

ATTACHMENT BOOKLET

ORDINARY COUNCIL MEETING
29 JULY 2020

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Planning Proposal Zone Boundary Adjustment

146 Newbridge Road, Moorebank

Prepared for Mirvac Homes NSW Pty Ltd
February 2019





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Planning Proposal – Zone Boundary Adjustment

146 Newbridge Road, Moorebank

Report Number

J190061 RP1

Client

Mirvac Homes NSW Pty Ltd

Date

12 February 2019


Version

v1 Final

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12 February 2019

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12 February 2019

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1 Introduction

1.1 Proposal background

An original planning proposal RZ-2/2015 (original proposal) was lodged with Liverpool City Council (Council) on 12 January 2015 which sought an amendment to Schedule 1 of the Liverpool Local Environmental Plan 2008 (LLEP) for the inclusion of an additional permitted use for residential development within RE2 zoned land on the Georges Cove Marina site. In October 2016, this application was amended to include a zone boundary adjustment to the northern residential use envelope, known as the proposed Moorebank Cove Residential Estate. The amended proposal was granted support by the Council on 31 August 2016 and subsequently a Gateway Determination was made by the Greater Sydney Commission (the Commission) on 9 March 2017 to proceed subject to certain conditions. On 21 June 2018, the proposal was amended to remove the request for additional permitted use and therefore only be for the zone boundary adjustment for the Moorebank Cove Residential Estate.

The owner of the adjoining land, Moorebank Recyclers, appealed to the Land and Environment Court (LEC) against the Gateway Determination of the original proposal on the grounds that Council did not appropriately consider State Environmental Planning Policy 55 Remediation of Land (SEPP 55). The LEC dismissed the appeal on 21 December 2017. Moorebank Recyclers then appealed the LEC decision to the Supreme Court. The Supreme Court upheld the appeal on 14 December 2018 and declared the Gateway Determination made by the Commission on 9 March 2017 for RZ-2/2015 was invalid.

Following the Supreme Court's decision, the proponent decided, in consultation with Council, to lodge a new application for the zone boundary adjustment only.

The request for an additional permitted use for residential development has been lodged with the Council as a separate application by Mirvac (RZ-5/2018, prepared by SquareLink, dated July 2018) and, therefore, it is not discussed in this planning proposal.

1.2 Proponent

The proponent of this planning proposal is Mirvac Homes NSW Pty Ltd.

1.3 Guidelines

This planning proposal has been prepared in accordance with Section 3.33 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) and in accordance with the Department of Planning and Environment's (DPE) *A guide to preparing planning proposals* (DPE 2018a).

2 Site characteristics and current zoning

2.1 The site and surrounds

The site the subject of this planning proposal is located at 146 Newbridge Road Moorebank, within the Liverpool Local Government Area (LGA). The legal description of the entire land within which the site situates is Lot 7 DP 1065574 (the land). The land is 22 ha and the site occupies approximately 0.41 ha, situated in the western corner of the land. The site has an existing elevated ground level that is similar in height to that of the adjoining R3 Medium Density Residential land and has an irregular shape.

To the north of the site is the yet to be approved Moorebank Cove Residential Estate (DA-24/2017, DA-519/2017 and DA-758/2017), Georges Cove Village (RZ-9/2017, prepared by EMM Consulting Pty Ltd, dated October 2017) and the proposed Flower Power mixed use development. The Georges Cove Marina is to the south of the site. The land is located adjacent to the Georges River to the east, Newbridge Road to the north and George's Fair residential estate to the west. Land to the east of Georges River is located within the Bankstown LGA and is characterised as expansive recreational open space. To the south of the land is the Wurrungwuri Reserve and the former Moorebank Recycler's site is further south (being Lot 6 in DP 065574).

The land is currently used as an extractive industry; however, the available resource has nearly been depleted. The majority of the land (excepting the site) is proposed as a future marina development, known as the Georges Cove Marina development. A development application (DA-611/2018) was lodged with Council in July 2018 and is currently under assessment.

2.2 Current zoning

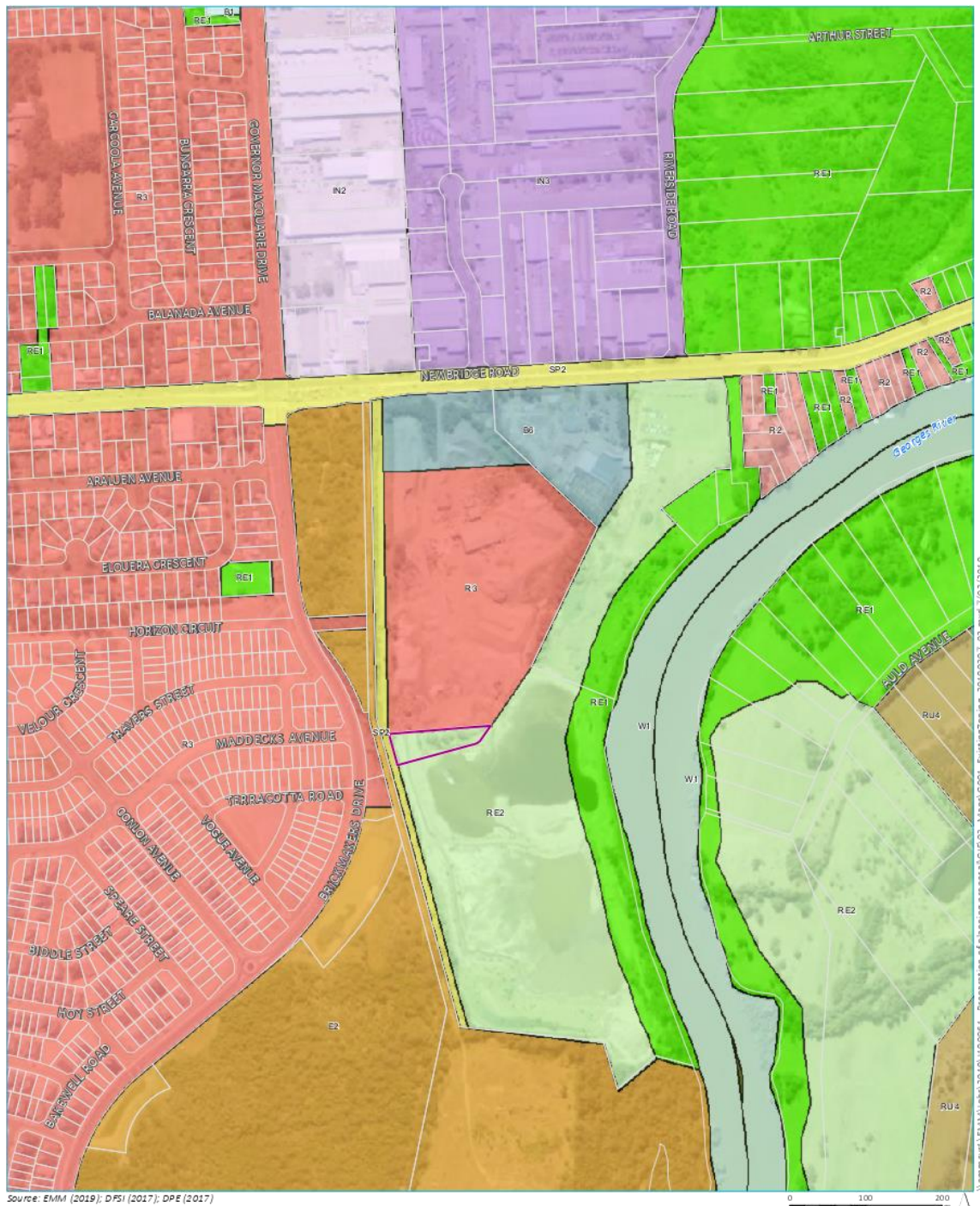
The current zoning of the site and the land is RE2 Private Recreation under the LLEP. Directly north of the site is land zoned R3 – Medium Density Residential. The existing zoning is shown in Figure 2.1.

The objectives of the RE2 zone are:

- to enable land to be used for private open space or recreational purposes;
- to provide a range of recreational settings and activities and compatible land uses;
- to protect and enhance the natural environment for recreational purposes; and
- to enable land uses that are compatible with, and complimentary to, recreational uses.

The RE2 zone allows development of the land for recreation and some public infrastructure purposes. Residential development is prohibited under the RE2 zone.

Restrictions under the current zoning do not enable efficient use of the land that takes into consideration the current and future land uses within the area, ie the proposed Moorebank Cove Residential Estate located to the north of the land. This planning proposal presents an alternative based on an analysis of relevant planning instruments and policies and environmental constraints.



KEY

- Site boundary
- Cadastral boundary

Existing zoning

- B1 Neighbourhood Centre
- B6 Enterprise Corridor
- E2 Environmental Conservation
- IN2 Light Industrial
- IN3 Heavy Industrial
- R2 Low Density Residential
- R3 Medium Density Residential
- RE1 Public Recreation
- RE2 Private Recreation
- RU4 Primary Production Small Lots
- SP2 Infrastructure
- W1 Natural Waterways

Existing zoning

Zone boundary adjustment
 Planning proposal
 Figure 2.1

3 The proposal

This planning proposal seeks to extend the R3 Medium Density Residential zone boundary southwards to incorporate the site (a further approximate 0.41 ha of land currently zoned as RE2 Private Recreation) as shown in Figure 3.1, herein referred to as the zone boundary adjustment.

The zone boundary adjustment will address the misalignment between the boundaries of the Georges Cove Marina site to the south and the proposed Moorebank Cove Residential Estate to the north. It will better align the future uses of both zones, allow for a more logical and appropriate development on-site and facilitate greater flexibility in the master planning. The zone boundary adjustment will not alter the overall design of the Georges Cove Marina development.

3.1 Proposed zoning

The zone boundary adjustment would rezone the site from RE2 Private Recreation to R3 Medium Density Residential. The proposed zoning is shown in Figure 3.2.

The objectives of the R3 zone are:

- to provide for the housing needs of the community within a medium density residential environment;
- to provide a variety of housing types within a medium density residential environment;
- to enable other land uses that provide facilities or services to meet the day to day needs of residents;
- to provide for a concentration of housing with access to services and facilities;
- to provide for a suitable visual transition between high-density residential areas and lower density areas; and
- to ensure that a high level of residential amenity is achieved and maintained.

3.2 Objectives and intended outcomes

The site has an existing elevated ground level that is similar in height to that of the adjoining R3 Medium Density Residential land. Further, its small surface area and irregular shape would discourage future uses on the site associated with the Georges Cove Marina site. Therefore, it is considered appropriate for the site to be rezoned to supplement the existing R3 zoned land.

