Bevian Road Concept Application

Services and Infrastructure Report

Final: November 2007

Patterson Britton & Partners Pty Ltd
consulting engineers

Marsim (trading as Nature Coast Developments P/L)

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draft				
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Issue No.2

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1 EXECUTIVE SUMMARY

Marsim (trading as Nature Coast Developments P/L) propose the 806 lot residential and 20 lot community Bevian Road Residential Development at Rosedale.

The Rosedale site consists of approximately 173 ha of cleared rural land at the southern end of the Batemans Bay urban area. It was delineated as an urban expansion zone in the Eurobodalla Rural Local Environmental Plan (1987).

This report addresses the services and infrastructure issues relating to the Concept Plan Application to the Minister for Planning. The application seeks approval of two specific plans, being the Concept Approval Plans. These plans are:

- A plan of the Net Developable Area – known as The Constraints Map (refer **Figure 1**); and
- A 806 lot residential and 20 lot community subdivision generally in accordance with the layout proposal in the Concept Plan (refer **Figure 2**).

The Director General of NSW Planning has provided the issues to be addressed in the application in the Director General's requirements (refer **Appendix A**).

In summary, there is substantial existing infrastructure available to service the Rosedale site. The development of the site will allow utilisation of this existing infrastructure with upgrades as required.

It has been established through consultation with the service authorities that the proposed development can be serviced with water, sewer and power. This meets the Director General's requirement Issue 9.1.

There will be staged implementation of infrastructure to suit the rate of development, beginning at the northern end of the site. The road, sewerage and runoff control infrastructure would suggest that development staging would occur on a catchment by catchment basis. These issues are not likely to be that significant to preclude other forms of staging. This meets the Director General's requirement Issue 9.2.

Council's contribution plans for water, sewer, road and drainage infrastructure have been reviewed and the proposed infrastructure for the development does not significantly conflict with these plans. The development would need to contribute funding for provision of infrastructure external to the site to support the proposed development. This meets the Director General's requirement Issue 9.3.

An odour management study has been undertaken to assess the appropriate buffer for residential development from the sewage treatment works. The recommended buffer distance was 180m from the odour source in the STP being the clarifiers. The nearest residential development is proposed to be a minimum of 400m from the STP to conform to the DOP guidelines. This setback is readily acceptable based on the Odour Management Study. In a subsequent letter dated 14 June

2007 (refer **Appendix D**) from Holmes Air, it was confirmed that the buffer distance found acceptable in the Odour Management Study also conformed to the Assessment and Management of Odour from Stationary Sources in NSW (*Technical Framework and Supporting Technical Notes, DEC, November 2006*). This meets the Director General's requirements at Issues 9.4 and 9.5.

Road infrastructure including entry roads can be provided to service the development with safe and convenient access. The roads will be designed in sympathy with the natural environment, making due allowance for factors such as proximity to wetlands and existing site topography.

The Concept Approval Plans (The Constraints Map and The Concept Plan – **Figures 1** and **2**) incorporate the road infrastructure and can be serviced with water, sewerage, power and drainage such that they adequately address the infrastructure related to the Director General's requirements. As such, it is concluded that the Concept Approval Plans are satisfactory.

2 INTRODUCTION

2.1 BACKGROUND

Patterson Britton & Partners *(PBP)* have been engaged by Marsim (trading as Nature Coast Developments Pty. Ltd.) to address the water management issues for a concept plan application to the Minister for Planning, for the Bevian Road Residential Development at Rosedale, Batemans Bay. The application seeks approval of two specific plans, being the Concept Approval Plans. These plans are:

- A plan of the Net Developable Area known as The Constraints Map (refer **Figure 1**); and
- A 806 lot residential and 20 lot community subdivision generally in accordance with the layout proposed in the Concept Plan (refer **Figure 2**).

The Eurobodalla Rural Local Environmental Plan (1987) delineated Rosedale as an urban expansion zone. Development Control Plan (DCP) No. 160 entitled “Rosedale Urban Expansion Area” was adopted by Eurobodalla Council in 1989.

The Director General of NSW Planning has provided the issues to be addressed in the application in the Director General’s Requirements (refer to **Appendix A**).

This report addresses the proposed services and road infrastructure and demonstrates how the development and infrastructure would conform to the Director General’s requirements for the project.

2.2 SITE DESCRIPTION

The Rosedale site consists of approximately 173 ha of cleared land located at the southern end of the Batemans Bay urban area.

The site is adjacent to State Forest on its western and northern boundaries with the villages of Rosedale and Guerilla Bay to the east of the site. The site is currently used for rural activities, such as the grazing of cattle, and contains a number of farm dams mainly in the northern area.

The northern half of the site drains to the east into Salt Water Creek. This portion of the site consists of a number of valleys which have only isolated riparian vegetation along the creeklines. The headwaters of the catchment are only just outside the boundary of the site.

The southern half of the site drains to Bevian Wetland, which is a SEPP 14 Wetland. This portion of the site is undulating without any creeklines. The valleys consist of broad grass swales with the runoff travelling generally as sheetflow across the ground surface.

George Bass Drive, which is the main road connecting the southern villages to the Batemans Bay urban area is located to the east and south of the site. There are access roads to George Bass Drive from the north eastern and south western corners of the site.

The proposed masterplan layout is presented on **Figure 3**.

2.3 DIRECTOR-GENERAL'S REQUIREMENTS

Key issues noted in the Director-General's Environmental Assessment Requirements (refer to **Appendix A**) that are relevant to this report include:

> ***9.*** *Infrastructure Provision*
>
> ***9.1*** *Address existing capacity and requirements of the development for sewerage, water and electricity in consultation with the relevant agencies.*
>
> ***9.2*** *Identify staging, if any of infrastructure works.*
>
> ***9.3*** *Address provision of public services and infrastructure having regard to the Council's Section 94 Contributions Plans.*
>
> ***9.4*** *Prepare an Odour Management Study to address potential odour issues in conflict with provision of the POEO Act.*
>
> ***9.5*** *An appropriate buffer distance should be identified in accordance with the Assessment and Management of Odour from Stationary Sources in NSW (Technical Framework and Supporting Technical Notes (DEC, November 2006)).*

3 WATER SUPPLY

Potable water use would be reduced by the installation of water saving devices and appliances and rainwater harvesting for reuse in toilets, washing machines, irrigation and car washing. Roof water would be captured in rainwater tanks. Water balance modelling outlined in the Water Management Report derived optimum sizes of the rainwater tanks. Generally, on smaller lots, 4kL slimline rainwater tanks were recommended while two 4kL slimline tanks were recommended for the larger lots. This would maximise the reduction in potable water use while controlling runoff to mimic the existing site hydrology. Potable water use reduction would exceed 40% which is the BASIX requirement.

Council has confirmed that the site is within Council's water supply area and as such, is able to be supplied with potable water from Council's Burri Point reservoir. The document titled *Eurobodalla Shire Council Development Servicing Plan for Water Supply Services* illustrates the planning undertaken for the site. A reservoir located on a high part of the site would be required to provide adequate pressure for areas of the site higher than RL 40m AHD. This reservoir would be required to provide two days storage capacity.

An existing 450 mm trunk main is located in the southeastern section of the site. A pressure main would be required from the trunk main through the development to supply the reservoir. The reticulation network would be designed in future design phases of the development.

The servicing strategy for the proposed development is integrally linked to the water management strategy, in that a sustainable approach to water management has reduced the potable water demand considerably. Further details of the potable water demand reduction are described in the accompanying *Water Management Report*.

This addresses Issue 9.1 in the Director General's requirements confirming that the development can be serviced with potable water.

4 SEWERAGE

4.1 CAPACITY OF THE SEWERAGE SYSTEM

Council has confirmed that there is capacity planned at the sewage treatment plant for this development. Council has a programme of upgrades to the treatment plant to cater for future development at the site. The document titled *Eurobodalla Shire Council Development Servicing Plan for Sewerage Services*, illustrates the planning undertaken for the site.

4.2 PROPOSED SEWERAGE RETICULATION

The development would be serviced by a series of sewage pumping stations delivering sewage to the Council's sewage treatment plant adjacent to the south eastern corner of the site. The provision of the sewerage reticulation, pumping stations and rising mains to the sewage treatment plant would be the responsibility of the developer.

This addresses Issue 9.1 in the Director General's requirements.

4.3 SUSTAINABLE ALTERNATIVES

It was decided that an onsite sewage treatment system would not be practical for the development site. This would involve disposal of a significant portion of effluent via irrigation and provision of wet weather storage to cater with excess effluent during wet weather. The high slopes of some areas could lead to runoff of effluent into watercourses. Furthermore, during wet weather periods, irrigation would not be available and therefore large on site storages would be required to contain excess treated sewage for disposal. It is likely that there would be a requirement for zero spillage given the sensitive nature of the downstream receiving waters.

Council has no plans to distribute recycled water from the existing sewage treatment plant.

4.4 ODOUR MANAGEMENT

As Council's sewage treatment plant is adjacent to the site, a requirement of the Director-General was to undertake an odour management study. This study was carried out in 2004 and at that time the development proposal had residences within 180 metres of the sewage treatment plant. The study found that "the predicted odour levels at the residences comply with the most stringent DEC 99th percentile two odour unit goal" and that "it is unlikely that odour would be a nuisance to the proposed residential development". The development concept has now been amended such that residences are more than 400m from the sewage treatment plant which conforms to the Department of Planning guidelines.

Also, Holmes Air, who undertook the odour management study in 2004, has reviewed their report content and the DEC November 2006 guidelines specified in the Director General's requirements (Issue 9.5). Their letter dated 14 June 2007 confirms that the 2004 report is still valid and the development concept conforms to the DEC November 2006 guidelines. The letter and 2004 report are attached in **Appendix D**.

This conforms with Issues 9.4 and 9.5 in the Director General's requirements confirming that the development has a more than adequate buffer to the sewerage treatment works.

5 POWER

The estimated power demand from the proposed 816 lots would be approximately 4MVA. There is an 11kVA feeder above ground on poles along the western side of the site. An 11kV feeder has up to about a 4MVA capacity depending on the distance from the supply point and demand from other users. This existing feeder may be able to supply power to the initial development.

Country Energy has indicated that it can service the proposed development with power. It can service up to 100 to 125 dwellings from its existing infrastructure in George Bass Drive opposite the north eastern entry road to the site. Country Energy will upgrade their supply to the site with a new feeder from the south to service development beyond this initial development. For the ultimate development, Country Energy would have a supply to the development along both entry roads in the north east and south west.

A letter from Country Energy confirming the power supply is included at **Appendix E**.

The power reticulation in the development would be underground along the road verge. The high voltage 11kV feeder would supply kiosk substations (5.4m x 2.4m) located in the road verge. The low voltage supply to residences and street lighting would be distributed from the kiosk substations.

Infrastructure in the road reserve would be the responsibility of Country Energy.

This meets Issue 9.1 in the Director General's requirements confirming that the development can be serviced with power.

6 TELECOMMUNICATIONS

Telstra can service the entirety of the proposed development from existing optical fibre cable located on the northern side of George Bass Drive.

The development could be serviced from optical fibre joints located:

- Opposite the Barlings Beach Caravan Park (*for the southern site area*); and
- In the vicinity of Rosedale Avenue, Rosedale (*for the northern site area*).

Optical fibre cable is capable of delivering broadband internet services however this would only be provided by Telstra or other providers if it was considered economically viable. Spare conduits would be laid in the verge of the road reserve in the development to cater for alternative providers of digital services in the future.

This meets Issue 9.1 in the Director General's requirements confirming that the development can be serviced with telecommunications infrastructure.

7 GAS

There is no gas reticulation along the south coast past Nowra. As such, reticulated gas would not form part of the servicing infrastructure for the proposed development.

Spare conduits could be laid in the verge of the road reserve to permit ready provision of gas reticulation around the development in the future should gas be extended to Batemans Bay, at the final discretion of the developer.

8 ROADS

8.1 ENTRY ROADS

8.1.1 Alignment

The site would be connected to George Bass Drive, which generally loops around the site to its east and south, via two entry roads;

- The connection in the north eastern corner is provided by an upgraded version of the existing Bevian Road; and
- The connection in the south western corner would be provided by an upgraded version of the existing Bevian Road adjacent to the Bevian Wetland.

Investigations into alternate options for the southern road connection to George Bass Drive were considered, but have not proved feasible. Two alternate road alignments were considered for connection to George Bass Drive at the southern end of the site. One alignment was east of the Bevian Wetland but there were a number of reasons this alignment was not feasible, viz:

- the alignment was through areas of Endangered Ecological Communities and Bevian Wetland which have no disturbance at present;
- there was high potential for significant aboriginal heritage items in the area which would be disturbed by an entry road;
- the land was privately owned with little chance of obtaining landowners consent for an entry road; and
- it was low lying with high potential for flooding.

The second alignment considered was east of the existing sewage treatment plant. This alignment was not feasible because of unsatisfactory intersection conditions with George Bass Drive due to steep grades (large level difference between the existing levels on George Bass Drive and the entry road land) and the poor sight distances.

The preferred alignment on the western side of Bevian Wetland on the existing road has the advantages of an existing intersection with George Bass Drive and it is an existing disturbed area adjacent to the wetland. It has been concluded by Conacher Travers after lengthy investigation and consideration that the proposed alignment of the road has the best environmental outcome.

8.2 ROAD DETAILS

8.2.1 Dedication

The main spine road through the development and the entry roads would be dedicated to Council. The remaining local roads would remain with the Community Title and not be Council roads.

8.2.2 Design

The road cross sectional design has been formulated by the urban designer and traffic planner to be adequate for the expected traffic volumes, respond to the site topography and provide an amenity which complements the desired urban character. The adopted road cross sections are presented in the urban design report. The roads to be dedicated to Council have been designed in close consultation with Council officers.

8.2.3 Layout

The road layout has been designed to minimise the cut and fill by generally being aligned parallel to the ground contours or perpendicular to them. The layout provides access to all lots. Lanes have been used to alleviate the dominance of garage doors at the front of residences.

8.2.4 Carriageways

Carriageways would generally be asphalt surfaced, with flush coats considered for rural residential roads. Special treatments, such as segmental paving, may be used to emphasise special areas, such as transitions or crossings.

8.2.5 Drainage

Road drainage would be designed following the standard major/minor system, with the provision of overland flowpaths where necessary.

Bio-retention swales to treat road runoff will be provided along many roadways as required to meet water quality targets. The swales would generally be 4 m wide with a 1 m wide base width and 1 in 3 side slopes.

Details of bio-retention swales and stormwater management are presented in the accompanying *Water Management Report*.

8.3 SOUTHERN ENTRY ROAD

The entry road from George Bass Drive in the south western corner of the site is located in an existing 20m wide public road reserve. Its location, width, alignment and water management features have been designed in close consultation with Eurobodalla Council in order to minimise the impact on the Bevian Wetland. The proposed details of the entry road are presented on **Figure 4**.

Conacher Travers mapped the physical edge of the Bevian Wetland along the alignment of the southern entry road. This edge is plotted on **Figure 4**. The entry road is located on the existing dirt road alignment of what is known as Bevian Road. At the interface of this dirt road and the wetland, there is typically an earth mound which is likely to have formed due to past grading of this dirt road. The edge of this mound adjacent to the wetland was an obvious alignment of the wetland. It was typically located on the Conacher Travers wetland alignment or landward of it. This edge of the earth mound was selected as the eastern edge of the road infrastructure.

The width available for the entry road is limited not only by the wetland but also by a steep embankment on the western side. Through extensive discussions with Council officers, it was agreed that the minimum width of the road could be 6.5m provided bus passing bays were provided at regular intervals.

A 3.2m wide vegetated bioretention swale was incorporated into the road cross section to remove pollutants in the road runoff prior to discharge to the wetland. It also permits broad sheetflow discharge to the wetland as occurs at present and avoids the need for pipe discharge points. The swale would have a gabion basket to support the swale, act as a coarse filter of runoff and to form a firm edge to the existing wetland.

The entry road would have a one way crossfall to the swale so that all runoff would be treated prior to discharge to the wetland.

On the western edge of the road there would be a 2.4m wide verge with a 1.2m wide footpath. There would be a 1V:3H batter formed through the existing embankment and where necessary, a concrete retaining wall installed in the existing areas where the embankment is steeper than 1V:3H.

The intersection with George Bass Drive would be a seagull type with dedicated right turn lanes into and out of the site and appropriate acceleration and deceleration distances. There will be a deceleration lane for left turns into the site. Colston Budd & Kafes has defined storage lengths for the right turn lanes and these will need to be integrated with the proposed intersection to the Barlings Beach development further to the east. The provision for car stacking in the right turn lane into the site will require lengthening of the culverts forming the outlet under George Bass Drive for the wetland.

The entry road level would be at or above the predicted 100 year ARI flood level in Bevian Wetland.

The entry road would be constructed by first installing the gabion baskets along the edge of the wetland. One extra basket above the design level would be placed to form a barrier to equipment and runoff entering or damaging the wetland. A heavy geofabric would be placed on the road side wall of the gabion along with a row of hay bales. This would trap coarse and fine sediments in runoff prior to discharge to the wetland. As the road is gradually sealed these runoff control measures would be removed and the bioretention swale installed. In this way, the wetland would be protected for the duration of the entry road construction.

8.4 NORTHERN ENTRY ROAD

The northern entry road follows an existing dirt road which intersects with George Bass Drive to the north east of the site. The existing road would be widened to a 7m wide sealed carriageway with 1.5m wide shoulders on both sides (refer **Figure 5**). The road would have a oneway crossfall to a vegetated bioretention swale on one side of the road. It is proposed that gabion baskets be used on the low side of the road to minimise the widening of the existing road.

The existing intersection layout at George Bass Drive would be upgraded to the same seagull format as for the southern entry road. There would be dedicated right turn bays and deceleration lanes for left turns into the site. The vertical alignment of the existing entry road would be adjusted near the intersection to improve site distances.

During construction of the road, appropriate soil and erosion control measures would be implemented to ensure no significant adverse impacts on the adjacent bushland and creeklines. These measures would include:

- Diversion mounds along the high side to divert runoff from undisturbed areas around the road construction area;
- Silt fence along the low side of the road to manage runoff on the road;
- Provide check dams, filter fences and hay bales along the bioretention swale to slow down runoff and capture suspended sediments;
- Provide diversion drains from the swale to level spreaders at regular intervals to dissipate the flow – install filter fences across the spreading flow area about 2m from the discharge point to trap any remaining sediment; and
- Minimise the extent of road construction disturbed at any one time.

This addresses Issue 9.1 in the Director General's requirements confirming that the development can be serviced with roads.

9 STAGING

The staging of the development will be influenced by a range of factors including house product, market conditions and cost of servicing and access. In terms of the cost of servicing and access, the important issues relating to staging are discussed below for each type of infrastructure.

