | 59.000

281.81
45' 25"

BOUNDARY LINE

OVERLAND DRAINAGE SWALE ON BOTH SIDES TO STORMWATER DRAWINGS

LOT 36
DP3050

LOT 36
DP3050

1M | 4M | 10M | 15M | 20M

SCALE BAR

NOTE
1. Contractors to verify all dimensions on site before any shop drawings or work is commenced.
2. Figured dimensions to be taken in preference to scaled dwgs.
3. This drawing is to be read in conjunction with the specification and engineers drawings.

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Nominated Registered Architect: Peter Israel (reg no. 5044)

CLIENT
MICHAEL ANTOUN

PROJECT
PROPOSED WASTE RESOURCE RECOVERY FACILITY

DRAWING
SITE PLAN (PART B) - MARTIN RD EAST

NORTH

DRAWN VW | CHECKED PI

PROJECT No P513 | SCALE 1:200 @ A1, 1:400 @ A3

A SK 03 J
disc stage. dwg no. revision

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Appendix B

Traffic Counts

R.O.A.R. DATA

Reliable, Original & Authentic Results

Ph.88196847, Mob.0418-239019

Client : TUPA

Job No/Name : 6565 BADGERYS CREEK Lawson Rd

Day/Date : Thursday 31st August 2017

Lights

Time Per	WEST Elizabeth Dr T	WEST Elizabeth Dr R	SOUTH Lawson Rd L	SOUTH Lawson Rd R	EAST Elizabeth Dr L	EAST Elizabeth Dr T	TOT
0700 - 0715	184	1	0	2	2	52	**241**
0715 - 0730	211	2	1	1	2	72	**289**
0730 - 0745	225	0	1	2	0	73	**301**
0745 - 0800	229	0	3	2	0	86	**320**
0800 - 0815	178	0	0	4	3	64	**249**
0815 - 0830	147	0	1	3	3	57	**211**
0830 - 0845	122	1	1	0	2	73	**199**
0845 - 0900	100	0	0	3	2	83	**188**
Per End	**1396**	**4**	**7**	**17**	**14**	**560**	**1998**

Heavies

Time Per	WEST Elizabeth Dr T	WEST Elizabeth Dr R	SOUTH Lawson Rd L	SOUTH Lawson Rd R	EAST Elizabeth Dr L	EAST Elizabeth Dr T	TOT
0700 - 0715	14	0	0	3	1	11	**29**
0715 - 0730	14	0	0	1	0	7	**22**
0730 - 0745	10	0	0	2	1	15	**28**
0745 - 0800	15	0	1	1	0	15	**32**
0800 - 0815	18	0	0	1	1	16	**36**
0815 - 0830	25	0	0	1	2	16	**44**
0830 - 0845	17	0	0	1	1	22	**41**
0845 - 0900	24	0	0	1	0	13	**38**
Per End	**137**	**0**	**1**	**11**	**6**	**115**	**270**

Combined

Time Per	WEST Elizabeth Dr T	WEST Elizabeth Dr R	SOUTH Lawson Rd L	SOUTH Lawson Rd R	EAST Elizabeth L	EAST Elizabeth T	TOT
0700 - 0715	198	1	0	5	3	63	**270**
0715 - 0730	225	2	1	2	2	79	**311**
0730 - 0745	235	0	1	4	1	88	**329**
0745 - 0800	244	0	4	3	0	101	**352**
0800 - 0815	196	0	0	5	4	80	**285**
0815 - 0830	172	0	1	4	5	73	**255**
0830 - 0845	139	1	1	1	3	95	**240**
0845 - 0900	124	0	0	4	2	96	**226**
Per End	**1533**	**4**	**8**	**28**	**20**	**675**	**2268**

Lights

Peak Per	WEST Elizabeth Dr T	WEST Elizabeth Dr R	SOUTH Lawson Rd L	SOUTH Lawson Rd R	EAST Elizabeth Dr L	EAST Elizabeth Dr T	TOT
0700 - 0800	849	3	5	7	4	283	**1151**
0715 - 0815	843	2	5	9	5	295	**1159**
0730 - 0830	779	0	5	11	6	280	**1081**
0745 - 0845	676	1	5	9	8	280	**979**
0800 - 0900	547	1	2	10	10	277	**847**
PEAK HR	**843**	**2**	**5**	**9**	**5**	**295**	**1159**

Heavies

Peak Per	WEST Elizabeth Dr T	WEST Elizabeth Dr R	SOUTH Lawson Rd L	SOUTH Lawson Rd R	EAST Elizabeth Dr L	EAST Elizabeth Dr T	TOT
0700 - 0800	53	0	1	7	2	48	**111**
0715 - 0815	57	0	1	5	2	53	**118**
0730 - 0830	68	0	1	5	4	62	**140**
0745 - 0845	75	0	1	4	4	69	**153**
0800 - 0900	84	0	0	4	4	67	**159**
PEAK HR	**57**	**0**	**1**	**5**	**2**	**53**	**118**

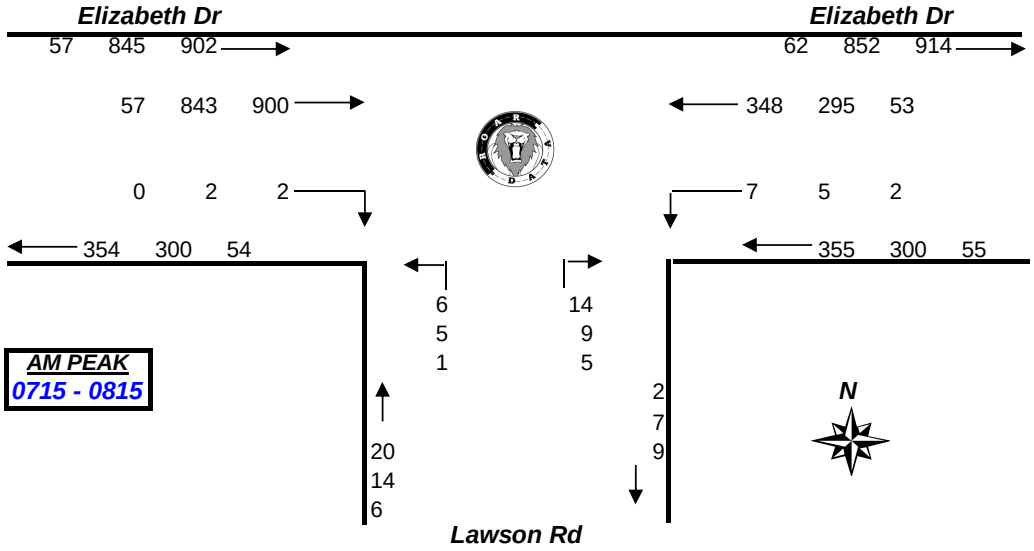
Combined

Peak Per	WEST Elizabeth Dr T	WEST Elizabeth Dr R	SOUTH Lawson Rd L	SOUTH Lawson Rd R	EAST Elizabeth L	EAST Elizabeth T	TOT
0700 - 0800	902	3	6	14	6	331	**1262**
0715 - 0815	900	2	6	14	7	348	**1277**
0730 - 0830	847	0	6	16	10	342	**1221**
0745 - 0845	751	1	6	13	12	349	**1132**
0800 - 0900	631	1	2	14	14	344	**1006**
PEAK HR	**900**	**2**	**6**	**14**	**7**	**348**	**1277**

Peds

Time Per	WEST Elizabeth Dr	SOUTH Lawson Rd	EAST Elizabeth Dr	TOT
0700 - 0715				**0**
0715 - 0730		*NOT*		**0**
0730 - 0745		*REQUIRED*		**0**
0745 - 0800				**0**
0800 - 0815				**0**
0815 - 0830				**0**
0830 - 0845				**0**
0845 - 0900				**0**
Per End	**0**	**0**	**0**	**0**

Peak Per	WEST Elizabeth Dr	SOUTH Lawson Rd	EAST Elizabeth Dr	TOT
0700 - 0800	0	0	0	**0**
0715 - 0815	0	0	0	**0**
0730 - 0830	0	0	0	**0**
0745 - 0845	0	0	0	**0**
0800 - 0900	0	0	0	**0**
PEAK HR	**0**	**0**	**0**	**0**



R.O.A.R. DATA

Reliable, Original & Authentic Results

Ph.88196847, Mob.0418-239019

Client : TUPA

Job No/Name : 6565 BADGERYS CREEK Lawson Rd

Day/Date : Thursday 31st August 2017

Lights

Time Per	WEST Elizabeth Dr T	WEST Elizabeth Dr R	SOUTH Lawson Rd L	SOUTH Lawson Rd R	EAST Elizabeth Dr L	EAST Elizabeth Dr T	TOT
1530 - 1545	99	0	3	1	4	168	**275**
1545 - 1600	82	1	0	2	3	165	**253**
1600 - 1615	82	0	0	1	3	162	**248**
1615 - 1630	89	0	1	5	4	183	**282**
1630 - 1645	82	1	0	1	3	180	**267**
1645 - 1700	87	0	1	0	1	192	**281**
1700 - 1715	75	2	0	4	0	194	**275**
1715 - 1730	64	1	0	1	1	197	**264**
Per End	**660**	**5**	**5**	**15**	**19**	**1441**	**2145**

Heavies

Time Per	WEST Elizabeth Dr T	WEST Elizabeth Dr R	SOUTH Lawson Rd L	SOUTH Lawson Rd R	EAST Elizabeth Dr L	EAST Elizabeth Dr T	TOT
1530 - 1545	11	0	0	1	0	8	**20**
1545 - 1600	11	0	0	0	1	17	**29**
1600 - 1615	10	0	0	0	2	21	**33**
1615 - 1630	10	0	0	1	0	18	**29**
1630 - 1645	4	0	0	0	0	15	**19**
1645 - 1700	7	0	0	0	0	14	**21**
1700 - 1715	4	0	0	0	0	6	**10**
1715 - 1730	13	0	0	0	0	9	**22**
Per End	**70**	**0**	**0**	**2**	**3**	**108**	**183**

Combined

Time Per	WEST Elizabeth Dr T	WEST Elizabeth Dr R	SOUTH Lawson Rd L	SOUTH Lawson Rd R	EAST Elizabeth L	EAST Elizabeth T	TOT
1530 - 1545	110	0	3	2	4	176	**295**
1545 - 1600	93	1	0	2	4	182	**282**
1600 - 1615	92	0	0	1	5	183	**281**
1615 - 1630	99	0	1	6	4	201	**311**
1630 - 1645	86	1	0	1	3	195	**286**
1645 - 1700	94	0	1	0	1	206	**302**
1700 - 1715	79	2	0	4	0	200	**285**
1715 - 1730	77	1	0	1	1	206	**286**
Per End	**730**	**5**	**5**	**17**	**22**	**1549**	**2328**

Lights

Peak Per	WEST Elizabeth Dr T	WEST Elizabeth Dr R	SOUTH Lawson Rd L	SOUTH Lawson Rd R	EAST Elizabeth Dr L	EAST Elizabeth Dr T	TOT
1530 - 1630	352	1	4	9	14	678	**1058**
1545 - 1645	335	2	1	9	13	690	**1050**
1600 - 1700	340	1	2	7	11	717	**1078**
1615 - 1715	333	3	2	10	8	749	**1105**
1630 - 1730	308	4	1	6	5	763	**1087**
PEAK HR	**333**	**3**	**2**	**10**	**8**	**749**	**1105**

Heavies

Peak Per	WEST Elizabeth Dr T	WEST Elizabeth Dr R	SOUTH Lawson Rd L	SOUTH Lawson Rd R	EAST Elizabeth Dr L	EAST Elizabeth Dr T	TOT
1530 - 1630	42	0	0	2	3	64	**111**
1545 - 1645	35	0	0	1	3	71	**110**
1600 - 1700	31	0	0	1	2	68	**102**
1615 - 1715	25	0	0	1	0	53	**79**
1630 - 1730	28	0	0	0	0	44	**72**
PEAK HR	**25**	**0**	**0**	**1**	**0**	**53**	**79**

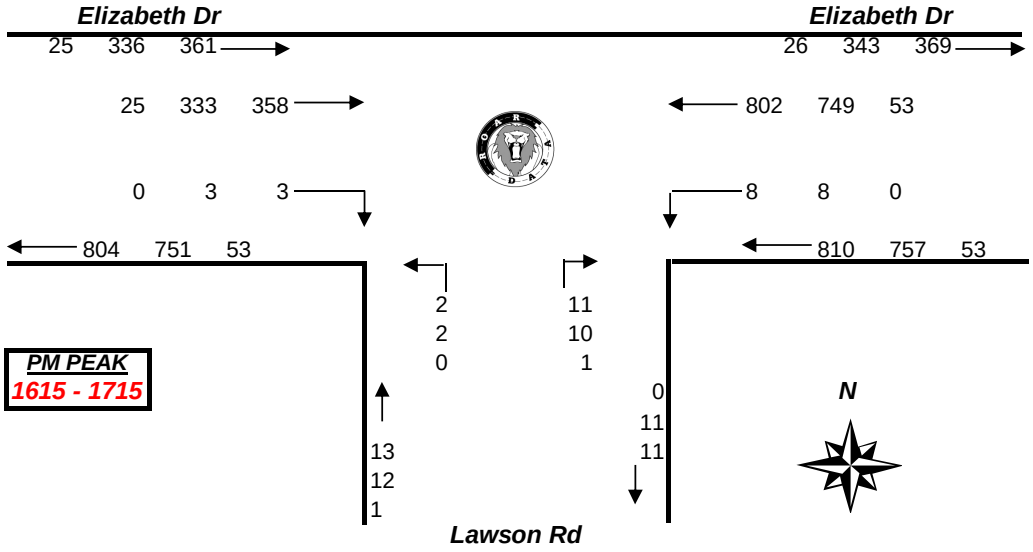
Combined

Peak Per	WEST Elizabeth Dr T	WEST Elizabeth Dr R	SOUTH Lawson Rd L	SOUTH Lawson Rd R	EAST Elizabeth L	EAST Elizabeth T	TOT
1530 - 1630	394	1	4	11	17	742	**1169**
1545 - 1645	370	2	1	10	16	761	**1160**
1600 - 1700	371	1	2	8	13	785	**1180**
1615 - 1715	358	3	2	11	8	802	**1184**
1630 - 1730	336	4	1	6	5	807	**1159**
PEAK HR	**358**	**3**	**2**	**11**	**8**	**802**	**1184**

Peds

Time Per	WEST Elizabeth Dr	SOUTH Lawson Rd	EAST Elizabeth Dr	TOT
1530 - 1545				**0**
1545 - 1600		*NOT*		**0**
1600 - 1615		*REQUIRED*		**0**
1615 - 1630				**0**
1630 - 1645				**0**
1645 - 1700				**0**
1700 - 1715				**0**
1715 - 1730				**0**
Per End	**0**	**0**	**0**	**0**

Peak Per	WEST Elizabeth Dr	SOUTH Lawson Rd	EAST Elizabeth Dr	TOT
1530 - 1630	0	0	0	**0**
1545 - 1645	0	0	0	**0**
1600 - 1700	0	0	0	**0**
1615 - 1715	0	0	0	**0**
1630 - 1730	0	0	0	**0**
PEAK HR	**0**	**0**	**0**	**0**



Appendix C

SIDRA Movement Summaries

MOVEMENT SUMMARY

Site: 101 [Lawson Rd at Elizabeth Dr, Badgerys Creek. AM Peak]

EXISTING OPERATION
Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Lawson Rd											
1	L2	6	16.7	0.005	5.7	LOS A	0.0	0.0	0.00	0.57	54.4
3	R2	15	35.7	0.097	27.1	LOS B	0.3	2.5	0.86	0.94	38.7
Approach		21	30.0	0.097	20.7	LOS B	0.3	2.5	0.60	0.83	42.4
East: Elizabeth Dr (east)											
4	L2	7	28.6	0.005	7.5	LOS A	0.0	0.0	0.00	0.63	56.8
5	T1	366	15.2	0.210	0.0	LOS A	0.0	0.0	0.00	0.00	79.9
Approach		374	15.5	0.210	0.2	NA	0.0	0.0	0.00	0.01	79.3
West: Elizabeth Dr (west)											
11	T1	947	6.3	0.498	0.1	LOS A	0.0	0.0	0.00	0.00	79.7
12	R2	2	0.0	0.002	8.4	LOS A	0.0	0.1	0.38	0.59	57.4
Approach		949	6.3	0.498	0.1	NA	0.0	0.1	0.00	0.00	79.6
All Vehicles		1344	9.2	0.498	0.4	NA	0.3	2.5	0.01	0.02	78.5

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Lawson Rd at Elizabeth Dr, Badgerys Creek. PM Peak]

EXISTING OPERATION
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Lawson Rd											
1	L2	2	0.0	0.002	5.5	LOS A	0.0	0.0	0.00	0.58	58.7
3	R2	12	9.1	0.053	19.5	LOS B	0.2	1.1	0.80	0.92	46.2
Approach		14	7.7	0.053	17.4	LOS B	0.2	1.1	0.68	0.87	47.8
East: Elizabeth Dr (east)											
4	L2	8	0.0	0.005	6.9	LOS A	0.0	0.0	0.00	0.63	65.4
5	T1	844	6.6	0.459	0.1	LOS A	0.0	0.0	0.00	0.00	79.7
Approach		853	6.5	0.459	0.1	NA	0.0	0.0	0.00	0.01	79.6
West: Elizabeth Dr (west)											
11	T1	377	7.0	0.199	0.0	LOS A	0.0	0.0	0.00	0.00	79.9
12	R2	3	0.0	0.007	12.8	LOS A	0.0	0.1	0.67	0.74	53.7
Approach		380	6.9	0.199	0.1	NA	0.0	0.1	0.01	0.01	79.6
All Vehicles		1246	6.7	0.459	0.3	NA	0.2	1.1	0.01	0.02	79.0

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Lawson Rd at Elizabeth Dr, Badgerys Creek. AM Peak]

FUTURE OPERATION
Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Lawson Rd											
1	L2	7	28.6	0.006	5.9	LOS A	0.0	0.0	0.00	0.57	51.7
3	R2	17	43.8	0.117	28.4	LOS B	0.3	3.1	0.87	0.95	37.2
Approach		24	39.1	0.117	21.6	LOS B	0.3	3.1	0.61	0.83	40.7
East: Elizabeth Dr (east)											
4	L2	9	44.4	0.007	7.8	LOS A	0.0	0.0	0.00	0.63	53.0
5	T1	366	15.2	0.210	0.0	LOS A	0.0	0.0	0.00	0.00	79.9
Approach		376	16.0	0.210	0.2	NA	0.0	0.0	0.00	0.02	78.9
West: Elizabeth Dr (west)											
11	T1	947	6.3	0.498	0.1	LOS A	0.0	0.0	0.00	0.00	79.7
12	R2	3	33.3	0.004	9.3	LOS A	0.0	0.1	0.40	0.61	55.6
Approach		951	6.4	0.498	0.1	NA	0.0	0.1	0.00	0.00	79.6
All Vehicles		1351	9.7	0.498	0.5	NA	0.3	3.1	0.01	0.02	78.1

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Lawson Rd at Elizabeth Dr, Badgerys Creek. PM Peak]

FUTURE OPERATION
Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Lawson Rd											
1	L2	3	33.3	0.003	5.9	LOS A	0.0	0.0	0.00	0.57	50.7
3	R2	14	23.1	0.067	21.0	LOS B	0.2	1.6	0.82	0.92	43.2
Approach		17	25.0	0.067	18.2	LOS B	0.2	1.6	0.66	0.86	44.4
East: Elizabeth Dr (east)											
4	L2	11	20.0	0.007	7.3	LOS A	0.0	0.0	0.00	0.63	59.2
5	T1	844	6.6	0.459	0.1	LOS A	0.0	0.0	0.00	0.00	79.7
Approach		855	6.8	0.459	0.2	NA	0.0	0.0	0.00	0.01	79.4
West: Elizabeth Dr (west)											
11	T1	377	7.0	0.199	0.0	LOS A	0.0	0.0	0.00	0.00	79.9
12	R2	4	25.0	0.010	14.2	LOS A	0.0	0.3	0.69	0.78	52.0
Approach		381	7.2	0.199	0.2	NA	0.0	0.3	0.01	0.01	79.5
All Vehicles		1253	7.1	0.459	0.4	NA	0.2	1.6	0.01	0.02	78.6

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

WASTE MANAGEMENT PLAN
FOR
RESOURCE RECOVERY FACILITY
55 MARTIN ROAD, BADERYS CREEK

Prepared for: AMJ Demolition and Excavation

Prepared by: Patrick Finnerty, Environmental Scientist
R T Benbow, Principal Consultant

Report No: 171127_WMP_Rev1
February 2018

Benbow ENVIRONMENTAL

Engineering a Sustainable Future for Our Environment

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Emma Hansma	Environmental Engineer		22 February 2018

Approved by:	Position:	Signature:	Date:
R T Benbow	Principal Consultant		22 February 2018

DOCUMENT REVISION RECORD

Revision	Date	Description	Checked	Approved
1	22-2-2018	Rev 1	E Hansma	R T Benbow

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1	22-2-2018	AMJ Demolition and Excavation	Benbow Environmental

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Contents

Tables

1. INTRODUCTION

Benbow Environmental (BE) have been commissioned by AMJ Demolition and Excavation to undertake a Waste Management Plan for Demolition, Construction and Use of Premises to accompany a Development Application for a proposed Resource Recovery Facility located at 55 Martin Road, Badgerys Creek.

The report will identify the type of waste that will be generated and will advise Council of how the proponent intends to reuse, recycle or dispose of the waste. The information provided on the form (and on submitted plans) will be assessed against the objectives of the DCP.

1.1 APPLICANT AND PROJECT DETAILS (ALL DEVELOPMENTS)

Table 1-1: Applicant and Project Details

Applicant Details			
Application Number			
Name			
Address			
Phone Number(s)		Fax	
Email			
Project Details			
Address of Development	55 Martin Road, Badgerys Creek NSW (Lot 4 in DP611519)		
Existing building and other structures currently on site	The existing site is typical of a rural property. The site is mostly cleared with a dwelling and some trees near the western border and in the south eastern corner of the site. The site is connected to potable water, electricity, phone and internet but not a public sewer system. The dwelling greywater is drained to a septic tank.		
Description of proposed development	AMJ Demolition and Excavation proposes to establish a resource recovery facility that would receive, handle and process both Construction and Demolition (C&D) waste, including soil (VENM/ENM) and green waste (only garden waste). The amount of waste to be processed is estimated to be approximately 95,000 tonnes per year.		

This development achieves the waste objectives set out in the DCP. The details on this form are the provisions and intentions for minimising waste relating to this project. All records demonstrating lawful disposal of waste will be retained and kept readily accessible for inspection by regulatory authorities such as council, NSW EPA or SafeWork NSW.

Name	
Signature	
Date	

2. SECTION 1 – DEMOLITION STAGE (ALL TYPES OF DEVELOPMENTS)

The existing building is to be retained and used as an office and showroom. Therefore no demolition works are proposed.

Table 2-1: Demolition Stage Waste Management

Type of waste generated	Reuse	Recycling	Disposal	Specify method of onsite reuse, contractor and recycling outlet and /or waste depot to be used
	Estimated volume (m^3) or Weight (t)	Estimated volume (m^3) or Weight (t)	Estimated volume (m^3) or Weight (t)	
Excavation material	0	0	0	N/A
Timber (specify)	0	0	0	N/A
Concrete	0	0	0	N/A
Bricks/pavers	0	0	0	N/A
Tiles	0	0	0	N/A
Metal (specify)	0	0	0	N/A
Glass	0	0	0	N/A
Furniture	0	0	0	N/A
Fixtures and fittings	0	0	0	N/A
Floor coverings	0	0	0	N/A
Packaging (used pallets, pallet wrap)	0	0	0	N/A
Garden organics	0	0	0	N/A
Containers (cans, plastic, glass)	0	0	0	N/A
Paper/Cardboard	0	0	0	N/A
Residual waste	0	0	0	N/A
Hazardous/special waste e.g. asbestos (specify)	0	0	0	N/A
Other (specify)	0	0	0	N/A

3. SECTION 2 – CONSTRUCTION STAGE (ALL TYPES OF DEVELOPMENTS)

Construction of the proposed resource recovery facility will result in the generation of waste. The expected type, quantity and fate of these wastes are outlined in the following table.

Table 3-1: Construction Stage Waste Management

Type of waste generated	Reuse	Recycling	Disposal	Specify method of onsite reuse, contractor and recycling outlet and /or waste depot to be used
	Estimated volume (m^3) or Weight (t)	Estimated volume (m^3) or Weight (t)	Estimated volume (m^3) or Weight (t)	
Excavation material	0	0	0	N/A
Timber (specify) - **pallets**	0	1 tonne	0	Recycled offsite Timber will be sent offsite for recycling to landscaping suppliers and composting facilities.
Concrete	2 tonne	2 tonne	0	Re-used onsite/recycled offsite Concrete will be crushed and re-used as fill material. Residual concrete will be recycled offsite by a licensed waste recovery facility
Bricks/pavers	0	0	0	N/A
Tiles	0	0	0	N/A
Metal (Copper, Aluminium)	0	0.05 tonne	0	Recycled offsite To be re-used or recycled offsite by recycling facility.
Glass	0	0	0	N/A
Plasterboard (offcuts)	0	0	0	N/A
Fixtures and fittings	0	<0.025 tonne	<0.025 tonne	Recycled offsite/Landfill To be re-used or recycled offsite where possible, otherwise sent to landfill for disposal.
Floor coverings	0	0	0	N/A
Packaging (used pallets, pallet wrap)	0	<1T	<1T	An accredited waste disposal company will be engaged as the waste contractor.
Garden organics	0	0	0	N/A

Table 3-1: Construction Stage Waste Management

Type of waste generated	Reuse	Recycling	Disposal	Specify method of onsite reuse, contractor and recycling outlet and /or waste depot to be used
	Estimated volume (m^3) or Weight (t)	Estimated volume (m^3) or Weight (t)	Estimated volume (m^3) or Weight (t)	
Containers (cans, plastic, glass)	0	0	0	N/A
Paper/Cardboard	0	0	0	N/A
Residual waste	0	0	0	N/A
Hazardous/special waste e.g. asbestos (specify)	0	0	0	N/A
Other (specify)	0	0	0	N/A

3.1 Construction Design (All Types of Developments)

This section outlines how measures for waste avoidance have been incorporated into the design, material, purchasing and construction techniques of the development

3.1.1 Materials

The proposed development will occupy the existing facilities, greatly reducing materials otherwise required for construction. Equipment will be manufactured/constructed to specifications offsite preventing waste materials from being generated during installation.