The zone boundary adjustment will provide benefits to the locality by facilitating greater flexibility in the master planning and future subdivision of the R3 Medium Density Residential area and allow for nine additional residential allotments on the land which would otherwise remain unused. Furthermore, it would provide dwellings within close-proximity to public transport along Newbridge Road thereby promoting the achievement of broader Ecologically Sustainable Development (ESD) goals by providing greater opportunity for reductions in car use and trip generation. The conceptual subdivision layout for the site is shown in Figure 3.3.

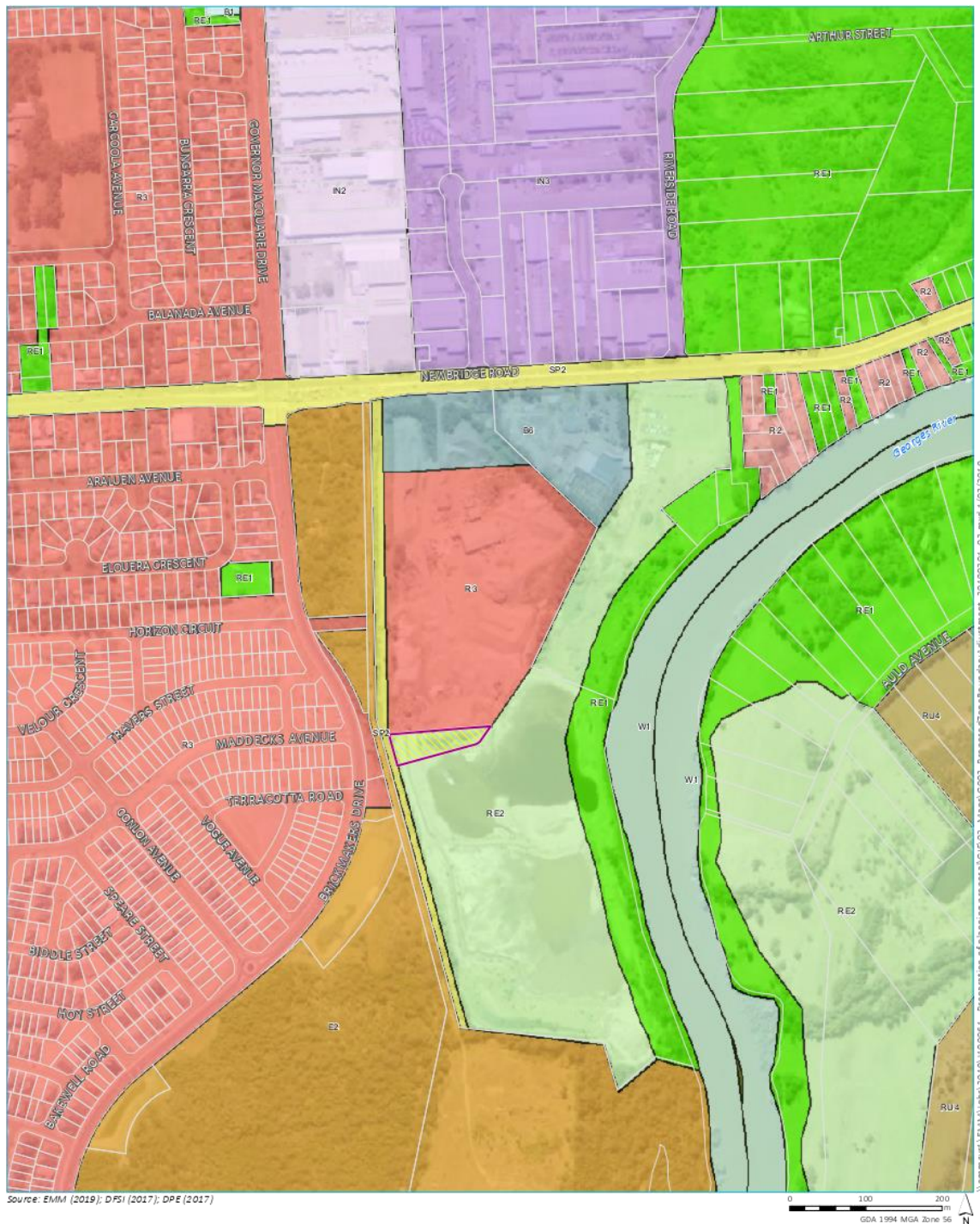
3.3 Explanation of provision

An amendment to the LLEP is sought in this planning proposal. The proposed outcome will be achieved by:

- amending the LLEP 2008 Land Zoning Map in accordance with the proposed zoning map shown in Figure 3.2;

- amending the LLEP 2008 Height of Building Map in accordance with the proposed height map shown in Appendix A, which indicates a maximum permissible height of 8.5 m on the site;
- amending the LLEP 2008 Floor Space Ratio Map in accordance with the proposed floor space ratio map shown in Appendix A, which indicates a maximum permissible floor space ratio of 0.65:1 on the site; and
- amending the LLEP 2008 Lot Size Map in accordance with the proposed lot size map shown in Appendix A, which indicates a minimum lot size of 300 m² on the site.

Refer to Appendix A for LEP maps illustrating the minimum lot size, floor space ratio (FSR) and maximum building heights.



KEY

- Site boundary
- Cadastral boundary

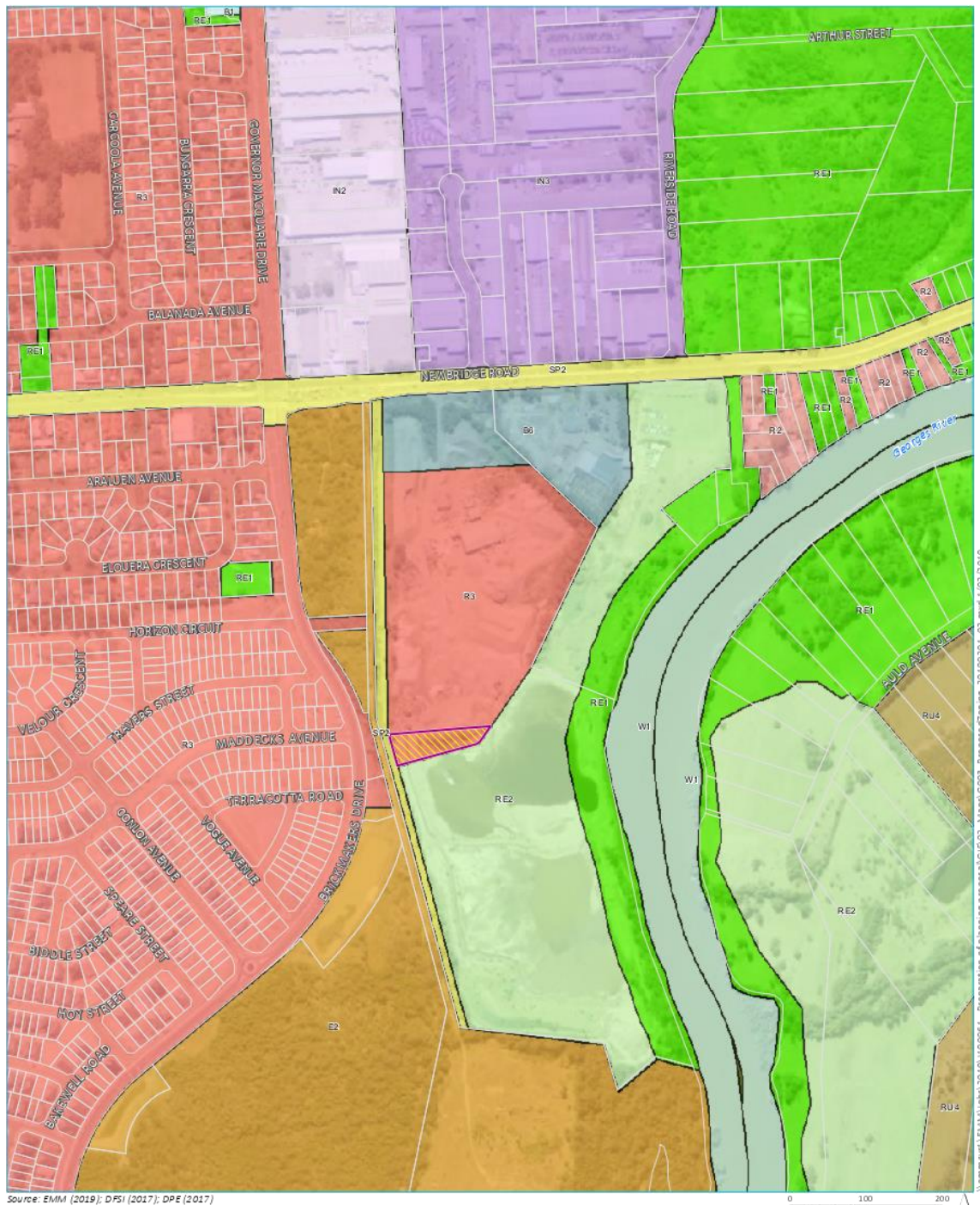
- Approximate area to be rezoned R3
- Existing zoning
- B1 Neighbourhood Centre
- B6 Enterprise Corridor
- E2 Environmental Conservation
- IN2 Light Industrial
- IN3 Heavy Industrial

- R2 Low Density Residential
- R3 Medium Density Residential
- RE1 Public Recreation
- RE2 Private Recreation
- RU4 Primary Production Small Lots
- SP2 Infrastructure
- W1 Natural Waterways