The bulk water supply will come from the south eastern area of the site. The most cost effective staging for water supply would be from south to north although it is likely that areas developed first would be below RL 40m AHD which is the limit of supply from the existing infrastructure. Similarly for sewerage infrastructure, with the STP at the southern end of the site, the most cost effective staging would be from south to north. The cost of trunk infrastructure would however not necessarily preclude staging of development in the other direction from north to south.

The power infrastructure would suit initial development at the north eastern end of the site however a new feeder could be provided to support initial development at the southern end if other infrastructure or considerations were more important.

The runoff control measures and drainage infrastructure should be developed on a catchment basis preferably commencing at the downstream end of a catchment. This would allow progressive provision of drainage infrastructure as development proceeds in an upstream direction.

This is similar to roads which are best constructed gradually from the downstream end adjacent to the entry road and proceeding in an upstream direction. This is the most cost effective method of staging development.

Neither the drainage or road infrastructure is sensitive to commencement at either the southern or northern end of the development.

The staging of the development would commence at the northern end, as the provision of infrastructure does not preclude development commencing from either end.

This addresses the Director General's requirements Issue 9.2 confirming likely infrastructure staging.

10 COUNCIL'S CONTRIBUTION PLANS

The Council is responsible for its water, sewer and community infrastructure. The community infrastructure is funded under Section 94 contributions plans for:

- open space and recreation;
- cycleways and pedestrian facilities;
- community facilities;
- car parking;
- waste disposal; and
- administration of the Section 94 plans.

The proposed development would provide considerable community infrastructure on site which would offset some of the Section 94 contributions.

The development would fund the provision of water and sewer trunk and reticulation infrastructure to service the development. It would have to contribute to Council for the cost of regional water and sewer infrastructure such as the STP and bulk water supply for which the development relies upon to provide water and sewerage services. These costs are set out in the respective Development Servicing Plans for sewerage and water supply and charged as Section 64 contributions.

This addresses Issue 9.3 of the Director General's requirements confirming that the development would make contributions where appropriate to Council for water, sewer and community infrastructure.

11 CONCLUSION

It has been established through consultation with the service authorities that the proposed development can be serviced with water, sewer and power. This meets the Director General's requirement Issue 9.1.

There will be staged implementation of infrastructure to suit the rate of development, beginning at the northern end of the site. The road, sewerage and runoff control measures infrastructure would suggest that development staging would occur on a catchment by catchment basis. These issues are not likely to be that significant to preclude other forms of staging. This meets the Director General's requirement Issue 9.2.

Council's contribution plans for water, sewer, road and drainage infrastructure have been reviewed and the proposed infrastructure for the development does not significantly conflict with these plans. The development would need to contribute funding for provision of infrastructure external to the site to support the proposed development. This meets the Director General's requirement Issue 9.3.

An odour management study has been undertaken to assess the appropriate buffer for residential development from the sewage treatment works. The recommended buffer distance was 180m from the odour source in the STP being the clarifiers. The nearest residential development is proposed to be a minimum of 400m from the STP to conform to the DOP guidelines. This setback is readily acceptable based on the Odour Management Study. In a subsequent letter dated 14 June 2007 (refer **Appendix D**) from Holmes Air, it was confirmed that the buffer distance found acceptable in the Odour Management Study also conformed to the Assessment and Management of Odour from Stationary Sources in NSW (*Technical Framework and Supporting Technical Notes, DEC, November 2006*). This meets the Director General's requirements at Issues 9.4 and 9.5.

Road infrastructure including entry roads can be provided to service the development with safe and convenient access. The roads will be designed in sympathy with the natural environment, making due allowance for factors such as proximity to wetlands and existing site topography.

The Concept Approval Plans (The Constraints Map and Plan of Subdivision – **Figures 1** and **2**) incorporate the road infrastructure and can be serviced with water, sewerage, power and drainage such that they adequately address the infrastructure related to the Director General's requirements. As such, it is concluded that the Concept Approval Plans are satisfactory.

12 REFERENCES

1. Bill Guy & Partners, 2002, *Rosedale Urban Expansion Area Roads and Services Infrastructure Report*

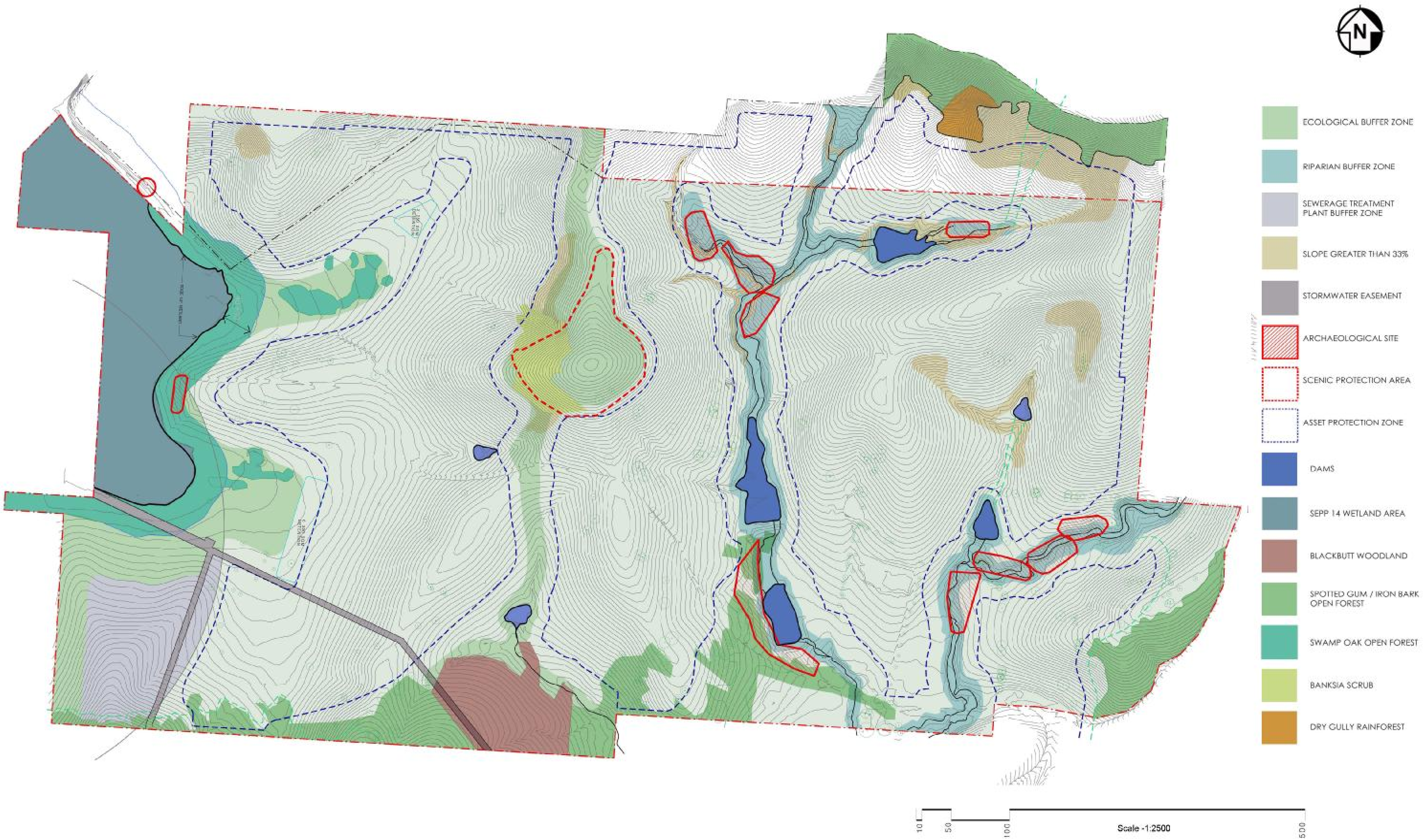
2. Patterson Britton & Partners, 2007, *Water Management Report*

3. Eurobodalla Shire Council, 2005, *Development Servicing Plan for Sewerage Services*

4. Eurobodalla Shire Council, 2005, *Development Servicing Plan for Water Supply Services*

FIGURES

FIGURE 1



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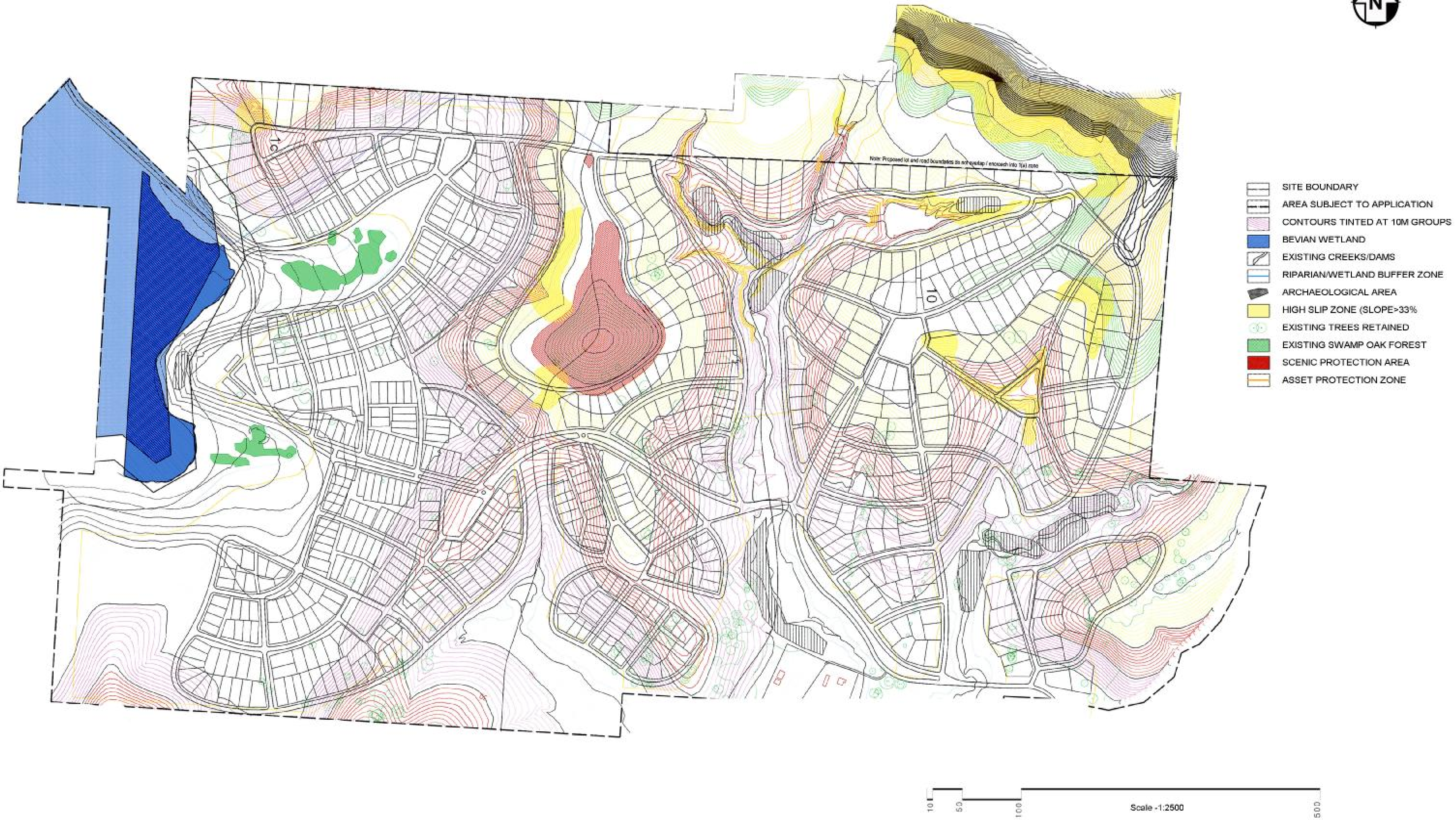
CONSTRAINTS MAP

FIGURE 2



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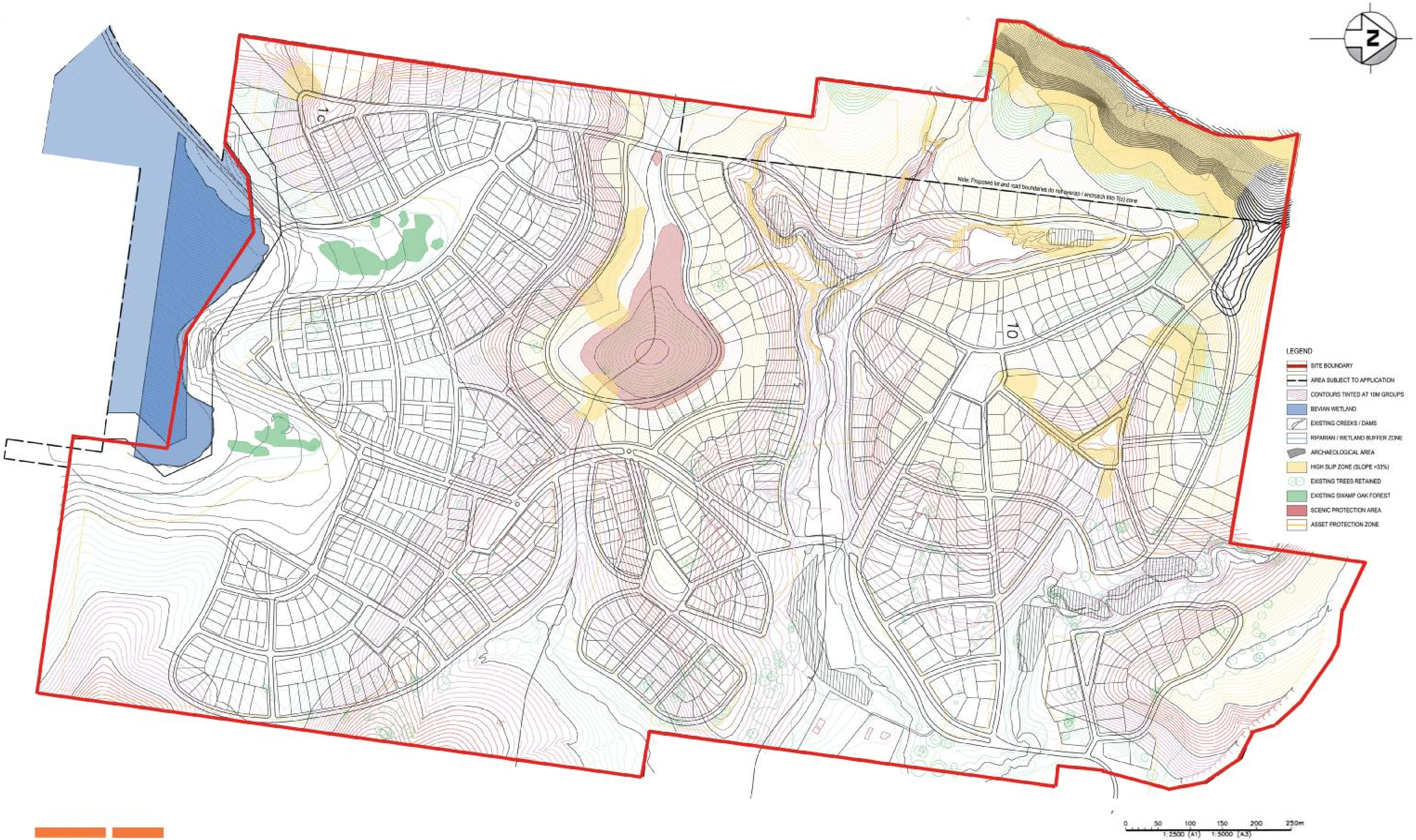
CONCEPT PLAN

FIGURE 3



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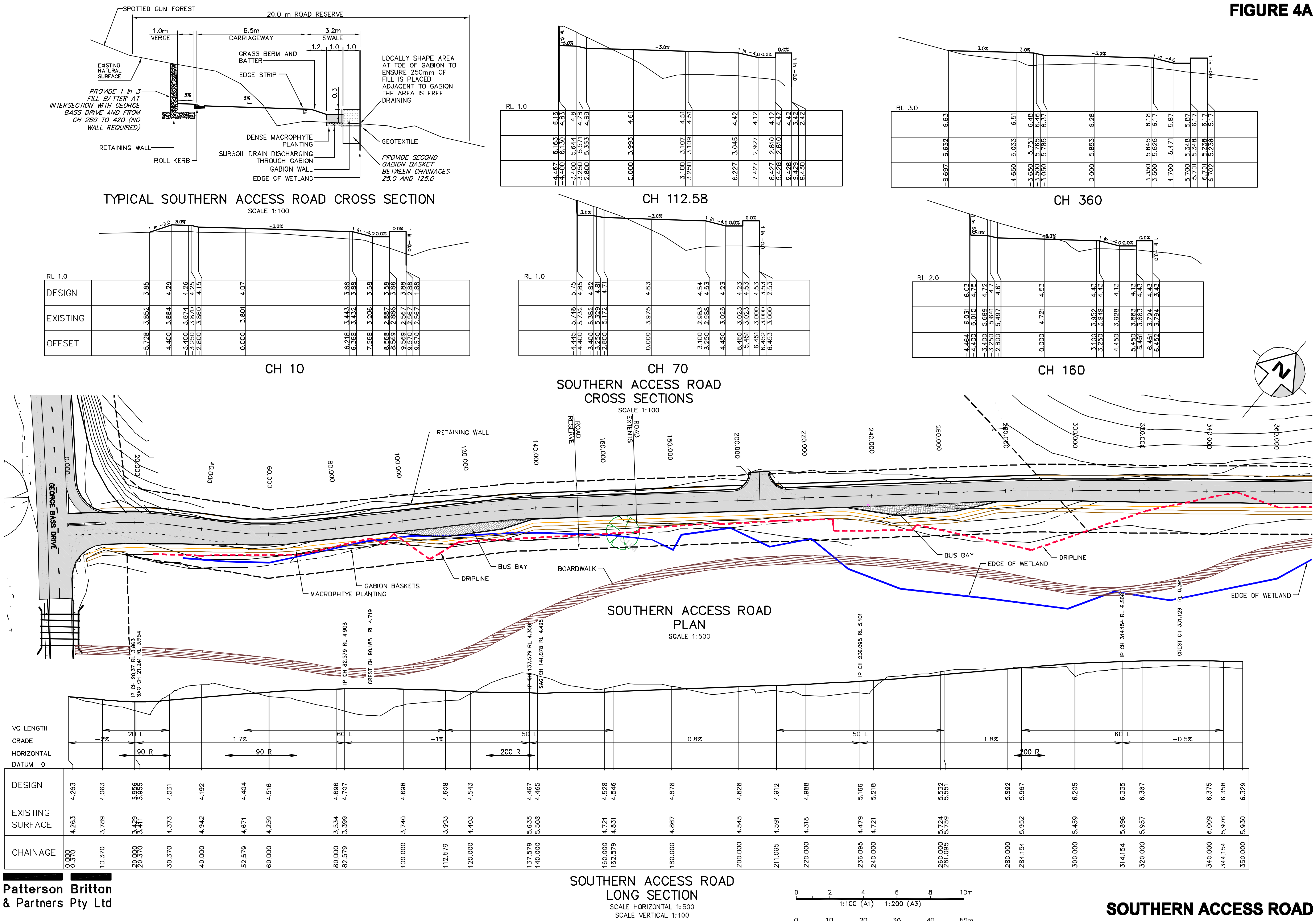
PROPOSED DEVELOPMENT LAYOUT