3.1.2 Lifecycle

The existing building is constructed out of building materials with a long lifecycle (brick walls corrugated roof and steel structure). Equipment will be designed to Australian standards with a long lifecycle and can be reused in the event of closure or relocation.

4. SECTION 3 – ONGOING MANAGEMENT OF WASTE (RESIDENTIAL, MULTI UNIT, COMMERCIAL, MIXED USE AND INDUSTRIAL)

The following table shows the total volume of waste expected to be generated by the development and the associated waste storage requirements.

Table 4-1: Operation Stage Waste Management

	Recyclables		Compostable	Residual waste[A]	Other	
	Paper/ Cardboard	Metals/ Plastics/glass	Timber		C&D waste that cannot be recovered from sorting process	Bricks/ Concrete
Amount generated (L per unit per day)	19.4L	4956.1L	45161.3L	0	45161.3L	203225.8L
Amount generated (L per development per week)	116.13L	29736.6L	270967.6L	0	270967.6L	1219354.8L
Any reduction due to compacting equipment	N/A	N/A	N/A	N/A	N/A	N/A
Frequency of collections (per week)	0.5	N/A	N/A	N/A	N/A	N/A
Number and size of storage bins required	2-4 residential sized bins	1-2 15 m x 25 m storage bays	1-2 15 m x 25 m storage bays	N/A	1-2 15 m x 25 m storage bays	1-2 15 m x 25 m storage bays
Floor area required for storage bins (m^2)	N/A	375 – 750 m^2	375 – 750 m^2	N/A	375 – 750 m^2	375 – 750 m^2
Floor area required for manoeuvrability (m^2)	N/A	N/A	N/A	N/A	N/A	N/A
Height required for manoeuvrability (m)	N/A	N/A	N/A	N/A	N/A	N/A

NOTE: A) Current "non-recyclables" waste generation rates typically include food waste that might be further separated for composting.
B) Waste engine oils will be stored on site and is destined for reuse at another facility.

5. SECTION 4 – CHECKLIST

The following checklists are designed to help ensure Waste Management Plans are accompanied by sufficient information to allow assessment of the application.

5.1 PLANS AND DRAWINGS (ALL DEVELOPMENTS)

Drawings accompanying the development application are submitted to scale, clearly indicating the location of and provisions for the storage and collection of waste and recyclables during operation. Drawings for demolition and construction are not considered warranted for this application as the existing building is to be occupied.

5.2 DEMOLITION

Table 5-1: Demolition checklist

Do the site plans detail/indicate:	Tick Yes
Size and location(s) of waste storage area(s)	N/A
Access for waste collection vehicles	N/A
Areas to be excavated	N/A
Types and numbers of storage bins likely to be required	N/A
Signage required to facilitate correct use of storage facilities	N/A

5.3 CONSTRUCTION

Table 5-2: Construction Checklist

Do the site plans detail/indicate:	Tick Yes
Size and location(s) of waste storage area(s)	N/A
Access for waste collection vehicles	N/A
Areas to be excavated	N/A
Types and numbers of storage bins likely to be required	N/A
Signage required to facilitate correct use of storage facilities	N/A

Bins will be provided on site for minor construction waste, the majority of which will be recyclable.

5.4 ONGOING OPERATION

Table 5-3: Operational Checklist

Do the site plans detail/indicate:	Tick Yes
Space	
Size and location(s) of waste storage area(s)	✓
Recycling bins placed next to residual waste bins	N/A
Space provided for access to and the manoeuvring of bins/equipment	✓
Any additional facilities	✓
Access	
Access route(s) to deposit waste in storage room/area	✓
Access route(s) to collect waste from storage room/area	✓
Bin carting grade	N/A
Location of final collection point	✓
Clearance, geometric design and strength of internal access driveways and roads	N/A
Direction of traffic flow for internal access driveways and roads	✓
Amenity	
Aesthetic design of waste storage areas	
Signage – type and location	✓
Construction details of storage rooms/areas (including floor, walls, doors, ceiling design, sewer connection, lighting, ventilation, security, wash down provisions etc)	✓

As the proposed development is a resource recovery facility. Details of storage, manoeuvring space and unloading/loading areas are provided in the drawings.

This concludes the report.

Patrick Finnerty
Environmental Scientist

R T Benbow
Principal Consultant

6. LIMITATIONS

Our services for this project are carried out in accordance with our current professional standards for site assessment investigations. No guarantees are either expressed or implied.

This report has been prepared solely for the use of AMJ Demolition and Excavation, as per our agreement for providing environmental services. Only AMJ Demolition and Excavation is entitled to rely upon the findings in the report within the scope of work described in this report. Otherwise, no responsibility is accepted for the use of any part of the report by another in any other context or for any other purpose.

Although all due care has been taken in the preparation of this study, no warranty is given, nor liability accepted (except that otherwise required by law) in relation to any of the information contained within this document. We accept no responsibility for the accuracy of any data or information provided to us by AMJ Demolition and Excavation for the purposes of preparing this report.

Any opinions and judgements expressed herein, which are based on our understanding and interpretation of current regulatory standards, should not be construed as legal advice.

AIR QUALITY IMPACT ASSESSMENT
RESOURCE RECOVERY FACILITY
55 MARTIN ROAD, BADGERYS CREEK

Prepared for: AMJ Demolition and Excavations
Claron Consulting

Prepared by: Emma Hansma, Environmental Engineer
Lauren O'Brien, Environmental Intern
R T Benbow, Principal Consultant

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Benbow
ENVIRONMENTAL

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Contents

Page

Tables

Page

Figures

Page

Attachments

1. INTRODUCTION

Benbow Environmental has been engaged by AMJ Demolition and Excavations and Claron Consulting to undertake an air quality impact assessment (AQIA) to support an Environmental Impact Statement (EIS) for the development of the proposed resource recovery facility at 55 Martin Road, Badgerys Creek, NSW. The assessment determines the predicted air pollutant contribution from the proposed resource recovery operations at the nearest sensitive receptors.

1.1 PURPOSE OF REPORT

The purpose of this study is to assess the potential impacts of dust emissions on ambient air quality, as a direct result of the proposal, being the operation of the proposed resource recovery facility only. Should the results of this assessment show any exceedance of the adopted criteria for the specific emissions, mitigation measures would be recommended, in order to prevent or reduce to an acceptable level any detrimental effects to ambient air quality and any impacts on the local community.

1.2 SCOPE OF WORKS

The scope of works undertaken for this AQIA consists of the following:

- Reviewing site details and the proposed operations;
- Determining the most suitable pollutant emission data for the proposal;
- Undertaking air dispersion modelling of the proposed operations to determine the potential air quality impacts at the nearest sensitive receptors;
- Assessing the predicted pollutant levels against NSW EPA guidelines; and
- Compiling the methods and results of the assessment in a report, with a final statement on the potential air quality impacts resulting from the proposal.

1.3 RELEVANT LEGISLATION AND PUBLICATIONS

Various publications have been followed for generic guidance and/or utilised to comply with statutory requirements for the preparation of this AQIA report. The most relevant ones are listed as follows:

- *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (NSW EPA, 2016) [referred to as *Approved Methods*];
- National Pollutant Inventory Emission Estimation Technique Manual (NPI EETM) for Mining (2012);
- National Pollutant Inventory Emission Estimation Technique Manual (NPI EETM) for Mining and Processing of Non-Metallic Materials (2014); and
- National Pollutant Inventory Emission Estimation Technique Manual (NPI EETM) for Concrete Batching and Concrete Product Manufacturing (1999).

2. SITE DETAILS AND PROPOSED DEVELOPMENT

This section provides a description of the site, surroundings, and proposed development.

2.1 SITE LOCATION

The proposed subject site is located at 55 Martin Road, Badgerys Creek, Lot 4 in DP 611519 and has a second street frontage on Lawson Road. The site is located in the Liverpool Local Government Area of New South Wales and lies approximately 15 kilometres south-east of Penrith and 40 kilometres west of the Sydney CBD.

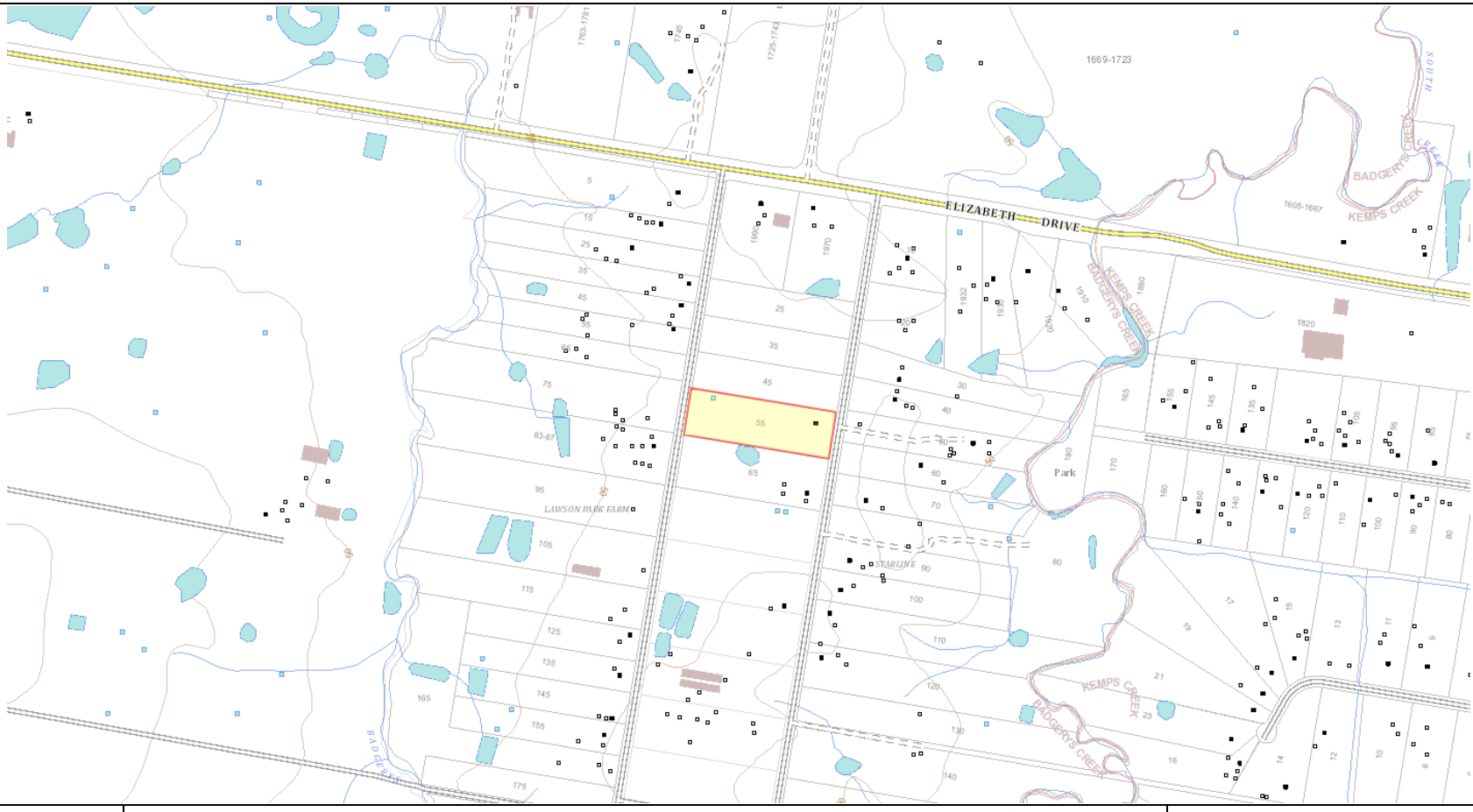
Figure 2-1 shows the location of the site in a local context and Figure 2-2 shows an aerial photo of the site and surrounding area.

2.2 DESCRIPTION OF THE SITE AND SURROUNDING AREA

The site consists of one rectangular lot of gently sloping grassy land, approximately 2.5 hectares in area, with a small dam near the north-west boundary and a one storey brick residence near the north-east corner. Elizabeth Drive, to the north of the site, leads east to the Westlink M7 approximately 8 km away and Leppington Railway Station is located approximately 10 km to the south-east of the site

The subject site is zoned as 'RU1 – Primary Production' under the Liverpool Local Environmental Plan (LLEP) 2008 and the surrounding developments are typical of this zone including poultry farms, plantations, stockpiling, crop growing, greenhouse horticulture and rural residences.

Figure 2-1: Site Location in Local Context



↑N
Not to scale

Source: SIX Maps 2017
Legend: Site boundaries

Benbow Environmental
13 Daking Street,
North Parramatta NSW 2151

Figure 2-2: Aerial view of the Site

↑N Not to scale	**Source:** SIX Maps 2017 **Legend:** Site boundaries	Benbow Environmental 13 Daking Street, North Parramatta NSW 2151

2.3 NEAREST IDENTIFIED SENSITIVE RECEPTORS

The subject site is surrounded by nearby developments and a number of residential dwellings that could be potentially affected by odour and dust emissions from the proposed site activities. In AQIA reports, these potentially affected sites are referred to as 'sensitive receptors'. A sensitive receptor is defined in the *Approved Methods* (EPA, 2016) as follows:

> *"A location where people are likely to work or reside; this may include a dwelling, school, hospital, office or public recreational area. An air quality impact assessment should also consider the location of known or likely future sensitive receptors."*

Table 2-1 provides a list of the nearest identified sensitive receptors and Figure 2-3 shows the location of these receptors in relation to the subject site. The distance between the sensitive receptors and the proposed development is measured as the distance between the nearest façade of the potentially impacted building and the proposed site boundary.

Table 2-1: Nearest Identified Sensitive Receptors

Receptor ID	Address	Lot & DP	Approx. Distance from Proposed Development	Type of Receptor
R1	1990 Elizabeth Drive, Badgerys Creek	Lot 10 DP 860338	370 m N	Residential
R2	1970 Elizabeth Drive, Badgerys Creek	Lot 11 DP 860338	370 m N	Residential
R3	30 Martin Road, Badgerys Creek	Lot 8 DP 226448	150 m NE	Residential
R4	40 Martin Road, Badgerys Creek	Lot 7 DP 226448	110 m NE	Residential
R5	50 Martin Road, Badgerys Creek	Lot 6 DP 226448	50 m E	Residential
R6	60 Martin Road, Badgerys Creek	Lot 5 DP 226448	170 m E	Residential
R7	70 Martin Road, Badgerys Creek	Lot 4 DP 226448	130 m SE	Residential
R8	80 Martin Road, Badgerys Creek	Lot 2 DP 530595	220 m SE	Residential
R9	90 Martin Road, Badgerys Creek	Lot 2 DP 226448	210 m SE	Residential
R10	75 Martin Road, Badgerys Creek	Lot 34 DP 3050	290 m S	Residential
R11	65 Martin Road, Badgerys Creek	Lot 36 DP 3050	Adjacent S	Residential
R12	83-87 Lawson Road, Badgerys Creek	Lot 6 DP 3050	70 m SW	Residential
R13	75 Lawson Road, Badgerys Creek	Lot 5 DP 3050	70 m W	Residential
R14	65 Lawson Road, Badgerys Creek	Lot 1 DP 104049	200 m W	Residential

Receptor ID	Address	Lot & DP	Approx. Distance from Proposed Development	Type of Receptor
R15	55 Lawson Road, Badgerys Creek	Lot 1 DP 1084967	110 m NW	Residential
R16	45 Lawson Road, Badgerys Creek	Lot 14 DP 531743	170 m NW	Residential
R17	35 Lawson Road, Badgerys Creek	Lot 13 DP 531743	200 m NW	Residential
R18	25 Martin Road, Badgerys Creek	Lot 1 DP 611519	150 m N	Industrial
R19	10 Martin Road, Badgerys Creek	Lot 10 DP 226448	270 m NE	Industrial
R20	105 Lawson Road, Badgerys Creek	Lot 8 DP 3050	220 m SW	Industrial

Figure 2-3: Nearest Sensitive Receptors Considered

2.4 SITE DESIGN AND OPERATIONAL DETAILS

2.4.1 Proposed Development

The proposed development consists of the construction and operation of a resource recovery facility which would receive, handle and process non-putrescible construction and demolition (C&D) waste, including soil and green waste (comprising of garden waste only). The amount of overall waste to be processed will be approximately 95,000 tonnes per year.

2.4.2 Construction Details

The construction of the facility involves building a large shed ('unloading and processing shed') to enclose all the processing operations, including unloading from trucks, sorting, crushing and shredding. The construction phase also involves the erection of five (5) material stockpile bays, the base of which will be sealed by hardstand, and which will be covered with a Colorbond skillion roof. Additionally, a weighbridge and wheel wash will be installed next to the Lawson Road entrance. A car park and landscaped area will be built to the east of the property, near the existing one storey brick building, fronting Martin Road. No demolition works would be needed. Construction waste, from the facility's construction phase, is expected to consist of General Solid Waste (non-putrescible) and would be recycled or disposed of offsite. Waste would be stored within enclosed bins. The one storey brick building will function as a showroom and office. The site plans are presented in Figure 2-4.

2.4.3 Operational Details

The operation of the facility involves the following activities to be undertaken on site:

- Unloading and loading of materials;
- Material handling and sorting;
- Crushing and screening of concrete, bricks, untreated timber and similar waste materials;
- Shredding of green garden waste; and
- Material storage.

Wastes to be accepted on site are typical building materials, including bricks, concrete, timber, glass, metal, as well as garden waste, soil (Excavated and Virgin Excavated Natural Material) and general waste. The quantity for each material may vary significantly depending on the source that generated the waste. Nevertheless, all incoming material will be unloaded and sorted within the shed, which will be provided with concrete flooring. The materials to be recovered will then be stored in bays, located in the materials stockpile area within the shed, in order to be stored or processed further; further processing may involve shredding, or crushing and screening, depending on the type of material.

Recovered materials would be stored in the material stockpile bays for re-selling, either directly from site to trade clients or to a landscape supply outlet offsite. Any processed waste that is not suitable for resource recovery will be collected by a licensed waste contractor for final disposal to landfill.

A full process description is provided in Section 3 of the EIS.

2.4.4 Hours of Operation

The proposed resource recovery facility seeks approval to operate during the following hours: Monday to Friday, 7am to 6pm, and Saturday, 7am to 5pm. No work is proposed to be undertaken on Sundays.

Figure 2-4: Site Plan for Proposed Resource Recovery Facility (A)

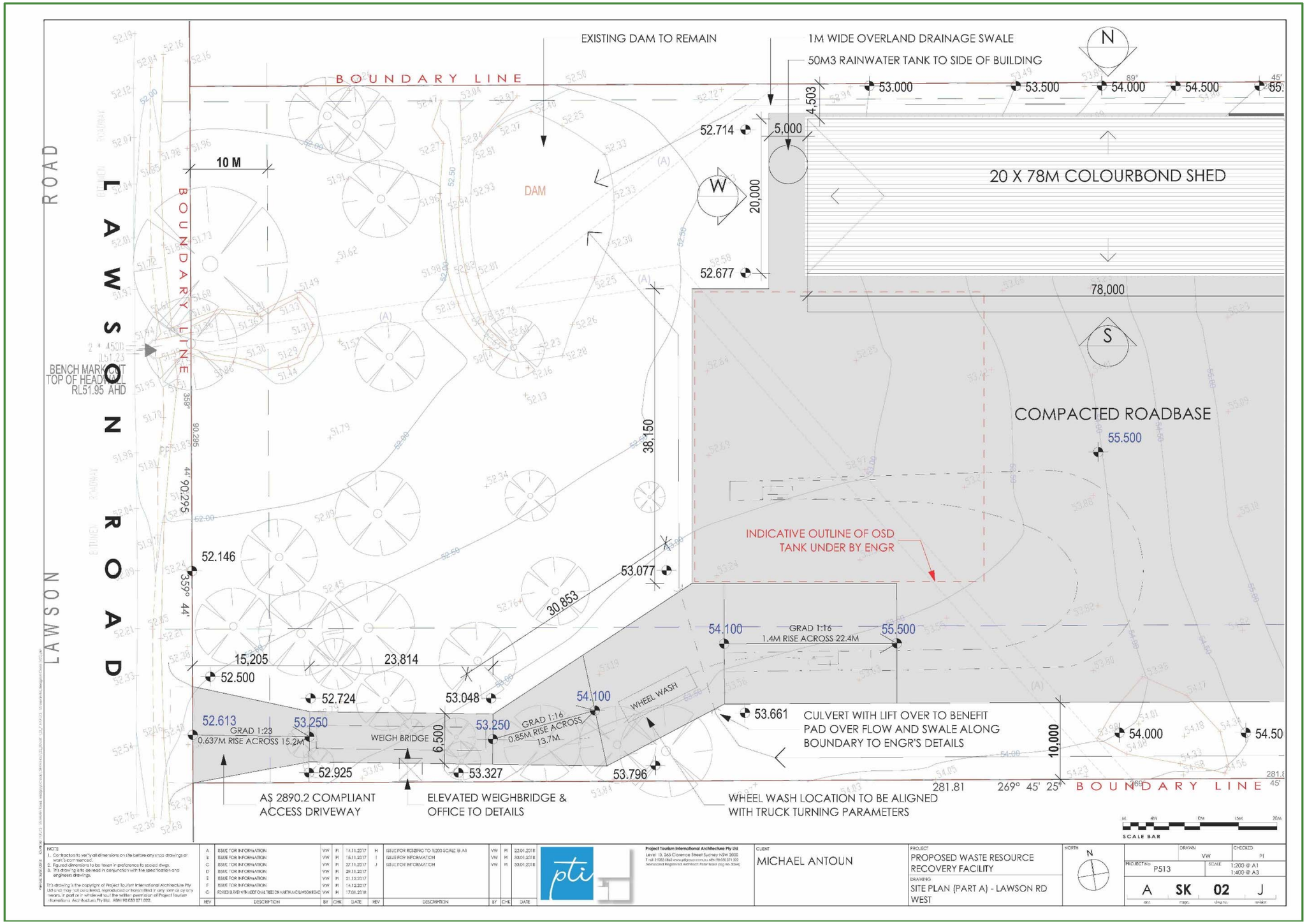
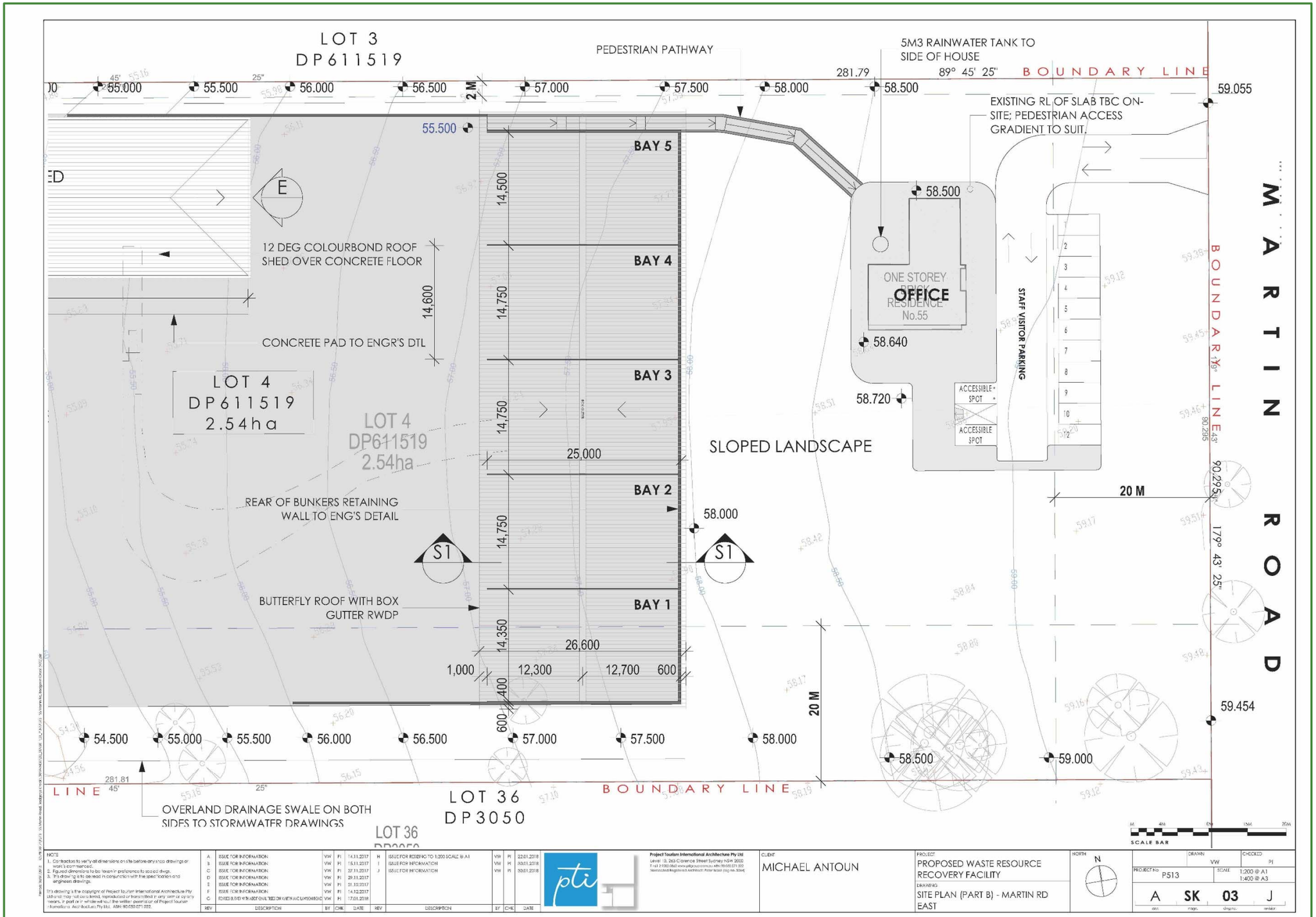


Figure 2-5: Site Plan for Proposed Resource Recovery Facility (B)



3. METEOROLOGY AND LOCAL AIR QUALITY

3.1 PROJECT SITE REPRESENTATIVE METEOROLOGICAL DATA

The nearest weather monitoring station to the subject site is the Badgerys Creek AWS operated by the Bureau of Meteorology. This monitoring station is located approximately 3.7 kilometres to the south-west of the subject site and was considered to be the most appropriate source of data for meteorological modelling due to its proximity to the site, completeness of data, and similar topography to the subject site.