Proposed zone boundary adjustment

Zone boundary adjustment
 Planning proposal
 Figure 3.1





KEY

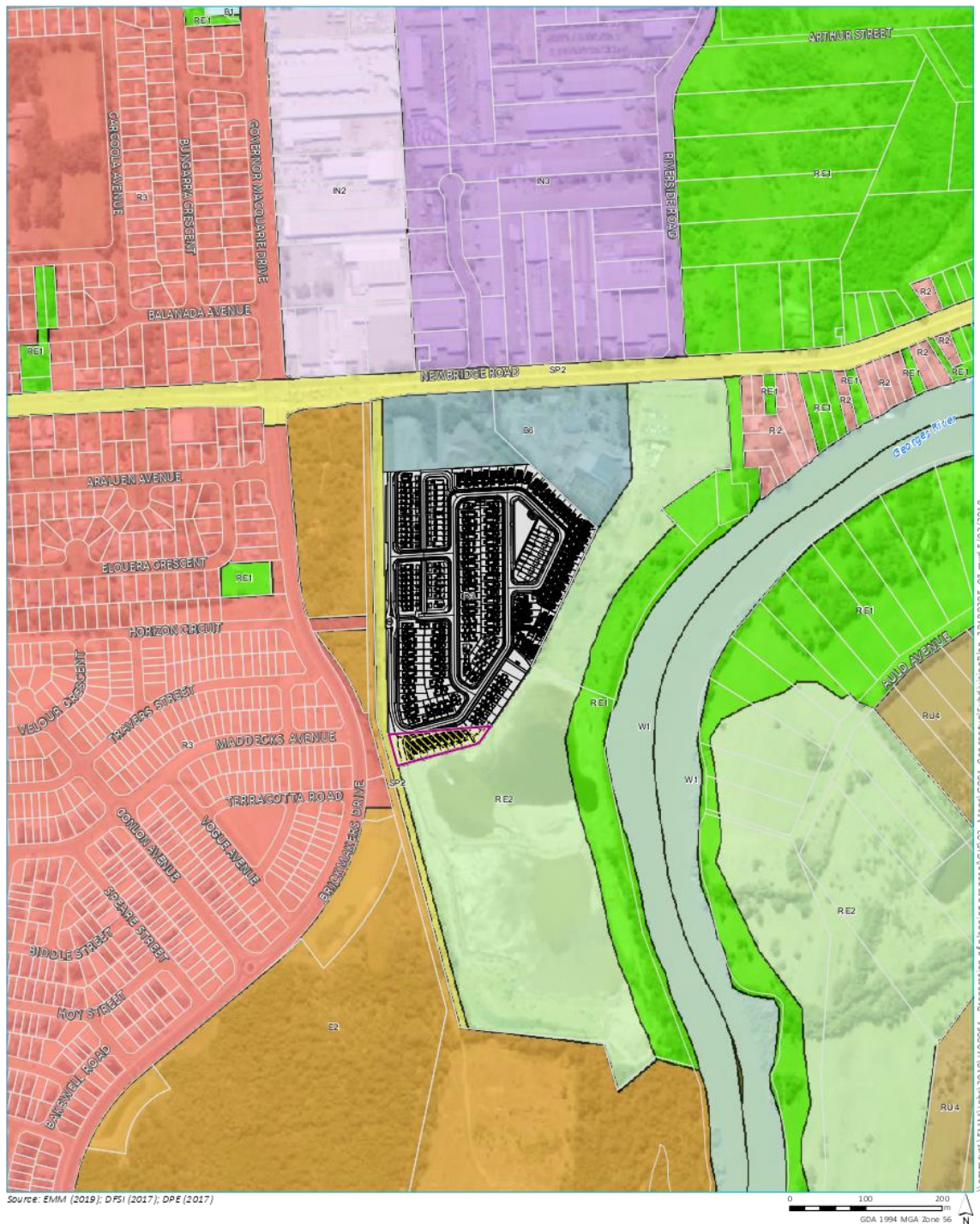
- Site boundary
- Cadastral boundary

- Approximate area to be rezoned R3
- Proposed zoning
- B1 Neighbourhood Centre
- B6 Enterprise Corridor
- E2 Environmental Conservation
- IN2 Light Industrial
- IN3 Heavy Industrial

- R2 Low Density Residential
- R3 Medium Density Residential
- RE1 Public Recreation
- RE2 Private Recreation
- RU4 Primary Production Small Lots
- SP2 Infrastructure
- W1 Natural Waterways

Proposed zoning

Zone boundary adjustment
 Planning proposal
 Figure 3.2



KEY

Site boundary	Approximate area to be rezoned R3	R2 Low Density Residential
Concept layout plan	Proposed zoning	R3 Medium Density Residential
Cadastral boundary	B1 Neighbourhood Centre	RE1 Public Recreation
	B6 Enterprise Corridor	RE2 Private Recreation
	E2 Environmental Conservation	RU4 Primary Production Small Lots
	IN2 Light Industrial	SP2 Infrastructure
	IN3 Heavy Industrial	W1 Natural Waterways

Conceptual subdivision plan

Zone boundary adjustment
 Planning proposal
 Figure 3.3



4 Justification

4.1 Need for the planning proposal

1. Is the planning proposal a result of an endorsed local strategic planning statement, strategic study or report?

The planning proposal is not a result of any strategic planning statement, strategic study or report; however, it relates to the future use of the Moorebank Cove Residential Estate and aligns with the Liverpool Residential Development Strategy (LCC 2008). The proposed zone boundary adjustment is considered justified as it will utilise a small parcel of underused land for consistent land use purposes with adjoining residential land and provide sufficient land area to achieve the overall design merit of the Moorebank Cove Residential Estate.

2. Is the planning proposal the best means of achieving the objectives or intended outcomes, or is there a better way?

The planning proposal is considered the best means of achieving the objectives and intended outcomes as indicated in Section 3.2 of this planning proposal. The site has an existing elevated ground level that is similar in height to that of the adjoining R3 Medium Density Residential land and has a small surface area and irregular shape which will discourage future uses on the site associated with the proposed Georges Cove Marina.

The zone boundary adjustment will provide benefits to the locality by facilitating greater flexibility in the master planning and future subdivision of the R3 Medium Density Residential area and allow for nine additional residential allotments on the land which would otherwise remain unused.

4.2 Relationship to the strategic planning framework

3. Will the planning proposal give effect to the objectives and actions of the applicable regional or district plan or strategy (including any exhibited draft plans or strategies)?

The following strategies are relevant to the planning proposal:

- A Metropolis of Three Cities – The Greater Sydney Regional Plan (DPE 2018c); and
- Western City District Plan (DPE 2018d).

A Metropolis of Three Cities – The Greater Sydney Region Plan aims to rebalance growth and deliver its benefits more equally and equitably to residents across Greater Sydney. The plan is built on a vision of three cities where most residents live within 30 minutes of their jobs, education and health facilities, services and great places.

The site is located within the Liverpool LGA, part of the Western Parkland City, where the future population of Greater Sydney is projected to grow over the next 40 years. The vision for the Western Parkland City is to be achieved by providing infrastructure and employment opportunities; development of a liveable and connected community through urban renewal; delivery of a 30-minute productive city and provision of a sustainable parkland setting. Of relevance, the planning proposal contributes to the Western Parkland City vision by providing housing in proximity to jobs, essential services and transport.

The aim of the Western City District Plan is to translate the vision of The Greater Sydney Region Plan to the local level. The site is located in the area covered by the Western City District Plan.

The Western City District Plan provides planning priorities to guide the sustainable growth of Western City over the next 20 to 40 years. The District's population is expected to grow by around 464,000 (between 2016 and 2036), and

households in Liverpool LGA are expected to grow by 91%. In support of this, the overarching planning priorities to maintain and enhance liveability include:

- W3 – providing services and social infrastructure to meet people’s changing needs;
- W4 – fostering healthy, creative, culturally rich and socially connected communities;
- W5 – providing housing supply, choice and affordability, with access to jobs, services and public transport; and
- W6 – creating and renewing great places and local centres, and respecting the District’s heritage.

The planning proposal meets ‘objective 10 greater housing supply’ of the Western City District Plan as it would provide for a greater number of housing supply on land which would otherwise be underutilised. The land directly north of the site is currently zoned as R3 Medium Density Residential. The planning proposal is, therefore, proposing a consistent land use to the neighbouring zone. The zone boundary adjustment would allow an additional nine residential allotments to be built, which contributes to providing increased housing supply in the Liverpool LGA and the wider Western City District. The planning proposal is, therefore, consistent with this objective.

4. Will the planning proposal give effect to a council’s endorsed local strategic planning statement, or another endorsed local strategy or strategic plan?

Relevant local strategy and local strategic plans include:

- Residential Development Strategy (LCC 2008a);
- Community Strategic Plan – Our Home, Liverpool 2027 (LCC 2017); and
- Liverpool Development Control Plan 2008 (LCC 2008b).

An assessment which demonstrates the planning proposal’s consistency with these strategies is provided in Table 4.1.

Table 4.1 Assessment against Council’s local strategic plans

Strategic plan	Direction	Response
Residential Development Strategy 2008	<ul style="list-style-type: none"> • Provide different types of housing than are currently available within Liverpool; • provide new housing options in different locations in Liverpool; • create certainty for development, making it simpler and more attractive; • encourage modest affordable private housing types within medium density zones, particularly around main town centres at Moorebank, Casula, Miller and Green Valley; and • introduce new location-specific development standards (minimum lot size, floor space ratio and building height) to respond to specific capacity or existing or desired urban characters of different areas. 	<p>The planning proposal is consistent with these strategic directions to provide housing supply within the Liverpool LGA.</p> <p>Furthermore, the land was previously used as an extractive industry. By developing quality housing and landscaping would have environmental, social and economic benefits to the community, and making it more attractive than its current state.</p>

Table 4.1 Assessment against Council's local strategic plans

Strategic plan	Direction	Response
Liverpool Community Strategic Plan Our Home, Liverpool 2027	Strengthening and protecting our environment. The direction is about planning high-quality, sustainable, urban environments to create a great place to live, work and play.	The planning proposal is consistent with this direction in that it will facilitate the provision of additional housing supply in an otherwise underutilised area. The prime location of the land, adjacent to the Georges River will provide a high-quality, sustainable place to live and play.
Liverpool Development Control Plan 2008	Part 2.10 of the Liverpool DCP relates to development in Moorebank East. Section 3.1 of Part 2.10 states that a maximum of 216 residential dwellings are permitted on the Moorebank East land.	The zone boundary adjustment of a small portion of the site will enable the development of an additional nine residential allotments to the proposed residential development to the north of the lot, resulting in a total yield of 178 residential allotments. This is in keeping with the objectives and controls of the Liverpool DCP.

5. Is the planning proposal consistent with applicable State Environmental Planning Policies?

An assessment which demonstrates the planning proposal's consistency with the relevant State Environmental Planning Policies (SEPPs) is provided in Table 4.2.

Table 4.2 Assessment against the relevant State Environmental Planning Policies

SEPP	Relevant clause	Assessment
State Environmental Planning Policy No.55 – Remediation of Land	Clause 6 Contamination and remediation to be considered in zoning or rezoning proposal	The aim of this policy is to ensure the appropriate management and remediation of contaminated land. This planning proposal is supported by a preliminary site investigation report, prepared by Douglas Partners (Appendix B). Previous investigations have been undertaken as part of the Remediation Action Plan (RAP). The site is currently subject to a Statutory Site Audit by an NSW EPA accredited site auditor under the NSW <i>Contaminated Land Management Act 1997</i> as part of the remediation works. The report concludes that due to the remediation strategy previously proposed and subject to validation under the existing RAP, it is considered the small parcel of land proposed for zone boundary adjustment will be suitable for rezoning from RE2 to R3 Medium Density Residential. The planning proposal is, therefore, consistent with this policy.
State Environmental Planning Policy (Infrastructure) 2007	Clause 104 Traffic generating development	The planning proposal is supported by a Transport Planning Assessment Report, prepared by EMM (Appendix D). The report identifies that the cumulative development of the planning proposal, along with the surrounding proposed, approved and completed projects will generate additional traffic in the Moorebank East area. The additional traffic will have an impact on intersection performance and result in vehicle delays during the morning and afternoon peak hour. However, the delays are considered acceptable and no additional upgrades are required. The planning proposal is, therefore, consistent with this policy.