J4561_01/FIG3_ProposedDevelopmentLayout_SIReport.jpg

FIGURE 4A



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4561-01 *ROSEDALE*

SOUTHERN ACCESS ROAD
ROSEDALE URBAN EXPANSION AREA

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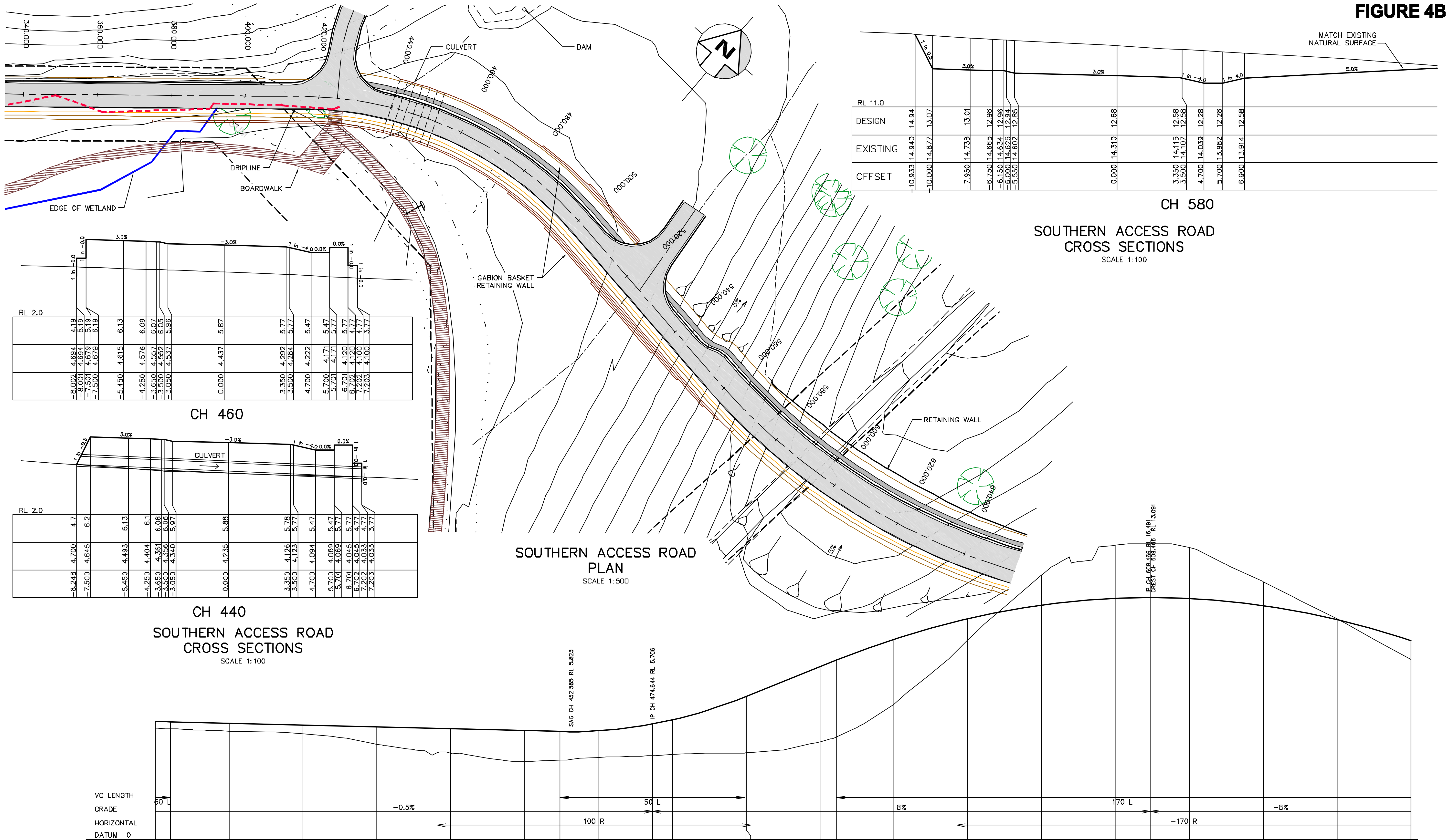
FIGURE 4B



DESIGN	6.375	6.358	6.279	6.179	6.079	5.979	5.879	5.831	5.870	6.237	6.462	7.706	7.734	9.334	9.691	10.821	11.940	12.683	13.049	13.091	13.039	12.653	11.890	10.750
EXISTING SURFACE	6.009	5.976	5.853	5.708	5.143	4.651	4.235	4.279	4.437	4.535	4.587	4.673	4.679	5.274	5.545	7.307	10.788	14.310	15.921	15.985	15.782	13.940	11.930	9.746
CHAINAGE	340.000	344.154	360.000	380.000	400.000	420.000	440.000	449.644	460.000	474.644	480.000	499.644	500.000	520.000	524.466	540.000	560.000	580.000	600.000	609.466	620.000	640.000	660.000	680.000

SOUTHERN ACCESS ROAD
LONG SECTION
SCALE HORIZONTAL 1:500
SCALE VERTICAL 1:100

0 2 4 6 8 10m
1:100 (A1) 1:200 (A3)

0 10 20 30 40 50m
1:500 (A1) 1:1000 (A3)

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4561-01 *ROSEDALE*

SOUTHERN ACCESS ROAD
ROSEDALE URBAN EXPANSION AREA

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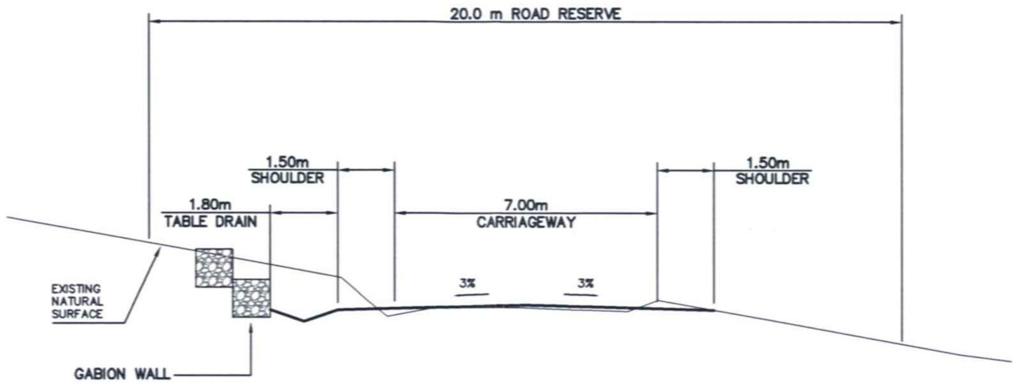
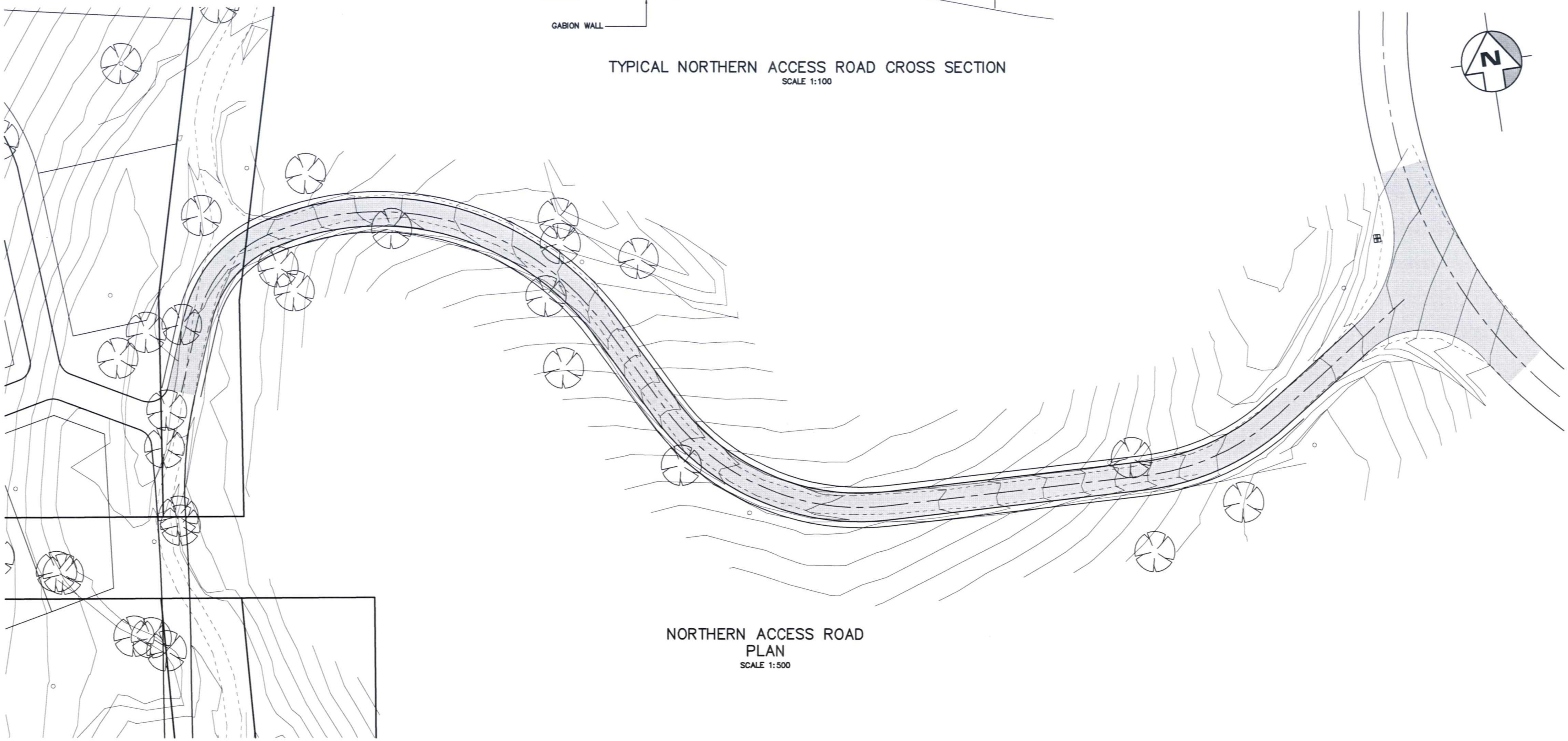
FIGURE 5



TYPICAL NORTHERN ACCESS ROAD CROSS SECTION

SCALE 1:100



NORTHERN ACCESS ROAD
PLAN

SCALE 1:500

0 10 20 30 40 50m
1:500 (A1) 1:1000 (A3)

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4561-01 *ROSEDALE*

GEORGE BASS DRIVE NORTH EASTERN ENTRY ROAD
ROSEDALE URBAN EXPANSION AREA

APPENDIX A
DIRECTOR GENERAL'S REQUIREMENTS

NSW GOVERNMENT
Department of Planning

Contact: John Amold
Phone: (02) 9228 6398
Fax: (02) 9228 6540
Email: john.a.amold@planning.nsw.gov.au

Our ref: MP05_0199
Your ref:
File: 9041393-1

John Kass, Director
Kass-hermes
Urban Planning + Development
76 Drumalbyn Road, Bellevue Hill
NSW 2023

Dear Mr Kass

Subject: Director-General's Environmental Assessment Requirements for the Environmental Assessment of a Concept Plan for a Proposed Residential Subdivision at George Bass Drive, Rosedale (MP05_0199)

The Department has received your application for the above project (Application Number: 05_0199).

The Director General's Environmental Assessment Requirements (DGRs) for the environmental assessment of the project for a Concept Plan are attached to this correspondence at **Attachment 1.** These requirements have been prepared in consultation with the relevant government agencies including council, and have been based on the information that you have provided to date. Please note that the Director-General may alter these requirements at any time.

Attachment 2 lists the relevant plans and documents which are likely to be required upon submission of your proposal; however, this should be confirmed with the Department prior to lodgement.

It should be noted that the DGRs have been prepared based on the information provided to date. Under section 75F(3) of the Act, the Director-General may alter or supplement these requirements if necessary and in light of any additional information that may be provided prior to the proponent seeking approval for the project.

It would be appreciated if you would contact the Department at least two weeks before you propose to submit the Environmental Assessment for the project to determine:

- the fees applicable to the application;
- consultation and public exhibition arrangements that will apply; and
- number and format (hard-copy or CD-ROM) of the Environmental Assessment that will be required.

A list of some relevant technical and policy guidelines which may assist in the preparation of this Environmental Assessment are attached at **Attachment 3.**

Prior to exhibiting the Environmental Assessment, the Department will review the document to determine if it adequately addresses the DGRs. The Department may consult with other relevant government agencies in making this decision. If the Director-General considers that the Environmental Assessment does not adequately address the DGRs, the Director-General may require the proponent to revise the Environmental Assessment to address the matters notified to the proponent.

Following this review period the Environmental Assessment will be made publicly available for a minimum period of 30 days.

If your proposal includes any actions that could have a significant impact on matters of National Environmental Significance, it will require an additional approval under the Commonwealth Environment Protection Biodiversity Conservation Act 1999 (EPBC Act). This approval would be in addition to any approvals required under NSW legislation. If you have any questions about the application of the EPBC Act to your proposal, you should contact the Commonwealth Department of Environment and Heritage in Canberra (6274 1111 or http://www.deh.gov.au).

If you have any queries regarding these requirements, please contact John Arnold on 9228 6398 or email john.a.arnold@planning.nsw.gov.au.

Yours sincerely

29.12.05

Chris Wilson
Executive Director
as delegate for the Director General

Attachment 1
Director-General's Environmental Assessment Requirements

Section 75F of the *Environmental Planning and Assessment Act 1979*

Application number	05_0199
Project	**A Concept Plan Application for Proposed Residential Subdivision at George Bass Drive, Rosedale**
Location	**Lots 11, 29, 32, 72, 102, 118, 119 and 213 in DP755902; Lot 2 DP627034 and Lot 2 DP623340**
Proponent	Marsim
Date issued	December 2006
Expiry date	2 years from date of issue
General requirements	The Environmental Assessment (EA) for the **Concept Plan** must include: • An executive summary; • A outline of the scope of the project including: (i) Any development options; (ii) Justification for the project taking into consideration any environmental impacts of the project, the suitability of the site and whether the project is in the public interest; (iii) Outline of the staged implementation of the project, if applicable; • A thorough site analysis and description of existing environment; • Consideration of any relevant statutory and non-statutory requirements, in particular relevant provisions of Environmental Planning Instruments, draft South Coast Regional Strategy and Development Control Plans as well as impacts, if any, on matters of national environmental significance under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*; • Where relevant, demonstrate compliance with BCA and relevant Australian Standards for proposed building; traffic, road and parking; utilities; noise and flooding; • An environmental risk analysis of the project including consideration of the issues raised during consultation; • An assessment of the potential impacts of the project and a draft Statement of Commitments, outlining environmental management, mitigation and monitoring measures to be implemented to minimise any potential impacts of the project; • The plans and documents outlined in **Attachment 2**; • A signed statement from the author of the Environmental Assessment certifying that the information contained in the report is neither false nor misleading; • A Quantity Surveyor's certificate of cost to verify the capital investment value of the project; and • An assessment of the key issues specified below and a table outlining how these key issues have been addressed.
Key issues	The Environmental Assessment for the Concept Plan must address the following key issues: **1. Conceptual Layout** 1.1. Address the requirements of the *Eurobodalla Rural Local Environmental Plan 1987 (as amended)* and Eurobodalla Council's *DCP No. 160 - Rosedale* and *DCP No. 157 - Rural Subdivision.* Demonstrate consistency with all relevant zone objectives and standards. 1.2. Identify the extent of potential development footprints, building envelopes

6.2. Address potential impacts on the water quality of surface and groundwater, on all water courses, and on ground water dependent ecosystems. Consideration must also be given to the protection of the Bateman's Marine Park.

6.3. Address and outline measures for an Integrated Water Cycle Management Plan (including stormwater concept) based upon Water Sensitive Urban Design principles. This should include measures to ensure no net increase in nutrient/pollutant loads entering the watercourses including both construction and post construction operational management measures.

7. Traffic and Access

7.1. Prepare a Traffic Impact Study (TIS) in accordance with the *RTA Guide to Traffic Generation Developments*.

7.2. Identify the needs to upgrade roads/junctions and improvement works to ameliorate any traffic inefficiency and safety impacts associated with the development, particularly in relation to access points from George Bass Drive. This should include identification of pedestrian movements and appropriate treatments.

7.3. Consult with Eurobodalla Shire Council and the Department of Lands with regard to management and ownership of Crown roads.

8. Hazard Management and Mitigation

8.1. Address the requirements of *Planning for Bush Fire Protection 2001* (RFS) in particular the provision of adequate access for fighting bushfire, adequate asset protection zones and water supply for bushfire suppression operations.

8.2. Prepare a plan of management for fuel management including the provision and maintenance of APZ's, natural area, buffer zones and revegetation.

8.3. Address *AS 3959: Building in Bush Fire Prone Areas*.

8.4. Demonstrate the use of best management sediment and erosion techniques particularly to the area immediately surrounding the SEPP 14 Bevian Wetland.

8.5. Undertake a Flood Study having regard to the requirements of the *NSW Floodplain Management Manual*. Address potential impacts of flooding on the development, the impact of development on flood behaviour (including cumulative impacts), and the impact of flooding on the safety of people over a full range of possible floods up to the probable maximum flood (PMF) and mitigation measures.

8.6. Address sea level rise and coastal inundation restricting where necessary development in low lying areas.

9. Infrastructure Provision

9.1. Address existing capacity and requirements of the development for sewerage, water and electricity in consultation with relevant agencies.