The representative meteorological year of 2016 was selected based on long term averages from Badgerys Creek AWS. Meteorological data for 2016 was compared with long term averages for minimum temperature, maximum temperature, and wind run and found to be consistent. Wind roses representing the annual frequency of wind speed and direction were also compared for the five most recent meteorological years and found to be reasonably consistent (Attachment 1).

3.1.1 WRF

The Weather Research and Forecasting (WRF) Model is a next-generation mesoscale numerical weather prediction system designed as a collaborative effort between the American National Center for Atmospheric Research (NCAR) and other meteorological specialist organisations. It was created for both atmospheric research and operational forecasting applications and serves a wide range of meteorological applications across scales from tens of meters to thousands of kilometres.

A prognostic meteorological data file was created by Lakes Environmental using the WRF model with observational meteorological data from 2016 (NCAR , 2017).

3.1.2 AERMET

AERMET is a meteorological pre-processor that organises data and estimates the necessary boundary layer parameters for dispersion calculations in AERMOD.

A meteorological data file was produced for inclusion in the air dispersion model using AERMET ver. 16216. The WRF prognostic data was entered into AERMET as onsite and upper air data. The surrounding land use was set to grassland.

3.2 WIND ROSE PLOTS

Wind rose plots show the direction from which the wind is coming with triangles known as “petals”. The petals of the plots in Figure 3-1 summarise wind direction data into 8 compass directions ie. north, north-east, east, south-east, etc.

The length of the triangles, or “petals”, indicates the frequency that the wind blows from the direction presented. Longer petals for a given direction indicate a higher frequency of wind from that direction. Each petal is divided into segments, with each segment representing one of the six wind speed classes. Thus, the segments of a petal show what proportion of wind for a given direction falls into each class.

The proportion of time for which wind speed is equal to or less than 0.5 m/s, when speed is negligible, is referred to as calm hours or “calms”. Calms are not shown on a wind rose as they have no direction, but the proportion of time that they make up for the period under consideration is noted under each wind rose.

The concentric circles in each wind rose are the axes that denote wind frequencies. In comparing the plots it should be noted that the axis varies between wind roses, although all wind roses are the same size. The frequencies shown in the first quadrant (top-left quarter) of each wind rose are stated beneath the wind rose.

3.3 LOCAL WIND TRENDS

Seasonal wind rose plots representing the annual frequency of wind speed and direction for the subject site were created using Badgerys Creek AWS 2016 data. Trends in wind speed and direction are described in detail below and wind rose plots have been included in Figure 3-1.

The 2016 annual average wind speeds were estimated to be 2.39 m/s with a calms frequency of 5.67%. Annual winds from the south-west were found to be dominant and were present for approximately 21% of the time.

The average 2016 summer wind speed was estimated to be 2.24 m/s, with a calms frequency of 5.27%. Easterly winds were found to be dominant at a frequency of around 14%. Winds from the south-west to the south-east were found to be present for approximately 12-14% of the time.

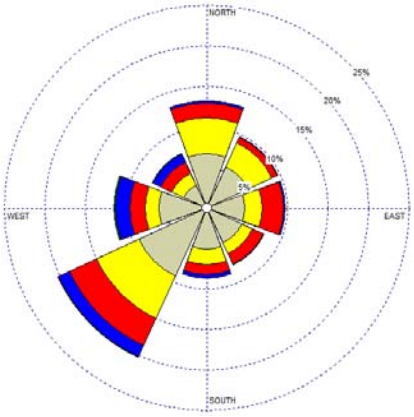
In autumn 2016, dominant winds blew from the south-west (24%) and all other wind directions occurred at frequencies less than 15%. The average autumn wind speed was 2.07 m/s with a calms frequency of 6.93%.

The 2016 winter data showed the prevalence of winds from the south-west and west at frequencies of 29% and 19% respectively. The average winter wind speed was 2.45 m/s with a calms frequency of 5.30%.

In spring 2016, average wind speeds of 2.77 m/s with a calms frequency of 5.18% were recorded. Dominant winds were found to be present from the south west (20%), with winds from the north and west occurring at a frequency of 16% each.

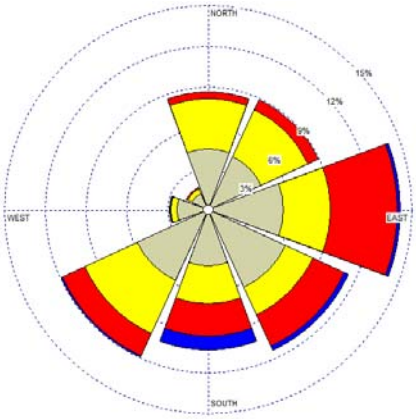
Figure 3-1: Wind Rose Plots for the Referenced Meteorological Station – Bureau of Meteorology Badgerys Creek AWS for 2016

All Seasons



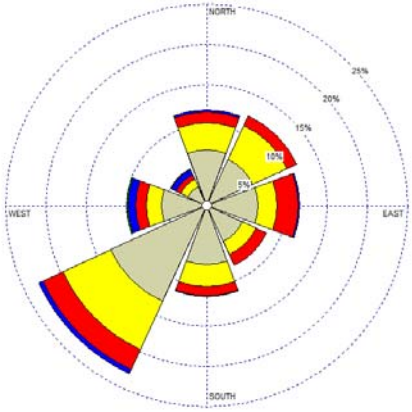
Average Wind Speed: 2.39 m/s
Calms Frequency: 5.67%
Axis Frequencies: 5%, 10%, 15%, 20%, 25%

Summer Season (December – February)



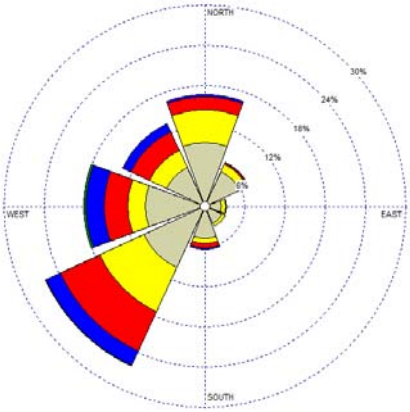
Average Wind Speed: 2.24 m/s
Calms Frequency: 5.27%
Axis Frequencies: 3%, 6%, 9%, 12%, 15%

Autumn Season (March – May)



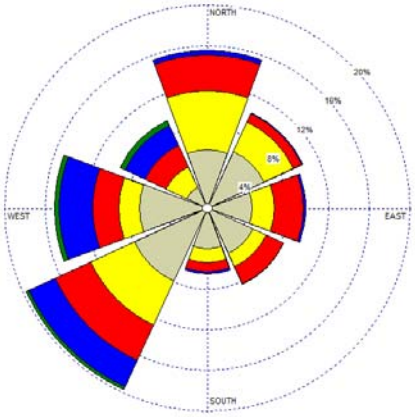
Average Wind Speed: 2.07 m/s
Calms Frequency: 6.93%
Axis Frequencies: 5%, 10%, 15%, 20%, 25%

Winter Season (June – August)



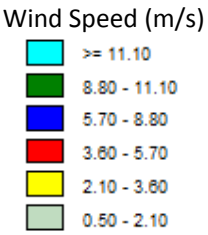
Average Wind Speed: 2.45 m/s
Calms Frequency: 5.30%
Axis Frequencies: 6%, 12%, 18%, 24%, 30%

Spring Season (September – November)



Average Wind Speed: 2.77 m/s
Calms Frequency: 5.18%
Axis Frequencies: 4%, 8%, 12%, 16%, 20%

Legend

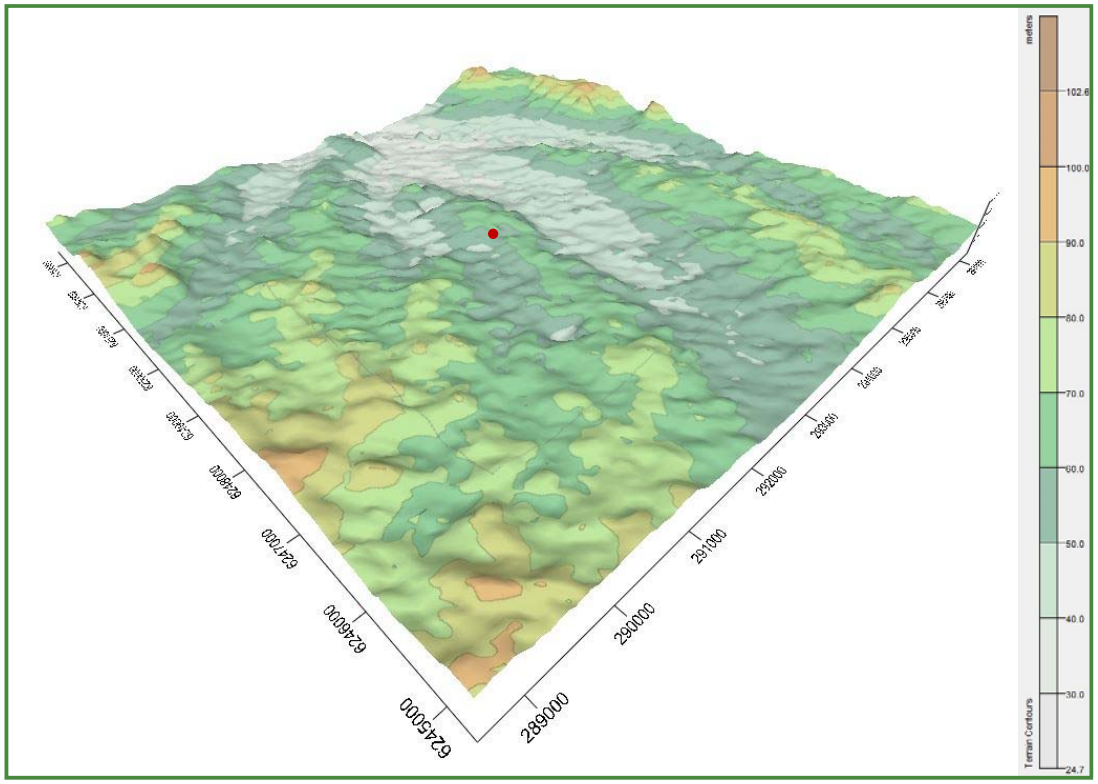


3.4 TERRAIN AND STRUCTURAL EFFECTS ON DISPERSION

The meteorological condition known as katabatic flow (or katabatic drift) is often identified as the condition under which maximum environmental impacts from primarily ground-based sources are likely to occur. Katabatic flow is simply the movement of cold air down a slope, generally under stable atmospheric conditions. Under such circumstances, dispersion of airborne pollutants is generally slow and the associated impacts can reach their peak.

Katabatic flow is unlikely to affect emissions from the subject site. Figure 3-2 shows the terrain with the z-axis (i.e. vertical axis) exaggerated by a factor of 10 (i.e. a given distance on the x-axis or y-axis appears three times as great on the z-axis) in order to provide a clearer description of the topography. A coloured scale bar shows elevations corresponding to the colours used in the figures. It should be noted that these figures are an approximation of the actual terrain, based on terrain information that have been digitised from local contour terrain maps.

Figure 3-2: Local Topography of Site, vertical exaggeration by a factor of 10



3.5 LOCAL AIR QUALITY

No air quality measurements have been undertaken specifically for this project. Instead, the nearest available air quality monitoring data was used to gain an understanding of what current pollutant levels may be around the site and to provide background air quality parameters for the assessment.

Background air quality parameters were obtained from the closest NSW OEH ambient air monitoring station located at Bringelly, approximately 4.5 km south of the subject site. The relevant assessable pollutant parameters available from the monitoring station are PM_{10} values for 2015, 2016 and 2017, and $PM_{2.5}$ values for the first six months of 2016, and 2017.

A summary of the background data is provided in Table 3-1.

Table 3-1: Referenced Background Particulate Matter Data from NSW OEH Monitoring Station at Bringelly (2016-2017)

Pollutant	Parameter	Concentration (µg/m^3)			
		2015	2016	2017	2015-2017
PM_{10}	Annual Average Concentration	15.84	16.92	19.77	17.54
	Peak 24 Hour Concentration	57 (06/05)	61.6 (07/05)	83.7 (11/07)	83.7 (11/07/17)
	Number of 24 Hour Ground Level Impact Criteria (50 µg/m^3) Exceedances	1	3	6	10
$PM_{2.5}$	Annual Average Concentration	N/A	7.64	7.47	7.55
	Peak 24 Hour Concentration	N/A	21.6 (04/07)	52.5 (14/08)	52.5 (14/08/17)
	Number of 24 Hour Ground Level Impact Criteria (25 µg/m^3) Exceedances	N/A	0	2	2

Table 3-1 shows that background levels of PM_{10} are reasonably consistent over the three years of 2015, 2016 and 2017. Therefore, ambient air quality levels for 2016 are deemed to be appropriate to represent the average background air quality at this site, and have been adopted for this assessment in order to be consistent with the meteorological data that has been obtained for use in the model. For $PM_{2.5}$, the average of all 18 months of data obtained has been adopted for assessment in order to best represent ambient air quality levels at the site.

As per Section 5.1.3 of *Approved Methods* (EPA 2016), where the existing ambient air pollutant concentrations exceed the assessment criteria it must be demonstrated that no additional exceedances of the impact assessment criteria occur as a result of the proposed activity. As such the cumulative impact for a 24 hour averaging period has been assessed with the exclusion of all peak background impacts occurring over 2016 for PM_{10} and 2016/2017 for $PM_{2.5}$. Therefore the fourth (4th) and third (3rd) highest 24 hour concentrations for PM_{10} and $PM_{2.5}$ respectively have been adopted as background levels for this assessment.

Using the worst-case particle size distribution data provided by the U.S. Environmental Protection Agency (USEPA) AP-42 Emissions Database, a PM_{10}-to-TSP ratio of 0.51 was used to estimate the TSP background concentration level of 33.18 µg/m^3 for an annual averaging period.

A summary of the adopted background air quality levels for assessment is provided in Table 3-2.

Table 3-2: Adopted Particulate Matter Background Levels for Assessment

Pollutant	Averaging Period	Concentration ($\mu g/m^3$)
Total Suspended Particulates (TSP)	Annual	33.18
PM_{10}	24 hours	40.4
	Annual	16.92
$PM_{2.5}$	24 Hours	22.1
	Annual	7.55

4. AIR QUALITY CRITERIA AND GUIDELINES

4.1 PROTECTION OF THE ENVIRONMENT OPERATIONS ACT 1997

The *Protection of the Environment Operations Act 1997* (POEO Act) applies the following definitions relating to air pollution:

> ***"Air pollution"*** *means the emission into the air of any air impurity.*
>
> *While "air impurity" includes smoke, dust (including fly ash), cinders, solid particles of any kind, gases, fumes, mists odours, and radioactive substances'*

The following sections of this Act have most relevance to the site:

- *Section 124 Operation of Plant - other than domestic plant*

> *The occupier of any premises who operates any plant in or on those premises in such a manner as to cause air pollution from those premises is guilty of an offence if the air pollution so caused, or any part of the air pollution so caused, is caused by the occupier's failure:*
>
> *(a) to maintain the plant in an efficient condition, or*
>
> *(b) to operate the plant in a proper and efficient manner.*

- *Section126 Dealing with Materials*

> *(1) The occupier of any premises who deals with materials in or on those premises in such a manner as to cause air pollution from those premises is guilty of an offence if the air pollution so caused, or any part of the air pollution so caused, is caused by the occupiers failure to deal with those materials in a proper and efficient manner.*
>
> *(2) In this section:*
>
> ***deal*** *with materials means process, handle, move, store or dispose of the materials.*
>
> ***Materials*** *includes raw materials, materials in the process of manufacture, manufactured materials, by-products or waste materials.*

- *Section 127 Proof of causing pollution*

> *To prove that air pollution was caused from premises within the meaning of Sections 124 – 126, it is sufficient to prove that air pollution was caused on the premises, unless the defendant satisfies the court that the air pollution did not cause air pollution outside the premises.*

- *Section 128 Standards of air impurities not to be exceeded*

(1) The occupier of any premises must not carry on any activity, or operate any plant, in or on the premises in such a manner as to cause or permit the emission at any point specified in or determined in accordance with the regulations of air impurities in excess of:

(a) The standard of concentration and the rate, or

(b) The standard of concentration or the rate.

Prescribed by the regulations in respect of any such activity or any such plant.

(2) Where neither such a standard nor rate has been so prescribed, the occupier of any premises must carry on any activity, or operate any plant, in or on the premises by such practicable means as may be necessary to prevent or minimise air pollution.

- *Section 129 Standards of air impurities not to be exceeded*

(1) The occupier of any premises at which scheduled activities are carried on under the authority conferred by a licence must not cause or permit the emission of any offensive odour form the premises to which the licence applies.

(2) It is a defence in proceedings against a person for an offence against this section if the person establishes that:

(a) The emission is identified in the relevant environment protection licence as a potentially offensive odour and the odour was emitted in accordance with the conditions of the licence directed at minimising the odour, or

(b) The only persons affected by the odour were persons engaged in the management or operation of the premises.

(3) A person who contravenes this section is guilty of an offence.

The proposed development is required to comply with this Act.

4.2 PROTECTION OF ENVIRONMENT OPERATIONS (CLEAN AIR) REGULATION 2010

In accordance with Part 5 of the *Protection of the Environment Operations (Clean Air) Regulation 2010* (herein referred to as the Clean Air Regulation), the proposed waste recycling facility would belong to Group 6 (Standards for scheduled premises) as the activity is to be "*commenced to be carried on, or to operate, on or after 1 September 2005 as a result of an environment protection licence granted under the* Protection of the Environment Operations Act 1997 *pursuant to an application made on or after 1 September 2005".*

Schedule 4 of the Clean Air Regulation provides standards of concentration for scheduled premises general activities and plant, any crushing, grinding, separating or materials handling activity:

Solid Particles (total) = 20 mg/m^3

The facility would be required to meet the above standard of concentration.

4.3 NSW Environment Protection Authority Guidelines

Approved Methods (EPA 2016) provides guidance on methodology and thresholds that are to be used for the air impact assessment of a proposed development. This air impact assessment has been conducted in accordance with this guideline. Assessable pollutants (along with their corresponding limits) are summarised in Table 4-1.

Table 4-1: Relevant Limits from the Approved Methods for Modelling and Assessment of Air Pollutants in New South Wales (2016)

Pollutant	Averaging Period	Percentile	Concentration		Application of Criteria
			pphm	µg/m^3	
TSP	Annual	100th	-	90	At the nearest existing or likely future off-site sensitive receptor
PM_{10}	24 Hours	100th	-	50	At the nearest existing or likely future off-site sensitive receptor
	Annual	100th	-	25	At the nearest existing or likely future off-site sensitive receptor
$PM_{2.5}$	24 Hours	100th	-	25	At the nearest existing or likely future off-site sensitive receptor
	Annual	100th	-	8	At the nearest existing or likely future off-site sensitive receptor

5. AIR QUALITY IMPACTS FROM CONSTRUCTION

The proposal involves the construction of the compacted roadbase, shed, stockpile bays, the new carpark and landscaped areas. Demolition is not required; however minor excavation to level the site will occur.

The construction activities have the potential to generate dust.

The following control measures are provided as suggestions only and may be implemented where appropriate. Local weather conditions should be taken into account in determining the level and suitability of controls required.

Potential Controls:

- Consider timing of demolition with regards to wind speed and direction;
- Use of water sprays and dust suppression surfactants regularly where there is a risk of dust being generated;
- Securely cover skips and minimise drop heights of materials;
- Minimise the time materials/wastes are stockpiled on site;
- Limit stockpile height and size;
- Locate stockpiles away from sensitive receptors;
- Position stockpiles near existing wind breaks such as trees, fences, earth banks;
- Install physical barriers e.g. screens, fences;
- Wet suppression of stockpiled materials as needed to ensure no visible dust emissions;
- Covering/tarping of stockpiles – this may include the use of mulch temporarily laid over the stockpile;
- Use wet cleaning methods or mechanical road sweepers to prevent the build-up of dusts on site road surfaces;
- Cover all loads entering and leaving the site;
- Vehicles leaving the site to be cleaned of dirt and other materials to avoid tracking these materials onto public roads; and
- Minimise area of soil disturbance.

6. EMISSIONS TO AIR

6.1 AIR EMISSION SOURCES

Particulate matter can be generated from a number of sources associated with the site's operation, including:

- Front end loader handling of materials;
- Excavator handling of materials;
- Screening;
- Brick crushing;
- Concrete crushing;
- Unloading materials;
- Loading materials; and
- Wind erosion of stockpiles.

6.1.1 Odour Impacts

The site's proposed operations include the shredding of green garden waste. Any such waste or timbers will be stored temporarily onsite, and no composting will occur. All other materials processed on site are non-odorous. Therefore odour has not been considered as a potential emission and no further assessment is required.

6.2 AIR IMPACT MITIGATION MEASURES

The following mitigation measures will be implemented at the subject site:

- A 2.1 m high Colourbond retaining wall surrounding the shed and stockpiles;
- A Colorbond skillion roof to cover the five (5) stockpile bins;
- All handling, sorting crushing and screening activities will be conducted within the building;
- All trafficable surfaces will be hardstand which means there will be negligible wheel generated emissions; and
- Installation of water sprays along the building openings and mist sprays within the building to limit airborne particulates being emitted from the building.
- Installation of water sprays along the walls surrounding the stockpiles to limit airborne particulates being emitted as a result of wind erosion.

6.3 EMISSION FACTORS

The following emission factors from the NPI EETM for Mining (2012) and NPI EETM for Mining and Processing of Non-Metallic Minerals (2014) (crushed stone processing data) were utilised in this assessment to represent the sites activities. The relevant NPI documents do not include data for estimating emission of $PM_{2.5}$.

The *Background Document for Revisions to Fine Fraction Ratios Used for AP-42 Fugitive Dust Emissions Factors* (2006) gives a ratio of 0.15 $PM_{2.5}/PM_{10}$ for 'Aggregate Handling and Storage Piles' which was used to estimate $PM_{2.5}$ emissions for wind erosion from external stockpiles.

The US EPA AP-42 *Appendix B.2 Generalized Particle Size Distributions* (1996) data for 'Mechanically Generated Processed Ores and Non-metallic Minerals' gives a ratio of 0.35 $PM_{2.5}/PM_{10}$ which was used to estimate $PM_{2.5}$ emissions from crushing and screening activities.

Table 6-1: Emission Factors

Reference (NPI EETM)	Source	$PM_{2.5}$ Emission Factor (kg/tonne)	PM_{10} Emission Factor (kg/tonne)	TSP Emission Factor (kg/tonne)
Mining	Front End Loader	0.0018	0.012	0.025
Mining	Excavator	0.0018	0.012	0.025
Mining and Processing of Non-Metallic Minerals	Screening	0.00151	0.0043	0.0125
Mining and Processing of Non-Metallic Minerals	Crushing	0.00042	0.0012	0.0027
Mining and Processing of Non-Metallic Minerals	Loading	0.00001	0.00005	[1]0.00010
Mining and Processing of Non-Metallic Minerals	Unloading	0.000001	0.000008	[1]0.00002
Mining	Wind Erosion from Stockpiles	[2]0.03 kg/ha/hr	0.2 kg/ha/hr	0.4 kg/ha/hr

[1] No TSP data available in NPI. As materials are made up of a variety of products (bricks, concrete, timber, metal, glass) a generic PM_{10} to TSP ratio of 0.51 has been assumed to estimate TSP emission factors.
[2] No $PM_{2.5}$ data available in NPI. A ratio of 0.15 $PM_{2.5}/PM_{10}$ has been adopted as per the *Background Document for Revisions to Fine Fraction Ratios Used for AP-42 Fugitive Dust Emissions Factors* (2006) 'Aggregate Handling and Storage Piles'

6.3.1 Reduction Factors

The following reduction factors were utilised as per the NPI EETM for Concrete Batching and Concrete Product Manufacturing, materials handling and the NPI EETM for Mining, control factors for mining operations.

- A reduction factor of 0.1 has been applied to activities undertaken within the building (enclosure 2 or 3 walls).
- A conservative reduction factor of 0.3 has been applied to the stockpiles as each of the five bays will be enclosed by three retaining walls, and will be covered by a roof; however there is a gap of approximately 1 m between the walls and the roof that particulates may escape by.

6.4 Emission Rate Derivation

All dust generating activities that occur within the building have been cumulatively modelled as a volume source from the building. Wind erosion from the stockpiles has been modelled as an area source, adopting the proposed area of the five 15 m by 25 m stockpiles, totalling 1875 m^2, as shown in Figure 2-4.

Based on the material composition breakdown anticipated, it has been conservatively assumed that 90% of the total materials are to be crushed and screened.

As is the nature of waste transfer facilities, the amount of waste processed on a daily basis can fluctuate depending on supply. The maximum quantity of materials that will be processed in one day is eleven 15 tonne trucks and eleven 32 tonne trucks. Therefore we have conservatively assumed a maximum quantity of materials to be crushed and screened in one 24 hour period as 495 tonnes and for all other activities a maximum quantity of 550 tonnes. These quantities have been adopted in order to more accurately predict the peak emission rates for $PM_{2.5}$ and PM_{10} under a 24 hour averaging period.

Sources within the building are assumed to be emitting for the duration of the proposed operating hours, being Monday to Friday, 7 am to 6 pm and Saturday 7 am to 5 pm. Wind erosion from the stockpiles is assumed to be emitting 24/7.

The emission rates for each source were estimated using the following equation by multiplying the emission factors previously discussed by the quantity of materials handled at the relevant activities for the corresponding activity period of time. Appropriate reduction factors were then applied.

$$ER = \frac{1000 \times EF \times Q \times RF}{OpHrs}$$

Where:
ER = Emission Rate (g/s)
EF = Emission Factor (kg/tonne)
OpHrs = Annual operational time (s/year) or (s/day)
Q = Materials processed (tonnes/year) or (tonnes/day)
RF = Reduction Factor (if applicable)

6.5 AIR EMISSIONS PARAMETERS

The calculated emission rates for $PM_{2.5}$, PM_{10} and TSP are given in Table 6-2 and Table 6-3 for the annual and 24 hour averaging periods respectively.