6. Is the planning proposal consistent with applicable Ministerial Direction (s.9.1 directions)?

An assessment which demonstrates the planning proposal's consistency with relevant Section 117 directions is provided in Table 4.3.

Table 4.3 Assessment against Section 117 directions

Direction	Assessment
4.1 Acid sulfate soils	<p>The site is mapped as Class 2 land on the LLEP Acid Sulfate Soils Map. Acid sulphate soils on Class 2 land are likely to be present below the ground surface. As no ground disturbance is proposed as part of the zone boundary adjustment, an assessment of acid sulfate soils is not considered to be required for this planning proposal.</p> <p>Further, it is considered that this is unlikely to be an impediment to future residential development of the site and that acid sulfate soil impacts can be satisfactorily addressed at the development application stage.</p>
4.3 Flood prone land	<p>The site is mapped as flood prone land on the LLEP Flood Planning Area Map.</p> <p>This planning proposal is supported by a Flood Impact Assessment, prepared by Cardno (Appendix E).</p> <p>The Flood Impact Assessment concludes that the zone boundary adjustment would have no adverse impacts on water levels at any location in the floodplain in comparison to the benchmark conditions and does not pose a scour risk.</p>
4.4 Planning for bushfire protection	<p>The site is not identified as bushfire prone land on the LLEP, however, part of the land to the west of the site is identified as a vegetation buffer zone.</p> <p>This planning proposal is supported by a Bushfire Assessment Report, prepared by BlackAsh Bushfire Consulting (Appendix F). The report concludes that appropriate bushfire protection measures can be achieved to support the zone boundary adjustment.</p>
6.3 Site-specific provisions	<p>The planning proposal seeks amendments to the minimum lot size, FSR and maximum building height controls for the site. It is considered that these amendments are of minor significance and will provide adequate flexibility for future development in terms of residential housing types.</p>

5 Environmental impacts

This chapter considers the environmental impacts of the zone boundary adjustment and, where potential impacts are identified, describes how they will be managed and/or mitigated.

7. Is there any likelihood that critical habitat or threatened species, populations or ecological communities, or their habitats, will be adversely affected as a result of the proposal?

The planning proposal is supported by a Biodiversity Assessment, prepared by Biosis (Appendix C). The assessment concluded that the planning proposal and any future residential development will not result in any ecological impacts as the site is currently highly disturbed and devoid of native vegetation and fauna habitat features. Therefore, critical habitat or threatened species, populations or ecological communities, or their habitats, will not be adversely affected as a result of the zone boundary adjustment.

8. Are there any other likely environmental effects as a result of the planning proposal and how are they proposed to be managed?

The zone boundary adjustment is not expected to have any material environmental effects. Any other environmental effects associated with development on the land proposed for zone boundary adjustment will be assessed as part of the application and community consultation for the residential development of this land. Development on the site will be guided by a master plan specifying building design, siting, materials and landscaping standards.

The likely environmental effects of the zone boundary adjustment and any proposed management measures are set out in the following sections.

5.1 Traffic and transport

A Traffic Impact Assessment (Appendix D) has been prepared for the planning proposal which identifies that the cumulative development of the planning proposal, along with the surrounding proposed, approved and completed projects will generate additional traffic in the Moorebank East area. However, the additional traffic is not expected to result in any adverse traffic effects on the local road network. Both levels of service at intersection and overall road safety will remain unchanged under a cumulative situation arising from all existing planning development in the locality. A detailed traffic investigation will accompany any future development application relating to the residential subdivision of the site.

5.2 Drainage and flooding

A Flood Impact Assessment, prepared by Cardno (Appendix E) concludes the zone boundary adjustment would have no adverse impacts on water levels at any location in the floodplain in comparison to the benchmark conditions and does not pose a scour risk. There are no drainage constraints on the site and, therefore, it will be possible to design future residential allotments to meet the Council's normal stormwater design requirements and also to protect water quality in the Georges River.

5.3 Bushfire

A Bushfire Assessment Report (Appendix F) has been prepared for the planning proposal which concludes that appropriate bushfire protection measures can be achieved to support the zone boundary adjustment. Appropriate bushfire protection measures include asset protection zones, electricity transmission lines to be kept underground, fire hydrants that comply with AS2419.1, non-combustible cladding used on the external façade of the buildings,

gas services that comply with AS/NZS 1596:2008, and the property access road to be constructed in accordance to *Planning for Bush Fire Protection 2006*.

5.4 Noise

An Acoustics Study (Appendix G) has been prepared to address potential industrial noise impacts on the proposed Moorebank Cove Residential Estate from the Moorebank Recycling Facility (if constructed), located south of the proposed Georges Cove Marina site. As the Georges Cove Marina site provides significant acoustic shielding, the remaining issues are potential truck movements from the Moorebank Recycling Facility and its impact on the future Moorebank Cove Residential Estate, and future operational noise from the marina activities. The study concludes these noise sources would not result in exceedances of relevant noise criteria at the future Moorebank Cove Residential Estate, which includes the site.

5.5 Heritage

An Aboriginal and historic due diligence report (Appendix H) has been prepared which concludes that background research and a field inspection did not find evidence of either Aboriginal sites or historical sites on the site. Further, the land had previously undergone a high level of disturbance through extensive quarrying activities that would have removed Aboriginal sites, if they existed. Therefore, there is no Aboriginal cultural heritage nor historical heritage constraints to the zone boundary adjustment.

6 Social and economic impacts

9. Has the planning proposal adequately addressed any social and economic effects?

The zone boundary adjustment will facilitate the delivery of additional housing supply which has a number of social and economic benefits for the existing and future community. They are:

- provide dwellings within close proximity to public transport on Newbridge Road thereby promoting the achievement of broader ESD goals by providing greater opportunity for reductions in car use and trip generation;
- promote enhanced neighbourhood safety and security through casual surveillance generated by the presence of a permanent resident population on the site;
- reinforce patronage to local retail businesses and services through an increase in resident population and complementary recreation, tourism and community facilities; and
- provide short-term economic benefits through construction expenditure and employment.

7 Community consultation

Community consultation will be undertaken in accordance with the requirements set out in *A guide to preparing planning proposals* (DPE 2018a) and *A guide to preparing local environmental plans* (DPE 2018b). For the purposes of public notification, this planning proposal is considered to be a low impact proposal as it is:

- consistent with the pattern of surrounding land use zones and/or land uses;
- consistent with the strategic planning framework;
- presents no issues with regard to infrastructure servicing;
- not a principal LEP; and
- does not reclassify public land.

The public exhibition period for a low impact planning proposal is 14 days.

Furthermore, community consultation will be undertaken during the development application process for future residential development.

8 Project timeline

A project timeline for the planning proposal is outlined in Table 8.1:

Table 8.1 Project timeline

Step	Proposed date
1. Submission for Gateway determination	1 April 2019
2. Government agency consultation	2 – 22 April 2019
3. Public exhibition period	1 – 15 May 2019
4. Consideration of submissions	16 – 31 May 2019
5. Preparation of draft LEP	14 June 2019
6. Finalisation of LEP	28 June 2019
7. Making of LEP, published on NSW legislation website and becomes law	12 July 2019

9 Conclusion

The planning proposal presents a consistent land use to the adjoining R3 Medium Density Residential zone to the north, which will have substantial planning and environmental benefits in its own right and particularly over the current land use. In accordance with the requirements of *A guide to preparing planning proposals* (DPE 2018a), a review of relevant strategic plans have been undertaken. It shows that the proposal is consistent with applicable metropolitan, regional and local strategic objectives.

The likely environmental impacts as a result of the planning proposal and future residential development of the site are considered minimal and, where impacts may occur, they can be easily mitigated. Therefore, there are no environmental constraints to the zone boundary adjustment.

The overall outcome of the planning proposal will be a positive resolution of planning outcomes for Moorebank and the regional community. The planning proposal is a direct response to government strategies seeking to meet the growing demands for a range of dwelling types within this region.

Development on the site will be guided by a master plan specifying building design, siting, materials and landscaping standards. All potential concerns and feedback will be taken into consideration at all stages of development.

Abbreviations

DPE	Department of Planning and Environment
FSR	floor space ratio
LEC	Land and Environment Court
LLEP	Liverpool Local Environmental Plan
LGA	local government area
SEPP	State Environmental Planning Policy

References

DPE 2018a, *A guide to preparing planning proposals*, Department of Planning and Environment.

DPE 2018b, *A guide to preparing local environmental plans*, Department of Planning and Environment.

DPE 2018c, *A Metropolis of Three Cities – Greater Sydney Regional Plan*, Department of Planning and Environment.

DPE 2018d, *Our Greater Sydney 2056 – Western City District Plan*, Department of Planning and Environment.

LCC 2008a, *Liverpool Residential Development Strategy*, Liverpool City Council.

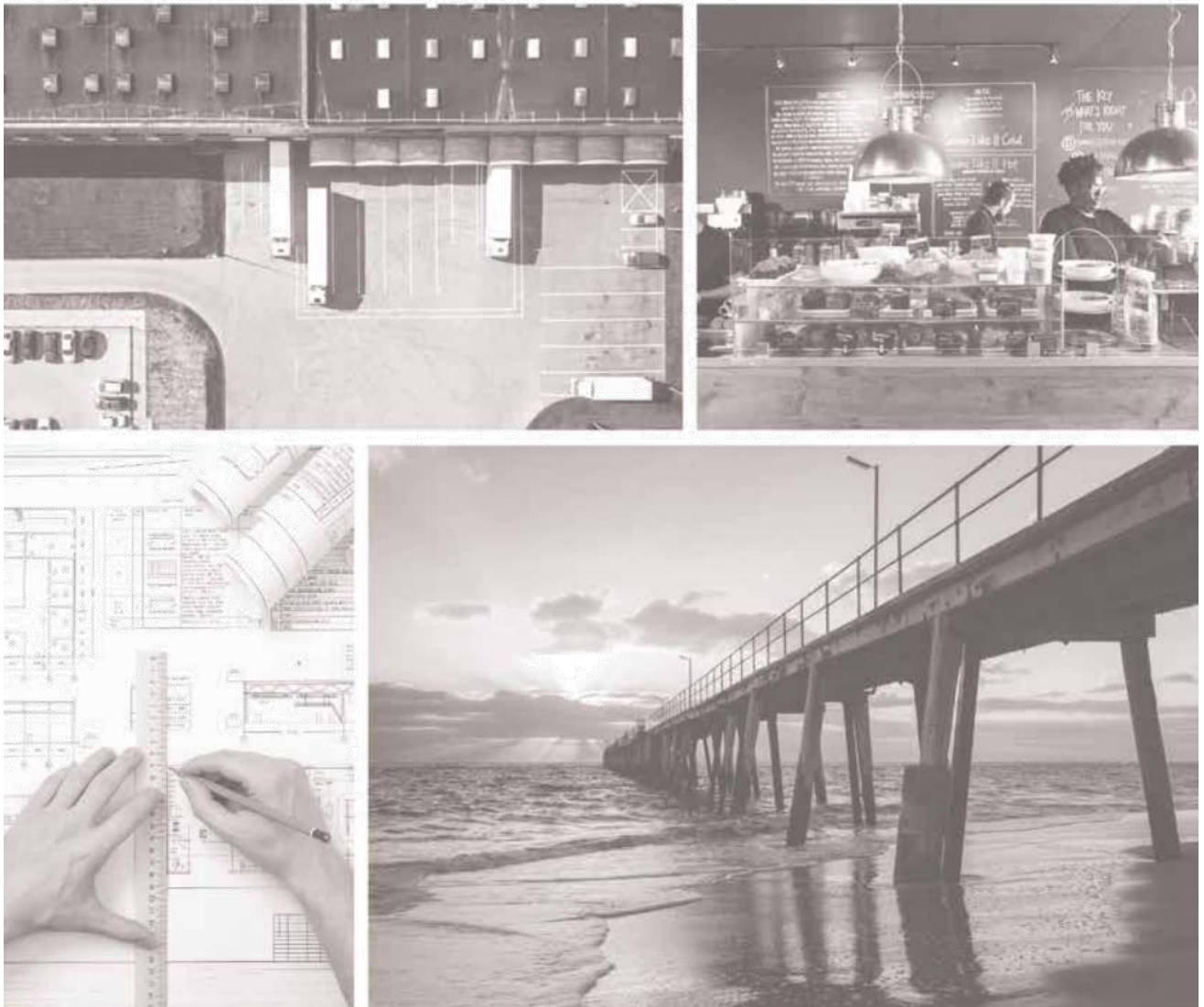
LCC 2008b, *Liverpool Development Control Plan*, Liverpool City Council.