9.2. Identify staging, if any, of infrastructure works.

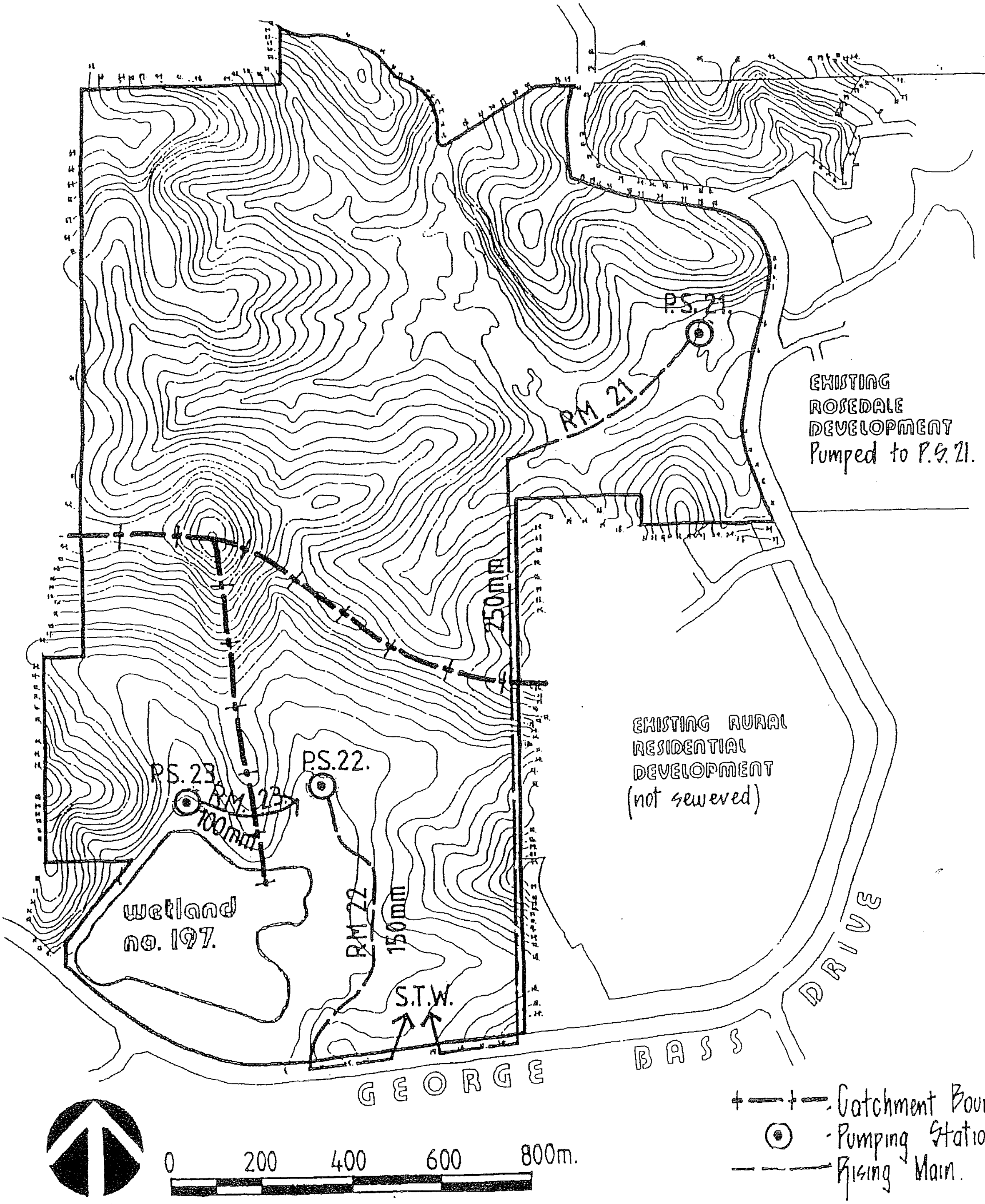
9.3. Address provision of public services and infrastructure having regard to the Council's Section 94 Contribution Plans.

9.4. Prepare an Odour Management Study to address potential odour issues in conflict with provision of the *POEO Act*. (note: the cost of odour management studies and cost of design and construction of any odour control works at the STP are to be fully funded by the applicant).

9.5. An appropriate buffer distance should be identified in accordance with the *Assessment and Management of Odour from Stationary Sources in NSW (Technical Framework and Supporting Technical Notes (DEC November 2006))*.

APPENDIX B
EXCERPT FROM EUROBODALLA SHIRE COUNCIL SEWERAGE SERVICING STRATEGY (1992)

ROSEDALE
URBAN EXPANSION ZONE



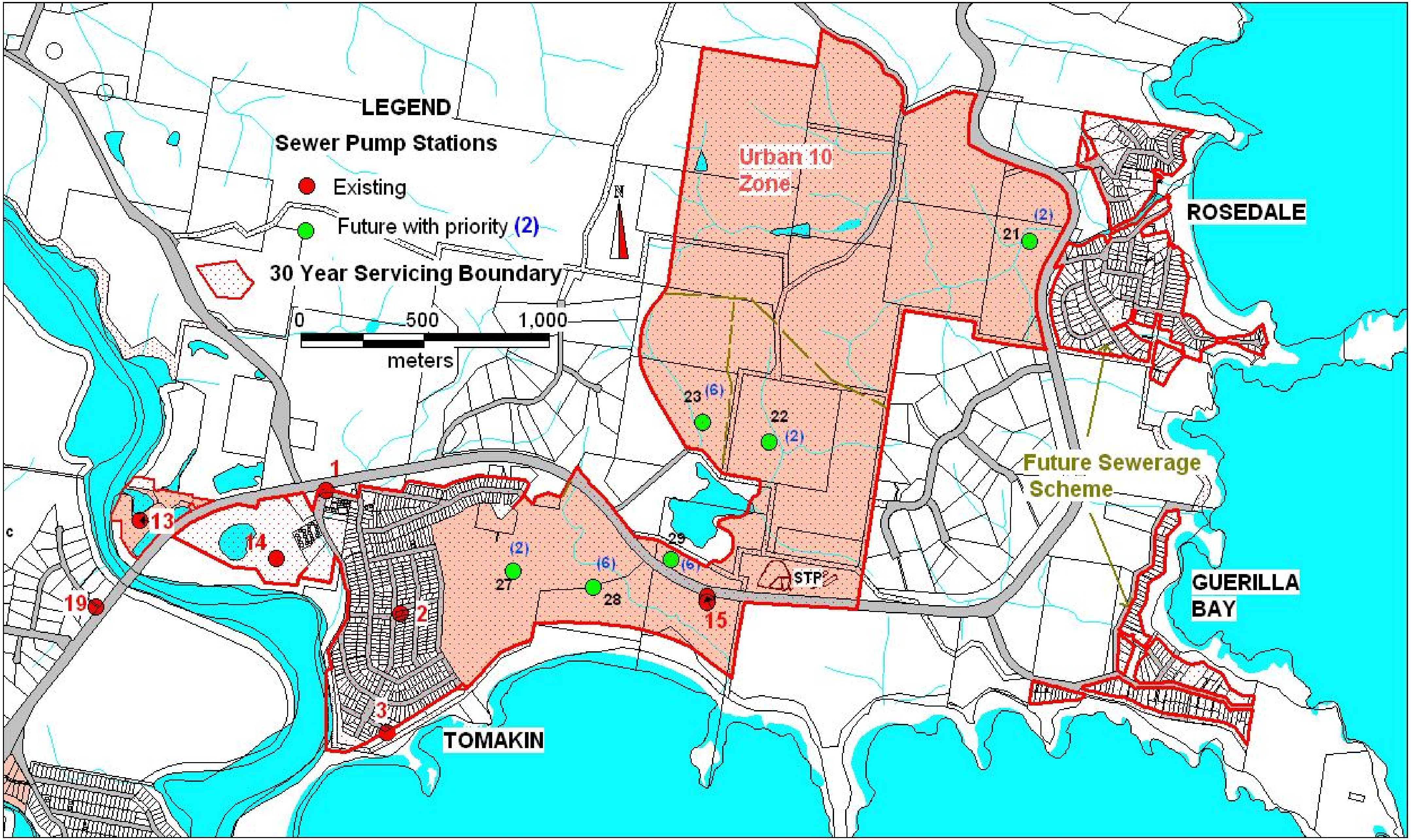
—+—+— Catchment Boundar
◎ Pumping Station.
— — — Rising Main.

SEWERAGE SERVICING STRATEGY

Pumping Station	Approx Capacity (ET)
21.	1200.
22.	420.
23.	170.

FIGURE 3·1 E.S.C. '92.

APPENDIX C
EXCERPT FROM EUROBODALLA SHIRE COUNCIL DEVELOPMENT SERVICING PLAN FOR SEWERAGE SERVICES (2006)



LEGEND
Sewer Pump Stations
Existing
Future with priority (2)
30 Year Servicing Boundary
0
500
1,000
meters
N
Urban 10
Zone
ROSEDALE
GUERILLA
BAY
TOMAKIN
Future Sewerage
Scheme
STP
1
2
3
13
14
15
19
21
22
23
27
28
29
(2)
(6)

APPENDIX D
ODOUR IMPACT ASSESSMENT

HOLMES AIR SCIENCES

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Mark Tooker
Patterson Britton & Partners Pty Ltd
PO Box 515
North Sydney
NSW 2059

14 June 2007

Subject: Rosedale development – odour impact assessment

Dear Mark

Further to our recent conversation, Holmes Air Sciences can confirm that the odour impact assessment completed in April 2004 titled "Odour Impact Assessment using On-site Measurements – Rosedale development" complies with the current odour modelling guidelines issued in November 2006 by the NSW Department of Environment and Climate Change - "*Assessment and Management of odour from Stationary Sources in NSW (Technical Framework and Supporting Technical Notes*".

It has been confirmed with Mark Hankinson of Eurobodalla Shire Council that there have been no major changes to the sources and/or operations at the Tomakin Sewage Treatment Plant (STP) since April 2004 and that the proposed augmentation of the site would not differ significantly from that modelled. Therefore, the conclusion remains that the current and Stage 2 operations of the STP are unlikely to be a nuisance at the proposed residential development.

Do not hesitate to contact me should you have any further queries.

Kindest regards

Judith Cox
Air Quality Engineer

ROSEDALE_CONFIRM_REV1.DOC

ODOUR IMPACT ASSESSMENT USING ON-SITE MEASUREMENTS
Rosedale development

FINAL April 2004

Prepared for
Patterson Britton & Partners Pty Ltd

by

Holmes Air Sciences
Suite 2B, 14 Glen Street
Eastwood NSW

ACN 003 741 035

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CONTENTS

FIGURES (all figures at the end of report)

TABLES

1. INTRODUCTION

This report has been prepared by Holmes Air Sciences for Patterson Britton who are in turn acting on behalf of The Marsim Group. It follows on from an initial assessment of the impacts of odour from the Tomakin Sewage Treatment Plant (STP) on the proposed residential development to be located north of the STP at Rosedale (approximately 13 km south of Batemans Bay) (Holmes Air Sciences, 2003). Odour measurements from another STP were used in a dispersion model along with synthetic meteorological data. The results of this desktop study indicated that the relevant odour goals would be complied with at the proposed development.

At the request of Eurobodalla Shire council, on-site odour measurements have been taken from the Tomakin STP and the dispersion modelling repeated using these data. In addition to this, the dispersion modelling has been run using the synthetic meteorological data and compared with the results using meteorological data from Moruya Airport which is located approximately 10 km southwest of the Tomakin STP. Justification for the validity of the TAPM data is included in this report.

The impacts of emissions have been assessed by comparing estimated odour concentrations at the closest residences in the proposed Rosedale development with relevant air quality criteria. These estimates have been made using the dispersion model known as AUSPLUME. AUSPLUME is an advanced Gaussian dispersion model developed on behalf of the Victorian EPA (VEPA, 1986).

2. LOCAL SETTING AND PROJECT DESCRIPTION

The location of the treatment plant and proposed Rosedale residential development is shown in Figure 1. The local terrain is rolling hills, surrounded by grazing pastures. Figure 2 shows a 3-dimensional representation of the area.

The Tomakin STP currently consists of an uncovered inlet works, an oxidation ditch, two secondary clarifiers (of which only one is operational at any one time), two sludge lagoons and a detention pond. It is designed to treat effluent from approximately 8,000 equivalent persons (ep). It currently treats between 2,000 and 4,000 ep, depending on the season. Provision has been made to augment the capacity to 16,000 ep by duplicating the existing equipment, and although there are no current plans for this to happen, the odour assessment has assessed both the current and possible future operation.

The Marsim Group propose to develop a residential area with a maximum of 850 dwellings, plus commercial zones, to the north of the STP. The closest proposed residence is approximately 20 m from the council owned STP boundary, although this is approximately 180 m away from the closest current odour source (the clarifiers).

3. AIR QUALITY ISSUES

3.1 Introduction

This section discusses air quality goals relating to odour. It should be noted that there is still considerable debate in the scientific community about appropriate odour goals as determined by dispersion modelling.

Odour is measured using panels of people who are presented with samples of odorous gas diluted with decreasing quantities of clean odour-free air. The panellists then note when the smell becomes detectable. Odour in the air is then quantified in terms of odour units which is the number of dilutions required to bring the odour to a level at which 50% of the panellists can just detect the odour. This process is known as olfactometry.

Olfactometry can involve a "forced choice" end point where panellists identify from multiple sniffing ports the one where odour is detected, regardless of whether they are sure they can detect odour. There is also a "yes/no" or "free choice" endpoint where panellists are required to say whether or not they can detect odour from one sniffing port. Forced choice olfactometry generally detects lower odour levels than yes/no olfactometry.

In both cases, odorous air is presented to the panellists in increasing concentrations. For the forced-choice method, where there are multiple ports for each panellist, the concentration is increased until all panellists consistently distinguish the port with the sample from the blanks. For a yes/no olfactometer (which has only one sniffing port) one method used is to increase the concentration of odour in the sample until all panellists respond. The sample is then shut off and once all panellists cease to respond, the sample is introduced again at random dilutions and the panellists are asked whether they can detect the odour.

There are variations in the literature in the terminology for odour thresholds. The New South Wales Department of Environment and Conservation (DEC) (formerly New South Wales Environment Protection Authority (NSW EPA)) has used the definition of the ***detection*** threshold as the lowest concentration which will elicit a response, but where the panellist is essentially <u>guessing</u> correctly. This corresponds to the first end point in the forced-choice olfactometry method. The odour ***recognition*** threshold is, by definition, the minimum concentration at which the panellist is <u>certain</u> they can detect the odour. This is also referred to as the certainty threshold and is the second endpoint in forced-choice olfactometry and similar to the first end point in yes/no olfactometry.

There has been a general move in Europe and Australia to adopt the certainty threshold as the odour standard and to reference this to a standard concentration of butanol (40 parts per billion (ppb)). The odour levels referred to in this report are the certainty odour levels OU_{50R} (Odour detected by 50% of panellists using the recognition threshold).

As with all sensory methods of identification there is variability between individuals. Consequently the results of odour measurements depend on the way in which the panel is selected and the way in which the panel responses are interpreted. The process by which these imprecise measurements are translated into regulatory goals is still being refined. However the DEC has now published a Draft Odour Policy which includes recommendations for odour criteria (NSW EPA, 2001). These are discussed below and have been used for this assessment.

3.1.1 Odour goals

The determination of air quality goals for odour and their use in the assessment of odour impacts is recognised as a difficult topic in air pollution science. The topic has received considerable attention in the past five years and the procedures for assessing odour impacts using dispersion models have been refined considerably.

The DEC has in recent times attempted to refine odour goals and the way in which they should be applied with dispersion models to assess the likelihood of nuisance impact arising from the emission of odour. However as discussed above these procedures are still being developed and odour goals are likely to be revised in the future.

There are two factors that need to be considered:

1. what "level of exposure" to odour is considered acceptable to meet current community standards in NSW and

2. how can dispersion models be used to determine if a source of odour meets the goals which are based on this acceptable level of exposure

The term "level of exposure" has been used to reflect the fact that odour impacts are determined by several factors the most important of which are:

- the Frequency of the exposure
- the Intensity of the odour
- the Duration of the odour episodes and
- the Offensiveness of the odour (the so-called FIDO factor)

In determining the offensiveness of an odour it needs to be recognised that for most odours the context in which an odour is perceived is also relevant. Some odours, for example the smell of sewage, hydrogen sulphide, butyric acid, landfill gas etc., are likely to be judged offensive regardless of the context in which they occur. Other odours such as the smell of jet fuel may be acceptable at an airport, but not in a house, and diesel exhaust may be acceptable near a busy road, but not in a restaurant.

In summary, whether or not an individual considers an odour to be a nuisance will depend on the FIDO factors outlined above and although it is possible to derive formulae for assessing odour annoyance in a community, the response of any individual to an odour is still unpredictable. Odour goals need to take account of these factors.

There is now a new Australian standard for odour measurement which is based on the European standard.

The DEC Draft Odour Policy includes some recommendations for odour criteria. They have been refined by the DEC to take account of population density in the area. Table 1 lists the odour certainty thresholds, to be exceeded not more than 1% of the time, for different population densities. The odour certainty thresholds presented in Table 1 have been used for this study.

The difference between odour goals is based on considerations of risk of odour impact rather than differences in odour acceptability between urban and rural areas. For a given odour level there will be a wide range of responses in the population exposed to the odour. In a densely populated area there will therefore be a greater risk that some individuals within the community will find the odour unacceptable than in a sparsely populated area.

Table 1: Odour Performance Criteria for the Assessment of Odour (DEC, 2001)	
Population of affected community	Odour performance criteria (nose response odour certainty units at the 99th percentile)
Single residence (2)	7
10 – 30	6
30 – 125	5
125 – 500	4
500 – 2000	3
Urban	2

It is common practice to use dispersion models to determine compliance with odour goals. This introduces a complication because Gaussian dispersion models are only able to directly predict concentrations over an averaging period of 3-minutes or greater. The human nose, however, responds to odours over periods of the order of a second or so. During a 3-minute period, odour levels can fluctuate significantly above and below the mean depending on the nature of the source.

To determine more rigorously the ratio between the one-second peak concentrations and three-minute and longer period average concentrations (referred to as the peak to mean ratio) that might be predicted by a Gaussian dispersion model, the DEC commissioned a study by Katestone Scientific Pty Ltd (1995, 1998). This study recommended peak to mean ratios for a range of circumstances. The ratio is also dependent on atmospheric stability and the distance from the source. For area sources in the far field, as applies in this case, the peak to-mean ratio is 2.3 for neutral conditions (stability class A-D) and 1.9 for stable conditions (stability class E - F). A summary of the factors is provided in Appendix A.

The DEC draft guidelines (NSW EPA, 2001) take account of this peaking factor and the goals shown in Table 1 are based on nose-response time.

4. VALIDATION OF APPROPRIATE METEOROLOGICAL DATA

The dispersion model used for this assessment, AUSPLUME, requires information about the dispersion characteristics of the area. In particular, data are required on wind speed, wind direction, atmospheric stability class[1] and mixing height[2].

The closest Bureau of Meteorology monitoring station to the site is at Moruya Airport, approximately 10 km southwest of the study area. Figure 3 shows the annual and seasonal windroses compiled from the Moruya Airport data for 2000. The data show a high frequency of winds from the western, northern and north-eastern quadrants on an annual basis. Winds in winter are predominantly from the west and from the northeast in summer. The annual average wind speed is 3.34 m/s. It is important to note that the Bureau of Meteorology sites are configured to collect data that provides information on general synoptic conditions. As a result of this, wind direction data are collected in ten-degree increments and are therefore not fully representative of all windflow patterns in the study area. In addition, the stalling speed of the anemometer is 1 m/s second and all windspeeds below this are recorded as zero. The treatment of calm winds poses a problem in Gaussian models (such as AUSPLUME) as they assume that concentration is inversely proportional to wind speed. Therefore, in the AUSPLUME dispersion model all wind speeds below 0.5 m/s are set to a default value of 0.5 m/s.