Table 6-2: Emission Rates – Annual Averaging Period

Source	$PM_{2.5}$ Emission Rate (g/s)	PM_{10} Emission Rate (g/s)	TSP Emission Rate (g/s)
Building	0.00417	0.02265	0.04981
Stockpiles	0.00047	0.00313	0.00625

Table 6-3: Emission Rates – 24 Hour Averaging Period

Source	$PM_{2.5}$ Emission Rate (g/s)	PM_{10} Emission Rate (g/s)	TSP Emission Rate (g/s)
Building	0.00742	0.04029	NA
Stockpiles	0.00047	0.00313	NA

Emissions from the building have been modelled as a volume source assumed to be released at a height of 5 m, which is the approximate height of the open roller doors on the southern wall of the shed.

Emissions from the stockpiles have been modelled as an area source with a release height for the stockpiles is 0.5 m above the ground. The stockpiles would in practice vary in height; however a lower release height has been conservatively adopted as it results in higher concentrations at receptors. Note that as the stockpile source is based on surface area, the emission rate remains the same for both annual averaging and peak 24 hour averaging.

7. AIR IMPACT MODELLING

7.1 DISPERSION MODEL

The new generation air dispersion model, AERMOD, was used for the prediction of off-site impacts associated with the air emissions from the proposed operations. AERMOD uses air dispersion based on planetary boundary layer turbulence structure and scaling concepts. The AERMOD model replaced AUSPLUME as the air dispersion model accepted by the Victorian EPA in January 2014 and is a suitable model to use for this air assessment.

Air emissions from the proposed development can be considered to have been adequately represented using the modelling program.

7.2 MODELLING RESULTS

The estimated impact results for TSP, PM_{10} and $PM_{2.5}$ over the corresponding averaging periods are given in Table 7-1 to Table 7-5 for the identified sensitive receptors. Incremental isopleths for each averaging period are also provided. For the 24 hour averaging periods, 'background' denotes the highest 24 hour background concentration which does not already exceed the criteria.

Table 7-1: Estimated Impact Results for TSP, Annual Averaging Period

Receptors	Incremental Impact (µg/m³)	Background (µg/m³)	Cumulative Impact (µg/m³)	100th Percentile Limit (µg/m³)	Pass (Yes/No)
R1	0.09	33.18	33.27	90	Yes
R2	0.09		33.27		Yes
R3	0.55		33.73		Yes
R4	0.75		33.93		Yes
R5	0.25		33.43		Yes
R6	0.24		33.42		Yes
R7	0.36		33.54		Yes
R8	0.18		33.36		Yes
R9	0.32		33.50		Yes
R10	0.21		33.39		Yes
R11	1.35		34.53		Yes
R12	0.51		33.69		Yes
R13	0.38		33.56		Yes
R14	0.10		33.28		Yes
R15	0.34		33.52		Yes
R16	0.26		33.44		Yes
R17	0.19		33.37		Yes
R18	0.40		33.58		Yes
R19	0.14		33.32		Yes
R20	0.23		33.41		Yes

Figure 7-1: Isopleth for TSP, Annual Averaging Period (Incremental Impact)

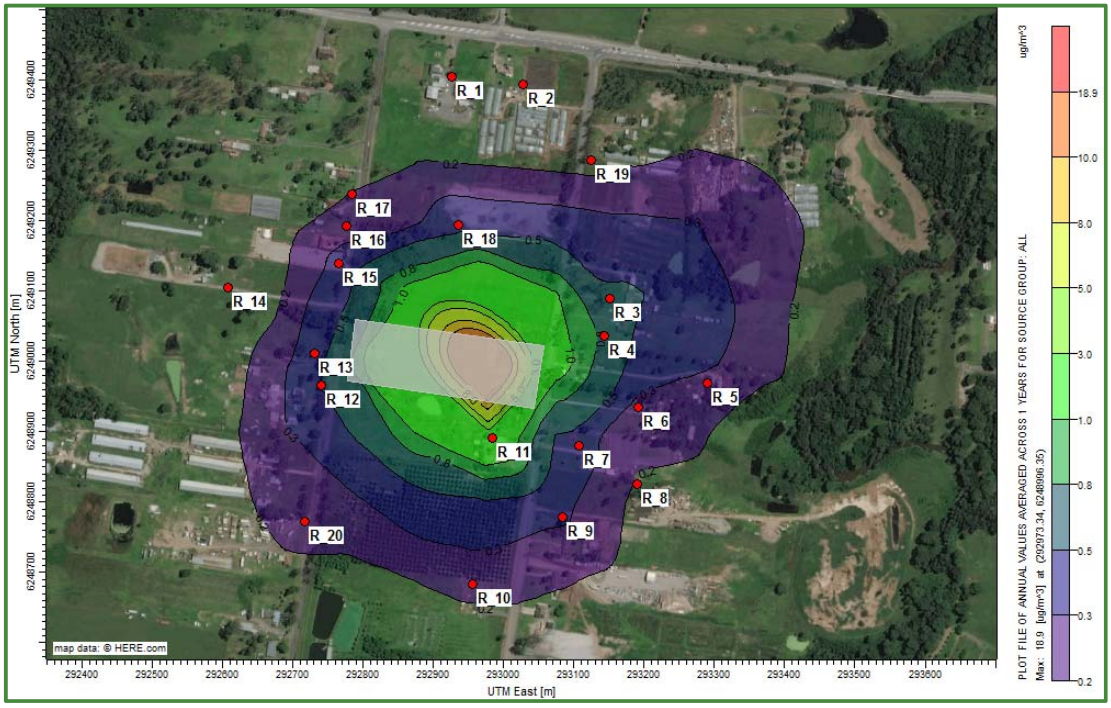


Table 7-2: Estimated Impact Results for PM_{10}, 24 Hour Averaging Period

Receptors	Incremental Impact (µg/m³)	Background (µg/m³)	Cumulative Impact (µg/m³)	100th Percentile Limit (µg/m³)	Pass (Yes/No)
R1	1.49	40.4	41.89	50	Yes
R2	1.46		41.86		Yes
R3	1.23		41.63		Yes
R4	3.07		43.47		Yes
R5	2.59		42.99		Yes
R6	1.77		42.17		Yes
R7	2.01		42.41		Yes
R8	1.23		41.63		Yes
R9	2.87		43.27		Yes
R10	2.33		42.73		Yes
R11	7.59		47.99		Yes
R12	3.47		43.87		Yes
R13	2.67		43.07		Yes
R14	1.76		42.16		Yes
R15	4.10		44.50		Yes
R16	3.11		43.51		Yes
R17	2.34		42.74		Yes
R18	3.44		43.84		Yes
R19	1.78		42.18		Yes
R20	2.35		42.75		Yes

Figure 7-2: Isopleth for PM_{10}, 24 Hour Averaging Period (Incremental Impact)

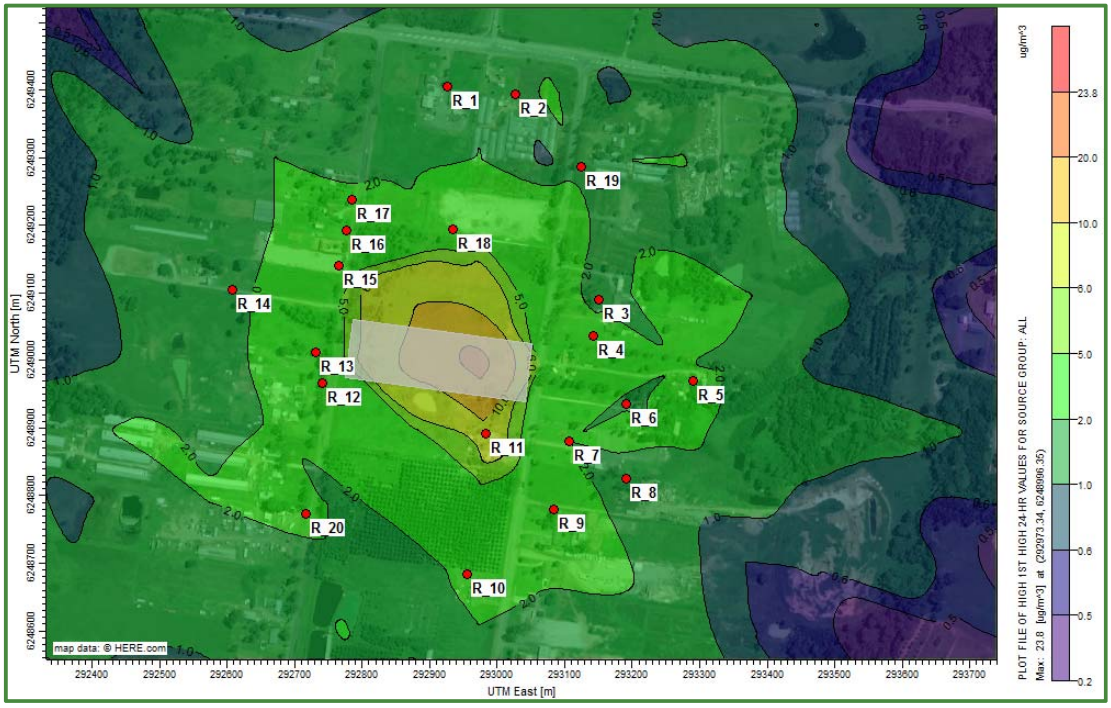


Table 7-3: Estimated Impact Results for PM_{10}, Annual Averaging Period

Receptors	Incremental Impact (µg/m³)	Background (µg/m³)	Cumulative Impact (µg/m³)	100th Percentile Limit (µg/m³)	Pass (Yes/No)
R1	0.04	16.92	16.96	25	Yes
R2	0.04		16.96		Yes
R3	0.27		17.19		Yes
R4	0.37		17.29		Yes
R5	0.12		17.04		Yes
R6	0.12		17.04		Yes
R7	0.18		17.10		Yes
R8	0.09		17.01		Yes
R9	0.16		17.08		Yes
R10	0.10		17.02		Yes
R11	0.67		17.59		Yes
R12	0.24		17.16		Yes
R13	0.18		17.10		Yes
R14	0.05		16.97		Yes
R15	0.16		17.08		Yes
R16	0.12		17.04		Yes
R17	0.09		17.01		Yes
R18	0.19		17.11		Yes
R19	0.07		16.99		Yes
R20	0.11		17.03		Yes

Figure 7-3: Isopleth for PM_{10}, Annual Averaging Period (Incremental Impact)

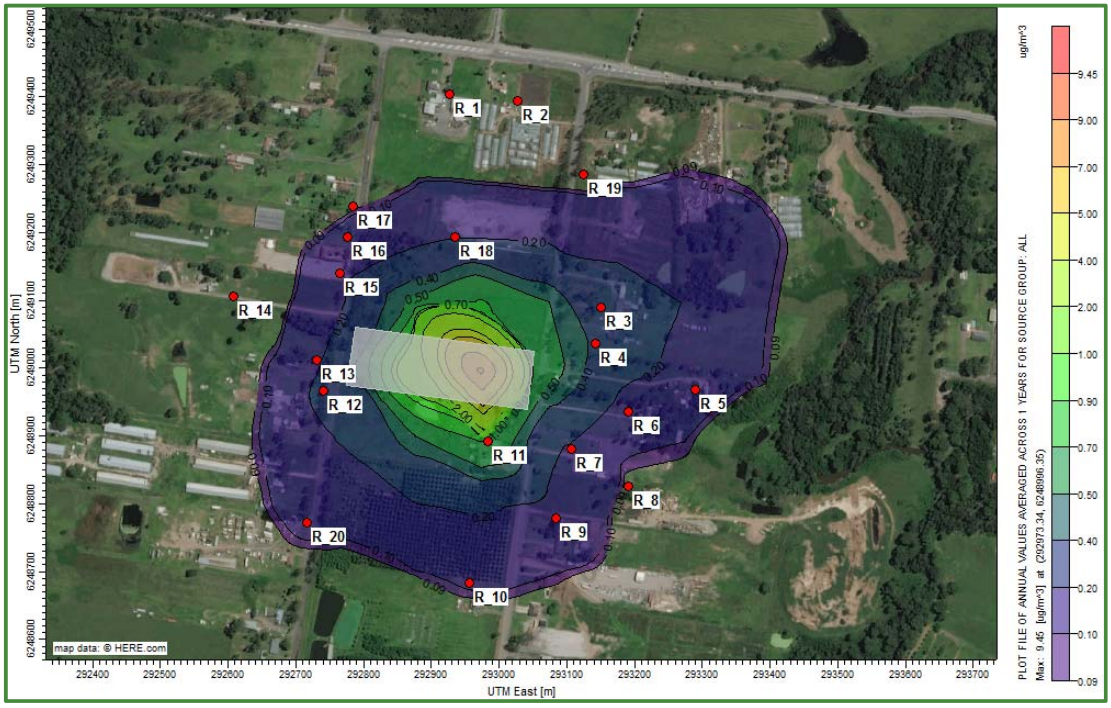


Table 7-4: Estimated Impact Results for $PM_{2.5}$, 24 Hour Averaging Period

Receptors	Incremental Impact (µg/m³)	Background (µg/m³)	Cumulative Impact (µg/m³)	100th Percentile Limit (µg/m³)	Pass (Yes/No)
R1	0.27	22.1	22.37	25	Yes
R2	0.27		22.37		Yes
R3	0.19		22.29		Yes
R4	0.46		22.56		Yes
R5	0.46		22.56		Yes
R6	0.29		22.39		Yes
R7	0.34		22.44		Yes
R8	0.22		22.32		Yes
R9	0.52		22.62		Yes
R10	0.43		22.53		Yes
R11	1.33		23.43		Yes
R12	0.64		22.74		Yes
R13	0.49		22.59		Yes
R14	0.32		22.42		Yes
R15	0.75		22.85		Yes
R16	0.57		22.67		Yes
R17	0.43		22.53		Yes
R18	0.63		22.73		Yes
R19	0.32		22.42		Yes
R20	0.42		22.52		Yes

Figure 7-4: Isopleth for $PM_{2.5}$, 24 Hour Averaging Period (Incremental Impact)

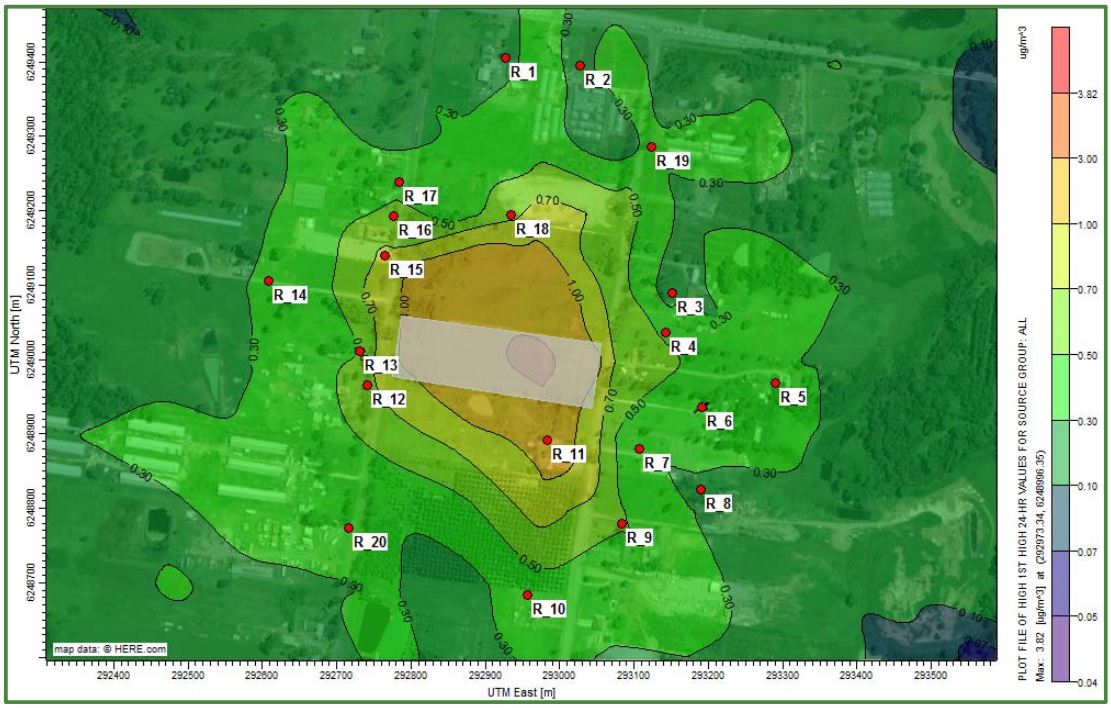
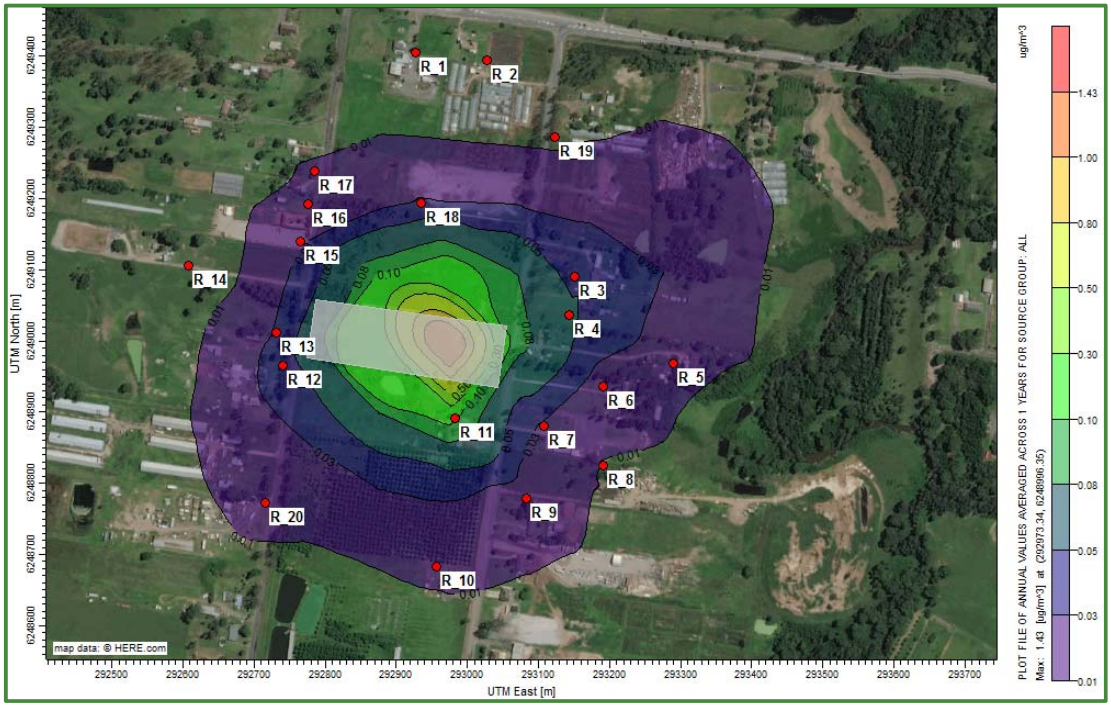


Table 7-5: Estimated Impact Results for $PM_{2.5}$, Annual Averaging Period

Receptors	Incremental Impact (µg/m³)	Background (µg/m³)	Cumulative Impact (µg/m³)	100th Percentile Limit (µg/m³)	Pass (Yes/No)
R1	0.01	7.55	7.56	8	Yes
R2	0.01		7.56		Yes
R3	0.04		7.59		Yes
R4	0.06		7.61		Yes
R5	0.02		7.57		Yes
R6	0.02		7.57		Yes
R7	0.03		7.58		Yes
R8	0.01		7.56		Yes
R9	0.02		7.57		Yes
R10	0.02		7.57		Yes
R11	0.10		7.65		Yes
R12	0.04		7.59		Yes
R13	0.03		7.58		Yes
R14	0.01		7.56		Yes
R15	0.03		7.58		Yes
R16	0.02		7.57		Yes
R17	0.02		7.57		Yes
R18	0.03		7.58		Yes
R19	0.01		7.56		Yes
R20	0.02		7.57		Yes

Figure 7-5: Isopleth for $PM_{2.5}$, Annual Averaging Period (Incremental Impact)



8. STATEMENT OF AIR QUALITY IMPACTS

TSP, PM_{10} and $PM_{2.5}$ emissions were modelled for the operation of the proposed resource recovery facility in accordance with the "*Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*" (EPA 2016). Odour is not considered as a potential emission that would be generated from the proposed development and therefore was not assessed. The predicted cumulative impacts of TSP, PM_{10} and $PM_{2.5}$ at all identified receptors for an annual averaging period were below the specified criteria.

The subject site is located in a region that can experience 24 hour periods of elevated background $PM_{2.5}$ and PM_{10} levels. As described in Section 3.5, the background values for the 24 hour period that exceeded the impact assessment criteria were excluded in accordance with a Level 1 Assessment in *Approved Methods*. The results of air dispersion modelling demonstrate that no additional exceedances occur under a 24 hour averaging period as a result of the proposal for PM_{10} or $PM_{2.5}$. Additionally, there are various dust controls planned that were not included in the model, such as water and mist sprays inside the building and onto the stockpiles. These controls would further reduce particulate matter generation at the site.

Therefore, the *Approved Methods* criteria are satisfied at all residential receptors for all particulate air pollutants modelled. No further controls are recommended.

This concludes the report.

Emma Hansma	Lauren O'Brien	R T Benbow
Environmental Engineer	Environmental Intern	Principal Consultant

9. LIMITATIONS

Our services for this project are carried out in accordance with our current professional standards for site assessment investigations. No guarantees are either expressed or implied.

This report has been prepared solely for the use of AMJ Demolition and Excavations and Claron Consulting, as per our agreement for providing environmental services. Only AMJ Demolition and Excavations and Claron Consulting is entitled to rely upon the findings in the report within the scope of work described in this report. Otherwise, no responsibility is accepted for the use of any part of the report by another in any other context or for any other purpose.

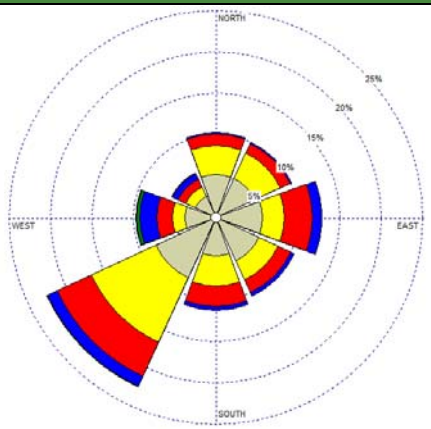
Although all due care has been taken in the preparation of this study, no warranty is given, nor liability accepted (except that otherwise required by law) in relation to any of the information contained within this document. We accept no responsibility for the accuracy of any data or information provided to us by AMJ Demolition and Excavations and Claron Consulting for the purposes of preparing this report.

Any opinions and judgements expressed herein, which are based on our understanding and interpretation of current regulatory standards, should not be construed as legal advice.

ATTACHMENTS

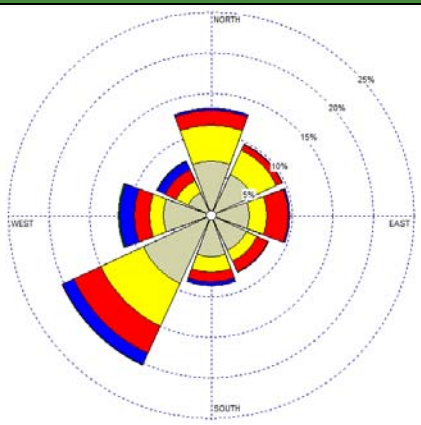
Attachment 1: Comparison of Annual Average Windroses From Badgerys Creek AWS Meteorological Data From 2012, 2014-2017

2017



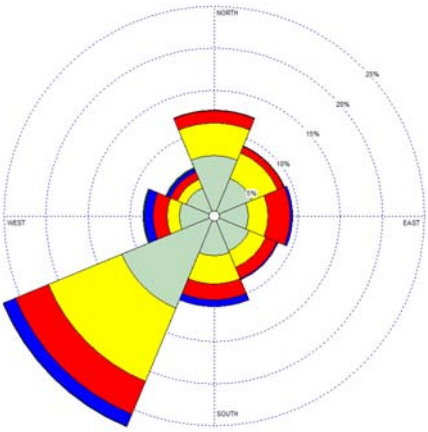
Average Wind Speed: 2.54 m/s
Calms Frequency: 7.12%
Axis Frequencies: : 5%, 10%, 15%, 20%, 25%

2016



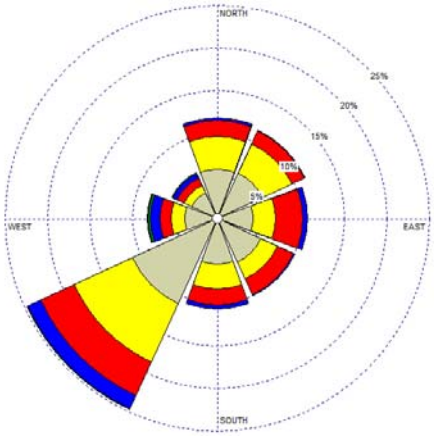
Average Wind Speed: 2.39 m/s
Calms Frequency: 5.67%
Axis Frequencies: 5%, 10%, 15%, 20%, 25%

2015



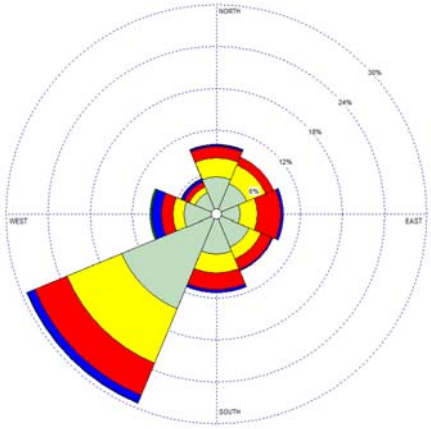
Average Wind Speed: 2.34 m/s
Calms Frequency: 7.06%
Axis Frequencies: 5%, 10%, 15%, 20%, 25%

2014

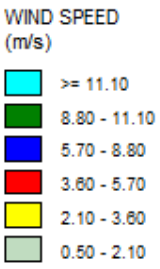


Average Wind Speed: 2.44 m/s
Calms Frequency: 6.10%
Axis Frequencies: : 5%, 10%, 15%, 20%, 25%

2012



Average Wind Speed: 2.34 m/s
Calms Frequency: 7.55%
Axis Frequencies: 6%, 12%, 18%, 24%, 30%



Proposed Resource Recovery Facility
55 Martin Road, Badgerys Creek
COMMUNITY INFORMATION SHEET

AMJ Demolition & Excavations is proposing a resource recovery facility to be located at 55 Martin Road, Badgerys Creek. The land is located in the Liverpool Local Government Area in Sydney's West and is a primary production area. An Environmental Impact Statement (EIS) for the proposal is currently being prepared for submission to Liverpool City Council. The EIS will be exhibited for a designated 30 day period, at which time the community are invited to make submissions.