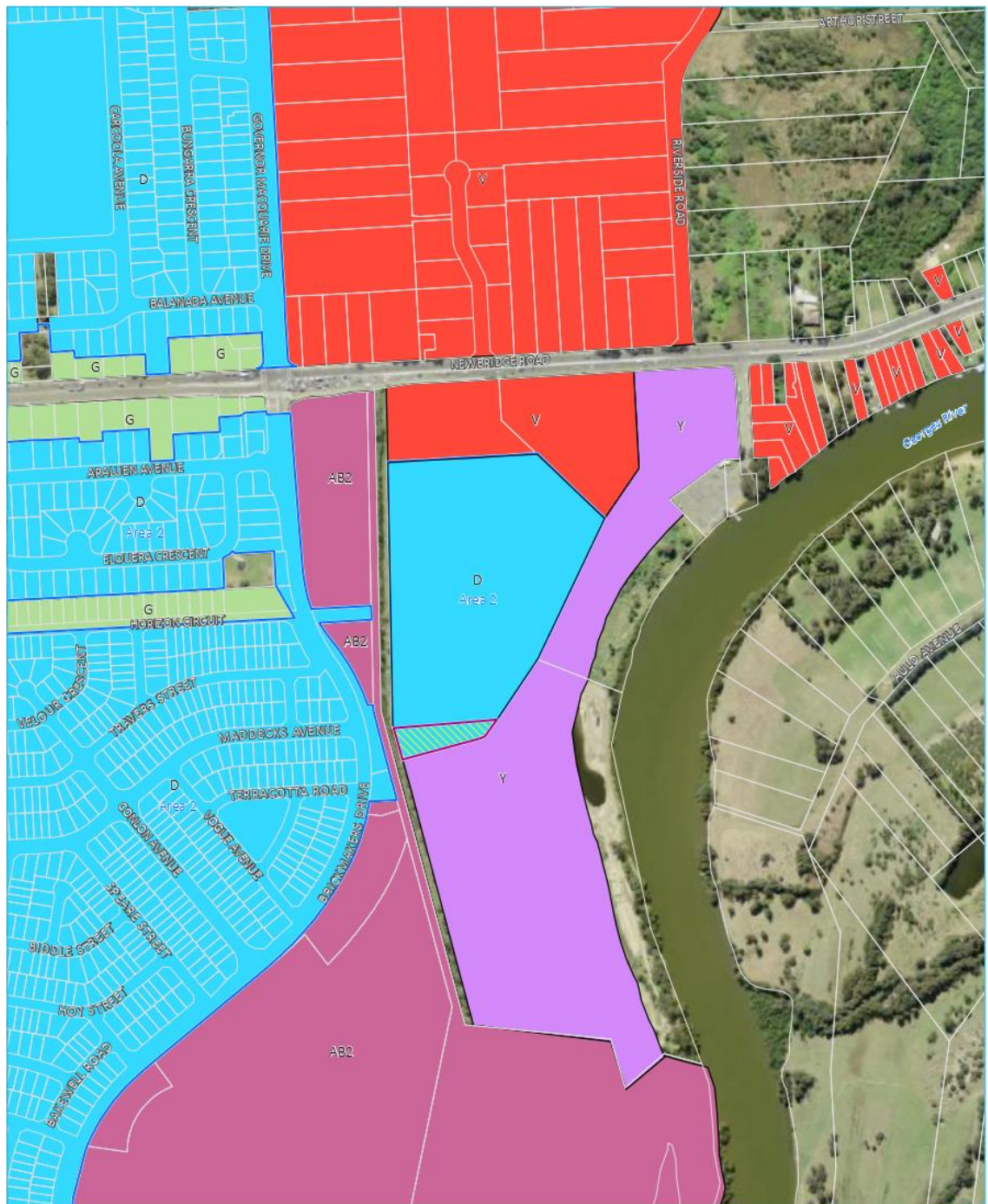
LCC 2017, *Our Home, Liverpool 2027 – Community Strategic Plan*, Liverpool City Council.



Appendix A

LEP maps for proposed R3 zoning





KEY

Site boundary

Refer to clause 4.1 (Area 2)

Cadastral boundary

Approximate area subject to LEP amendment

Minimum lot size (sq m)

D 300

G 450

V 2000

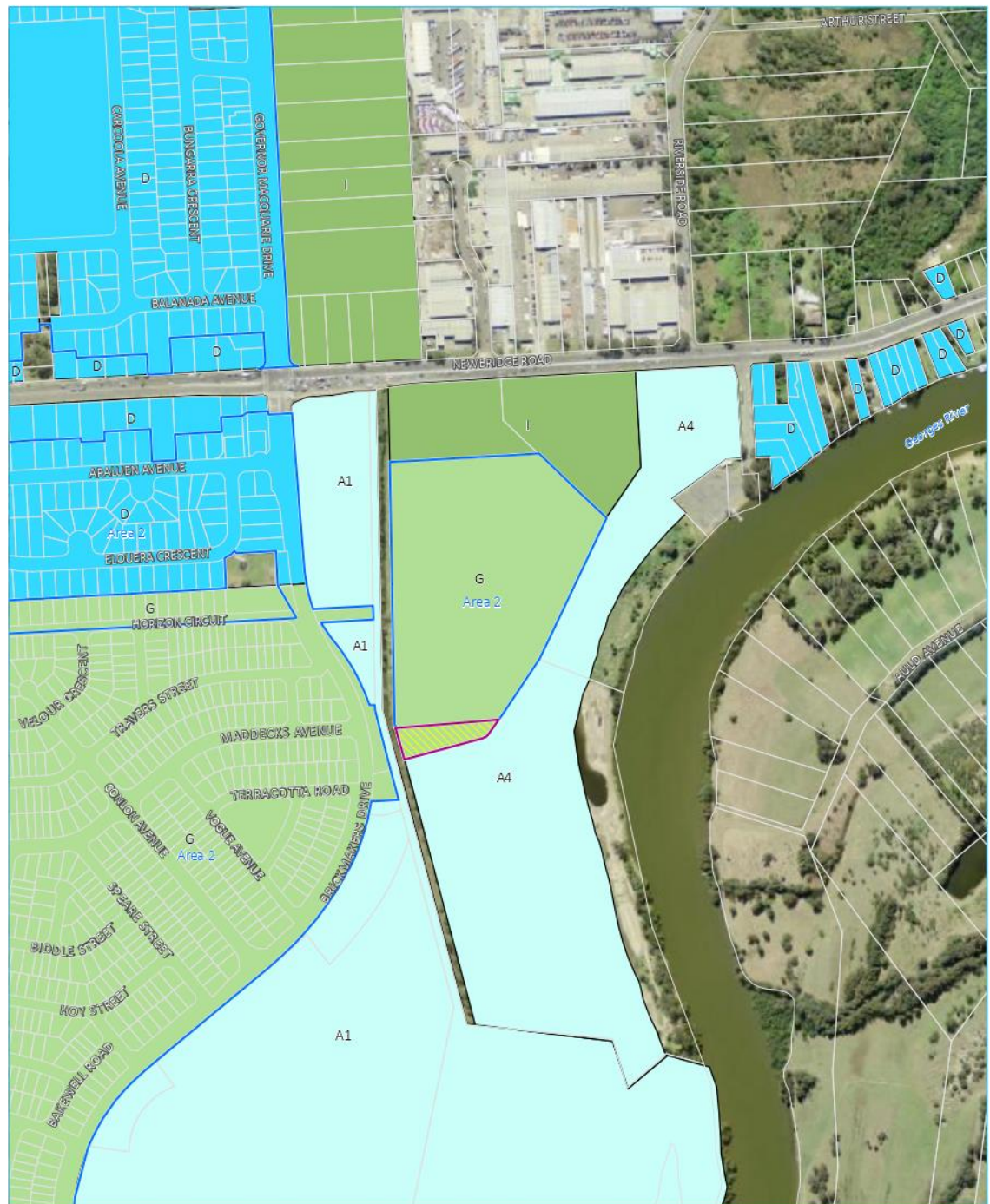
Y 10000

AB2 40 ha

Proposed lot size

Zone boundary adjustment
 Planning proposal
 Figure A.1

EMM
 creating opportunities



KEY

Site boundary

Refer to clause 4.1 (Area 2)

Cadastral boundary

Approximate area subject to LEP amendment

Maximum floor space ratio (n:1)