In dispersion modelling it is often the case that there are no on-site data available and as with this assessment the closest Bureau of Meteorology data are not site-specific and due to limitations in the data collection they may not represent all features of wind flow in the local area. The topography at the proposed residential site is shown in Figure 2.

To aid in the assessment of projects where meteorological data are lacking, the Commonwealth Scientific and Industrial Research Organisation (CSIRO) has developed a prognostic model – The Air Pollution Model (TAPM) – which predicts flows important to local scale meteorology, such as sea breezes and terrain induced flows. It uses data from the Bureau of Meteorology Global AnalysiS and Prediction (GASP) model. This feeds into the Limited Area Prediction System (LAPS) (Puri ***et al.,*** 1997) which is used to provide meteorological predictions over 37 km grids. TAPM uses information such as terrain and sea breezes to fine tune these data to provide meteorological data on a smaller scale. The model is discussed further in the user manual (Hurley, 2002a).

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

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

A synthetic, site-specific meteorological data set for the site was created using TAPM Version 2.0. Figure 4 shows the annual and seasonal windroses compiled from the data generated using TAPM. These show a very similar distribution of the wind when compared with the Moruya Airport data, except for during the autumn months when there are a higher percentage of winds from the southwest and northeast. The annual average windspeed is 4.15 m/s.

Verification studies across Australia have shown that TAPM meteorological results perform well in a variety of regions throughout Australia (for example, coastal, inland and generally complex terrain for sub-tropical to mid-latitude conditions) for both case studies and year-long simulations.

Table 2 presents a summary of some of the verification studies. The Index of Agreement (IOA) provides a more consistent measure of performance than the correlation coefficient (also shown for comparison). The IOA is a measure of how well predicted variations about the observed mean are represented, with a value greater than about 0.50 considered to be good. Results are given for wind speed at 10 m above the ground (WS10); the west-east component of the wind (U10); the south-north component of the wind (V10) and temperature (Temp). These results show good agreement between modelled meteorology and observed data. A full analysis of these studies can be found in Hurley et al., 2002b.

Table 2: Results of TAPM verification studies

Location	Cape Grimm		Melbourne (average of 11 sites)				Kwinana (Perth)		Melbourne		Perth	
Date	Dec 1997 – Feb 1998		July 1998		December 1998		1997		July 1996 – June 1997		1999	
Variable	CORR	IOA	CORR	IOA	CORR	IOA	CORR	IOA	CORR	IOA	CORR	IOA
WS10	0.76	0.71	0.82	0.89	0.71	0.82	0.72	0.67	0.73	0.85	0.69	0.78
U10	0.90	0.89	0.74	0.85	0.84	0.90	0.85	0.87	0.75	0.86	0.86	0.91
V10	0.77	0.82	0.79	0.87	0.80	0.88	0.82	0.84	0.85	0.92	0.82	0.90
Temp	0.86	0.92	0.75	0.84	0.92	0.95	0.92	0.96	0.92	0.95	0.92	0.95

CORR = Pearson Correlation Coefficient (0 = no correlation, 1 = exact correlation)
IOA = Index of Agreement (0 = no agreement, 1 = perfect agreement)

In addition to the wind parameters, another important parameter in dispersion modelling is the prevailing atmospheric stability class. Stability is usually assigned according to six classes A to F. Table 3 shows the frequency of occurrence of the different stability categories for the Moruya Airport and TAPM data. Moruya Airport shows a higher percentage of F class stabilities (which indicates that emissions will disperse slowly) than the TAPM dataset and a lower percentage of D class stabilities (which will cause emissions to disperse more quickly).

Table 3: Percentage frequency of occurrence of stability classes		
	Moruya Airport	TAPM
Stability Class	Percentage occurrence	
A	2.7	2.6
B	13.7	11.0
C	17.7	15.3
D	19.3	33.3
E	8.8	14.3
F	37.8	23.5
Total	100	100

The TAPM meteorological data are deemed to be more appropriate for use in this assessment for the following reasons:

- Limitations in the collection of wind direction and windspeed data from Moruya Airport.
- Moruya Airport is located approximately 10 km away from the study area.
- The topography of the two sites is very different - Moruya Airport is situated on flat terrain just behind the sand dunes, whereas the study area is located on a hill between 700 m and 1 km away from the ocean.

5. ESTIMATED EMISSIONS

5.1 Odour

Odour emission rates from area sources (for example, aeration tanks, sludge lagoons) are probably the most difficult to measure for a variety of reasons. Firstly the source is often heterogeneous. For example, in the case of a sewage treatment plant, there will be different odour emission rates from different parts of some area sources. Secondly, unlike stack emissions, area emission rates are dependent upon atmospheric conditions including wind speed, degree of turbulence, temperature, etc. This clearly adds another level of complexity to odour assessments.

For biological processes such as sewage treatment plants there will also be a seasonal variation in emission rates. Odour emissions from some of the processes are higher in the warmer months when microbial activity is greatest. The pumps operate intermittently for 24 hours per day. Variation in odour emissions would also occur throughout the day depending upon the plant throughput.

Odour samples were taken by Australian Water Technologies (AWT) at the Tomakin STP in March 2004. A copy of the results are attached in Appendix B. The odour emission rates used were all taken with measurements using an isolation flux hood. The specific odour emission rates are calculated by multiplying the odour strength by a conversion factor (based on the area of flux hood and rate of air flow).

Table 4: Results of odour monitoring

Source	Sample ID	Odour Strength OU_{50R} (ou)	Specific Odour Emission Rate ($ou.m^3/m^2/s$)	Average SOER ($ou.m^3/m^2/s$)
Inlet works	Sample 1	10200	4.13	4.29
	Sample 2	11000	4.46	
Oxidation ditch	Sample 1	510	0.21	0.23
	Sample 2	630	0.26	
Secondary clarifier	Sample 1	90	0.04	0.03
	Sample 2	80	0.03	
Sludge lagoon	Sample 1	1470	0.60	0.62
	Sample 2	1570	0.64	
Biosolids Stockpile	Sample 1	110	0.04	0.05
	Sample 2	130	0.05	

Table 5 shows that the measured on-site odour levels are lower than those assumed in the original desktop assessment for all the sources except the sludge lagoon. Also, the emissions from the biosolids stockpile that were not previously available are very low. Covering of the inlet works could result in a small reduction in odour levels from this source.

Table 5: Comparison of odour emissions

	Specific Odour Emission Rate ($ou.m^3/m^2/s$)	
Source	On-site data	Data used in desktop study
Inlet works	4.29	45.4
Oxidation ditch	0.23	1.0
Secondary clarifier	0.03	0.13
Sludge Lagoon	0.62	0.50
Biosolids Stockpile	0.05	N/A

6. APPROACH TO ASSESSMENT

Potential impacts of the STP on the proposed development have been assessed using AUSPLUME (Version 5.4). The model requires data on wind speed, wind direction, atmospheric stability class and mixed-layer height together with emission rates from the source. Two sets of meteorological data were used:

1. the synthetic data generated by TAPM
2. the measured data from Moruya Airport

The way in which the model has been used in this study has been to predict the 1-hour average odour levels (expressed in odour units) at a grid of receptors arranged 5 km by 5 km with 200m spacing. Additional receptors were positioned in the proposed residential area as shown in Figure 5. In the present study, 1-hour averaging times have been used for consistency with DEC odour criteria. In addition peak-to-mean factors have been applied to the emission rates to correct for nose response times. In the original desktop assessment, far field peak-to-mean factors were applied, that is, a factor of 1.9 was applied to the emission rates for stable atmospheric conditions (stability class E & F), and a factor of 2.3 was applied for neutral and unstable conditions (stability classes A – D). In order to provide the most conservative estimate for this assessment, near field factors have been applied. Therefore, for stable atmospheric conditions (stability class E & F) a factor of 2.3 has been applied. For neutral and unstable conditions (stability classes A – D) a factor of 2.5 has been used.

The odour sources have been treated as area sources and located according to the plant layout. As with the original desktop assessment two scenarios have been modelled:

- Stage 1 with the current equipment in operation
- Stage 2 with double the current equipment

Table 6: Modelled emission rates and source dimensions

Source	Average SOER (ou.m^3/m^2/s)	Nose response emission rate (ou.m^3/m^2/s)		Area of Source (m^2)
		P/M Neutral =2.5	P/M Stable =2.3	
Stage 1 operations				
Inlet works 1	4.29	10.73	9.87	10
Oxidation ditch 1	0.23	0.58	0.53	1000
Secondary clarifier 1	0.03	0.09	0.08	254
Secondary clarifier 2	0.03	0.09	0.08	254
Sludge lagoon 1	0.62	1.54	1.42	1000
Sludge lagoon 2	0.62	1.54	1.42	1000
Biosolids Stockpile 1	0.05	0.12	0.11	177
Stage 2 operations				
Inlet works 1	4.29	10.73	9.87	10
Oxidation ditch 1	0.23	0.58	0.53	1000
Secondary clarifier 1	0.03	0.09	0.08	254
Secondary clarifier 2	0.03	0.09	0.08	254
Sludge lagoon 1	0.62	1.54	1.42	1000
Sludge lagoon 2	0.62	1.54	1.42	1000
Inlet works 2	4.29	10.73	9.87	10
Oxidation ditch 2	0.23	0.58	0.53	1000
Secondary clarifier 3	0.03	0.09	0.08	254
Secondary clarifier 4	0.03	0.09	0.08	254
Sludge lagoon 3	0.62	1.54	1.42	1000
Sludge lagoon 4	0.62	1.54	1.42	1000
Biosolids Stockpile	0.05	0.12	0.11	353

For the purposes of presenting the results, the maximum predicted odour level at each receptor has been retained by the model and a contour plot has been prepared showing the distribution of these highest 1-hour levels. The contour plots do not represent the dispersion pattern at any particular instant in time, but show the highest predicted 1-hour average odour level that occurred at each location. These maxima are used to show odour levels which can possibly be reached under the modelled conditions. Plots of the 99% compliance level have also been compiled, showing the extent to which odours are predicted to occur for 99% of the time. These data have been presented as contour plots.

7. ASSESSMENT OF IMPACTS

Table 7 presents the maximum and 99th percentile predicted odour levels at the residential receptors for the both the existing (Stage 1) operations and Stage 2 operations at Tomakin STP using the TAPM and Moruya Airport meteorological data.

Using the TAPM data, predicted odour levels at all the residences are predicted to be well within the most stringent of the DEC's goal of 2 odour units "nose-response" 99% level.

With the Moruya Airport data there are a number of locations where the 99th percentile value is predicted to be the same as the maximum predicted level. This is due to the limitations of the meteorological data in terms of wind direction and ability to detect low windspeed. This has resulted in a large number of hours having the same dispersion characteristics and hence the same predicted odour level. For example, for the Stage 1 operation, the maximum predicted concentration at Residence ID 1 occurred on 1st March 2000 at 1 AM. At this time the meteorological data shows an F class stability with wind speed of 0.5 m/s and a wind direction of 180^{o} (that is, the wind is coming directly from the south). Analysis of the meteorological data shows that there are a total of 595 hours with exactly these same conditions. Therefore the 99th percentile and the 95th percentile values are exactly the same as the maximum value. In reality this is a highly unlikely situation. The 90th percentile value is just 0.29 ou which is substantially below the goal.

The predictions for the Stage 2 operations show the same situation occurring at a number of residences, and where the 99th percentile is different to the maximum but still predicted to be over the 2 ou goal, the 90th percentile shown in Table 8, demonstrates that the limitations of the Moruya Airport meteorological data is resulting in overly conservative predictions. The data are suitable for predicting worst-case impacts but are less reliable for predictions of percentile impacts.

Figure 6 and Figure 7 present the maximum predicted and 99th percentile 1-hour odour levels for the existing operations using the TAPM and Moruya Airport meteorological data. Figure 8 and Figure 9 present the maximum predicted and 99th percentile 1-hour odour levels for the approved operations using the TAPM and Moruya Airport meteorological data.

Output from the AUSPLUME modelling run is presented in Appendix C.

Table 7: Predicted odour levels at residential receptors

	Stage 1 operations				Stage 2 operations			
	TAPM met data		Moruya Airport met data		TAPM met data		Moruya Airport met data	
ID	Maximum odour level (ou)	99th percentile odour level (ou)	Maximum odour level (ou)	99th percentile odour level (ou)	Maximum odour level (ou)	99th percentile odour level (ou)	Maximum odour level (ou)	99th percentile odour level (ou)
1	3.22	0.42	7.60	7.60	7.86	1.16	11.88	8.65
2	5.43	0.41	6.30	1.40	5.83	1.25	12.04	12.04
3	2.88	0.36	6.26	1.32	7.18	1.17	15.34	15.34
4	3.02	0.37	5.95	0.94	12.65	1.22	11.86	3.07
5	2.55	0.39	5.19	1.00	8.72	1.39	18.98	3.06
6	1.44	0.42	3.85	0.92	7.92	1.26	16.43	2.90
7	1.47	0.20	3.08	0.33	4.19	0.65	10.28	1.34
8	1.25	0.20	3.56	0.35	7.68	0.64	7.29	1.70
9	2.63	0.20	3.62	1.06	3.87	0.65	10.21	10.21
10	0.70	0.09	1.49	0.20	3.33	0.28	2.69	0.63
11	0.56	0.08	1.72	0.95	2.15	0.27	5.19	5.19
12	0.50	0.09	1.09	0.26	1.75	0.27	2.78	0.35
13	0.48	0.07	0.87	0.04	1.62	0.21	1.52	0.14
14	0.69	0.05	0.66	0.12	1.96	0.16	2.75	0.43
15	0.41	0.04	0.98	0.86	1.15	0.15	3.18	3.09
16	0.42	0.04	0.45	0.03	1.48	0.13	2.09	0.09
17	0.30	0.03	0.38	0.03	1.16	0.10	1.37	0.08
18	0.18	0.04	0.72	0.27	0.60	0.11	2.11	0.44
19	0.30	0.03	0.81	0.54	1.00	0.11	2.66	2.27
20	0.46	0.04	0.60	0.07	1.11	0.11	2.26	0.48
21	0.25	0.03	0.61	0.15	0.61	0.09	2.09	0.81
22	0.20	0.03	0.72	0.55	0.63	0.10	2.22	1.31
23	0.15	0.03	0.62	0.16	0.51	0.09	1.82	0.26
24	0.18	0.03	0.39	0.03	0.76	0.08	1.05	0.07
25	0.20	0.03	0.56	0.13	0.55	0.08	1.90	0.68
26	0.20	0.02	0.66	0.54	0.54	0.08	2.11	1.60
27	0.14	0.03	0.59	0.21	0.42	0.08	1.77	0.41
28	0.14	0.02	0.42	0.02	0.41	0.07	1.18	0.07

Table 8: Stage 2 90th percentile predictions (Moruya Airport met data)			
Residence ID	Maximum odour level (ou)	99th percentile odour level (ou)	90th percentile odour level (ou)
1	11.88	8.65	0.71
2	12.04	12.04	0.96
3	15.34	15.34	1.06
4	11.86	3.07	1.21
5	18.98	3.06	1.13
6	16.43	2.90	0.39
9	10.21	10.21	0.48
11	5.19	5.19	0.18
15	3.18	3.09	0.08
19	2.66	2.27	0.06

8. CONCLUSIONS

Dispersion modelling has been used to assess the impacts of odour on the proposed Rosedale residential of the Tomakin STP. Comparison has been made using both a synthetic TAPM meteorological file and data measured at Moruya Airport. While the Moruya Airport data are useful to provide information for synoptic purposes, the limits of detection in the equipment that measures wind direction and windspeed means the data have limitations in their usefulness in dispersion modelling. TAPM has been validated for use in other studies and it is concluded that it is the more reliable data set for this assessment.

Modelling with the TAPM data shows that the predicted odour levels at the residences comply with the most stringent DEC 99th percentile two odour unit goal. The results using the Moruya Airport data show some unreliable predictions due to the lack of sensitivity within the data to both windspeed and direction and should not be relied upon.

On the basis of the dispersion modelling using the TAPM data and on-site measurement of odour from the current operations at Tomakin STP, it is unlikely that odour would be a nuisance to the proposed residential development. In addition, modelling has shown that the Stage 2 operations at the STP would be unlikely to cause a nuisance to the proposed development under normal plant operating conditions.

It should be noted however, that when potentially odorous operations are located close to sensitive receptors, there is always an increased risk of impacts, particularly during upset conditions. The modelling presented in this report indicates that the proposed development can be located close to the STP, provided the STP continues to operate as it does currently.

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APPENDIX A
PEAK TO MEAN TABLES

Table A1 – Recommended factors for estimating peak concentrations for different source types, distances and stabilities									
		Near field				Far field			
Source type	Stability	i_{max}	x_{max}	P/M 60	P/M 3	i	P/M 60	P/M 3	p
Area	Neutral, Convective	0.5	500 – 1000	2.5	1.9	0.4	2.3	1.7	0.15
	Stable	0.5	300 – 800	2.3	1.7	0.3	1.9	1.4	0.10
Line	Neutral, Convective	1.0	350	6	2.8	0.75	6	2.8	0.25
	Stable	1.0	250	6	2.8	0.65	6	2.8	0.25
Surface point	Neutral	2.5	200	25	10	1.2	5 - 7	3	0.2
	Stable	2.5	200	25	10	1.2	5 - 7	3	0.2
	Convective	2	1000	12	7	0.6	3 - 4	2.5	0.15
Tall point	Neutral, Stable	4.5	5 h	35	8	1.0	6	1.3	0.5
	Convective	2.3	2.5 h	17	4	0.5	3	1.1	0.5
Wake affected point	Neutral, Convective	0.4	-	2.3	1.4	-	2.3	1.4	0.1
Volume	Neutral, Convective	0.4	-	2.3	1.4	-	2.3	1.4	0.1

Source: Katestone Scientific (1998)

i_{max} is maximum centreline intensity of concentration
x_{max} is the approximation location of i_{max} in metres
P/M 60 is the peak-to-mean ratio for long averaging times (typically 1 hour), at a probability of 10^{-3}
P/M 3 is the best estimates of the peak-to-mean ratio for 3 minute averages, at probability 10^{-3}
p is the averaging time power law exponent
h is stack height

APPENDIX B
ODOUR MEASUREMENT RESULTS

26 March 2004

Holmes Air Sciences
Suite 2B, 14 Glen Street
EASTWOOD NSW 2122

DRAFT

Attention Judith Cox

RE: Results from the Tomakin STP.