About AMJ Demolition & Excavations

AMJ Demolition & Excavations is a business trading under its parent company, Antoun's Construction which was formed to take on work in the demolition and excavation industry. Antoun's Construction Pty Ltd is a family owned and operated business and has been providing services for over 10 years in various applications in the construction industry. With their experience, knowledge and professionalism, AMJ Demolition and Excavations have expanded into different fields of the construction industry.

Project Benefits

The project would provide a number of benefits including preventing construction and demolition waste entering landfill, improving efficiency, making the process less labour intensive and enabling production of higher quality products. It would also allow workers to undertake the majority of their job under cover. In addition, housing operations within buildings would reduce noise and dust emissions from these processes.

The Proposed Site

The site is located at 55 Martin Road, Badgerys Creek. The land is approximately 2.5 hectares in area and is rectangular in shape. The site is located with frontage to Martin Road while Lawson Road is the site boundary to the west.

Figure 1: Site Location (Source: Google Maps)

The Proposed Development

AMJ Demolition & Excavations propose to construct a facility which will receive, handle and process construction and demolition waste as well as green waste. The amount of waste processed is estimated to be approximately 95,000 tonnes per year.

Figure 2: Trees on the south-western boundary, Lawson Road frontage

The Manufacturing Process

The operation of the facility involves the following activities to be undertaken on site:

- Unloading and loading of materials;
- Material handling and sorting;
- Crushing and screening of concrete, bricks, untreated timber and similar waste materials;
- Shredding of green garden waste; and
- Material storage.

Wastes to be accepted on site are typical building materials, including bricks, concrete, timber, glass, metal, as well as garden waste, soil and general solid waste (non-putrescible). The quantity for each material may vary significantly depending on the source that generated the waste. Nevertheless, all incoming material will be unloaded and sorted within the processing shed. Concrete bricks and similar waste would be crushed and screened within the processing shed. Timber and green garden waste would also be shredded and screened within the processing shed.

Processed waste would be stored in the undercover storage bays for re-selling, either directly from site to trade clients or to a landscape supply outlet offsite. Any waste that is not suitable for resource recovery will be collected by licensed waste contractor for final disposal to landfill.

Proposed Resource Recovery Facility
55 Martin Road, Badgerys Creek
COMMUNITY INFORMATION SHEET

Environmental Considerations

The environment will be carefully considered at each stage of planning. Primary environmental issues that will be addressed in the EIS include:

- Waste Management – the facility uses construction and demolitions waste as a raw material and process the waste for reuse or further recycling. This waste would otherwise be sent to landfill.
- Air Quality – the operations generate dust emissions during processing and stockpiling. A dust impact assessment would be conducted to NSW EPA Guidelines.
- Soil and Water – the minor excavations proposed are unlikely to intercept acid sulphate soils or other contaminants. Stringent environmental safeguards will be put in place to minimise the potential for pollution to waters during construction and operation.
- Noise – noise during construction and operation would be assessed in the EIS and controls recommended to ensure noise limits are adhered to. Daytime hours would be worked with no production activities on Sundays or Public Holidays.
- Traffic and Transport – increased traffic would be associated with the construction and operations. This increase and mitigation measures would be assessed in a traffic assessment in the EIS.
- Fire and Risk – environmental protection equipment would be installed at the premises to minimise the fire risk.
- Visual Amenity – the new buildings would be the main issue in regards to visual amenity of the area, however these would be designed to be similar in size and nature to structures that exist nearby so that the development would not differ significantly from other uses in the area. An extensive landscaping program would be implemented with tree plantings along the boundaries to improve the appearance of the site.
- Flora and Fauna – a flora and fauna study would address threatened species, populations or ecological communities and their habitats should they exist at the site. An Arboriculture Impact Assessment would be prepared to evaluate the trees on site.

Figure 3: Trees on the Martin Road frontage

The environmental impacts of the processes would be reduced with specific processes being undertaken within a building. Environmental safeguards and controls would be designed into the facility to ensure impacts on the environment are minimised.

For More Information

For further information contact Benbow Environmental on (02) 9890 5099 or email admin@benbowenviro.com.au.

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NOISE IMPACT ASSESSMENT
FOR AMJ DEMOLITION AND EXCAVATION
55 MARTIN ROAD, BADGERYS CREEK

Prepared for: AMJ Demolition and Excavation Pty Ltd
Claron Consulting

Prepared by: Peter Gangemi, Acoustical Engineer
R T Benbow, Principal Consultant

Report No: 171127_NIA_Rev3
March 2018
(Released: 22 March 2018)

Benbow
ENVIRONMENTAL

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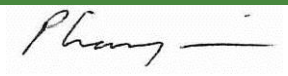
DOCUMENT CONTROL

Prepared by:	Position:	Signature:	Date:
Peter Gangemi	Acoustical Engineer		22 March 2018

Reviewed by:	Position:	Signature:	Date:
Emma Hansma	Environmental Engineer		22 March 2018

Approved by:	Position:	Signature:	Date:
R T Benbow	Principal Consultant		22 March 2018

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EXECUTIVE SUMMARY

This document presents a noise impact assessment conducted by Benbow Environmental for the proposed resource recovery facility located at 55 Martin Road, Badgerys Creek. The amount of waste to be processed is estimated to be approximately 95,000 tonnes per year.

The nearest receivers and the noise generating activities have been identified. Noise criteria for the project have been formed, with assessment of the proposed site activities conducted against the NSW Noise Policy for Industry (EPA, 2017), NSW Interim Construction Noise Guideline (DECC, 2009) and the NSW Road Noise Policy (DECCW, 2011). Modelling of the activities was conducted using the noise modelling software SoundPlan 7.3.

This noise impact assessment finds that predicted noise levels will be below the criteria set out in accordance with the NSW Noise Policy for Industry, at all receivers and time periods. Recommendations for noise controls are given in section 7.3, including sound power levels for the front end loader, perimeter fencing, equipment and automated roller doors usage.

The generation of additional road traffic associated with the site's activities has been assessed and it was predicted to comply with the guidelines set out in the NSW Road Noise Policy.

Construction activities are recommended to be limited to standard hours in accordance with the Interim Construction Noise Guideline.

This report concludes that following the carrying out of the recommendations in this report, the proposed site activities will have an acceptable noise impact on the surrounding receivers.

Contents

Tables Page

Figures

Page

Attachments

1. INTRODUCTION

Benbow Environmental has been engaged to undertake a noise impact assessment for the proposed resource recovery facility at 55 Martin Road, Badgerys Creek.

The site is located within a RU1 Primary Production Zoning in Badgerys Creek, within Liverpool City Council. The nearest residential receptors are located approximately adjacent to the northern boundary of the site.

Operations at the site would consist of trucks unloading Construction and Demolition (C&D) waste, including soil (VENM/ENM) and green waste (only garden waste). The amount of waste to be processed is estimated to be approximately 95,000 tonnes per year.

Noise emissions from the site were predicted by using noise modelling software, SoundPlan (V7.3).

This noise impact assessment has been prepared in accordance with the following guidelines and documents:

- NSW Environment Protection Authority (EPA), Noise Policy for Industry 2017;
- Department of Environment, Climate Change and Water (DECCW) NSW, Road Noise Policy (RNP) 2011; and
- Department of Environment and Climate Change (DECC) NSW, Interim Construction Noise Guideline (ICNG) 2009.

1.1 SCOPE OF WORKS

This noise impact assessment has been limited to the following scope of works:

- Site inspection and review of the proposed site operations;
- Long term unattended noise monitoring and short term attended noise monitoring in accordance with relevant guidelines;
- Establish project specific noise levels;
- Determine all potential noise sources associated with the existing and proposed development;
- Collect required noise sources data;
- Predict potential noise impacts at the nearest potentially affected receptors to the site;
- Assess potential noise impacts against relevant legislation and guidelines;
- Recommend general ameliorative measures/control solutions (where required); and
- Compile this report with concise statements of potential noise impact.

To aid in the review of this report, supporting documentation has been referenced within this report. A glossary of terminology is included in Attachment 1.

2. PROPOSED DEVELOPMENT

2.1 OVERVIEW OF OPERATIONS

The proponent is seeking to establish a resource recovery facility at 55 Martin Road, Lot 4 DP 611519. The following is to be constructed on the site:

- Unloading and processing shed;
- Five storage bays;
- Weighbridge and wheel wash; and
- Car park and landscaped area.

Trucks will enter the site from Lawson Street, and unload materials in the unloading and processing shed. Materials are handled and sorted, concrete will be crushed and green waste will be shredded inside the shed. Sorted concrete, bricks, untreated timber and shredded green garden waste are stockpiled on site.

Recovered materials would be stored in the external storage bays for re-selling, either directly from site to trade clients or to a landscape supply outlet offsite. Any processed waste that is not suitable for resource recovery will be collected by a licensed waste contractor for final disposal to landfill.

The majority of stationary noise sources, including the screen and crusher are located inside the building. Mobile equipment such as trucks, excavators and loaders may be located outside the building. Truck movements per day include 10 x 15 tonne truck trips and 6 x 32 tonne truck trips, or a maximum of 2 truck trips per hour.

2.2 HOURS OF OPERATIONS

The resource recovery facility is proposed to operate from Monday to Friday 7am to 6pm and Saturday from 7am to 5pm. The site is not proposed to operate on Sundays or Public Holidays.

2.3 DESCRIPTION OF THE PROPOSAL

2.3.1 Site Description

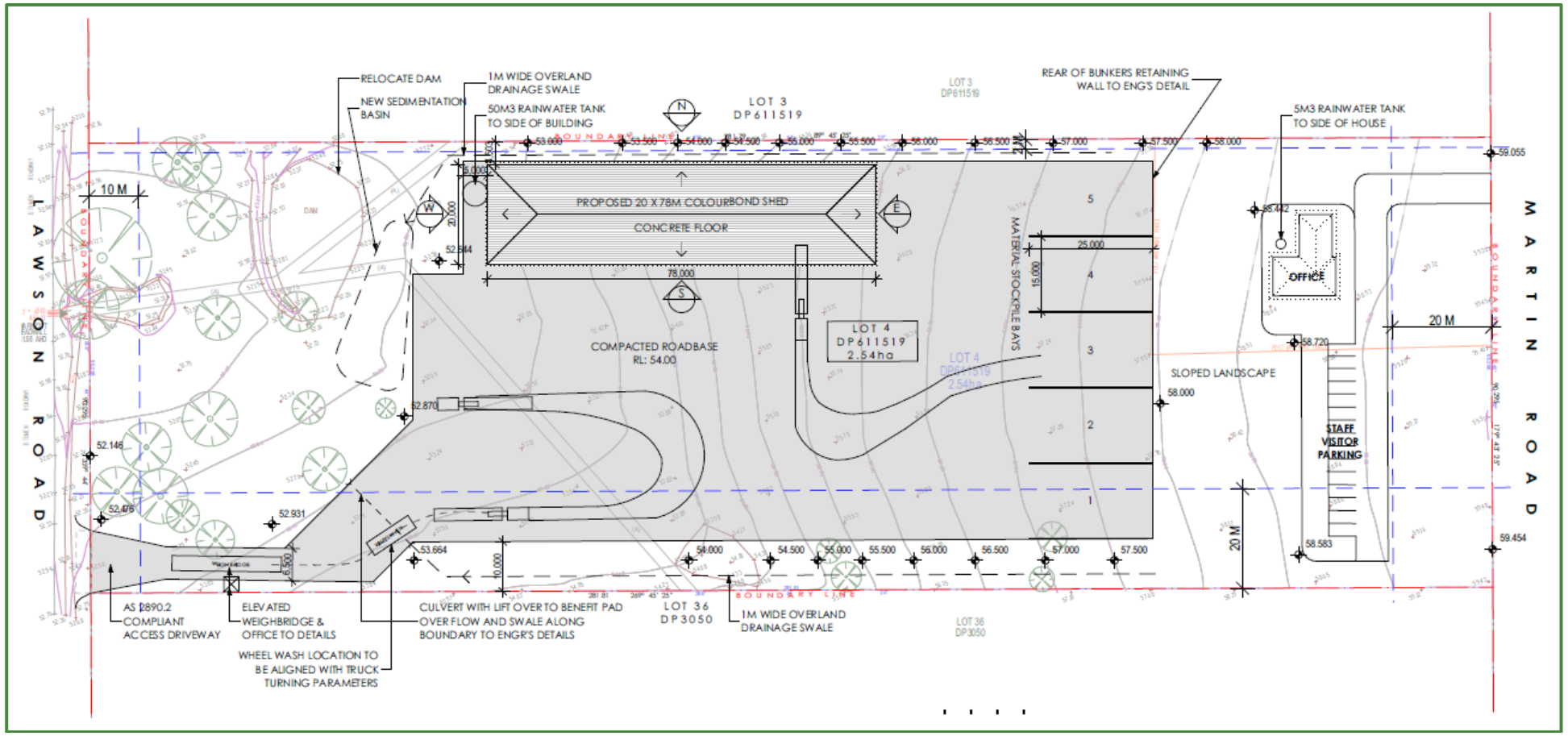
The proposal site is located at 55 Martin Road, Badgerys Creek. The block is rectangular shaped and 25,400 m^2 in size. A brick building is located on the eastern end of the property. The land and surrounds is zoned RU1 Primary Production in the Liverpool Council Local Environment Plan 2008.

An unloading and processing shed is proposed to be located on the northern boundary of the property. Trucks are proposed to enter and exit the site from Lawson Road. A weighbridge is to be located on the western edge of the property off Lawson Road, and a wheel wash is located further up the driveway, in alignment with truck turning parameters.

Cars are proposed to enter and exit the site from Martin Road, driving into a new carpark between the existing brick building and Martin Road.

A site layout plan of the 55 Martin Road property is shown in Figure 2-1.

Figure 2-1: Site Layout



2.3.2 Process Description

The processes involved in the sorting operations are as follows:

- Trucks drive to the site with waste materials from construction and demolition sites, entering the property from western access point off Lawson Road.
- Trucks arrive on site at a rate of sixteen per day (sixteen truck movements entering the site and sixteen truck movements exiting the site).
- Trucks drive into the unloading and processing shed and unload materials in the holding area.
- Green waste, concrete and timber are separated from the waste stream.
- Concrete is crushed and screened.
- Sorted materials are loaded to the materials stockpile area by excavator. Materials are sorted into bricks, concrete, timber, glass, metal, as well as garden waste and soil (VENM/ENM).
- Products are either exported from site by truck, or sold on location.

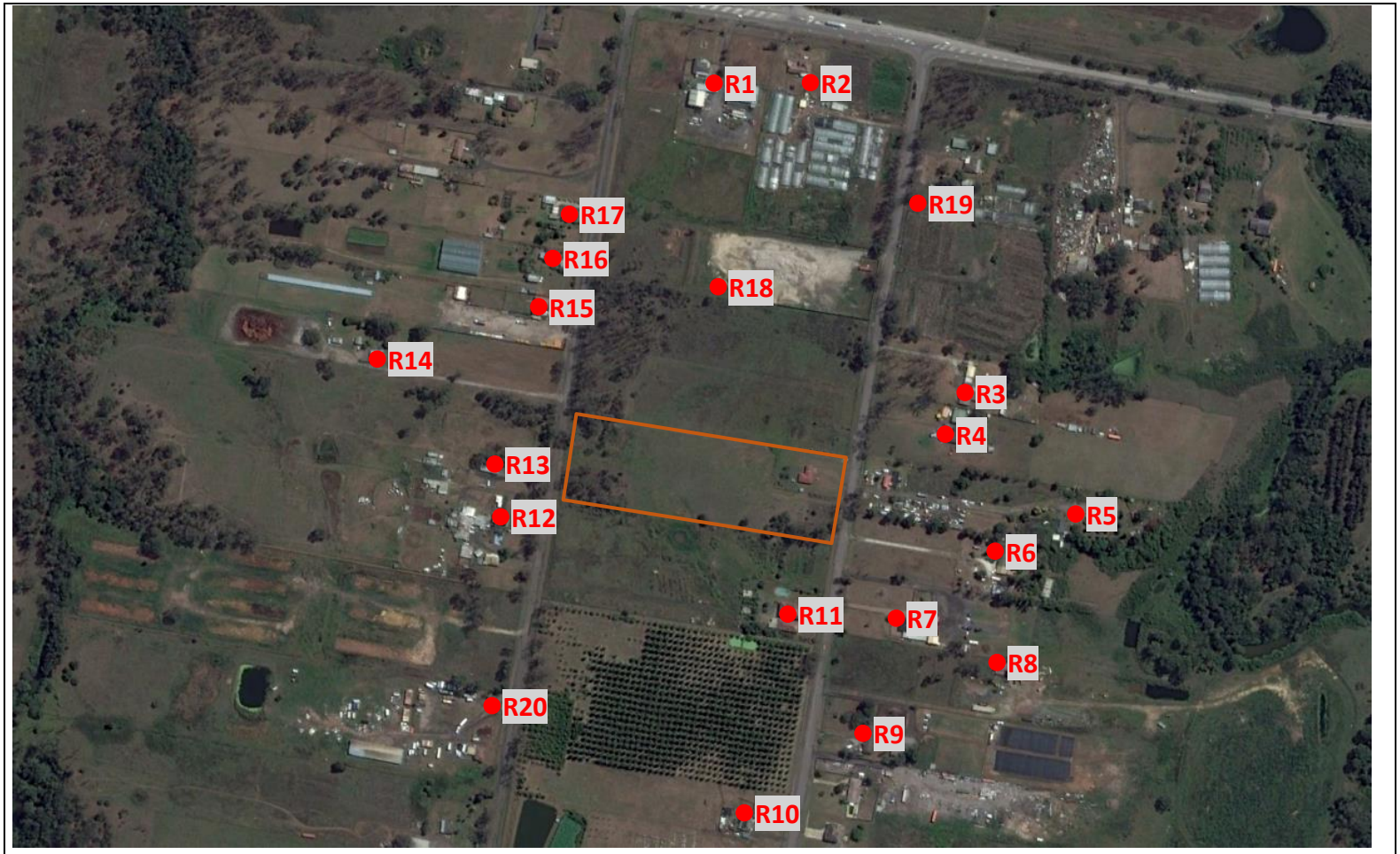
3. NEAREST SENSITIVE RECEPTORS

Table 3-1 identifies the nearest sensitive receptors that have the potential to be affected by the proposal. The aerial photographs of the sensitive residential and non-residential receivers are shown in Figure 3-1. These receptors were selected based on their proximity and directional bearing from the subject site.

Table 3-1: Residential and Non-Residential Receivers

Receptor ID	Address	Lot & DP	Approx. Distance from Proposed Development	Type of Receptor
R1	1990 Elizabeth Drive, Badgerys Creek	Lot 10 DP 860338	370 m N	Residential
R2	1970 Elizabeth Drive, Badgerys Creek	Lot 11 DP 860338	370 m N	Residential
R3	30 Martin Road, Badgerys Creek	Lot 8 DP 226448	150 m NE	Residential
R4	40 Martin Road, Badgerys Creek	Lot 7 DP 226448	110 m NE	Residential
R5	50 Martin Road, Badgerys Creek	Lot 6 DP 226448	50 m E	Residential
R6	60 Martin Road, Badgerys Creek	Lot 5 DP 226448	170 m E	Residential
R7	70 Martin Road, Badgerys Creek	Lot 4 DP 226448	130 m SE	Residential
R8	80 Martin Road, Badgerys Creek	Lot 2 DP 530595	220 m SE	Residential
R9	90 Martin Road, Badgerys Creek	Lot 2 DP 226448	210 m SE	Residential
R10	75 Martin Road, Badgerys Creek	Lot 34 DP 3050	290 m S	Residential
R11	65 Martin Road, Badgerys Creek	Lot 36 DP 3050	Adjacent S	Residential
R12	83-87 Lawson Road, Badgerys Creek	Lot 6 DP 3050	70 m SW	Residential
R13	75 Lawson Road, Badgerys Creek	Lot 5 DP 3050	70 m W	Residential
R14	65 Lawson Road, Badgerys Creek	Lot 1 DP 104049	200 m W	Residential
R15	55 Lawson Road, Badgerys Creek	Lot 1 DP 1084967	110 m NW	Residential
R16	45 Lawson Road, Badgerys Creek	Lot 14 DP 531743	170 m NW	Residential
R17	35 Lawson Road, Badgerys Creek	Lot 13 DP 531743	200 m NW	Residential
R18	25 Martin Road, Badgerys Creek	Lot 1 DP 611519	150 m N	Industrial
R19	10 Martin Road, Badgerys Creek	Lot 10 DP 226448	270 m NE	Industrial
R20	105 Lawson Road, Badgerys Creek	Lot 8 DP 3050	220 m SW	Industrial

Figure 3-1: Residential and Non-Residential Receptors



↑N	LEGEND: Site Receptor ●	Benbow Environmental 13 Daking Street, North Parramatta NSW 2151

4. EXISTING ACOUSTIC ENVIRONMENT

The level of background and ambient noise is assessed separately for the daytime, evening and night time assessment periods. The NSW EPA Noise Policy for Industry defines these periods as follows:

- **Day** is defined as 7.00am to 6.00pm, Monday to Saturday and 8.00am to 6.00pm Sundays and Public Holidays;
- **Evening** is defined as 6.00pm to 10.00pm, Monday to Sunday and Public Holidays; and
- **Night** is defined as 10.00pm to 7.00am, Monday to Saturday and 10.00pm to 8.00am Sundays and Public Holidays.

Unattended long-term noise monitoring was undertaken from 29th September 2017 to 10th October 2017 at two (2) residential locations.

4.1 NOISE MONITORING EQUIPMENT AND METHODOLOGY

The background noise level measurements were carried out using a Svantek SVAN 957 Precision Sound Level Meter (attended noise monitoring) and two (2) Acoustic Research Laboratories statistical Environmental Noise Loggers, type EL-215 (unattended noise monitoring). The instrument sets complied with AS IEC 61672.1–2004 and were calibrated by a NATA accredited laboratory within two years of the measurement period. Calibration certificates have been included in Attachment 2.

Measurements of background and ambient noise levels were carried out in accordance with the Australian Standard AS 1055–1997 *Acoustics – Description and measurements of environmental noise* – Part 1 and Part 2 and the Noise Policy for Industry (EPA, 2017).

To ensure accuracy and reliability in the results, field reference checks were applied both before and after the measurement period with an acoustic calibrator. There were no excessive variances observed in the reference signal between the pre-measurement and post-measurement calibration. The instruments were set on A-weighted Fast response and noise levels were measured over 15-minute statistical intervals. QA/QC procedures applied for the measurement and analysis of noise levels have been presented in Attachment 3. The microphones were fitted with windsocks and were positioned between 1.2 and 1.5 metres above ground level.

In assessing the background noise levels, any data affected by adverse weather conditions has been discarded according to the requirements of the Noise Policy for Industry. The weather data was sourced from the Bureau of Meteorology Automatic Weather Station (AWS) located at Badgerys Creek (ID 067108).

Details of the instrumentation and setting utilised are provided in Table 4-1.

Table 4-1: Instrumentation and Setup Details

Type of Monitoring	Equipment	Serial Number	Setup Details
Long-term Unattended	ARL-215	194441	A-weighted Fast Response 15 minute integration period
Long-term Unattended	ARL-215	194552	A-weighted Fast Response 15 minute integration period
Short-term Attended	Svantek SVAN957 Type 1 Integrating Sound and Vibration analyser	15336	Three channels: A-weighted Fast Response C-weighted Fast Response A-weighted Impulse Response 15 minute integration period 1/3 octave band recorded every 100 ms Logger file Recorded at steps of 100 ms

4.2 MEASUREMENT LOCATIONS

The environmental noise loggers were utilised to measure the existing ambient and background noise levels. Unattended long-term noise monitoring was undertaken from 29th September 2017 to 10th October 2017 at two (2) residential locations. The monitoring locations were selected, to represent the closest receivers off Martin Road and Lawson Road.

Attended noise monitoring was undertaken on 29th September 2017.

The noise logger locations are shown in Figure 4-1 and listed in Table 4-2. Noise logger charts are presented in Attachment 4.

Table 4-2: Noise Monitoring Locations

Monitoring Location	Methodology	Address
A	Attended monitoring and unattended monitoring	55 Martin Road, Badgerys Creek
B	Attended monitoring and unattended monitoring	83-87 Lawson Road, Badgerys Creek

Figure 4-1: Logger Locations

Table 4-3 identifies the receptor locations that have been associated with the two (2) noise logger locations and will therefore utilise the noise criteria derived from the measurement data obtained from the respective noise logger.

Table 4-3: Associated Residential Receptors

Logger	Associated Residential Receptor Locations
A	R1-R11
B	R12-R17

4.3 MEASURED NOISE LEVELS

4.3.1 Long-Term Unattended Noise Monitoring Results

The data was analysed to determine a single assessment background level (ABL) for each day, evening and night time period, in accordance with the Noise Policy for Industry. That is, the ABL is established by determining the lowest tenth-percentile level of the L_{A90} noise data over each period of interest. The background noise level or rating background level (RBL) representing the day, evening and night assessment periods is based on the median of individual ABL's determined over the entire monitoring period. The results of the long-term unattended noise monitoring are displayed in Table 4-4.

Existing road noise levels are presented in Table 4-5.

Table 4-4: Unattended Noise Monitoring Results, dB(A)

Monitoring Location and associated receptors	Assessment Background Level ABL (L_{90})			Equivalent Ambient Noise Level L_{eq}		
	Day	Evening	Night	Day	Evening	Night
Logger A	37	33	29	50	46	47
Logger B	37	35	30	51	49	48

Table 4-5: Road Traffic Noise Data at Locations A and B

Date	Existing Road Traffic Noise – dB(A)			
	Daytime (7am to 10pm)		Night-time (10pm to 7am)	
	$L_{eq\ (15\ hour)}$	$L_{eq\ (1\ hour)}$	$L_{eq\ (9\ hour)}$	$L_{eq\ (1\ hour)}$
Logger A	51	52	45	48
Logger B	51	52	45	49

4.3.2 Short Term Operator Attended Noise Monitoring Results

Given that the results of the unattended noise monitoring are affected by all ambient noise sources such as local fauna, road traffic and industrial sources, it is not possible to determine with precision the contribution of each component based on unattended monitoring alone. Therefore, the attended noise monitoring allows for a more detailed understanding of the existing ambient noise characteristics and a more meaningful final analysis to be undertaken. The results of the short-term attended noise monitoring are displayed in Table 4-6.