A1 0.01

A4 0.25

D 0.5

G 0.65

I 0.75

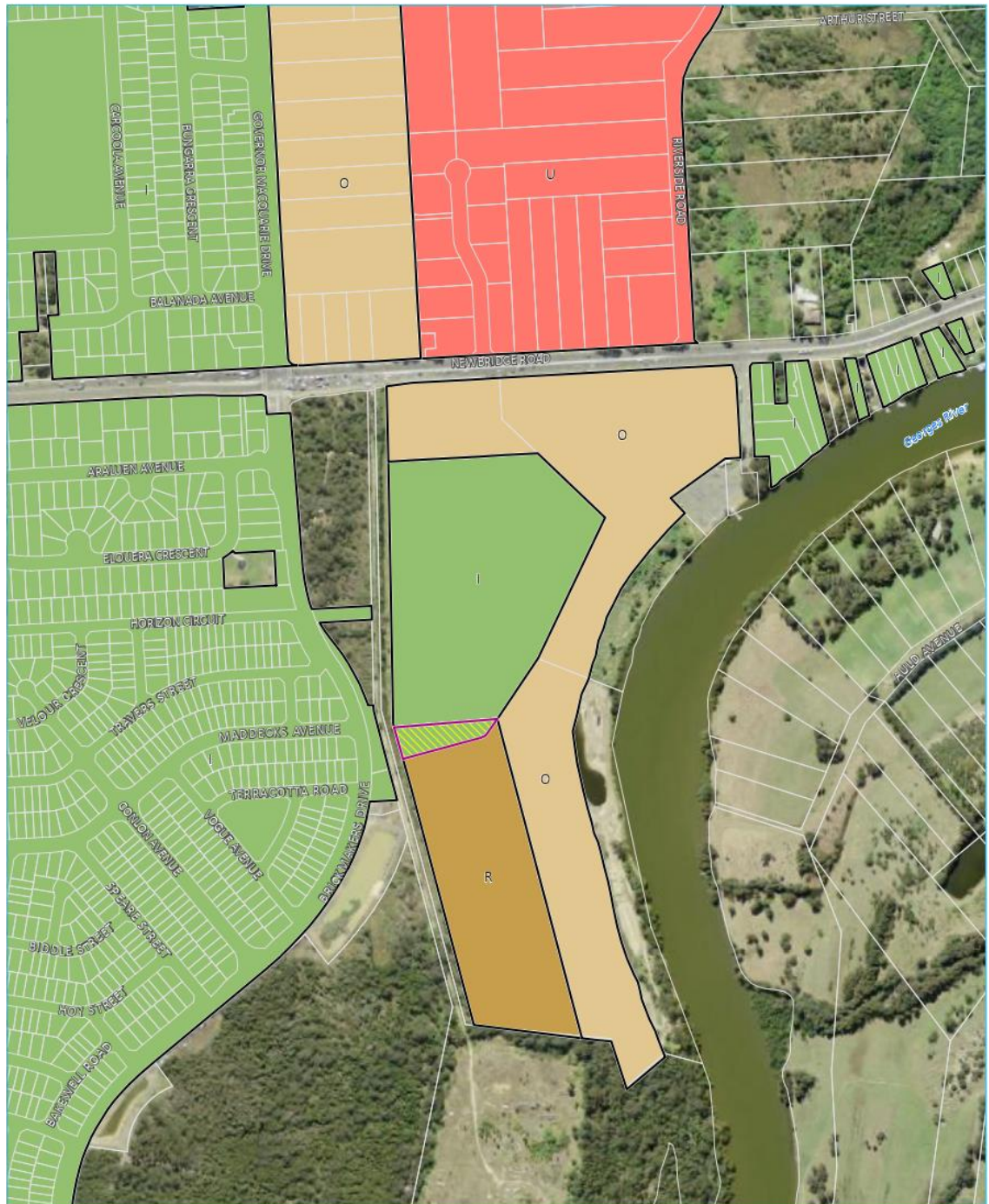
Proposed floor space ratio

Zone boundary adjustment

Planning proposal

Figure A.2

EMM
 creating opportunities



KEY

- Site boundary
 - Cadastral boundary
 - Approximate area subject to LEP amendment
- Maximum building height (m)
- | | | |
|--|---|-----|
| | I | 8.5 |
| | O | 15 |
| | R | 21 |
| | U | 30 |

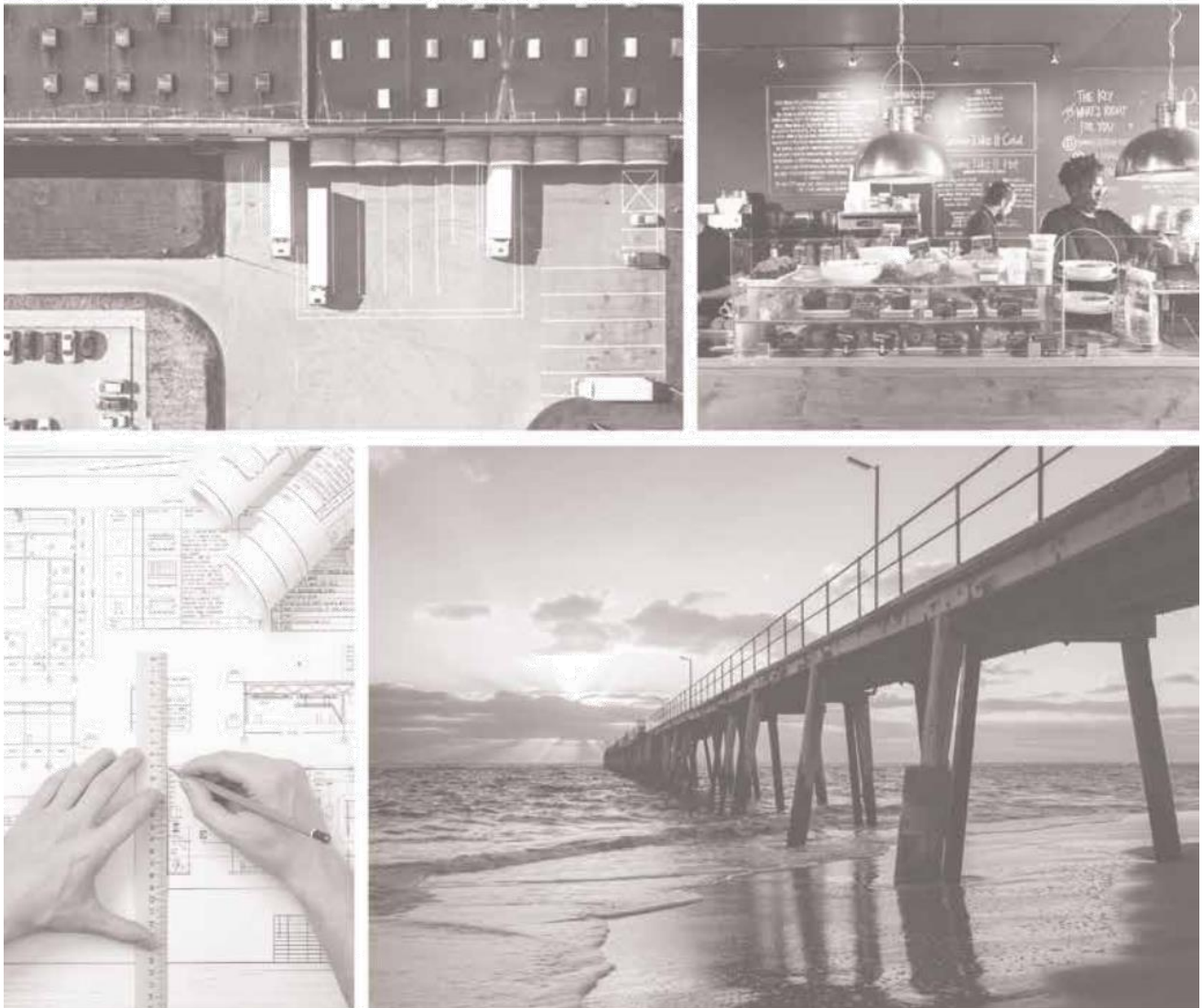
Proposed height of buildings

Zone boundary adjustment
 Planning proposal
 Figure A.3



Appendix B

Preliminary site investigation





Preliminary Site Investigation

Proposed Rezoning (Area 1) and Georges Cove
Marina (Area 2)
146 Newbridge Road, Moorebank

Prepared for
Mirvac Homes NSW Pty Ltd and Tanlane Pty Ltd

Project 71459.10
May 2018

Integrated Practical Solutions





Document History

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The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

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Reviewer		28 May 2018



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Preliminary Site Investigation
Proposed Rezoning (Area 1) and Georges Cove Marina (Area 2)
146 Newbridge Road, Moorebank

1. Introduction

Douglas Partners Pty Ltd (DP) has prepared this Preliminary Site Investigation (PSI) in order to support a planning proposal to allow a residential use in two areas (for the purpose of this report designated as Area 1 and Area 2) within the overall site located at 146 Newbridge Road, Moorebank. The site has been subject to several studies, Development Applications and planning proposals. The investigation was commissioned by Mirvac Homes NSW Pty Ltd and Tanlane Pty Ltd and was undertaken in accordance with DP's proposal SYD180001 (Rev1) dated 17 January 2018.

The objective of this PSI is to assess the potential for site contamination within Areas 1 and 2 and evaluate whether they are (or can be made) suitable for the proposed rezoning (Area 1) and enabling clause (Area 2) that would permit residential land use. The objective is to also identify whether any additional investigations and/or site remediation is required in order to render Area 1 and Area 2 suitable for residential land use.

Previous contamination assessments have been conducted at the site which encompasses Areas 1 and 2. This PSI contains a review of these reports supplemented by additional sampling, covering soil contamination and hazardous ground gases in order to augment the existing data. It is noted that assessment and management of existing surface water quality issues associated with the former dredge ponds is being addressed by overlapping reports prepared by others (refer to Section 3).

1.1 Site Identification

The overall site is located at 146 Newbridge Road, Moorebank, legally identified as Lot 7 DP 1065574, and covers an approximate area of 22 ha (Drawing 1, Appendix B). The previous Development Applications and planning proposals at the site have generally related to two distinct areas within the overall 146 Newbridge Road site being:

- The northern part of the site comprising a proposed residential estate; and
- The southern part of the site comprising the former dredge ponds.

The boundary between the northern proposed residential estate and the southern former dredge ponds can be loosely defined by the northern extent of the dredge ponds.

The two areas within the wider site which are the subject of this report have been designated Area 1 and Area 2. Area 1 is within the proposed residential estate (i.e. northern part of the site) and Area 2 is located to the south, within the former dredge pond area (i.e. southern part of the site). A site plan depicting the relevant overall site boundary, northern and southern part of the site boundaries and Areas 1 and 2 within these boundaries are shown on Drawing 1, Appendix B.



The following is understood in relation to subject Areas 1 and 2:

- Area 1 (area to be rezoned R3) – The first part being a rezoning of a portion of land from RE2 Private Open Space to R3 Residential to join the existing zoned R3 residential area subject to development under an application with Liverpool City Council. Area 1 covers an approximate area of 0.5 ha.
- Area 2 (residential use envelope) – The second part is for the approval of an enabling clause for terraces and residential flat buildings over part of the existing zoned RE2. Area 2 covers an approximate area of 3 ha and is currently partially submerged (i.e. within the dredge pond). The approximate area of the above water land within Area 2 is estimated to be 0.8 ha.