Ten odour samples were collected from the Tomakin STP on 24/03/04. The samples were analysed for odour strength. This produced the result tabulated below in the terminology of the Draft Procedures for Dynamic Olfactometry from the EPA - WB.

DRAFT	Date of Analysis	Odour Strength OU_{50R}
Secondary Clarifier Sample # 1	25/03/04	90
Secondary Clarifier Sample # 2	25/03/04	80
Biosolids Stockpile Area Sample # 1	25/03/04	110
Biosolids Stockpile Area Sample # 2	25/03/04	130
Oxidation Ditch Sample # 1	25/03/04	510
Oxidation Ditch Sample # 2	25/03/04	630
Sludge Lagoon Sample # 1	25/03/04	1,470
Sludge Lagoon Sample # 2	25/03/04	1,570
Inlet Works Sample # 1	25/03/04	10,200
Inlet Works Sample # 2	25/03/04	11,000

The analysis was carried out on the AC'SCENT Olfactometer according to the Australian New Zealand standard: Air Quality - Determination of odour concentration by dynamic olfactometry (AS/NZS 4323.3:2001).

Regards,

B. Andersen, Air Quality Coordinator.

APPENDIX C
AUSPLUME MODEL OUTPUT FILE

1

Rosedale Development - measured odour- TAPM met

```
Concentration or deposition                       Concentration
Emission rate units                               OUV/second
Concentration units                               Odour_Units
Units conversion factor                           1.00E+00
Constant background concentration                         0.00E+00
Terrain effects                                   None
Smooth stability class changes?                   No
Other stability class adjustments ("urban modes") None
Ignore building wake effects?                     Yes
Decay coefficient (unless overridden by met. file) 0.000
Anemometer height                                 10 m
Roughness height at the wind vane site            0.300 m

                   DISPERSION CURVES
Horizontal dispersion curves for sources <100m high  Pasquill-Gifford
Vertical  dispersion  curves for sources <100m high  Pasquill-Gifford
Horizontal dispersion curves for sources >100m high  Briggs Rural
Vertical  dispersion  curves for sources >100m high  Briggs Rural
Enhance horizontal plume spreads for buoyancy?       Yes
Enhance  vertical  plume spreads for buoyancy?       Yes
Adjust horizontal P-G formulae for roughness height? Yes
Adjust  vertical  P-G formulae for roughness height? Yes
Roughness height                                     0.400m
Adjustment for wind directional shear                None

                    PLUME RISE OPTIONS
Gradual plume rise?                                  Yes
Stack-tip downwash included?                         Yes
Building downwash algorithm:                       PRIME method.
Entrainment coeff. for neutral & stable lapse rates 0.60,0.60
Partial penetration of elevated inversions?          No
Disregard temp. gradients in the hourly met. file?   No
```

and in the absence of boundary-layer potential temperature gradients given by the hourly met. file, a value from the following table (in K/m) is used:

Wind Speed Category	Stability Class A	B	C	D	E	F
1	0.000	0.000	0.000	0.000	0.020	0.035
2	0.000	0.000	0.000	0.000	0.020	0.035
3	0.000	0.000	0.000	0.000	0.020	0.035
4	0.000	0.000	0.000	0.000	0.020	0.035
5	0.000	0.000	0.000	0.000	0.020	0.035
6	0.000	0.000	0.000	0.000	0.020	0.035

WIND SPEED CATEGORIES
Boundaries between categories (in m/s) are: 1.54, 3.09, 5.14, 8.23, 10.80

WIND PROFILE EXPONENTS: "Irwin Rural" values (unless overridden by met. file)

AVERAGING TIMES
1 hour

Rosedale Development - measured odour- TAPM met

SOURCE CHARACTERISTICS

INTEGRATED AREA SOURCE: INLET1

X0(m)	Y0(m)	Ground El	Length X	Length Y	Or. Angle	Ver. spread	Height
247761	6031483	0m	5m	2m	150deg	1m	0m

Emission rates by stability and wind speed, in OUV/second per square metre:

Wind speeds (m/s):	< 1.5	1.5_ 3.1	3.1_ 5.1	5.1_ 8.2	8.2_10.8	>10.8
Stability A:	1.07E+01	1.07E+01	1.07E+01	1.07E+01	1.07E+01	1.07E+01
Stability B:	1.07E+01	1.07E+01	1.07E+01	1.07E+01	1.07E+01	1.07E+01
Stability C:	1.07E+01	1.07E+01	1.07E+01	1.07E+01	1.07E+01	1.07E+01
Stability D:	1.07E+01	1.07E+01	1.07E+01	1.07E+01	1.07E+01	1.07E+01
Stability E:	9.87E+00	9.87E+00	9.87E+00	9.87E+00	9.87E+00	9.87E+00
Stability F:	9.87E+00	9.87E+00	9.87E+00	9.87E+00	9.87E+00	9.87E+00

No gravitational settling or scavenging.

INTEGRATED AREA SOURCE: OXIDA1

X0(m)	Y0(m)	Ground El	Length X	Length Y	Or. Angle	Ver. spread	Height
247805	6031495	0m	67m	16m	150deg	1m	0m

Emission rates by stability and wind speed, in OUV/second per square metre:

Wind speeds (m/s):	< 1.5	1.5_ 3.1	3.1_ 5.1	5.1_ 8.2	8.2_10.8	>10.8
Stability A:	5.80E-01	5.80E-01	5.80E-01	5.80E-01	5.80E-01	5.80E-01
Stability B:	5.80E-01	5.80E-01	5.80E-01	5.80E-01	5.80E-01	5.80E-01
Stability C:	5.80E-01	5.80E-01	5.80E-01	5.80E-01	5.80E-01	5.80E-01
Stability D:	5.80E-01	5.80E-01	5.80E-01	5.80E-01	5.80E-01	5.80E-01
Stability E:	5.30E-01	5.30E-01	5.30E-01	5.30E-01	5.30E-01	5.30E-01
Stability F:	5.30E-01	5.30E-01	5.30E-01	5.30E-01	5.30E-01	5.30E-01

No gravitational settling or scavenging.

INTEGRATED CIRCULAR AREA SOURCE: CLARI1

X0(m)	Y0(m)	Ground El	Radius	No. Vertices	Ver. spread	Height
247790	6031531	0m	9m	20	1m	0m

Emission rates by stability and wind speed, in OUV/second per square metre:

Wind speeds (m/s):	< 1.5	1.5_ 3.1	3.1_ 5.1	5.1_ 8.2	8.2_10.8	>10.8
Stability A:	9.00E-02	9.00E-02	9.00E-02	9.00E-02	9.00E-02	9.00E-02
Stability B:	9.00E-02	9.00E-02	9.00E-02	9.00E-02	9.00E-02	9.00E-02
Stability C:	9.00E-02	9.00E-02	9.00E-02	9.00E-02	9.00E-02	9.00E-02
Stability D:	9.00E-02	9.00E-02	9.00E-02	9.00E-02	9.00E-02	9.00E-02
Stability E:	8.00E-02	8.00E-02	8.00E-02	8.00E-02	8.00E-02	8.00E-02
Stability F:	8.00E-02	8.00E-02	8.00E-02	8.00E-02	8.00E-02	8.00E-02

No gravitational settling or scavenging.

INTEGRATED POLYGON AREA SOURCE: LAGOO1

X0(m)	Y0(m)	Ground El	No. Vertices	Ver. spread	Height
247635	6031524	0m	8	1m	0m

Integrated Polygon Area Source Vertice Locations (in metres)

No.	X	Y	No.	X	Y
1	247635	6031524	2	247662	6031524
3	247664	6031503	4	247661	6031494
5	247655	6031487	6	247644	6031487
7	247637	6031494	8	247632	6031520

Emission rates by stability and wind speed, in OUV/second per square metre:

Wind speeds (m/s):	< 1.5	1.5_ 3.1	3.1_ 5.1	5.1_ 8.2	8.2_10.8	>10.8
Stability A:	1.54E+00	1.54E+00	1.54E+00	1.54E+00	1.54E+00	1.54E+00
Stability B:	1.54E+00	1.54E+00	1.54E+00	1.54E+00	1.54E+00	1.54E+00
Stability C:	1.54E+00	1.54E+00	1.54E+00	1.54E+00	1.54E+00	1.54E+00
Stability D:	1.54E+00	1.54E+00	1.54E+00	1.54E+00	1.54E+00	1.54E+00
Stability E:	1.42E+00	1.42E+00	1.42E+00	1.42E+00	1.42E+00	1.42E+00
Stability F:	1.42E+00	1.42E+00	1.42E+00	1.42E+00	1.42E+00	1.42E+00

No gravitational settling or scavenging.

INTEGRATED POLYGON AREA SOURCE: LAGOO2

X0(m)	Y0(m)	Ground El	No. Vertices	Ver. spread	Height
247626	6031525	0m	9	1m	0m

Integrated Polygon Area Source Vertice Locations (in metres)

No.	X	Y	No.	X	Y
1	247626	6031525	2	247633	6031496
3	247632	6031490	4	247627	6031484
5	247590	6031487	6	247588	6031491
7	247590	6031496	8	247614	6031524
9	247621	6031526			

Emission rates by stability and wind speed, in OUV/second per square metre:

Wind speeds (m/s):	< 1.5	1.5_ 3.1	3.1_ 5.1	5.1_ 8.2	8.2_10.8	>10.8
Stability A:	1.54E+00	1.54E+00	1.54E+00	1.54E+00	1.54E+00	1.54E+00
Stability B:	1.54E+00	1.54E+00	1.54E+00	1.54E+00	1.54E+00	1.54E+00
Stability C:	1.54E+00	1.54E+00	1.54E+00	1.54E+00	1.54E+00	1.54E+00
Stability D:	1.54E+00	1.54E+00	1.54E+00	1.54E+00	1.54E+00	1.54E+00
Stability E:	1.42E+00	1.42E+00	1.42E+00	1.42E+00	1.42E+00	1.42E+00
Stability F:	1.42E+00	1.42E+00	1.42E+00	1.42E+00	1.42E+00	1.42E+00

No gravitational settling or scavenging.

INTEGRATED AREA SOURCE: INLET2

X0(m)	Y0(m)	Ground El	Length X	Length Y	Or. Angle	Ver. spread	Height
247770	6031470	0m	5m	2m	150deg	1m	0m

(Constant) emission rate = 0.00E+00 OUV/second per square metre
No gravitational settling or scavenging.

INTEGRATED AREA SOURCE: OXIDA2

X0(m)	Y0(m)	Ground El	Length X	Length Y	Or. Angle	Ver. spread	Height
247889	6031495	0m	67m	16m	150deg	1m	0m

(Constant) emission rate = 0.00E+00 OUV/second per square metre
No gravitational settling or scavenging.

INTEGRATED CIRCULAR AREA SOURCE: CLARI2

X0(m)	Y0(m)	Ground El	Radius	No. Vertices	Ver. spread	Height
247813	6031546	0m	9m	20	1m	0m

Emission rates by stability and wind speed, in OUV/second per square metre:

Wind speeds (m/s):	< 1.5	1.5_ 3.1	3.1_ 5.1	5.1_ 8.2	8.2_10.8	>10.8
Stability A:	9.00E-02	9.00E-02	9.00E-02	9.00E-02	9.00E-02	9.00E-02
Stability B:	9.00E-02	9.00E-02	9.00E-02	9.00E-02	9.00E-02	9.00E-02
Stability C:	9.00E-02	9.00E-02	9.00E-02	9.00E-02	9.00E-02	9.00E-02
Stability D:	8.00E-02	8.00E-02	8.00E-02	8.00E-02	8.00E-02	8.00E-02
Stability E:	8.00E-02	8.00E-02	8.00E-02	8.00E-02	8.00E-02	8.00E-02
Stability F:	2.00E-01	2.00E-01	2.00E-01	2.00E-01	2.00E-01	2.00E-01

No gravitational settling or scavenging.

INTEGRATED CIRCULAR AREA SOURCE: CLARI3

X0(m)	Y0(m)	Ground El	Radius	No. Vertices	Ver. spread	Height
247811	6031546	0m	9m	20	1m	0m

(Constant) emission rate = 0.00E+00 OUV/second per square metre
No gravitational settling or scavenging.

INTEGRATED CIRCULAR AREA SOURCE: CLARI4

X0(m)	Y0(m)	Ground El	Radius	No. Vertices	Ver. spread	Height
247851	6031597	0m	9m	20	1m	0m

(Constant) emission rate = 0.00E+00 OUV/second per square metre
No gravitational settling or scavenging.

INTEGRATED AREA SOURCE: LAGOO3

X0(m)	Y0(m)	Ground El	Length X	Length Y	Or. Angle	Ver. spread	Height
247717	6031522	0m	50m	55m	150deg	1m	0m

(Constant) emission rate = 0.00E+00 OUV/second per square metre
No gravitational settling or scavenging.

INTEGRATED AREA SOURCE: LAGOO4

X0(m)	Y0(m)	Ground El	Length X	Length Y	Or. Angle	Ver. spread	Height
247766	6031552	0m	50m	55m	150deg	1m	0m

(Constant) emission rate = 0.00E+00 OUV/second per square metre
No gravitational settling or scavenging.

INTEGRATED CIRCULAR AREA SOURCE: BIOSOL

X0(m)	Y0(m)	Ground El	Radius	No. Vertices	Ver. spread	Height
247700	6031502	0m	8m	20	1m	0m

Emission rates by stability and wind speed, in OUV/second per square metre:

Wind speeds (m/s):	< 1.5	1.5_ 3.1	3.1_ 5.1	5.1_ 8.2	8.2_10.8	>10.8
Stability A:	1.20E-01	1.20E-01	1.20E-01	1.20E-01	1.20E-01	1.20E-01
Stability B:	1.20E-01	1.20E-01	1.20E-01	1.20E-01	1.20E-01	1.20E-01
Stability C:	1.20E-01	1.20E-01	1.20E-01	1.20E-01	1.20E-01	1.20E-01
Stability D:	1.20E-01	1.20E-01	1.20E-01	1.20E-01	1.20E-01	1.20E-01
Stability E:	1.10E-01	1.10E-01	1.10E-01	1.10E-01	1.10E-01	1.10E-01
Stability F:	1.10E-01	1.10E-01	1.10E-01	1.10E-01	1.10E-01	1.10E-01

No gravitational settling or scavenging.

1

Rosedale Development - measured odour- TAPM met

RECEPTOR LOCATIONS

The Cartesian receptor grid has the following x-values (or eastings):
245000.m 245200.m 245400.m 245600.m 245800.m 246000.m 246200.m
246400.m 246600.m 246800.m 247000.m 247200.m 247400.m 247600.m
247800.m 248000.m 248200.m 248400.m 248600.m 248800.m 249000.m
249200.m 249400.m 249600.m 249800.m 250000.m

and these y-values (or northings):
6029000.m 6029200.m 6029400.m 6029600.m 6029800.m 6030000.m 6030200.m
6030400.m 6030600.m 6030800.m 6031000.m 6031200.m 6031400.m 6031600.m
6031800.m 6032000.m 6032200.m 6032400.m 6032600.m 6032800.m 6033000.m
6033200.m 6033400.m 6033600.m 6033800.m 6034000.m

DISCRETE RECEPTOR LOCATIONS (in metres)

No.	X	Y	ELEVN	HEIGHT	No.	X	Y	ELEVN	HEIGHT
1	247638	6031748	0.0	0.0	15	247711	6032554	0.0	0.0
2	247696	6031744	0.0	0.0	16	247199	6032581	0.0	0.0
3	247761	6031756	0.0	0.0	17	247157	6032760	0.0	0.0
4	247822	6031744	0.0	0.0	18	247447	6032810	0.0	0.0
5	247868	6031725	0.0	0.0	19	247768	6032779	0.0	0.0
6	247936	6031725	0.0	0.0	20	247978	6032802	0.0	0.0
7	247940	6031870	0.0	0.0	21	247932	6032997	0.0	0.0
8	247852	6031874	0.0	0.0	22	247570	6032993	0.0	0.0
9	247722	6031882	0.0	0.0	23	247390	6032989	0.0	0.0
10	247971	6032153	0.0	0.0	24	247138	6032974	0.0	0.0
11	247738	6032183	0.0	0.0	25	247955	6033157	0.0	0.0
12	247482	6032191	0.0	0.0	26	247657	6033165	0.0	0.0
13	247130	6032206	0.0	0.0	27	247417	6033177	0.0	0.0
14	247963	6032520	0.0	0.0	28	247169	6033188	0.0	0.0