The attended measurements showed that the background noise levels consisted of traffic from Elizabeth Drive, birds and trees rustling in the wind. Ambient noise levels were dominated by vehicles on Martin Road and Lawson Road, aeroplanes and surrounding industrial noise.

Table 4-6: Operator Attended Noise Measurements, dB(A)

Location & Date/Time	L_{Aeq}	L_{A90}	L_{A10}	L_{A1}	Comments
Location A Friday 29/09/2017 12:55 Daytime Period	61	38	59	81	Cars Martin Road < 74 dB(A) Trucks Martin Road < 83 dB(A) Background traffic Elizabeth Drive < 35 dB(A) **Distant fan < 30 dB(A)** Birds in trees < 45 dB(A) Wind in trees < 35 dB(A) Dog barking < 44 dB(A) Aeroplane < 58 dB(A) **Tractor < 40 dB(A), 90 seconds** **Distant excavator < 30 dB(A), 30 seconds** **Estimated L_{Aeq} noise level from industrial sources = 31 dB(A)**
Location B Friday 29/09/2017 12:28 Daytime Period	53	38	54	65	Cars Lawson Road < 68 dB(A) Trucks Lawson Road < 75 dB(A) Background traffic Elizabeth Drive < 32 dB(A) **Truck revving < 35 dB(A), 10 seconds** Birds < 55 dB(A) Light wind in trees < 40 dB(A) Aeroplane < 56 dB(A) **Industrial scraping/banging < 40 dB(A), 2 minutes** **Estimated L_{Aeq} noise level from industrial sources = 31 dB(A)**

5. METEOROLOGICAL CONDITIONS

Wind and temperature inversions may affect the noise impact at the receptors. Therefore noise enhancing weather conditions should be assessed when wind and temperature inversions are considered to be a feature of the area.

A site-representative meteorological data file was obtained from the Bureau of Meteorology (BOM) for the Badgerys Creek Automatic Weather Station (AWS ID 067108). At the time of preparing this report, the last full year of data available is 2016, and was therefore considered appropriate.

5.1 WIND EFFECTS

Wind is considered to be a feature where source-to-receiver wind speeds (at 10 m height) of 3 m/s or below occur for 30% or more of the time in any assessment period in any season.

5.1.1 Wind Rose Plots

Wind rose plots show the direction that the wind is coming from, with triangles known as "petals". The petals of the plots in the figures summarise wind direction data into 8 compass directions i.e. north, north-east, east, south-east, etc. The length of the triangles, or "petals", indicates the frequency that the wind blows from that direction. Longer petals for a given direction indicate a higher frequency of wind from that direction. Each petal is divided into segments, with each segment representing one of the six wind speed classes.

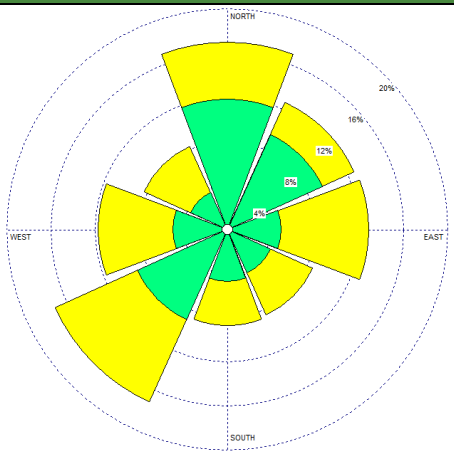
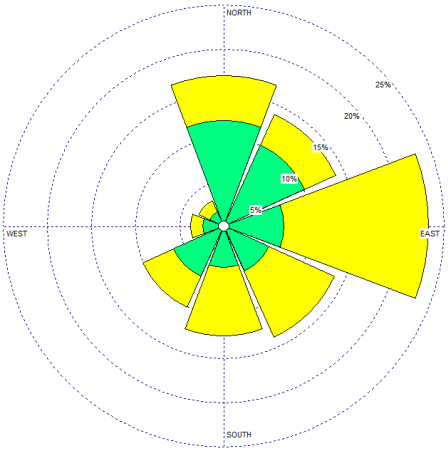
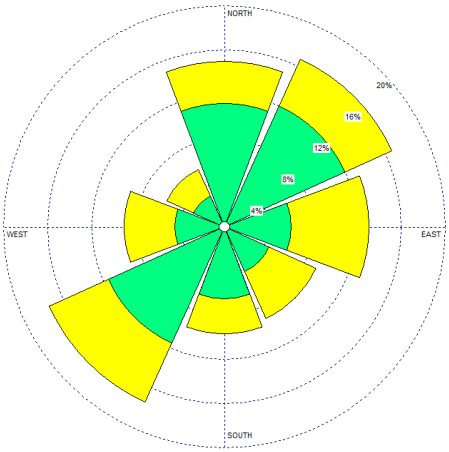
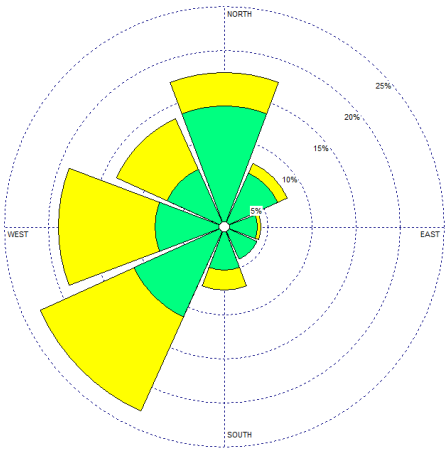
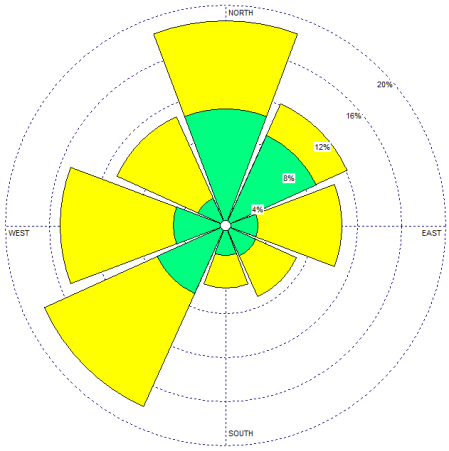
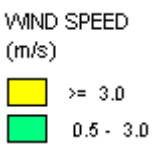
Thus, the segments of a petal show what proportion of wind for a given direction falls into each class. The proportion of time for which wind speed is less than 0.5 m/s, when speed is negligible, is referred to as calm hours or "calms". Calms are not shown on a wind rose as they have no direction, but the proportion of time consisting of the period under consideration is noted under each wind rose.

The concentric circles in each wind rose are the axis, which denote frequencies. In comparing the plots it should be noted that the axis varies between wind roses, although all wind roses are similar in size. The frequencies denoted on the axes are indicated beneath each wind rose.

5.1.2 Local Wind Trends

Seasonal wind rose plots for this site utilising Badgerys Creek AWS data have been included in Figure 5-1.

Figure 5-1: Wind Rose Plots – BOM Badgerys Creek AWS ID 067108 2016 – Day time

All Seasons	Summer Season (December – February)
	
Average Wind Speed: 3.01 m/s Axis Frequencies: 4%, 8%, 12%, 16%, 20%	Average Wind Speed: 3.00 m/s Axis Frequencies: 5%, 10%, 15%, 20%, 25%
Autumn Season (March – May)	**Winter Season (June – August)**
	
Average Wind Speed: 2.58 m/s Axis Frequencies: 4%, 8%, 12%, 16%, 20%	Average Wind Speed: 2.84 m/s Axis Frequencies: 5%, 10%, 15%, 20%, 25%
Spring Season (September – November)	**Legend**
	
Average Wind Speed: 3.62m/s Axis Frequencies: 4%, 8%, 12%, 16%, 20%	

Based on the information presented from the weather data, source-to receiver wind speeds of 3 m/s or below are present for less than 30% of the time therefore wind effects have not been included in the assessment.

5.2 TEMPERATURE INVERSIONS

Operations are to take place during the day period, Monday to Friday 7am to 6pm and Saturday from 7am to 5pm. As the night period is not being utilised, temperature inversions are therefore not considered any further.

5.2.1 Weather Conditions Considered in the Assessment

The following conditions will be considered in this noise impact assessment considered:

- Condition A: Neutral Weather Conditions.

Details of the considered meteorological conditions have been displayed in Table 5-1.

Table 5-1: Meteorological Conditions Assessed in Noise Propagation Modelling

Condition	Classification	Ambient Temp.	Ambient Humidity	Wind Speed	Wind Direction (blowing from)	Temperature Inversion	Affected Receiver	Applicability
A	Neutral	10 °C	70%	-	-	No	All	All periods

6. CURRENT LEGISLATION AND GUIDELINES

6.1 NSW EPA NOISE POLICY FOR INDUSTRY

The NSW Noise Policy for Industry was developed by the NSW EPA primarily for the assessment of noise emissions from industrial sites regulated by the NSW EPA.

The policy sets out two components that are used to assess potential site-related noise impacts. The intrusiveness noise level aims at controlling intrusive noise impacts in the short-term for residences. The amenity noise level aims at maintaining a suitable amenity for particular land uses including residences in the long-term. The more stringent of the intrusiveness or amenity level becomes the project noise trigger levels for the project.

6.1.1 Project Intrusiveness Noise Level

The project intrusiveness noise level is determined as follows:

$L_{Aeq,\ 15\ minute}$ = rating background noise level + 5 dB

Where the $L_{Aeq,(15minute)}$ is the predicted or measured L_{Aeq} from noise generated within the project site over a fifteen minute interval at the receptor.

This is to be assessed at the most affected point on or within the residential property boundary or if that is more than 30 m from the residence, at the most affected point within 30 m of the residential dwelling.

6.1.2 Amenity Noise Level

To limit continuing increases in noise levels, the maximum ambient noise level within an area from industrial noise sources should not normally exceed the acceptable noise levels specified in Table 2.2 of the NSW Noise Policy for Industry 2017. The relevant recommended noise levels applicable are reproduced in Table 6-1.

Table 6-1: Amenity noise levels.

Receiver	Noise Amenity Area	Time of Day	L_{Aeq} dB(A) Recommended amenity noise level
Residential	Rural	Day	50
		Evening	45
		Night	40
Industrial	All	When in use	70

Source: Table 2.2 NSW Noise Policy for Industry

The project amenity noise level for industrial developments = recommended amenity noise level minus 5 dB(A)

The following exceptions to the above method to derive the project amenity noise levels apply:

1. *In areas with high traffic noise levels*
2. *In proposed developments in major industrial clusters*
3. *Where the resultant project amenity noise level is 10 dB or more lower than the existing industrial noise level. In this case the project amenity noise levels can be set at 10 dB below existing industrial noise levels if it can be demonstrated that existing industrial noise levels are unlikely to reduce over time.*
4. *Where cumulative industrial noise is not a necessary consideration because no other industries are present in the area, or likely to be introduced into the area in the future. In such cases the relevant amenity noise level is assigned as the project amenity noise level for development.*

This development is not considered to be captured by the above exceptions.

6.1.3 Sleep Disturbance Criteria

In accordance with the NSW EPA Noise Policy for Industry, the potential for sleep disturbance from maximum noise level events from premises during the night-time period needs to be considered. Sleep disturbance is considered to be both awakenings and disturbance to sleep stages.

Where the subject development/premises night-time noise levels at a residential location exceed:

- **$L_{Aeq,\ 15\ minute}$ 40 dB(A) or the prevailing RBL plus 5 dB, whichever is the greater, and/or**
- **L_{AFmax} 52 dB(A) or the prevailing RBL plus 15 dB, whichever is the greater,**

A detailed maximum noise level assessment should be undertaken.

The development is not proposed to operate during the night period, and therefore a sleep disturbance assessment is not considered warranted.

6.1.4 Project Noise Trigger Levels

The project noise trigger levels for the site have been established in accordance with the principles and methodologies of the NSW Noise Policy for Industry (EPA, 2017).

Table 6-2 below presents the rating background level, project intrusive noise level, recommended amenity noise level, and project amenity noise level. The project noise trigger level is the lowest value of intrusiveness or project amenity noise level after conversion to $L_{Aeq\ 15\ minute}$, dB(A) equivalent level.

Different time periods apply for the noise criteria as the intrusive criterion considers a 15 minute assessment period while the amenity criterion requires assessment over the total length of time that a site is operational within each day, evening or night period. In order to ensure compliance under all circumstances, a 15 minute period assessment has been considered for all receptors.

Table 6-2: Project Noise Trigger Levels (PNTL) for Operational Activities, dB(A)

Receiver	Type of Receptor	Time of day	Rating background noise level	Project intrusiveness noise level ($L_{eq(15\ minute)}$)	Recommended amenity noise level $L_{Aeq\ period}$	Project amenity noise level $L_{Aeq\ 15\ minute}$ [2]	PNTL $L_{Aeq\ 15\ minute}$
R1-R11	Residential - Rural	Day	37	**42**	50	48	**42**
		Evening	33	**38**	45	43	**38**
		Night	30	**35**[1]	40	38	**35**
R12-R17	Residential - Rural	Day	37	**42**	50	48	**42**
		Evening	35	**40**	45	43	**40**
		Night	30	**35**	40	38	**35**
R18-R20	Industrial	When in use	-	-	70	68	**68**

Notes:
1) This value is based on the minimum assumed rating background level of 30 dB(A) for night time.
2) These levels have been converted to $L_{Aeq\ 15\ minute}$ using the following: $L_{Aeq\ 15\ minute} = L_{Aeq\ period} + 3$ dB (NSW Noise Policy for Industry Section 2.2).

6.2 NSW EPA Road Noise Policy

The NSW Road Noise Policy (RNP) has been adopted to establish the noise criteria for the potential noise impact associated with additional traffic generated by the proposal. The RNP was developed by the NSW EPA primarily to identify the strategies that address the issue of road traffic noise from:

- Existing roads;
- New road projects;
- Road redevelopment projects; and
- New traffic-generating developments.

6.2.1 Vehicle Route

Trucks and proposed to access the site from Lawson Road. Light vehicles are proposed to access the site from Martin Road. Both Lawson Road and Martin Road are accessed from the sub-arterial road, Elizabeth Drive. The proposed transport routes are shown in Figure 6-1. The potentially most impacted residents to the proposed route are located along Lawson Road and Martin Road, between Elizabeth Drive and the subject site.

Figure 6-1: Proposed Transport Route

6.2.2 Road Category

Based on the RNP road classification description, Martin Road and Lawson Roads would be classified as a 'local roads'.

6.2.3 Noise Assessment Criteria

Section 2.3 of the RNP outlines the criteria for assessing road traffic noise. The relevant section of Table 3 of the RNP is shown in Table 6-3.

Table 6-3: Road Traffic Noise Assessment Criteria For Residential Land Uses, dB(A)

Road Category	Type of Project/Land Use	Assessment Criteria, dB(A)	
		Day (7am-10pm)	Night (10pm-7am)
Local roads	6. Existing residences affected by additional traffic on existing local roads generated by land use developments	$L_{Aeq\ (1\ hour)}$ 55 dB (external)	$L_{Aeq\ (1\ hour)}$ 50 dB (external)

* measured at 1 m from a building façade.

6.2.4 Relative Increase Criteria

In addition to the assessment criteria outlined above, any increase in the total traffic noise level at a location due to a proposed project or traffic-generating development must be considered. Residences experiencing increases in total traffic noise levels above the relative criteria should also be considered for mitigation as described in Section 3.4 of the RNP. For road projects where the main subject road is a local road, the relative increase criterion does not apply.

As both Lawson Road and Martin Road are local roads, the relative increase criterion will not be further considered.

6.2.5 Assessment Locations for Existing Land Uses

Table 6-4: Assessment Locations for Existing Land Uses

Assessment Type	Assessment Location
External noise levels at residences	The noise level should be assessed at 1 metre from the façade and at a height of 1.5 metres from the floor. Separate noise criteria should be set and assessment carried out for each façade of a residence, except in straightforward situations where the residential façade most affected by road traffic noise can be readily identified. The residential noise level criterion includes an allowance for noise reflected from the façade ('façade correction'). Therefore, when taking a measurement in the free field where reflection during measurement is unlikely (as, for instance, when measuring open land before a residence is built), an appropriate correction – generally 2.5 dB – should be added to the measured value. The 'façade correction' should not be added to measurements taken 1 metre from the façade of an existing building. Free measurements should be taken at least 15 metres from any wall, building or other reflecting pavement surface on the opposite side of the roadway, and at least 3.5 metres from any wall, building or other pavement surface, behind or at the sides of the measurement point which would reflect the sound.
Noise levels at multi-level residential buildings	The external points of reference for measurement are the two floors of the building that are most exposed to traffic noise. On other floors, the internal noise level should be at least 10 dB less than the relevant external noise level on the basis of openable windows being opened sufficiently to provide adequate ventilation. (Refer to the Building Code of Australia (Australian Building Codes Board 2010) for additional information.)
Internal noise levels	Internal noise levels refer to the noise level at the centre of the habitable room that is most exposed to the traffic noise with openable windows being opened sufficiently to provide adequate ventilation. (Refer to the Building Code of Australia (Australian Building Codes Board 2010) for additional information.)

Table 6-4: Assessment Locations for Existing Land Uses

Assessment Type	Assessment Location
Open space – passive or active use	The noise level is to be assessed at the time(s) and location(s) regularly attended by people using the space. In this regard, 'regular' attendance at a location means at least once a week.

6.2.6 Road Traffic Project Specific Noise Levels

Based on the traffic noise data obtained though the long term road traffic noise measurement, the current existing road traffic noise levels exceed the assessment criteria.

The selected project specific noise levels associated with road traffic noise are presented in Table 6-5.

Where existing traffic noise levels are above the noise assessment criteria, any increase in the total traffic noise level should be limited to 2 dB above that of the corresponding 'no build option'.

Table 6-5: Project Specific Noise Levels Associated with Road Traffic, dB(A)

Receptor along	Period	Existing Road Traffic Noise L_{eq}	Assessment Criteria L_{eq}	PSNL Cumulative Road Traffic Noise Level L_{eq}
R4, Martin Road (Local Road)	Day	48	55	**55**
	Night	44	50	**50**
R17, Lawson Road (Local Road)	Day	56	55	**58**
	Night	53	50	**55**

6.3 Construction Noise and Vibration Criteria

Criteria for construction and demolition noise has been obtained from the NSW Interim Construction Noise Guideline (DECC, 2009). Guidance for construction vibration has been taken from British Standard BS7385-Part 2: 1993 '*Evaluation and measurement for vibration in buildings*' and other standards.

6.3.1 NSW Interim Construction Noise Guideline

Residential Criteria

Table 2 of the Interim Construction Noise Guideline (DECC, 2009), sets out construction noise management levels for noise at residences and how they are to be applied. The management noise levels are reproduced in Table 6-6 below. Restrictions to the hours of construction may apply to activities that generate noise at residences above the 'highly noise affected' noise management level.

Table 6-6: Management Levels at Residences Using Quantitative Assessment

Time of Day	Management Level $L_{Aeq(15\ minute)}$	How to Apply
Recommended standard hours: Monday to Friday 7am – 6pm Saturday 8am – 1pm No work on Sundays or Public Holidays	Noise Affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq(15\ minute)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practises to meet the noise affected level. • The proponent should also inform all potentially affected residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly Noise Affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. times identified by the community when they are less sensitive to noise (such as before and after school, or mid-morning or mid-afternoon for works near residents. 2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise Affected RBL + 5 dB	• A strong justification would typically be required for works outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise affected level. • Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community. • For guidance on negotiating agreements see section 7.2.2 (RNP)

Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m from the residence.

Other Land Uses

Table 6-7 sets out management levels for construction noise at other land uses applicable to the surrounding area.

Table 6-7: Management Levels at Other Land Uses

Land use	Management Level $L_{Aeq(15\ minute)}$ (applies when properties are being used)
Industrial Premises	External Noise Level 75 dB(A)

There are no other sensitive land uses in the area surrounding the proposed resource recovery facility.

The noise criterion for construction noise is presented in Table 6-8.

Table 6-8: Construction Noise Criterion dB(A)

Receiver	Land Use	Period	RBL L_{A90}	Management Level $L_{Aeq(15\ minute)}$
R1-R11	Residential	Standard Hours	37	47
R12-R17	Residential	Standard Hours	37	47
R18-R20	Industrial	Standard Hours	-	75

6.3.2 Vibration Criteria

A proposed list of operational equipment listed in Table 7-1 and construction equipment listed in Table 9-2 does not include significant sources of vibration, and is not expected to cause cosmetic damage to surrounding structures or cause human response to nearby receivers. Vibration impacts during the construction and operational activities have therefore not been further considered.

7. OPERATIONAL NOISE IMPACT ASSESSMENT

7.1 MODELLING METHODOLOGY

7.1.1 Noise Model

Noise propagation modelling was carried out using the ISO9613 algorithm within SoundPLAN v7.3. This model has been extensively utilised by Benbow Environmental for assessing noise emissions for existing and proposed developments, and is recognised by regulatory authorities throughout Australia. The model allows for the prediction of noise from a site at the specified receptor, by calculating the contribution of each noise source. Other model inputs included the noise sources, topographical features of the subject area and receiver locations.

The modelling scenarios have been carried out using the $L_{Aeq,\ 15\ minutes}$ descriptor. Using the descriptor, noise emission levels were predicted at the nearest potentially affected sensitive receptors to determine the noise impact against the relevant noise criteria in accordance with the NSW EPA Noise Policy for Industry.

7.1.2 Assumptions Made for Noise Modelling

It should be noted that the relevant assessment period for operational noise emissions has been considered to be 15 minutes. Therefore noise source durations detailed in the following assumptions should be considered per 15 minute period in view of potential noise impacts under worst-case scenarios. Each assessment-specific assumption has been detailed below:

- Off-site topographical information was obtained from Google Earth.
- On-site topography has been obtained from the site survey plans provided by the client.
- The unloading and processing shed has been modelled as an industrial building with internal point sources. The building dimensions are as shown on the survey plans. The majority of the industrial building walls and roof have been considered to be constructed of 1 mm colorbond sheet steel (R_w = 25 dB). The floor has been modelled as concrete.
- For scenario 1, the roller shutter doors have been modelled in the closed position for the entire 15 minute scenario. Pedestrian doors have been modelled open for 30 seconds per 15 minute scenario.
- For scenario 2, all roller shutter doors have been modelled in the closed position for the entire 15 minute scenario, except for door number 4 (the middle roller door). Roller door 4 has been modelled in the open position for 3 minutes, and closed for 12 minutes, simulating a truck or front end loader entering or exiting the shed. Pedestrian doors have been modelled open for 30 seconds per 15 minute scenario.
- For scenario 3, the roller shutter doors have been modelled in the open position for the entire 15 minute scenario. Pedestrian doors have been modelled open for 30 seconds per 15 minute scenario.
- A 2.1 m colorbond fence is modelled surrounding the perimeter of the site.

- All receptors were modelled at 1.5 m above ground level.
- All ground areas have been modelled considering different ground factors ranging from 0 to 1 (Soft to Hard ground). The subject site and immediate surrounding industrial area have been modelled with a ground absorption factor of 1.0 (soft).
- One (1) truck has been modelled entering the site as a worst case scenario over a 15 minute period. An on-site speed of 20 km/hr has been considered.
- Internal noise sources associated with the site activities (i.e. generator, excavator, triple deck screen, concrete crusher) have been modelled as point sources and will be operational for 100% of the operational hours of the site, when utilised in a scenario.
- Outdoor noise sources not associated with trucks (i.e. the truck manouvering and front end loader) has been modelled as point or line sources and will be operational for 100% of the operational hours of the site.
- The Front End Loader has been modelled with a sound power level of 97 dB(A), which is a relatively low level compared to other loaders on the market. The client intends to use a small compact loader which will meet this assumption.

An outline of the noise sources and operational noise modelling scenarios has been provided below.

7.1.3 Noise Sources

A-weighted octave band centre frequency sound power levels are presented in in Table 7-1 below. The sound power levels for the relevant noise sources have been calculated from measurements of sound pressure levels undertaken by an acoustic engineer from Benbow Environmental at similar sites and sourced from Benbow Environmental's extensive noise source database.

Table 7-1: A-weighted Sound Power Levels Associated with Operational Activities, dB(A)

Noise Source	Overall	Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
25T Excavator	**101**	80	83	89	95	94	93	90	83
Front End Loader	**97**	80	84	87	91	90	89	88	78
Triple Deck Screen	**100**	73	87	82	92	98	91	88	86
Concrete Crusher	**113**	80	90	97	103	106	107	107	105
Truck Manouvering	**102**	73	81	86	101	92	90	85	85
Generator	**97**	64	74	81	87	90	91	91	89

7.1.4 Noise Modelling Scenarios

Three operational scenarios were considered in the noise model. The first noise generating scenario considered a situation where all noise sources on site were operating over the 15 minute assessment period, and the roller doors to the building were closed. The second scenario considered the roller doors to the building to be closed, except for the middle roller door which is open for 3 minutes of the 15 minute period. Scenario 2 enables a truck or front end loader to enter or exit the building. The third scenario considered the roller doors to the building to be open for transfer of materials to the stockpile area via front end loader, but with the crusher and excavator not running. It is understood from the client that the crusher and associated excavator will only operate for a little under half of the operational hours.

In all three scenarios, pedestrian doors are open for 30 seconds per 15 minute scenario, to allow occasional foot traffic in and out of the building. The equipment list is detailed in Table 7-2, with equipment location diagrams for scenarios 1-3 in Figure 7-1 to Figure 7-3.