The sites operate under two environment protection licences (EPLs). EPL No. 10490 is for the recycling facility (northern site including Area 1) and EPL No. 4612 is for the dredge ponds (including Area 2).

2. Scope of Work

The scope of work for the PSI comprised the following:

- Undertake a review of relevant previous investigation including aspects related to the site history;
- Drilling of three boreholes (MW101, MW102 and MW103) to a maximum depth of up to 5.5 m (until groundwater was reached). Install a landfill gas monitoring well at each location;
- Excavation of two test pits (TP101 and TP102), to a depth of 3.0 m, and collection of soil samples from regular depth intervals;
- Surveying of borehole and test pit coordinates using a hand-held GPS (coordinates) and interpolating elevation from an existing survey plan provided by the client;
- Field sampling and laboratory analysis in compliance with standard environmental protocols, including a Quality Assurance/Quality Control (QA/QC) plan consisting of 10% replicate sampling (intra and inter-laboratory replicate samples), trip spikes, trip blanks, appropriate chain of custody procedures and in-house laboratory QA/QC testing;
- Screening of all samples collected with a photoionisation detector (PID) to assess the likely presence or absence of volatile organic compounds (VOC);
- Submission of selected soil samples (including QC samples) and two material samples (fragments of fibre cement) for analysis of a combination of the following common contaminants at a NATA accredited laboratory:
 - o priority metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, zinc);
 - o total recoverable hydrocarbons (TRH);
 - o monocyclic aromatic hydrocarbons (benzene, toluene, ethylbenzene and xylenes – BTEX);
 - o polycyclic aromatic hydrocarbons (PAH);
 - o organochlorine pesticides (OCP), organophosphorus pesticides (OPP);
 - o polychlorinated biphenyls (PCB);
 - o total phenols;
 - o asbestos (in soil and material fragments).



- Conduct two landfill gas monitoring events using a GA 5000 landfill gas analyser to measure gas concentrations and flow rates from each of the three installed wells; and
- Preparation of this PSI report detailing the methodology and results of the assessment with reference to EPA approved guidelines, including NEPC (2013).

3. Previous Investigations

A number of previous investigations have been undertaken by DP, Dames and Moore Pty Ltd (D&M), Environmental Investigation Services (EIS), Jeffery and Katauskas Pty Ltd (J&K) and EMM Consulting Pty Limited (EMM). These investigations have covered various areas of the site including Areas 1 and 2.

A summary of the relevant reports that are known to DP is provided in Table 1, below. The summary is not an exhaustive list.

Table 1: List of Previous Reports

Author	Year	Project No.	Report Title / Letter Report Title
D&M	1994	unknown	Report on Groundwater Sampling
DP	1999	27879	Proposed Environmental Monitoring Program, Sorting, Recovery and Transfer (SRT) Facility, 146 Newbridge Road, Moorebank
D&M	2000	unknown	Landfill Groundwater and Surface Water Monitoring and Assessment Program
DP	2002a	30410	Preliminary Geotechnical Assessment, 146 Newbridge Road, Moorebank
DP	2002b	30410	Report on Preliminary Contamination Assessment, Proposed Residential Development, 146 Newbridge Road, Moorebank
DP	2002c	30410	Geotechnical Assessment, 146 Newbridge Road, Moorebank
DP	2005	43479	Proposed Mixed Commercial / Residential Development, 146 Newbridge Road, Moorebank
DP	2008	45642.00	Preliminary Desktop Review, Benedict Sand and Gravel, Moorebank
DP	2009a	45642.01	Desktop Review, Benedict Sand and Gravel, Moorebank
DP	2009b	45642.02	Environmental and Geotechnical Advice, Benedict Sand and Gravel, 146 Newbridge Road, Moorebank
DP	2009c	45642.03	Review of Foundation Options, Proposed Residential Development, 146 Newbridge Road, Moorebank
DP	2009d	71459.00	Compaction and Grading, 146 Newbridge Road, Moorebank
EIS	2013	E26930KBprt	Stage 1 Environmental Site Assessment for Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW
J&K	2013	26930Zrpt	Geotechnical Investigation for Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW

Author	Year	Project No.	Report Title / Letter Report Title
EIS	2014a	E26930KBrpt-HGG	Preliminary Hazardous Ground Gas Screening for the Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW
EIS	2014b	E26930KBlet-HGGR2	Hazardous Ground Gas (HGG) Screening Results (Round 2), Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW
EIS	2014c	E26930KBlet-HGGR3	Hazardous Ground Gas (HGG) Screening Results (Round 3), Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW
EIS	2014d	E26930KBlet-HGGR4	Hazardous Ground Gas (HGG) Screening Results (Round 4), Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW
EIS	2014e	E26930KBlet-HGGR5	Hazardous Ground Gas (HGG) Screening Results (Round 5), Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW
DP	2014a	71459.01	Initial Comments on the Design of Landfill Gas Mitigation Measures 146 Newbridge Road, Moorebank Stage 1
DP	2014b	71459.01	Draft Concept Design for Landfill Gas Mitigation Measures 146 Newbridge Road, Moorebank Stage 1
EMM	2015	J14149RP1	Preliminary Investigation of Contamination, Proposed Georges Cove Marina
DP	2015a	71459.02	Construction Environmental Management Plan, Proposed Retaining Wall, 146 Newbridge Road, Moorebank, NSW
DP	2015b	71459.02	Sampling and Analysis Quality Plan, Proposed Residential Subdivision, 146 Newbridge Road, Moorebank, NSW
DP	2015c	71459.04	Report on Geotechnical Investigation, Proposed Residential Subdivision, 146 Newbridge Road, Moorebank
DP	2015d	71459.05	Report on Geotechnical Investigation, Retaining Wall, 146 Newbridge Road, Moorebank
EMM	2016a	J14149RP1	Supplementary Preliminary Investigation, Proposed Georges Cove Marina
EMM	2016b	J14149RP1	Remediation Action Plan, Proposed Georges Cove Marina
DP	2016	71459.03 Rev1	Detailed Site Investigation, Proposed Residential Development, 146 Newbridge Road, Moorebank
J&K	2016a	26930Zrpt Rev3	Geotechnical Evaluation for Proposed Residential Subdivision at 146 Newbridge Road, Moorebank, NSW
J&K	2016b	26903Zemail 3	Response to RAP Comments
DP	2017a	71459.06	Groundwater Data Review, Proposed Residential Development, 146 Newbridge Road, Moorebank
DP	2017b	71459.06 Rev5	Remediation Action Plan, Proposed Residential Development, 146 Newbridge Road, Moorebank
J&K	2017	26930Zrpt Rev5	Geotechnical Evaluation for Proposed Residential Subdivision at 146 Newbridge Road, Moorebank, NSW



The previous geotechnical and environmental (contamination) investigations carried out at the site have generally confirmed the presence of fill containing a component of construction and demolition waste of varying thickness of up to 11.5 m at the central portion of the site immediately north of the former dredge ponds.

4. Site Information

4.1 Geology, Topography and Hydrogeology

A review of the regional Penrith 1:100,000 Geology Sheet indicates that the site is underlain by the following natural formations:

- South and central sections – Quaternary (Qpn) aged deposits of medium grained sand and silty clay; and
- North, north-east and sections – Tertiary (Ta) aged deposits of clayey quartzose sand and clay.

Mapping and previous drilling indicates that the Tertiary and Quaternary deposits are underlain by shale bedrock.



Figure 1: Regional geology (source: Penrith 1:100,000 Geology Sheet)

A review summarised in EIS (2013) of the acid sulphate soil (ASS) risk map for Liverpool prepared by Department of Land and Water Conservation (1997) indicates that the site is located in the following ASS risk area:

- High Probability Risk Area – south and west sections of the site associated with low lying swamp areas. The depth of occurrence in this area is between 1 m and 3 m below ground level (bgl) associated with alluvial plains, alluvial swamps, alluvial levees and sand plains; and
- Disturbed Terrain – north, central and east sections of the site associated with the filled areas. The classification is adopted in large scale filled areas which often occur during reclamation of low lying swamps for urban development, in areas which may have been mined or dredged or have undergone significant ground disturbance through general urban development or the construction of dams and levees.



A review summarised in EIS (2013) of groundwater bores registered with the NSW Office of Water (NOW) was undertaken. The search was limited to registered bores located within approximately 1 km radius of the site. The search indicated that two registered bores were located within this radius. The boreholes were registered for irrigation (GW024357) and domestic (GW023146) purposes. The irrigation bore is located approximately 800 m to the east of the site beyond Georges River. The domestic bore is located approximately 1.2 km to the north-east of the site. Both the bores are in close proximity of Georges River and the associated flood plain. Based on the distance of the bores and the regional topography, these bores were not considered to be potential receptors of any contamination that may be present at the site.

EIS (2013) noted that the stratigraphy of the site is expected to consist of relatively high permeability alluvial soils overlying deep shale bedrock. Based on these conditions and the results of the groundwater bore search, groundwater may be a potential resource in the vicinity of the site.

4.2 Site History of Northern Part of the Site Including Area 1

The detailed site history information on the northern part of the site is provided in DP (2002b) and EIS (2013). A summary of the site history information extracted from the EIS (2013) report is provided in Table 2, below.