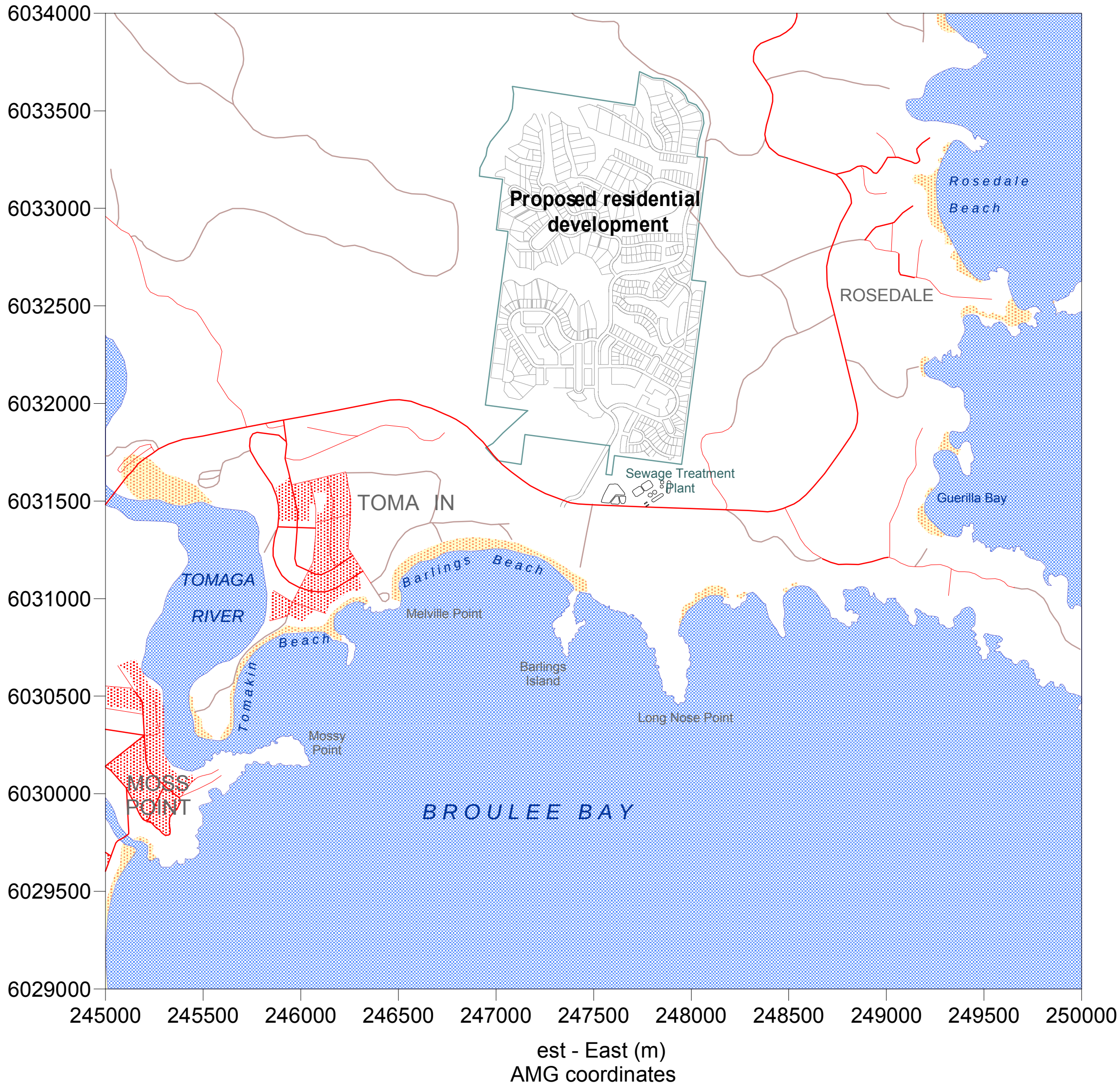
METEOROLOGICAL DATA : AUSPLUME METFILE

1 Peak values for the 100 worst cases (in Odour_Units)
Averaging time = 1 hour

Rank	Value	Time Recorded hour,date	Coordinates (* denotes polar)
1	1.15E+01	20,06/04/02	(247600, 6031400, 0.0)
2	1.03E+01	05,05/03/02	(247600, 6031400, 0.0)
3	9.95E+00	24,10/11/02	(247600, 6031600, 0.0)
4	9.05E+00	24,25/08/02	(247800, 6031400, 0.0)
5	8.94E+00	22,30/07/02	(247600, 6031600, 0.0)
6	8.82E+00	18,23/07/02	(247600, 6031400, 0.0)
7	7.84E+00	21,05/11/02	(247600, 6031400, 0.0)
8	7.66E+00	22,15/04/02	(247600, 6031600, 0.0)
9	7.47E+00	07,22/03/02	(247600, 6031600, 0.0)
10	7.19E+00	07,26/07/02	(247800, 6031400, 0.0)
11	7.13E+00	23,03/03/02	(247600, 6031600, 0.0)
12	7.10E+00	06,05/03/02	(247600, 6031400, 0.0)
13	6.40E+00	24,24/12/02	(247600, 6031600, 0.0)
14	6.17E+00	24,26/08/02	(247600, 6031400, 0.0)
15	5.95E+00	19,21/09/02	(247600, 6031400, 0.0)
16	5.90E+00	06,11/04/02	(247800, 6031400, 0.0)
17	5.89E+00	20,22/09/02	(248000, 6031400, 0.0)
18	5.87E+00	08,26/07/02	(247600, 6031400, 0.0)
19	5.59E+00	22,21/11/02	(247600, 6031400, 0.0)
20	5.57E+00	21,20/10/02	(247600, 6031400, 0.0)
21	5.56E+00	20,01/05/02	(247600, 6031600, 0.0)
22	5.43E+00	04,25/08/02	(247696, 6031744, 0.0)
23	5.38E+00	20,19/03/02	(247600, 6031600, 0.0)
24	5.14E+00	04,05/03/02	(247600, 6031400, 0.0)
25	5.06E+00	20,16/03/02	(247600, 6031400, 0.0)
26	4.95E+00	20,20/03/02	(247800, 6031400, 0.0)
27	4.92E+00	10,16/04/02	(247600, 6031600, 0.0)
28	4.91E+00	21,30/07/02	(247600, 6031600, 0.0)

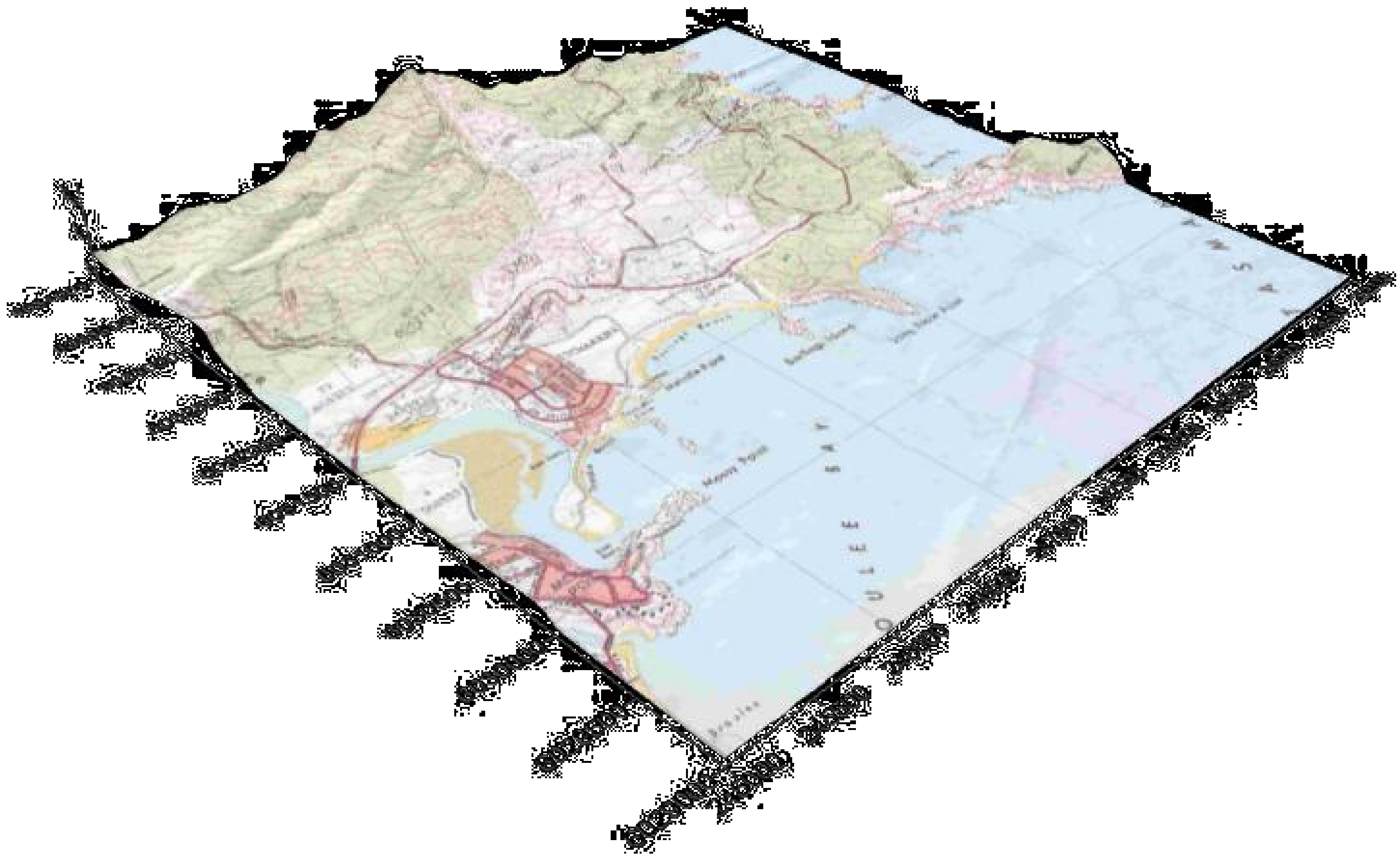
29	4.80E+00	21,03/11/02	(247400,	6031600,	0.0)
30	4.80E+00	20,21/02/02	(247600,	6031400,	0.0)
31	4.77E+00	21,22/01/02	(247600,	6031600,	0.0)
32	4.71E+00	01,26/01/02	(247600,	6031400,	0.0)
33	4.70E+00	21,16/04/02	(247600,	6031400,	0.0)
34	4.66E+00	20,01/10/02	(247600,	6031400,	0.0)
35	4.64E+00	18,05/06/02	(247600,	6031400,	0.0)
36	4.57E+00	05,11/04/02	(247800,	6031400,	0.0)
37	4.54E+00	04,15/01/02	(247600,	6031600,	0.0)
38	4.43E+00	19,17/03/02	(247600,	6031400,	0.0)
39	4.28E+00	23,19/02/02	(247600,	6031400,	0.0)
40	4.26E+00	22,15/12/02	(247600,	6031400,	0.0)
41	4.26E+00	23,28/11/02	(247600,	6031400,	0.0)
42	4.19E+00	09,14/12/02	(247600,	6031600,	0.0)
43	4.16E+00	20,16/08/02	(247400,	6031600,	0.0)
44	4.12E+00	22,18/08/02	(247696,	6031744,	0.0)
45	4.12E+00	24,25/01/02	(247600,	6031400,	0.0)
46	4.12E+00	04,26/11/02	(247600,	6031400,	0.0)
47	4.11E+00	20,17/10/02	(247600,	6031400,	0.0)
48	3.94E+00	01,27/08/02	(247800,	6031400,	0.0)
49	3.91E+00	18,02/08/02	(247600,	6031400,	0.0)
50	3.90E+00	19,03/06/02	(247800,	6031400,	0.0)
51	3.88E+00	22,14/02/02	(247600,	6031400,	0.0)
52	3.82E+00	22,28/03/02	(247600,	6031400,	0.0)
53	3.77E+00	22,05/03/02	(247600,	6031400,	0.0)
54	3.77E+00	24,27/12/02	(247600,	6031400,	0.0)
55	3.77E+00	06,21/09/02	(247800,	6031400,	0.0)
56	3.76E+00	21,27/08/02	(247600,	6031400,	0.0)
57	3.74E+00	23,18/11/02	(247600,	6031400,	0.0)
58	3.72E+00	08,22/03/02	(247600,	6031600,	0.0)
59	3.71E+00	23,04/01/02	(247600,	6031600,	0.0)
60	3.63E+00	06,26/03/02	(247600,	6031400,	0.0)
61	3.63E+00	24,19/01/02	(247600,	6031400,	0.0)
62	3.62E+00	24,19/12/02	(247600,	6031400,	0.0)
63	3.56E+00	03,17/01/02	(247600,	6031400,	0.0)
64	3.55E+00	22,13/02/02	(247600,	6031400,	0.0)
65	3.51E+00	21,16/12/02	(247600,	6031600,	0.0)
66	3.50E+00	24,13/12/02	(247800,	6031600,	0.0)
67	3.47E+00	22,24/02/02	(247600,	6031400,	0.0)
68	3.45E+00	20,13/09/02	(247600,	6031400,	0.0)
69	3.43E+00	05,26/03/02	(247600,	6031400,	0.0)
70	3.40E+00	22,29/10/02	(247600,	6031400,	0.0)
71	3.39E+00	20,17/02/02	(247600,	6031600,	0.0)
72	3.39E+00	23,24/11/02	(247600,	6031400,	0.0)
73	3.38E+00	23,27/01/02	(247600,	6031400,	0.0)
74	3.38E+00	22,09/11/02	(247800,	6031400,	0.0)
75	3.37E+00	19,05/05/02	(247600,	6031400,	0.0)
76	3.36E+00	07,12/07/02	(247800,	6031400,	0.0)
77	3.36E+00	02,13/07/02	(247800,	6031400,	0.0)
78	3.35E+00	21,12/12/02	(247600,	6031400,	0.0)
79	3.35E+00	01,21/12/02	(247600,	6031400,	0.0)
80	3.35E+00	24,20/01/02	(247600,	6031400,	0.0)
81	3.32E+00	22,28/10/02	(247800,	6031400,	0.0)
82	3.32E+00	03,11/04/02	(247800,	6031400,	0.0)
83	3.31E+00	03,26/11/02	(247800,	6031400,	0.0)
84	3.30E+00	04,20/11/02	(247800,	6031600,	0.0)
85	3.30E+00	06,12/07/02	(247800,	6031400,	0.0)
86	3.30E+00	05,04/10/02	(248000,	6031400,	0.0)
87	3.28E+00	18,31/05/02	(247600,	6031600,	0.0)
88	3.27E+00	18,17/09/02	(247600,	6031600,	0.0)
89	3.27E+00	02,31/01/02	(247600,	6031400,	0.0)
90	3.27E+00	20,11/04/02	(247600,	6031400,	0.0)
91	3.26E+00	22,23/12/02	(247600,	6031600,	0.0)
92	3.26E+00	19,27/07/02	(247600,	6031400,	0.0)
93	3.25E+00	05,27/01/02	(247800,	6031400,	0.0)
94	3.24E+00	18,14/07/02	(247600,	6031600,	0.0)
95	3.24E+00	23,26/03/02	(247600,	6031400,	0.0)
96	3.24E+00	22,22/03/02	(247600,	6031400,	0.0)
97	3.23E+00	06,05/05/02	(247800,	6031400,	0.0)
98	3.23E+00	22,21/10/02	(247600,	6031400,	0.0)
99	3.21E+00	02,21/12/02	(247600,	6031400,	0.0)
100	3.20E+00	20,16/02/02	(247600,	6031400,	0.0)

FIGURES



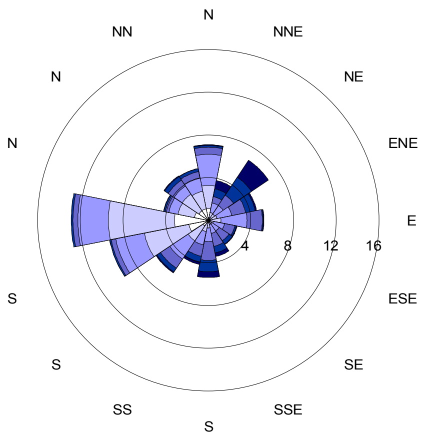
Location of study area

Figure 1



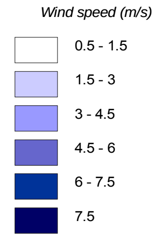
3D plot of area

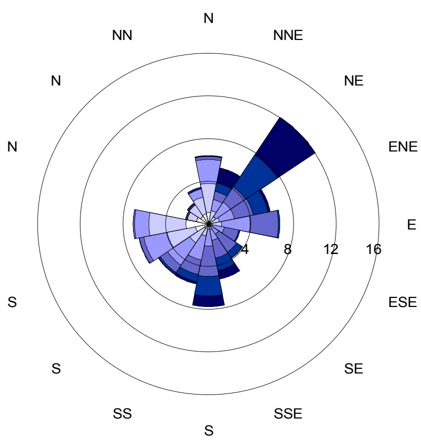
Figure 2



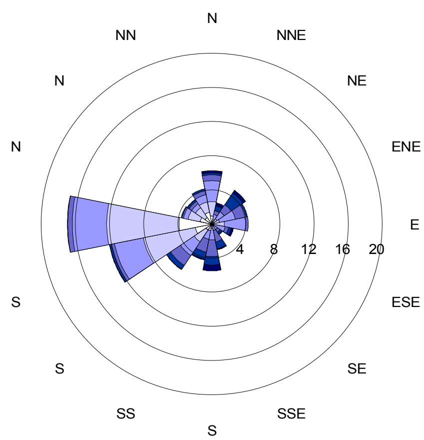
Annual

Annual and Seasonal Windroses for Moruya (2000)

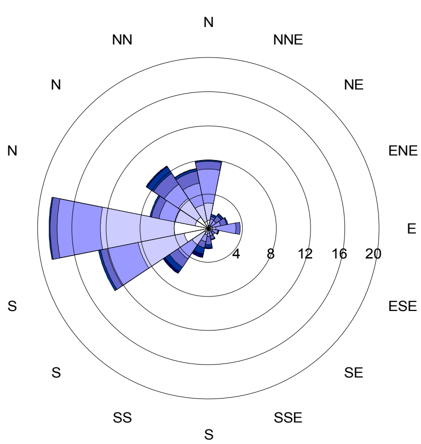




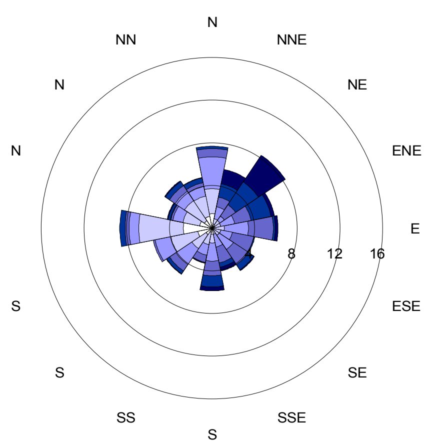
Summer



Autumn



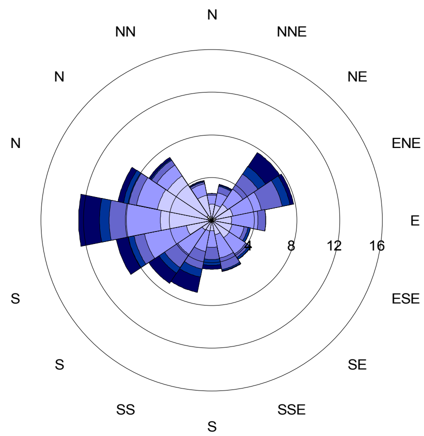
inter



Spring

Figure 3

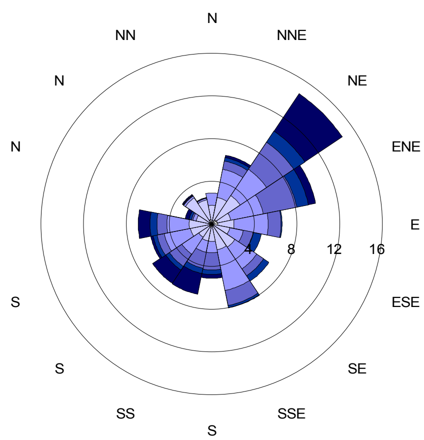
Annual and Seasonal Windroses for Rosedale (TAPM 2002)



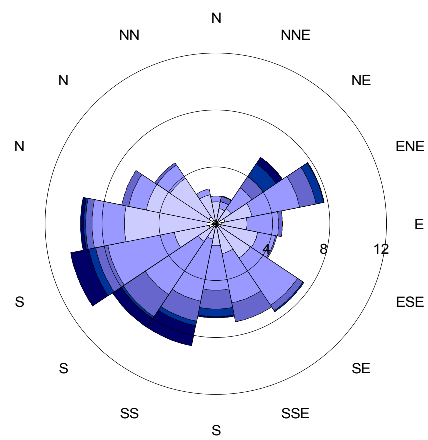
Annual

Wind speed (m/s)