Table 7-2: Modelled Noise Scenarios for Proposed Operations

Scenario	Time of the day	Noise Sources for Worst 15-minute Period
Scenario 1. All operations (all roller doors closed)	Monday – Friday 7am to 6pm Saturday 7am to 5pm	Indoor Noise Sources • Generator • Excavator • Triple decker screen • Concrete crusher Outdoor Noise sources • Truck manouvering • Front end loader
Scenario 2. Selected operations (all roller doors closed except for the middle roller door, open for 3 minutes out of a 15 minute period)	Monday – Friday 7am to 6pm Saturday 7am to 5pm	Indoor Noise Sources • Generator • Excavator • Triple decker screen • Concrete crusher Outdoor Noise sources • Truck manouvering • Front end loader
Scenario 3. Selected operations (all roller doors open)	Monday – Friday 7am to 6pm Saturday 7am to 5pm	Indoor Noise Sources • Generator • Triple decker screen Outdoor Noise sources • Truck manouvering • Front end loader

Figure 7-1: Scenario 1 – Roller Doors Closed – Operational noise sources

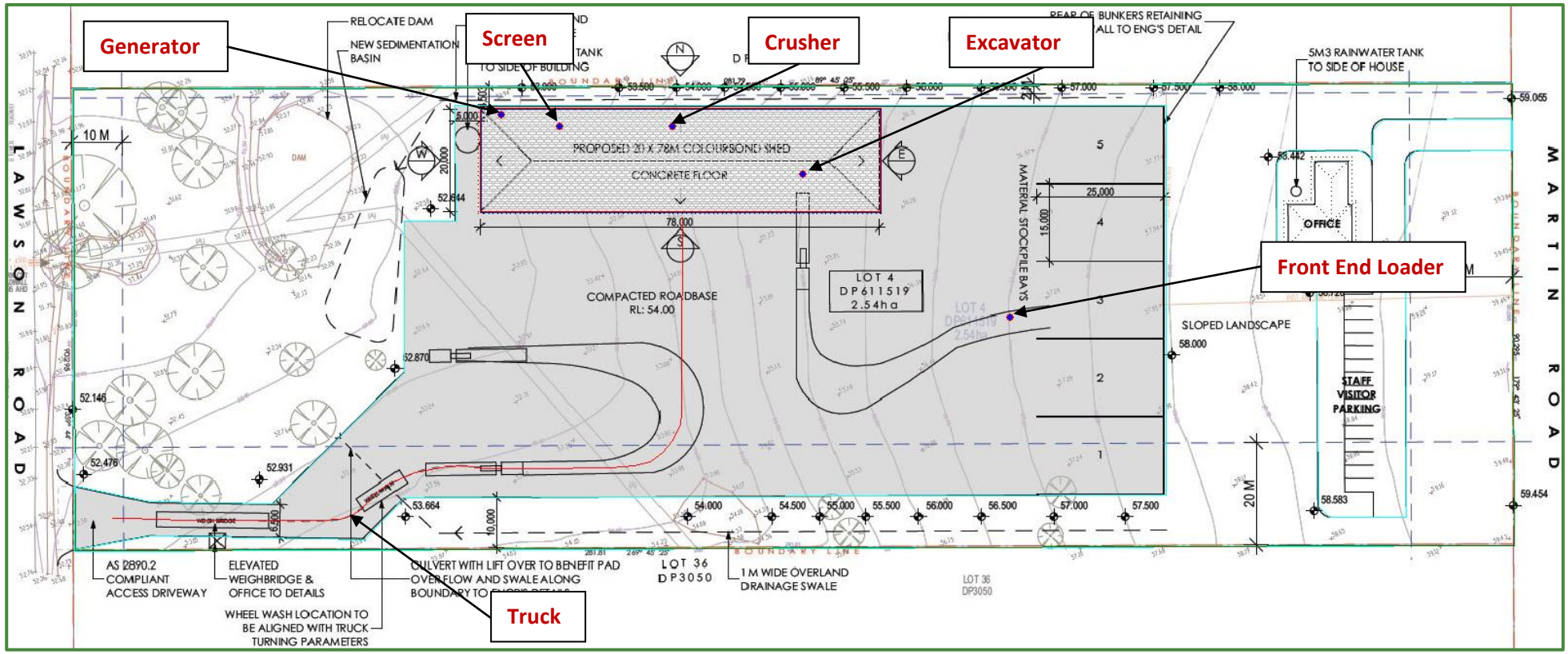


Figure 7-2: Scenario 2 – Roller Doors Mainly Closed – Operational noise sources

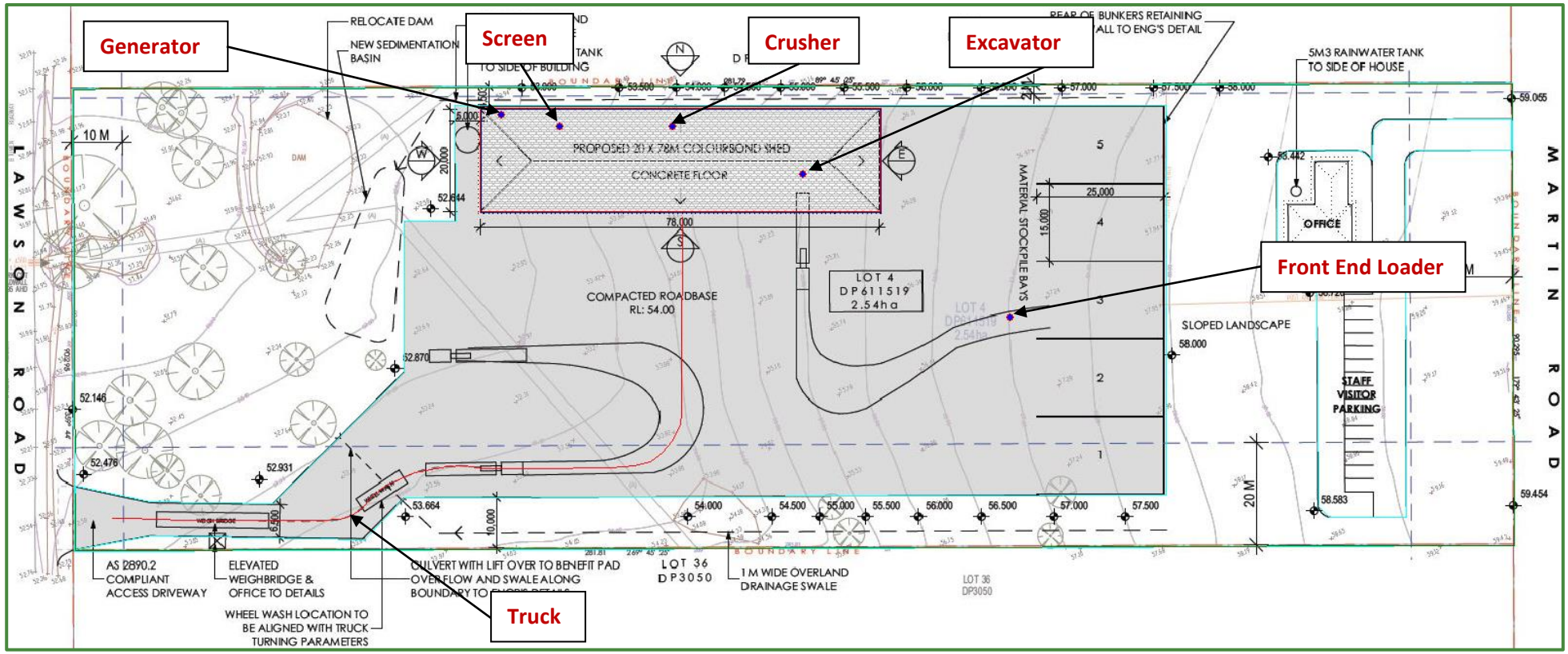
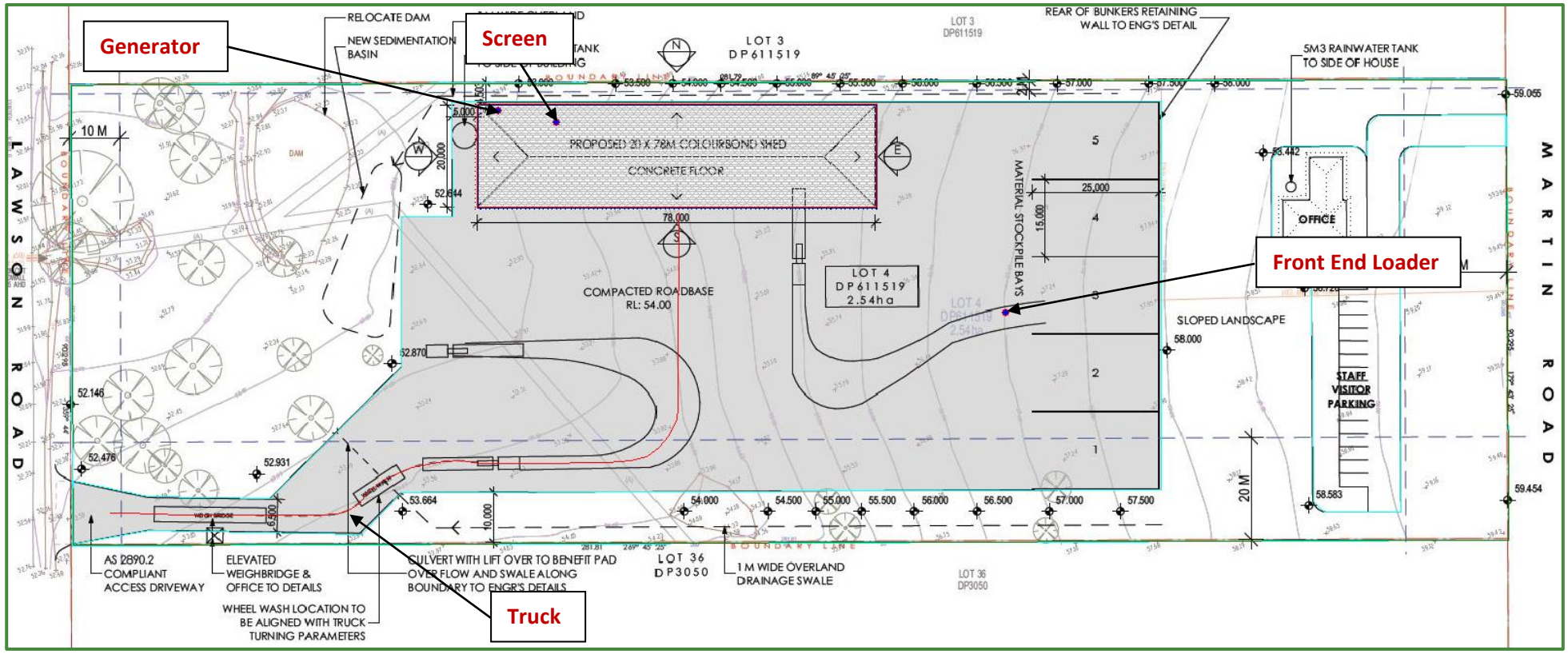


Figure 7-3: Scenario 3 – Roller Doors Open – Operational noise sources



7.2 OPERATIONAL PREDICTED NOISE LEVELS

Results of the predictive noise modelling of the operational activities are shown in Table 7-3.

During operations, noise levels are predicted to comply with the Noise Policy for Industry criteria at all receivers during all scenarios.

It is therefore concluded that the proposed site activities will not have a detrimental impact on the neighbouring receivers, if the noise control measures in section 7.3 are carried out.

Table 7-3: Noise Modelling Results Associated with Operational Activities, L_{eq}, dB(A)

Receiver	Criteria: PNTL ($L_{eq,15\ minute}$ dB(A)) – Day	Predicted: Scenario 1 (L_{eq}, dB(A))	Predicted: Scenario 2 (L_{eq}, dB(A))	Predicted: Scenario 3 (L_{eq}, dB(A))
R1	42	32 ✓	32 ✓	28 ✓
R2	42	31 ✓	31 ✓	28 ✓
R3	42	37 ✓	37 ✓	34 ✓
R4	42	37 ✓	37 ✓	36 ✓
R5	42	31 ✓	31 ✓	30 ✓
R6	42	34 ✓	35 ✓	35 ✓
R7	42	37 ✓	38 ✓	38 ✓
R8	42	33 ✓	34 ✓	34 ✓
R9	42	34 ✓	35 ✓	35 ✓
R10	42	32 ✓	33 ✓	33 ✓
R11	42	42 ✓	42 ✓	42 ✓
R12	42	40 ✓	41 ✓	41 ✓
R13	42	39 ✓	40 ✓	41 ✓
R14	42	33 ✓	33 ✓	30 ✓
R15	42	38 ✓	38 ✓	30 ✓
R16	42	36 ✓	36 ✓	28 ✓
R17	42	35 ✓	35 ✓	27 ✓
R18	68	40 ✓	40 ✓	35 ✓
R19	68	33 ✓	33 ✓	30 ✓
R20	68	33 ✓	34 ✓	34 ✓

7.3 NOISE CONTROL MEASURES

In order to achieve the predicted compliance levels at the nearest receptors, the following control measures are recommended to be implemented.

- A 2.1 m colorbond fence is recommended to be constructed surrounding the perimeter of the site.
- As per the assumptions listed in section 7.1.2 , the front end loader is recommended to have a sound power level of 97 dB(A) or lower. This is a relatively low level compared to other loaders on the market, so it will be a relatively small FEL.
- It is recommended that the client purchase a front end loader which has a guarantee that it is below a sound power level of 97 dB(A), or alternatively post commissioning testing of the equipment be carried out by an acoustic consultant to ascertain the sound power level of the equipment.
- Pedestrian doors are to self-closing, so the doors automatically close once a pedestrian is no longer using the door.
- The following equipment is restricted to indoors only:
  - Crusher;
  - Generator;
  - Screen; and
  - Excavator.
- When either the crusher or excavator is operating indoors, one roller shutter door is recommended to be open for only 3 minutes out of a 15 minute scenario (scenario 2). To enable this to practically occur, for example, for the arrival of a truck, it is recommended that automated roller shutter doors be installed to assist in the opening and closing of doors as fast as possible.
- The roller shutter doors should be selected based on their acoustic performance with regards to minimising breakout noise and minimising noise generated from opening and closing operations.
- Should the roller doors need to be opened for extended periods to enable the transfer of materials to the stockpile area (scenario 3), the crusher and excavator are to be stopped and only the front end loader is recommended to be used.
- It is recommended mobile equipment regularly used onsite such as the excavator and front end loader be fitted with reversing lights or a white noise reversing alarm.

It is also recommended the following additional management practices be implemented:

- Prohibition of extended periods of on-site revving/idling;
- Minimisation of the use of truck exhaust brakes on site;
- Enforcement of low on-site speed limits;
- On-site vehicles to be maintained in accordance with a preventative maintenance program to ensure optimum performance and early detection of wearing or noisy components;
- Ensure condition of roadway surface is maintained (by responsible party) to ensure deterioration of internal access road surface does not lead to increased noise sources; and
- Vehicles awaiting loading, unloading or servicing shall be parked on site with their engines turned off.

8. ROAD TRAFFIC NOISE IMPACT ASSESSMENT

A description of the calculation methodology and the noise predictions associated with road traffic has been provided below.

The proposed route for the heavy and light vehicles was presented in Figure 6-1. Trucks are proposed to access the site from Lawson Road. Light vehicles are proposed to access the site from Martin Road.

Calculation of road traffic noise contribution has been undertaken using the Calculation of Road Traffic Noise (CoRTN) algorithm within SoundPLAN v7.3. The CoRTN algorithm was utilised to predict the existing and proposed noise levels at the nearest residential receivers during the day and night time periods. The following correction factors have been used within the CoRTN algorithm:

- For Australian conditions (free field corrected), -0.7 dB;
- L_{10} to L_{eq}, -3.0 dB;
- For low traffic flow, -30 dB with the traffic volumes therefore multiplied by 1000;
- For Heavy Engines, -0.6 dB; and
- For Heavy Exhausts, -8.6 dB.

It is understood that a maximum of 16 truck movements are proposed per day between 7am and 5pm. 16 truck movements are assumed in each direction during the day period, with a maximum of three in any one hour period. A maximum of 10 light vehicle movements are expected in a one hour period. No truck movements are proposed during the night period. Vehicles are assumed to travel at the posted speed of 80 km/h.

The $L_{Aeq,\ 1\ hour}$ noise descriptor has been calculated at the most affected residential receptors located along Martin Road and Lawson Road. The predicted noise levels are displayed in Table 8-1. The highest noise levels would be predicted at these location, therefore they are the only results displayed.

Table 8-1: Predicted Levels for Road Traffic Noise

Receptor	Noise Criteria		Existing Traffic		Site Contribution		Cumulative Road Traffic Noise	
	Day $L_{Aeq,\ 1\ hour}$	Night $L_{Aeq,\ 1\ hour}$	Day $L_{Aeq,\ 1\ hour}$	Night $L_{Aeq,\ 1\ hour}$	Day $L_{Aeq,\ 1\ hour}$	Night $L_{Aeq,\ 1\ hour}$	Day $L_{Aeq,\ 1\ hour}$	Night $L_{Aeq,\ 1\ hour}$
R4, 40 Martin Road, Badgerys Creek	55	50	48	44	36 ✓	N/A ✓	48 ✓	44 ✓
R17, 35 Lawson Road, Badgerys Creek	58	55	56	53	52 ✓	N/A ✓	57 ✓	53 ✓

For residential dwellings that front onto Martin Road and Lawson Road, the predicted noise levels associated with the vehicle movements from the site would be below the daytime criteria of $L_{Aeq\ (1\ hour)}$ 55 dB for local roads. From Table 8-1, the predicted cumulative daytime $L_{Aeq,1\ hour}$ road traffic noise are below the noise criteria, as established from the NSW Road Noise Policy (RNP).

Step 3 of Section 3.4.1 of the RNP identifies possible reasonable and feasible control measures when exceedances of either the outlined criteria. As no exceedances are predicted, the proposed vehicle movements comply with the RNP, and no additional mitigation strategies are recommended.

9. CONSTRUCTION NOISE IMPACT ASSESSMENT

9.1 CONSTRUCTION ACTIVITIES

Construction activities are proposed to include the following:

- Site establishment;
- The building of the unloading and processing shed;
- The installation of a wheel wash and weighbridge;
- The setup of five storage bays; and
- Construction of the car park and landscaped area

The current residential dwelling is proposed to be kept, therefore no demolition works are proposed.

9.2 MODELLED NOISE GENERATING SCENARIOS

Considering the construction activities outlined in section 9.1, the three construction stages listed in Table 9-1 are modelled for civil works, concreting works and structure works. The noise generating stages consider a worst case scenario in which all equipment is running for 100% of the time over the 15 minute assessment period.

The equipment list for the stages is detailed in Table 9-1, with an equipment location diagrams in Figure 9-1 to Figure 9-3. Equipment is primarily located in the area of the proposed unloading and processing shed, as the majority of the construction works will take place at this location.

All works are proposed to be undertaken during standard construction hours, that is

- Monday to Friday, 7am to 6pm;
- Saturday 8am to 1pm ; and
- No work on Sundays or public holidays.

Table 9-1: Modelled Noise Stages for Proposed Construction Works

Scenario	Time of the day	Noise Sources for Worst 15-minute Period
Stage 1. Civil Works	Standard hours	• Dozer • Backhoe • Truck • Hand tools
Stage 2. Concreting construction works	Standard hours	• Concrete mixer truck • Concrete pump • Hand tools
Stage 3. Structure construction works	Standard hours	• Truck • Crane • Hand Tools

Figure 9-1: Construction Stage 1 – Civil Works

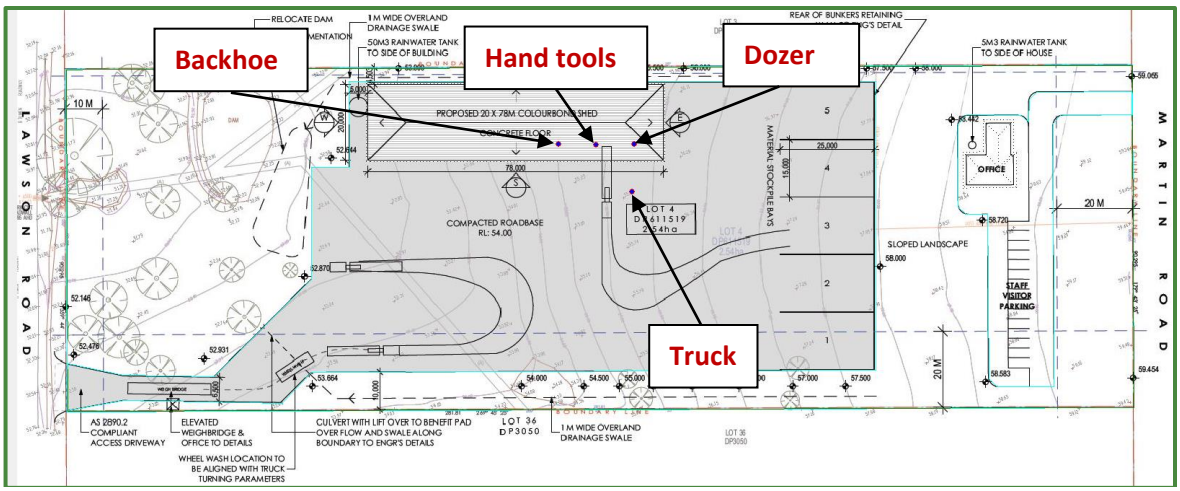


Figure 9-2: Construction Stage 2 – Concreting Construction Works

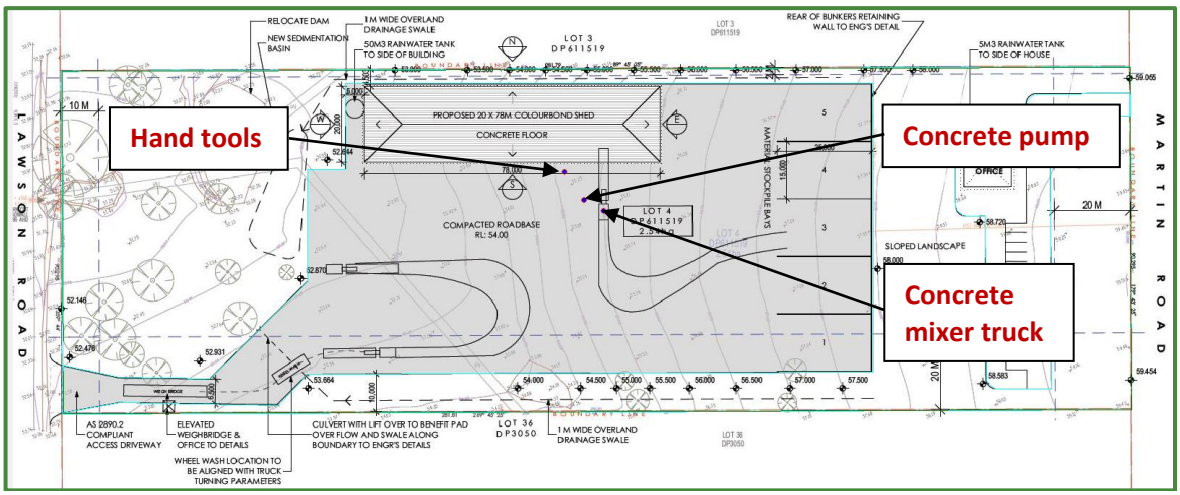
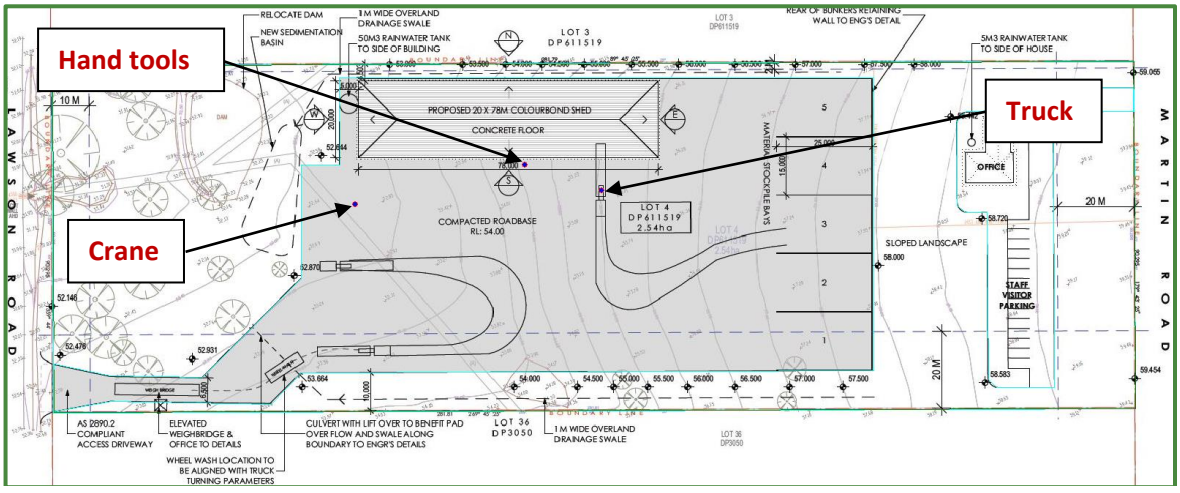


Figure 9-3: Construction Stage 3 – Structure Construction Works



9.3 MODELLING METHODOLOGY

9.3.1 Noise Model

Noise propagation modelling for the construction activities was carried out using the ISO 9613 algorithm within SoundPLAN v7.3. The construction stages were modelled using the $L_{Aeq,\ 15\ minutes}$ descriptor.

Assumptions made in the noise modelling of the construction noise stages are as follows:

- The relevant assessment period for operational noise emissions has been considered to be 15 minutes. Construction stages assume all equipment is running 100% of the time during the 15 minute assessment period, to provide a worst case scenario;
- Topographical information for off-site areas was obtained from Google Earth;
- Topographical information for on-site areas was obtained from the site survey;
- The model included the proposed 2.1 m colorbond fence around the perimeter of the site;
- All receptors were modelled at 1.5 m above ground level;
- The surrounding ground areas have been modelled with a ground absorption coefficient of 1.0 (soft); and
- All noise sources associated with the construction works have been modelled as point sources.

9.3.2 Noise Sources

A-weighted octave band centre frequency sound power levels are presented shown in Table 9-2 below. The sound power levels for the relevant noise sources have been calculated from measurements of sound pressure levels undertaken by an acoustic engineer from Benbow Environmental at similar sites and sourced from Benbow Environmental's noise source database, as well as taken from AS 2436-2010 and the UK Department for Environmental Food and Rural Affairs (DEFRA) database, *Update of noise database for prediction of noise on construction and open sites*.

Table 9-2: A-weighted Sound Power Levels Associated with Construction Activities, dB(A)

Noise Source	Overall	Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
Truck	**102**	73	81	86	101	92	90	85	85
Dozer	**110**	101	105	103	103	100	97	91	83
Backhoe	**104**	102	94	92	92	91	88	87	78
Hand tools	**100**	71	81	91	96	94	90	87	81
Concrete truck	**108**	85	86	85	94	98	107	89	82
Concrete pump truck	**105**	77	92	97	99	100	95	95	89
Crane	**110**	94	99	103	104	104	102	94	84

9.4 CONSTRUCTION PREDICTED NOISE LEVELS

Results of the predictive noise modelling of the construction activities are shown in Table 9-3. For stage 1, compliance is predicted at all receivers except for a 3 dB exceedance predicted at R11, and a 1 dB predicted at R12. For stage 2, compliance is predicted to be achieved at all receivers except for R11-R13 and R15. A maximum exceedance of a 5 dB is predicted at R11 in stage 2. For stage 3, compliance is predicted to be achieved at all receivers except R11-R13 and R15-R16. A maximum exceedance of 6 dB is predicted in stage 3.

Compliance with the construction noise criteria is therefore predicted to be achieved at the vast majority of receivers across the three stages during standard construction hours.

Construction activities are therefore proposed to take place during standard **construction** hours only as follows:

Monday to Friday:	7am to 5pm (with no hammering or saw-cutting to occur before 7.30am)
Saturday:	8am to 1pm (with no hammering or saw-cutting to occur before 8.30am)
Sunday and Public Holidays:	No works permitted

The predicted exceedances are minor in nature, and well below the 75 dB(A) “highly affected” noise criteria in the Interim Construction Noise Guideline. The following noise mitigation measures are therefore recommended:

- Construction works are recommended to take place during standard construction hours; and
- The 2.1 m colorbond fence is recommended to be installed on site prior to the remainder of the construction works taking place.

Table 9-3: Noise Modelling Results Associated with Construction Activities for L_{eq}, dB(A)

Receiver	Criteria: PSNL ($L_{eq,15\ minute}$ dB(A))	Predicted Levels: Stage (Standard Hours) (L_{eq}, dB(A))		
	Standard Hours	1	2	3
R1	47	41 ✓	43 ✓	43 ✓
R2	47	39 ✓	40 ✓	42 ✓
R3	47	45 ✓	46 ✓	47 ✓
R4	47	46 ✓	47 ✓	47 ✓
R5	47	41 ✓	42 ✓	43 ✓
R6	47	44 ✓	45 ✓	45 ✓
R7	47	46 ✓	47 ✓	47 ✓
R8	47	42 ✓	43 ✓	44 ✓
R9	47	44 ✓	44 ✓	45 ✓
R10	47	42 ✓	43 ✓	44 ✓
R11	47	50 ×	52 ×	52 ×
R12	47	48 ×	50 ×	53 ×
R13	47	47 ✓	49 ×	52 ×
R14	47	42 ✓	43 ✓	46 ✓
R15	47	47 ✓	48 ×	51 ×
R16	47	45 ✓	47 ✓	49 ×
R17	47	44 ✓	45 ✓	47 ✓
R18	75	48 ✓	50 ✓	50 ✓
R19	75	41 ✓	42 ✓	43 ✓
R20	75	42 ✓	43 ✓	46 ✓

✓Complies × Non-compliance

10. STATEMENT OF POTENTIAL NOISE IMPACT

A noise impact assessment was undertaken to assess the potential noise emissions from the proposed resource recovery facility at 55 Martin Road, Badgerys Creek. The site is proposed to process up to 95,000 tonnes per annum.

The noise impact assessment was undertaken in accordance with the following guidelines:

- NSW Environment Protection Authority Noise Policy for Industry 2017;
- Department of Environment, Climate Change and Water NSW Road Noise Policy 2011; and
- Department of Environment, Climate Change and Water NSW Interim Construction Noise Guideline 2009.

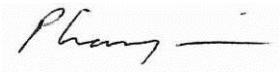
The nearest receivers and noise criteria were identified. The site operations were modelled using the predictive noise software, Sound Plan V7.3.

The activities proposed by the proponent were found to be within the framework of the NSW Noise Policy for Industry. The noise generating scenarios are predicted to comply with the project specific noise levels at all receivers. Recommendations for noise controls are given in section 7.3, including sound power levels for the front end loader, perimeter fencing, equipment and automated roller doors usage.

Compliance with the guidelines set out in the NSW Road Noise Policy was predicted at all considered receptors.

Construction activities are recommended to be limited to standard hours in accordance with the Interim Construction Noise Guideline.

This concludes the report.



Peter Gangemi
Acoustical Engineer

R T Benbow
Principal Consultant

11. LIMITATIONS

Our services for this project are carried out in accordance with our current professional standards for site assessment investigations. No guarantees are either expressed or implied.

This report has been prepared solely for the use of AMJ Demolition and Excavation, as per our agreement for providing environmental services. Only AMJ Demolition and Excavation is entitled to rely upon the findings in the report within the scope of work described in this report. Otherwise, no responsibility is accepted for the use of any part of the report by another in any other context or for any other purpose.

Although all due care has been taken in the preparation of this study, no warranty is given, nor liability accepted (except that otherwise required by law) in relation to any of the information contained within this document. We accept no responsibility for the accuracy of any data or information provided to us by AMJ Demolition and Excavation for the purposes of preparing this report.

Any opinions and judgements expressed herein, which are based on our understanding and interpretation of current regulatory standards, should not be construed as legal advice.

ATTACHMENTS

Glossary of Noise Terminology

'A' FREQUENCY WEIGHTING

The 'A' frequency weighting roughly approximates to the Fletcher-Munson 40 phon equal loudness contour. The human loudness perception at various frequencies and sound pressure levels is equated to the level of 40 dB at 1 kHz. The human ear is less sensitive to low frequency sound and very high frequency sound than midrange frequency sound (i.e. 500 Hz to 6 kHz). Humans are most sensitive to midrange frequency sounds, such as a child's scream. Sound level meters have inbuilt frequency weighting networks that very roughly approximates the human loudness response at low sound levels. It should be noted that the human loudness response is not the same as the human annoyance response to sound. Here low frequency sounds can be more annoying than midrange frequency sounds even at very low loudness levels. The 'A' weighting is the most commonly used frequency weighting for occupational and environmental noise assessments. However, for environmental noise assessments, adjustments for the character of the sound will often be required.

AMBIENT NOISE

The ambient noise level at a particular location is the overall environmental noise level caused by all noise sources in the area, both near and far, including all forms of traffic, industry, lawnmowers, wind in foliage, insects, animals, etc. Usually assessed as an energy average over a set time period 'T' (L_{Aeq},T).

AUDIBLE

Audible refers to a sound that can be heard. There are a range of audibility grades, varying from "barely audible", "just audible" to "clearly audible" and "prominent".

BACKGROUND NOISE LEVEL

Total silence does not exist in the natural or built-environments, only varying degrees of noise. The Background Noise Level is the minimum repeatable level of noise measured in the absence of the noise under investigation and any other short-term noises such as those caused by all forms of traffic, industry, lawnmowers, wind in foliage, insects, animals, etc.. It is quantified by the noise level that is exceeded for 90 % of the measurement period 'T' (L_{A90}, T). Background Noise Levels are often determined for the day, evening and night time periods where relevant. This is done by statistically analysing the range of time period (typically 15 minute) measurements over multiple days (often 7 days). For a 15 minute measurement period the Background Noise Level is set at the quietest level that occurs at 1.5 minutes.

'C' FREQUENCY WEIGHTING

The 'C' frequency weighting approximates the 100 phon equal loudness contour. The human ear frequency response is more linear at high sound levels and the 100 phon equal loudness contour attempts to represent this at various frequencies at sound levels of approximately 100 dB.

DECIBEL

The decibel (dB) is a logarithmic scale that allows a wide range of values to be compressed into a more comprehensible range, typically 0 dB to 120 dB. The decibel is ten times the logarithm of the ratio of any two quantities that relate to the flow of energy (i.e. power). When used in acoustics it is the ratio of square of the sound pressure level to a reference sound pressure level, the ratio of the sound power level to a reference sound power level, or the ratio of the sound intensity level to a reference sound intensity level. See also Sound Pressure Level and Sound Power Level. Noise levels in decibels cannot be added arithmetically since they are logarithmic numbers. If one machine is generating a noise level of 50 dB, and another similar machine is placed beside it, the level will increase to 53 dB (from $10 \log_{10} (10^{(50/10)} + 10^{(50/10)})$ and not 100 dB. In theory, ten similar machines placed side by side will increase the sound level by 10 dB, and one hundred machines increase the sound level by 20 dB. The human ear has a vast sound-sensitivity range of over a thousand billion to one so the logarithmic decibel scale is useful for acoustical assessments.

dBA – See 'A' frequency weighting

dBC – See 'C' frequency weighting

EQUIVALENT CONTINUOUS SOUND LEVEL, L_{Aeq}

Many sounds, such as road traffic noise or construction noise, vary repeatedly in level over a period of time. More sophisticated sound level meters have an integrating/averaging electronic device inbuilt, which will display the energy time-average (equivalent continuous sound level - L_{Aeq}) of the 'A' frequency weighted sound pressure level. Because the decibel scale is a logarithmic ratio, the higher noise levels have far more sound energy, and therefore the L_{Aeq} level tends to indicate an average which is strongly influenced by short term, high level noise events. Many studies show that human reaction to level-varying sounds tends to relate closer to the L_{Aeq} noise level than any other descriptor.

'F' (FAST) TIME WEIGHTING

Sound level meter design-goal time constant which is 0.125 seconds.

FREE FIELD

In acoustics a free field is a measurement area not subject to significant reflection of acoustical energy. A free field measurement is typically not closer than 3.5 metres to any large flat object (other than the ground) such as a fence or wall or inside an anechoic chamber.

FREQUENCY

The number of oscillations or cycles of a wave motion per unit time, the SI unit is the hertz (Hz). 1 Hz is equivalent to one cycle per second. 1000 Hz is 1 kHz.

IMPULSE NOISE

An impulse noise is typified by a sudden rise time and a rapid sound decay, such as a hammer blow, rifle shot or balloon burst.

MAXIMUM NOISE LEVEL, L_{AFmax}

The root-mean-square (rms) maximum sound pressure level measured with sound level meter using the 'A' frequency weighting and the 'F' (Fast) time weighting. Often used for noise assessments other than aircraft.

NOISE

Noise is unwanted, harmful or inharmonious (discordant) sound. Sound is wave motion within matter, be it gaseous, liquid or solid. Noise usually includes vibration as well as sound.

NOISE REDUCTION COEFFICIENT – See: "Sound Absorption Coefficient"

OFFENSIVE NOISE

Reference: Dictionary of the NSW Protection of the Environment Operations Act (1997).

"Offensive Noise means noise:
(a) that, by reason of its level, nature, character or quality, or the time at which it is made, or any other circumstances:
(i) is harmful to (or likely to be harmful to) a person who is outside the premise from which it is emitted, or
(ii) interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted, or
(b) that is of a level, nature, character or quality prescribed by the regulations or that is made at a time, or in other circumstances prescribed by the regulations."

SOUND ABSORPTION COEFFICIENT, α

Sound is absorbed in porous materials by the viscous conversion of sound energy to a small amount of heat energy as the sound waves pass through it. Sound is similarly absorbed by the flexural bending of internally damped panels. The fraction of incident energy that is absorbed is termed the Sound Absorption Coefficient, α. An absorption coefficient of 0.9 indicates that 90 % of the incident sound energy is absorbed. The average α from 250 to 2 kHz is termed the Noise Reduction Coefficient (NRC).

SOUND ATTENUATION

A reduction of sound due to distance, enclosure or some other devise. If an enclosure is placed around a machine, or an attenuator (muffler or silencer) is fitted to a duct, the noise emission is reduced or attenuated. An enclosure that attenuates the noise level by 20 dB reduces the sound energy by one hundred times.

SOUND PRESSURE

The rms sound pressure measured in pascals (Pa). A pascal is a unit equivalent to a newton per square metre (N/m^2).

SOUND PRESSURE LEVEL, Lp

The level of sound measured on a sound level meter and expressed in decibels (dB). Where L_P = 10 $\log_{10}$ $(Pa/Po)^2$ dB (or 20 log10 (Pa/ Po) dB) where Pa is the rms sound pressure in Pascal and Po is a reference sound pressure conventionally chosen is 20 µPa (20 x 10^{-6} Pa) for airborne sound. L_p varies with distance from a noise source.

SOUND POWER

The rms sound power measured in watts (W). The watt is a unit defined as one joule per second. A measures the rate of energy flow, conversion or transfer.

SOUND POWER LEVEL, Lw

The sound power level of a noise source is the inherent noise of the device. Therefore sound power level does not vary with distance from the noise source or with a different acoustic environment. $L_w = L_p + 10 \log_{10}$ 'a' dB, re: 1pW, (10^{-12} watts) where 'a' is the measurement noise-emission area (m^2) in a free field.

STATISTICAL NOISE LEVELS, Ln.

Noise which varies in level over a specific period of time 'T' (standard measurement times are 15 minute periods) may be quantified in terms of various statistical descriptors for example:-

- The noise level, in decibels, exceeded for 1 % of the measurement time period, when 'A' frequency weighted and 'F' time weighted is reference to as L_{AF1}, T. This may be used for describing short-term noise levels such as could cause sleep arousal during the night.
- The noise level, in decibels, exceeded for 10 % of the measurement time period, when 'A' frequency weighted and 'F' time weighted is reference to as L_{AF10}, T. In most countries the LAF10, T is measured over periods of 15 minutes, and is used to describe the average maximum noise level.
- The noise level, in decibels, exceeded for 90 % of the measurement time period, when 'A' frequency weighted and 'F' time weighted is reference to as L_{AF90}, T. In most countries the LAF90, T is measured over periods of 15 minutes, and is used to describe the average minimum or background noise level.

STEADY NOISE

Noise, which varies in level by 6 dB or less, over the period of interest with the time-weighting set to "Fast", is considered to be "steady". (Refer AS 1055.1—1997).

WEIGHTED SOUND REDUCTION INDEX, R_w

This is a single number rating of the airborne sound insulation of a wall, partition or ceiling. The sound reduction is normally measured over a frequency range of 100 Hz to 3.150 kHz and averaged in accordance with ISO standard weighting curves (Refer AS/NZS ISO 717-1:2004). Internal partition wall R_w + C ratings are frequency weighted to simulate insulation from human voice noise. The R_w + C is similar in value to the STC rating value. External walls, doors and windows may be R_w + C_{tr} rated to simulate insulation from road traffic noise. The spectrum adaptation term C_{tr} adjustment factor takes account of low frequency noise. The weighted sound reduction index is normally similar or slightly lower number than the STC rating value.

‘Z’ FREQUENCY WEIGHTING

The ‘Z’ (Zero) frequency weighting is 0 dB within the nominal 1/3 octave band frequency range centred on 10 Hz to 20 kHz. This is within the tolerance limits given in AS IEC 61672.1—2004: ‘*Electroacoustics – Sound level meters – Specifications*’.

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Sound Level Meter
AS 1259.1:1990 - AS 1259.2:1990
Calibration Certificate

Calibration Number C16368

Client Details Benbow Environmental
13 Daking Street
North Paramatta NSW 2151

Equipment Tested/ Model Number : ARL EL-215
Instrument Serial Number : 194441
Microphone Serial Number : N/A
Pre-amplifier Serial Number : N/A

Atmospheric Conditions
Ambient Temperature : 21.9°C
Relative Humidity : 34.2%
Barometric Pressure : 100kPa

Calibration Technician : Dennis Kim
Calibration Date : 13/07/2016
Secondary Check: Riley Cooper
Report Issue Date : 14/07/2016
Approved Signatory : Juan Aguero

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
10.2.2: Absolute sensitivity	*Pass*	10.3.4: Inherent system noise level	*Pass*
10.2.3: Frequency weighting	*Pass*	10.4.2: Time weighting characteristic F and S	*Pass*
10.3.2: Overload indications	*Pass*	10.4.3: Time weighting characteristic I	*Pass*
10.3.3: Accuracy of level range control	*Pass*	10.4.5: R.M.S performance	*Pass*
8.9: Detector-indicator linearity	*Pass*	9.3.2: Time averaging	*Pass*
8.10: Differential level linearity	*Pass*	9.3.5: Overload indication	*Pass*

Least Uncertainties of Measurement -

Acoustic Tests
31.5 Hz to 8kHz ±0.120dB
12.5kHz ±0.165dB
16kHz ±0.245dB
Electrical Tests
31.5 Hz to 20 kHz ±0.098dB

Environmental Conditions
Temperature ±0.3°C
Relative Humidity ±4.1%
Barometric Pressure ±0.1kPa

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

The sound level meter under test has been shown to conform to the type 2 requirements for periodic testing as described in AS 1259.1:1990 and AS 1259.2:1990 for the tests stated above.

NATA WORLD RECOGNISED ACCREDITATION

This calibration certificate is to be read in conjunction with the calibration test report.

Acoustic Research Labs Pty Ltd is NATA Accredited Laboratory Number 14172.
Accredited for compliance with ISO/IEC 17025.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/National standards.

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Sound Level Meter
AS 1259.1:1990 - AS 1259.2:1990
Calibration Certificate

Calibration Number C17333

Client Details Benbow Environmental
13 Daking Street
North Parramatta NSW 2151

Equipment Tested/ Model Number : ARL EL-215
Instrument Serial Number : 194552
Microphone Serial Number :
Pre-amplifier Serial Number :

Atmospheric Conditions
Ambient Temperature : 22.8°C
Relative Humidity : 35.5%
Barometric Pressure : 101.15kPa

Calibration Technician : Lucky Jaiswal
Calibration Date : 12/07/2017
Secondary Check: Riley Cooper
Report Issue Date : 12/07/2017

Approved Signatory : Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
10.2.2: Absolute sensitivity	*Pass*	10.3.4: Inherent system noise level	*Pass*
10.2.3: Frequency weighting	*Pass*	10.4.2: Time weighting characteristic F and S	*Pass*
10.3.2: Overload indications	*Pass*	10.4.3: Time weighting characteristic I	*Pass*
10.3.3: Accuracy of level range control	*Pass*	10.4.5: R.M.S performance	*Pass*
8.9: Detector-indicator linearity	*Pass*	9.3.2: Time averaging	*Pass*
8.10: Differential level linearity	*Pass*	9.3.5: Overload indication	*Pass*

Least Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
31.5 Hz to 8kHz	*±0.16dB*	*Temperature*	*±0.05°C*
12.5kHz	*±0.2dB*	*Relative Humidity*	*±0.46%*
16kHz	*±0.29dB*	*Barometric Pressure*	*±0.017Pa*
Electrical Tests			
31.5 Hz to 20 kHz	*±0.12dB*		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

The sound level meter under test has been shown to conform to the type 2 requirements for periodic testing as described in AS 1259.1:1990 and AS 1259.2:1990 for the tests stated above.

This calibration certificate is to be read in conjunction with the calibration test report.

Acoustic Research Labs Pty Ltd is NATA Accredited Laboratory Number 14172.
Accredited for compliance with ISO/IEC 17025.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/National standards.

NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration and inspection reports.

CERTIFICATE OF CALIBRATION

CERTIFICATE NO: 20949

EQUIPMENT TESTED: Sound Level Calibrator

Manufacturer: Rion
Type No: NC-73 **Serial No:** 10186522
Owner: Benbow Environmental
13 Daking Street
North Parramatta NSW 2151

Tests Performed: Measured output pressure level was found to be:

Parameter	Pre-Adj	Adj Y/N	Output: (db re 20 µPa)	Frequency: (Hz)	THD&N (%)
Level 1:	NA	N	94.03	991.4	2.00
Level 2:	NA	N	NA	NA	NA
Uncertainty:			±0.11 dB	±0.05 Hz	±0.2 %
Uncertainty (at 95% c.l.) k=2					

CONDITION OF TEST:
Ambient Pressure: 996 hPa ±1.5 hPa **Relative Humidity:** 42% ±5%
Temperature: 22 °C ±2° C
Date of Calibration: 05/07/2017 **Issue Date:** 06/07/2017
Acu-Vib Test Procedure: AVP02 (Calibrators)
Test Method: AS IEC 60942 - 2004
CHECKED BY: ... **AUTHORISED SIGNATURE:** .....
Jack Rich

Accredited for compliance with ISO/IEC 17025
The results of the tests, calibration and/or measurements included in this document are traceable to Australian/national standards.

NATA
WORLD RECOGNISED ACCREDITATION
Accredited Lab. 9262
Acoustic and Vibration Measurements

ACU-VIB ELECTRONICS
HEAD OFFICE
Unit 14, 22 Hudson Ave. Castle Hill NSW 2154
Tel: (02) 96808133 Fax: (02)96808233
Mobile: 0413 809806
Web site: www.acu-vib.com.au

CERTIFICATE OF CALIBRATION

CERTIFICATE NO.: SLM 21111 & FILT 4097

Equipment Description:	Sound & Vibration Analyser		
Manufacturer:	Svantek		
Model No:	Svan-957	**Serial No:**	15336
Microphone Type:	7052E	**Serial No:**	47869
Filter Type:	1/3 Octave	**Serial No:**	15336
Comments:	All tests passed for class 1. (See over for details)		
Owner:	Benbow Environmental 13 Daking Street North Parramatta 2151		
Ambient Pressure:	1004 hPa ±1.5 hPa		
Temperature:	21 °C ±2° C	**Relative Humidity:**	36% ±5%
Date of Calibration:	25/07/2017	**Issue Date:**	26/07/2017

Acu-Vib Test Procedure: AVP10 (SLM) & AVP06 (Filters)

CHECKED BY: ..... **AUTHORISED SIGNATURE:** .....
Jack Kidd

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Calibration of Sound Level Meters

A sound level meter requires regular calibration to ensure its measurement performance remains within specification. Benbow Environmental sound level meters are calibrated by a National Association of Testing Authority (NATA) registered laboratory or a laboratory approved by the NSW Environment Protection Authority (EPA) every two years and after each major repair, in accordance with AS IEC 61672.1–2004 Electroacoustics – Sound level meters - Specifications.

The calibration of the sound level meter was checked immediately before and after each series of measurements using an acoustic calibrator. The acoustic calibrator provides a known sound pressure level, which the meter indicates when the calibrator is activated while positioned on the meter microphone.

The sound level meters also incorporate an internal calibrator for use in setting up. This provides a check of the electrical calibration of the meter, but does not check the performance of the microphone. Acoustical calibration checks the entire instrument including the microphone. Calibration certificates for the instrument sets used have been included as Attachment 2.

Care and Maintenance of Sound Level Meters

Noise measuring equipment contains delicate components and therefore must be handled accordingly. The equipment is manufactured to comply with international and national standards and is checked periodically for compliance. The technical specifications for sound level meters used in Australia are defined in Australian Standard AS IEC 61672.1–2004 Electroacoustics – Sound level meters - Specifications.

The sound level meters and associated accessories are protected during storage, measurement and transportation against dirt, corrosion, rapid changes of temperature, humidity, rain, wind, vibration, electric and magnetic fields. Microphone cables and adaptors are always connected and disconnected with the power turned off. Batteries are removed (with the instrument turned off) if the instrument is not to be used for some time.

Investigation Procedures

All investigative procedures were conducted in accordance with AS 1055.1—1997 *Acoustics – "Description and Measurement of Environmental Noise (Part 1: General Procedures)"*.

The following information was recorded and kept for reference purposes:

- type of instrumentation used and measurement procedure conducted;
- description of the time aspect of the measurements, ie. measurement time intervals; and
- positions of measurements and the time and date were noted.

As per AS 1055.1—1997, all measurements were carried out at least 3.5 m from any reflecting structure other than the ground. The preferred measurement height of 1.2 m above the ground was utilised. A sketch of the area was made identifying positions of measurement and the approximate location of the noise source and distances in meters (approx.).

UNATTENDED NOISE MONITORING

NOISE MONITORING EQUIPMENT

ARL noise logger type NGARA and EL-215 were used to conduct the long-term unattended noise monitoring. This equipment complies with Australian Standard AS IEC 61672.1–2004 *Electroacoustics – Sound level meters – Specifications* and are designated as a Type 2 instrument suitable for field use.

The measured data is processed statistically and stored in memory every 15 minutes. The equipment was calibrated prior and subsequent to the measurement period using a Rion NC-73 sound level calibrator. There were no significant variances observed in the reference signal between the pre-measurement and post-measurement calibrations. Instrument calibration certificates have also been included in Attachment 2.

METEOROLOGICAL CONSIDERATION DURING MONITORING

For the long-term attended monitoring, meteorological data for the relevant period were provided by the Bureau of Meteorology, which was considered representative of the site for throughout the monitoring period.

Measurements affected by wind or rain over certain limits were excluded from the final analyses of the recorded data in accordance with the EPA's Noise Policy for Industry. The wind data were modified to take into account the difference of height between the AWS (Automatic Weather Station) used by the Bureau of Meteorology (10m above ground level), and the microphone (1.5 m above ground level). The correction factor applied to the data was calculated according to the Australian Standard AS 1170.2 2011 .

DESCRIPTORS & FILTERS USED FOR MONITORING

Noise levels are commonly measured using A-weighted filters and are usually described as dB(A). The "A-weighting" refers to standardised amplitude versus frequency curve used to "weight" sound measurements to represent the response of the human ear. The human ear is less sensitive to low frequency sound than it is to high frequency sound. Overall A-weighted measurements quantify sound with a single number to represent how people subjectively hear different frequencies at different levels.

Noise environments can be described using various descriptors depending on characteristics of noise or purpose of assessments. For this survey the L_{A90}, L_{Aeq} and L_{Amax} levels were used to analyse the monitoring results. The statistical descriptors L_{A90} measures the noise level exceeded for 90% of the sample measurement time, and is used to describe the "Background noise". Background noise is the underlying level of noise present in the ambient noise, excluding extraneous noise or the noise source under investigation. The L_{Aeq} level is the equivalent continuous noise level or the level averaged on an equal energy basis which is used to describe the "Ambient Noise". The L_{Amax} noise levels are maximum sound pressure levels measured over the sampling period and this parameter is commonly used when assessing noise impact.

Measurement sample periods were fifteen minutes. The Noise -vs- Time daily noise logger charts representing measured noise levels at the noise monitoring locations are presented in Attachment 4.