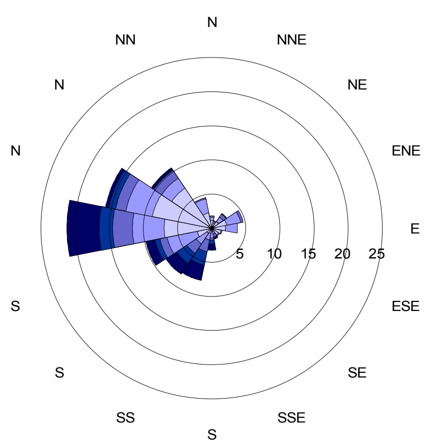
- 0.5 - 1.5
- 1.5 - 3
- 3 - 4.5
- 4.5 - 6
- 6 - 7.5
- 7.5



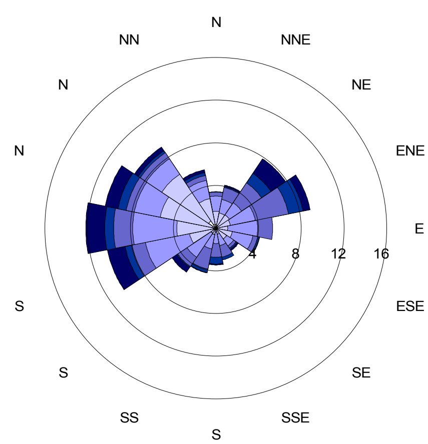
Summer



Autumn

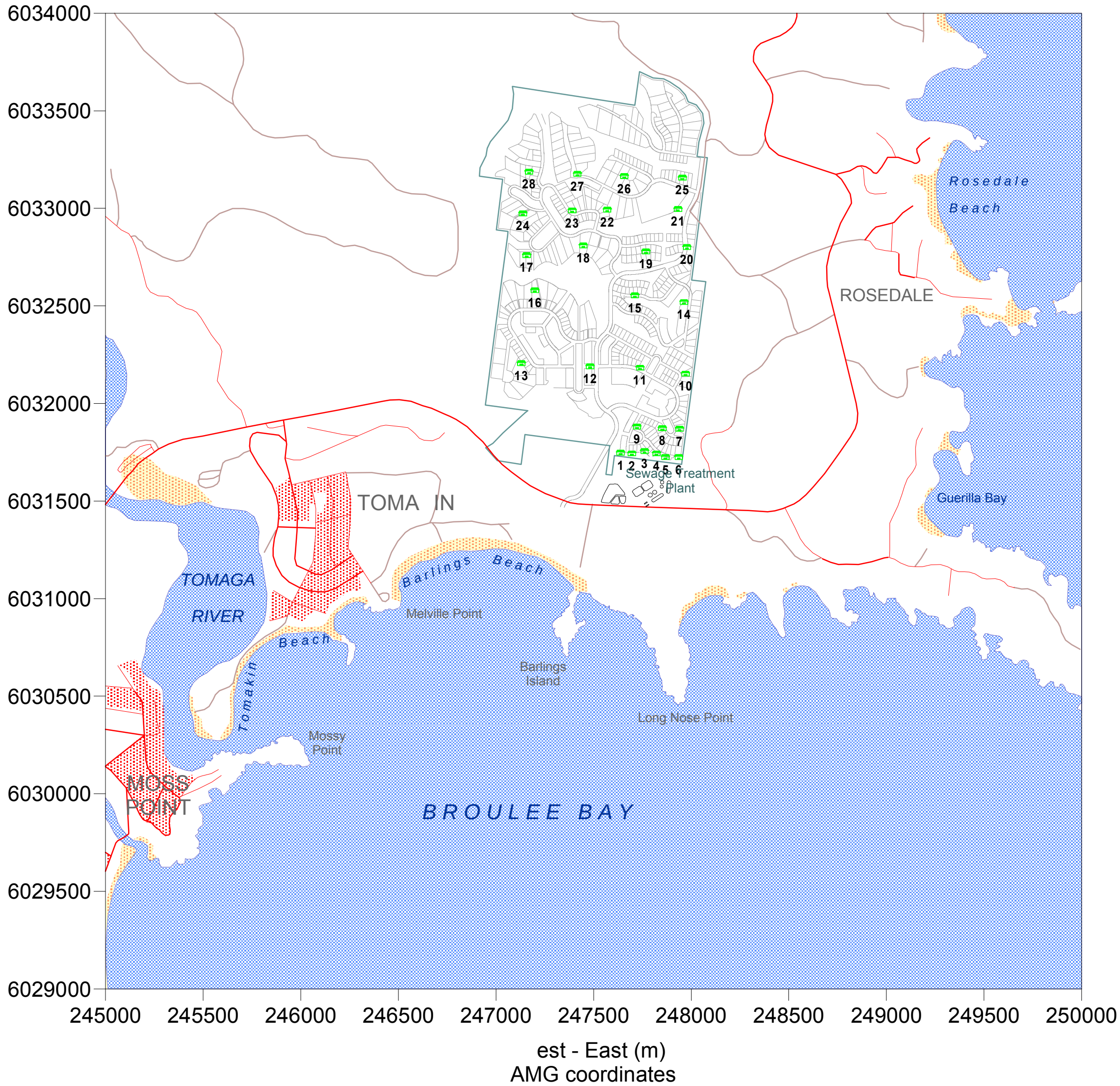


inter



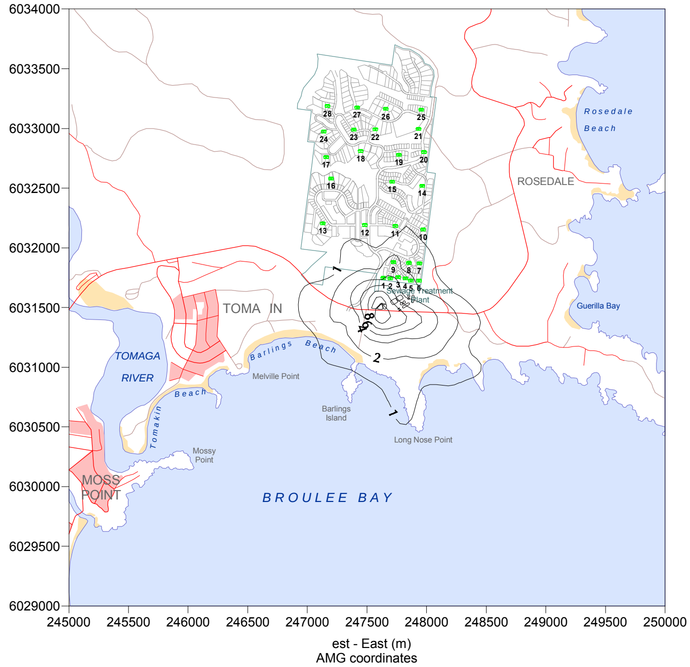
Spring

Figure 4

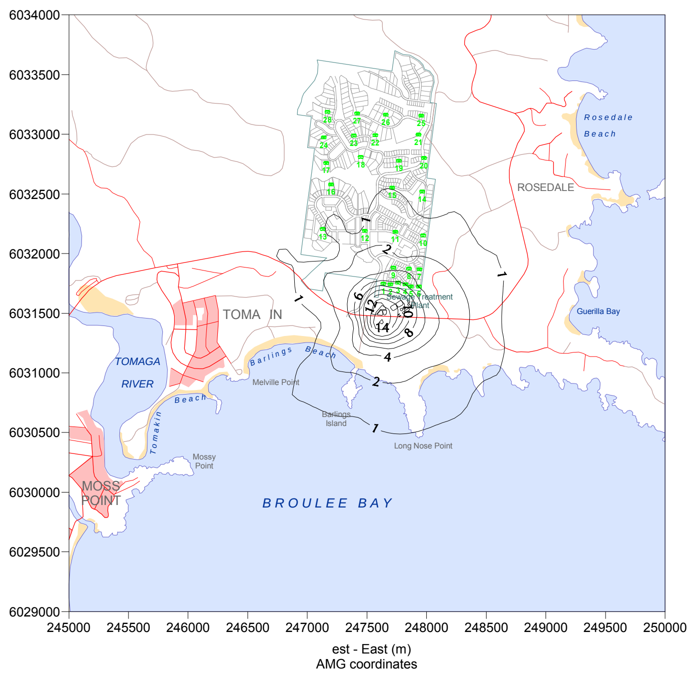


Location of residential receptors

Figure 5

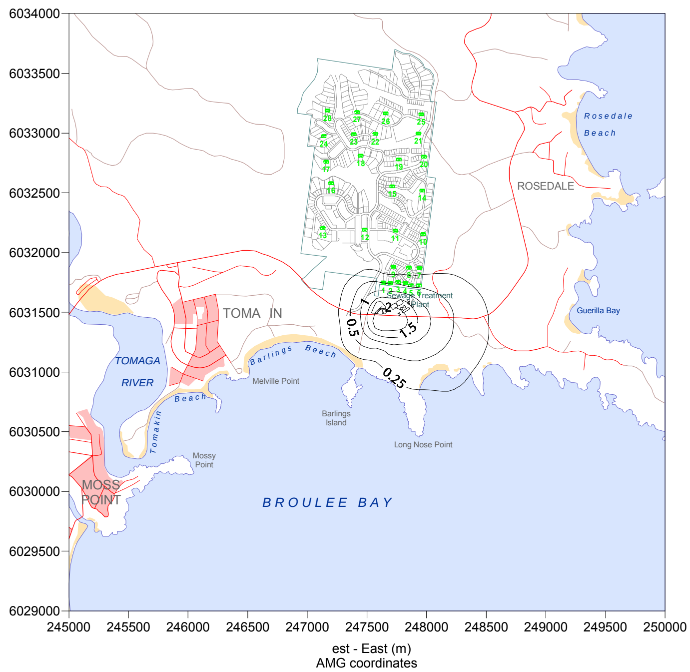


Ma imum predicted odour levels with e isting activities (ou)
(Measured odour emissions and TAPM meteorological data)

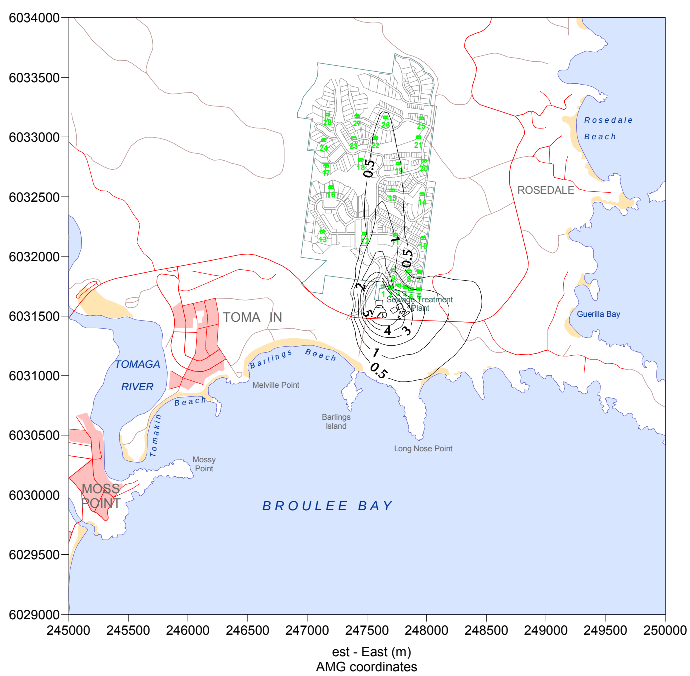


Ma imum predicted odour levels with e isting activities (ou)
(Measured odour emissions and Moruya Airport meteorological data)

Figure 6: Maximum predicted odour levels – Stage 1 operations (ou)

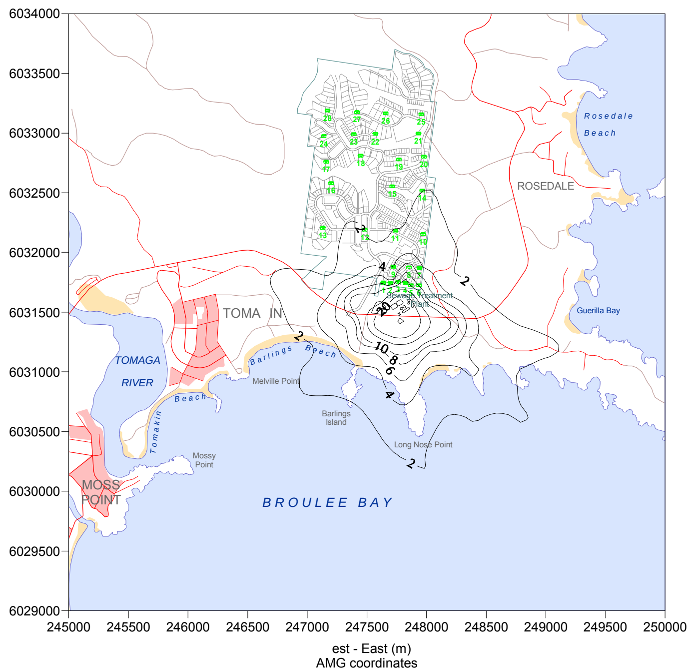


99th percentile predicted odour levels with e isting activities (ou)
(Measured odour emissions and TAPM meteorological data)

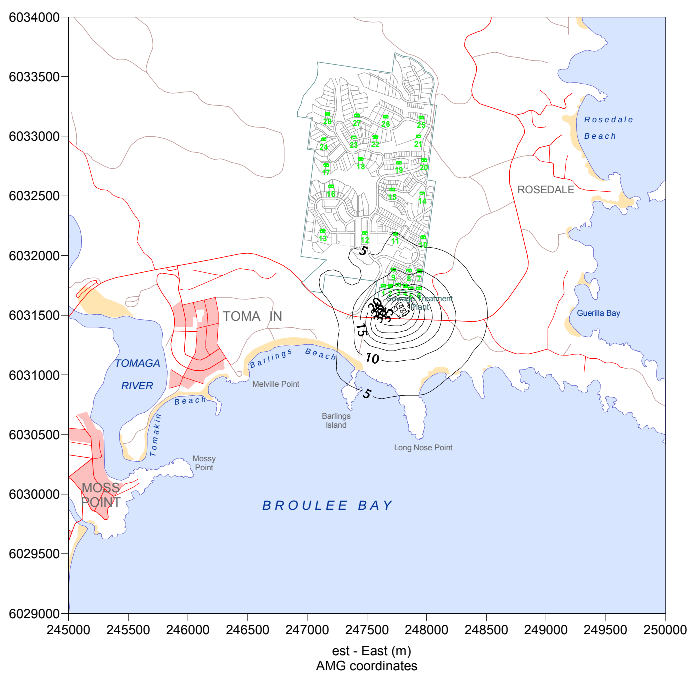


99th percentile predicted odour levels with e isting activities (ou)
(Measured odour emissions and Moruya Airport meteorological data)

Figure 7: 99th percentile odour levels – Stage 1 operations (ou)

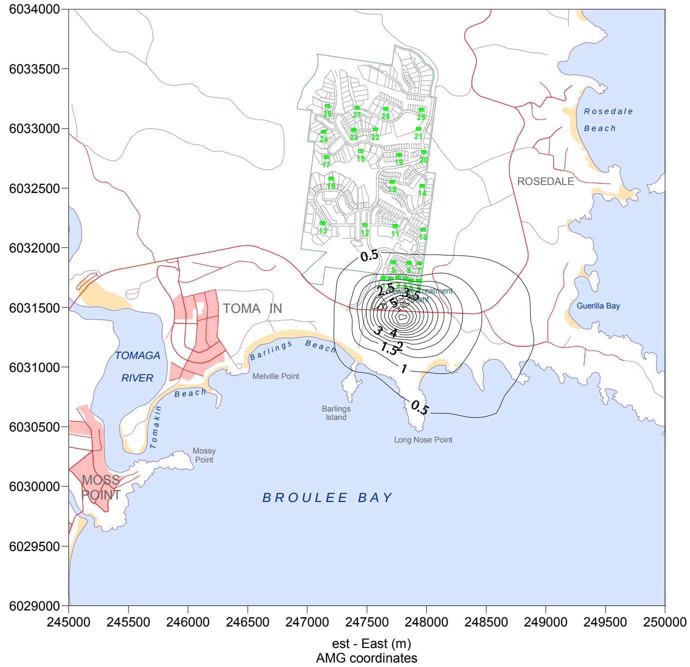


Ma imum predicted odour levels with Stage 2 activities (ou)
(Measured odour emissions and TAPM meteorological data)

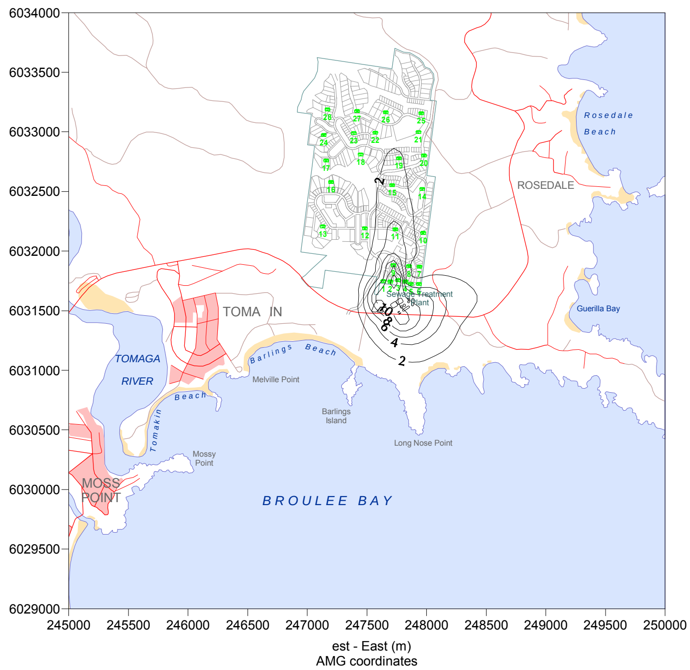


Ma imum predicted odour levels with Stage 2 activities (ou)
(Measured odour emissions and Moruya Airport meteorological data)

Figure 8: Maximum predicted odour levels – Stage 2 operations (ou)



99th percentile predicted odour levels with Stage 2 activities (ou)
(Measured odour emissions and TAPM meteorological data)



99th percentile predicted odour levels with Stage 2 activities (ou)
(Measured odour emissions and Moruya Airport meteorological data)

Figure 9: 99th percentile odour levels – Stage 2 operations (ou)

APPENDIX E
LETTER FROM COUNTRY ENERGY

countryenergy

Ref: GE:GE Rosedale

03/05/07

Pete Best

Nature Coast Property

Dear Pete Best

Rosedale Concept Master Plan- Infrastructure Provision

Electrical Infrastructure to the development can be made available from existing Country Energy network for the initial stages, Northern area of development, app100-125 Lots

As the development progresses beyond the capacity of the network to the north of the development, provision will be required to be made to connect to Country Energy's network to the south of the development to supply the remaining Lots

The ADMD for the development will be 5 kVA per lot.

As the development will be Community Title all Country Energy's infrastructure not installed on a public road reserve will require an easement.

Yours sincerely

Geoff Edmonds

Geoff. Edmonds
Planning Protection & Customer Connection Officer

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