Table 2: Summary of Site History (EIS, 2013)

Timeline	Details / Summary	Source of Information
1884 to 1924	The site was owned by private citizens and The Church of England Property Trust Diocese of Sydney. A portion of the land was owned by Perpetual Trustee Company Limited between 1920 and 1923. Based on a review of the 1930 aerial photograph, it is assumed that the site was predominantly vacant prior to 1930.	Land Title Records & Aerial Photos
1923 to 1947	The site was owned by New Bankstown Limited and The Greenacre Park Limited. A section of the site was also owned by private citizens between 1924 and 1965. A review of the 1943 historical aerial photograph indicates that cattle rearing and grazing activity had commenced at the site after 1930. Sections of the site had been cleared of vegetation during this period.	Land Title Records & Aerial Photos
1947 to 1997	The site was owned by Echo Dairies Pty Ltd and a few private individuals including Anthony Francis Brady (a dairyman). A review of the historical aerial photographs indicates that large sections of the site were cleared during this period for cattle grazing. Warehouses were constructed at the site and low lying areas in some sections were filled to form level ground. A dam was created in the north section of the site which was subsequently filled. A storm water channel/drain was created along the west site boundary. The aerial photos indicate that the dairy activity at the site appeared to have ceased some time prior to 1982. Large sections of the site were filled between 1982 and 1991. Stockpiles were visible at the site in the 1991 aerial photograph which indicates the commencement of waste processing/dredging activity at	Land Title Records & Aerial Photos

Timeline	Details / Summary	Source of Information
	the wider site (i.e. to the south of the proposed development area).	
1997 to present	<p>The site as at 2013 was owned by Tanlane Pty Ltd. Some filling was undertaken predominantly in 1993 and 1994 (according to the client). The site Land Title Records started to appear similar to the present layout from at least 2005. Council records indicate that a DA was submitted for the construction of a new road bridge at the subject site. A statement of environmental effects was prepared and submitted to council for the proposed development. The EPA has issued two licences (No. 4612, dated 2000 and 10490, dated 2001) under the POEO Act for the wider site. A number of variation notices were subsequently issued under s.58 of the Act between 2002 and 2013. Based on a review of the EPA information, the scheduled activities at the site included:</p> <ul style="list-style-type: none"> Crushing, grinding or separating; land-based extractive activity; and water-based extractive activity; Storage/transfer/separation of various waste streams; Importation of virgin excavated natural material (VENM) and potential acid sulfate soil (PASS) for backfilling sand quarry (according to the site owner, only minor quantities of PASS was ever accepted at the site); Dredging activities; Landfilling activities; Recovery, storage and processing (non-thermal treatment) of general waste including VENM; general solid waste (non-putrescible); general or specific exempted waste; wood waste; waste; paper or cardboard; gyprock; glass; building and demolition waste; asphalt waste (including asphalt resulting from road construction and waterproofing works); and waste tyres. <p>A clean up notice (No. 1051596) was issued under s.91 of the Act to Benedict Reclamations in October 2005. The notice was for the clean-up of bonded asbestos containing material (bonded ACM) – fibro encountered in some stockpiles at the site. It is understood that the clean-up order was promptly complied with.</p>	Historical Aerial Photos, Client (Tanlane), Council and NSW EPA records

4.3 Site History of Southern Part of the Site (Dredge Ponds) Including Area 2

The detailed site history information on the southern part of the site is provided in EMM (2015). EMM (2015) indicated that prior to 1960 the site (and potentially all of Lot 7 DP 1065574) was used for vegetable farming, and then as a dairy from 1960 to 1972. The report refers to a landfilling consent issued in 1972 (assumed to apply to the entirety of Lot 7 DP 1065574), and refers to evidence that parts of the site were used for landfilling between 1972 and 1993, although does not elaborate on the nature of that evidence. The report further indicates that development consent for sand mining was



granted in 1993, which required the landfilling consent to be surrendered, and that stockpiles of waste were removed from the site in 1992 prior to commencement of sand mining activities.

Based on the information provided in the EMM (2015) report the only visible evidence of potential landfilling on the site was what appeared to be a patch of cleared land in the northern area of the site in the 1978 aerial photograph, with an access track connecting it to what appeared to be an operational area on the northern portion of the site.

There was no evidence of land disturbance on the site to the south of this cleared patch in the 1978 aerial photograph. In addition, no evidence of land disturbance was evident anywhere on the Area 2 site in the 1986 aerial photograph, suggesting that the previous disturbance was restored by that stage. It is worth noting that the location of the cleared patch of land from the 1978 aerial photograph currently coincides with the northern portion of the dredge pond, suggesting that the land that was the subject of that activity in the 1978 aerial photograph was removed prior to, or during, the sand extraction operations on the Area 2 site.

5. Summary of Relevant Previous Investigations

The following subsections provide a summary of the conclusions and/or recommendations of those reports most relevant to the known site contamination issues.

5.1 Previous Investigations and Remediation Action Plan for Area 1

Area 1 is part of the northern portion of site and the proposed residential development (i.e. the Moorebank Cove Residential Site). Consequently, Area 1 has been included in all investigation and remediation works undertaken as part of the DP (2017b) Remediation Action Plan (RAP). Additionally, this site is currently subject to a Statutory Site Audit by a NSW EPA accredited site auditor under the *Contamination Land Management Act 1997* (NSW) as part of the remediation works.

Given that Area 1 has a proposed remediation strategy that will render the site suitable for the proposed residential development (i.e. the Moorebank Cove Residential Site), no additional intrusive site investigation is considered to be necessary on Area 1. Subject to the appropriate remediation and validation of this part of the site under the existing RAP (DP, 2017b) it is considered that Area 1 will be suitable for the proposed zone boundary change permitting R3 medium density residential development. On this basis, Area 1 has not been considered further by this PSI, however, some related comments are also provided in Section 13.

5.2 Previous Investigations and Remediation Action Plan for Area 2

The historical land uses of interest from a contamination perspective include landfilling (entire property), material recycling (northern portion only), and sand mining. A substantial portion of the Area 2 site currently consists of a dredge pond formed by suction dredge sand mining operations. The land surrounding the dredge pond consists of sandy to silty alluvial deposits, overlain in areas by fill material.



As part of the EMM (2016a) supplementary investigation, soil, sediment and groundwater tests were undertaken, in addition to previous testing undertaken in the preliminary investigation and other historical testing. The test locations from each of these investigations that fall within Area 2 are shown on Drawing 2, Appendix B.

A summary of the results from these investigations relevant to Area 2 are included alongside the current results of this investigation in the Table C1, Appendix C. In general contaminant concentrations were low and within the site assessment criteria (SAC) adopted for this assessment (see Section 10). There were, however some minor exceedances of the TRH (C₁₆-C₃₄) and benzo(a)pyrene (B(a)P) SAC for ecological screening level (ESL) in some sediment / soil samples. However, these results are not considered to be of concern as the final landform of the site has not yet been established and as such their location is unlikely to support a terrestrial ecology (i.e. some exceedances are currently submerged at the base of the pond). Further discussion of the previous EMM results in the context of the SAC adopted for this investigation is included in Section 12.4

It is noted that the EMM RAP (EMM 2016b) concluded:

'...this RAP identifies a range of actions to minimise risks to human health or ecology within the marina basin and adjoining Georges River...The land is suitable in its contaminated state (or will be suitable after remediation) for the proposed future land use as a proposed marina development as well as for high-density residential dwellings with minimal opportunities for soil access...' (EMM, 2016b Section 7.1)

6. Site Description

As part of the fieldwork a site walkover was undertaken on 16 March 2018. Selected photographs from the site walkover are included in Appendix D. In summary the following was observed:

- Area 1: At the time of inspection, Area 1 was a cleared area undergoing geotechnical improvement (compaction) / remediation and levelling as part of the redevelopment and RAP for the northern residential development (photo 1). Remediation of Area 1 involves the construction of a 3.0 m thick compacted clay cap with the upper ≥1.6 m comprising imported VENM (NB: importation and placement of VENM had not yet commenced at the time of the site inspection). The western boundary of the area was bordered by trees (photo 2); and
- Area 2: At the time of inspection, Area 2 comprised the western portion of the former dredge pond area. The dredge ponds are separated from the adjacent Georges River by a narrow (~15 m at narrowest point) strip of land which largely comprises an access track / road along the western boundary of the area (photo 3). A strip of land was present at the western boundary of Area 2 and the remainder of the area comprised a dredge pond (refer to photographs 3, 4, 5 and 6, Appendix D). Grassed areas with some shrubs, some stockpiles (photo 3 and 5) and some building materials (photo 4) are located between the road and the pond. Area 2 also contains a narrow, low lying grass covered spit, perpendicular to the access track, which extended east into the pond (photo 7). An open unlined drainage channel was located on along the western boundary of the site.



6.1 Proposed Development at Area 2

The proposed development involves the construction of terraced houses and residential flat buildings in the approximate configuration shown on Drawing 2, Appendix B. The development would require filling of the portion of the pond within the footprint of the residential use envelope. The filling / contouring of the land is also anticipated to require cut/fill of the current land area at the western boundary of Area 2.

In summary, the existing landform will require significant filling / re-contouring prior to form the foundation for the proposed residential buildings.

7. Conceptual Site Model of Area 2

A conceptual site model (CSM) is a representation of site-related information regarding contamination sources, receptors and exposure pathways between those sources and receptors (linkages). The CSM provides the framework for identifying how the site became contaminated and how potential receptors may be exposed to contamination either in the present or the future i.e. it enables an assessment of the potential source – pathway – receptor linkages. A CSM was developed by EMM in EMM (2016b).

The CSM in EMM (2016b) includes a focus of surface water quality issues associated with the former dredge ponds. The CSM developed in this report is related specifically to Area 2 and the residential use envelope. Aspects of the site-wide CSM, in particular, those related to surface water, are covered by EMM (2016b).

Potential Sources

Based on the available information, the following potential sources of contamination and associated contaminants of potential concern (COPC) have been identified.

- S1 – Filling used to form the current site levels:
COPC include metals, TRH, BTEX, PAH, OCP, OPP, PCB, phenols, asbestos and hazardous ground gases (HGG) (i.e. landfill gas) such as methane.
- S2 – Historical industrial uses and landfilling immediately north of Area 2 (i.e. Area 1 and beyond):
COPC include metals, TRH, BTEX, PAH, PCB, asbestos and hazardous ground gases (HGG) (i.e. landfill gas) such as methane.

Potential Receptors

Human health receptors:

- R1 – Construction and maintenance workers;
- R2 – Current users; and
- R3 – Adjacent site users (i.e. residents).

Environmental Receptors:

- R4 – Water bodies (former dredge ponds and the adjacent Georges River);
- R5 – Water Ecology (within the former dredge ponds adjacent Georges River)
- R6 – Groundwater; and
- R7 – Terrestrial ecology (within the landscaped areas of the proposed development).



Potential Pathways

- P1 – Ingestion and dermal contact;
- P2 – Inhalation of dust and/or vapours and explosive risk (methane);
- P3 – Surface water run-off;
- P4 – Leaching of contaminants and vertical migration into groundwater; and
- P5 – Lateral migration of groundwater directly to the former dredge ponds adjacent Georges River.

Summary of Potential Complete Pathways

A 'source–pathway–receptor' approach has been used to assess the potential risks of harm being caused to human, water or environmental receptors from contamination sources on or in the vicinity of the site, via exposure pathways (complete pathways). The possible pathways between the above sources (S1 and S2) and receptors (R1 to R7) are provided in Table 3 below.

Table 3: Summary of Potentially Complete Exposure Pathways

Source	Transport Pathway	Receptor	Risk Management Action Recommended
S1: Filling metals, TRH, BTEX, PAH, OCP, OPP, PCB, phenols, asbestos and HGG (i.e. landfill gas) such as methane S2: Historical industrial uses and landfilling immediately north of Area 2 (i.e. Area 1 and beyond) metals, TRH, BTEX, PAH, OCP, OPP, PCB, phenols, asbestos and HGG (i.e. landfill gas) such as methane	P1: Ingestion and dermal contact	R1: Construction and maintenance workers R2: Current users R7: Terrestrial Ecology	An intrusive investigation is recommended to assess possible contamination including chemical testing of the soils and landfill gas. If the site soils are contaminated at unacceptable levels, mitigation / remediation measures will need to be implemented to manage the risk to the identified receptors. If the land is affected by HGG then landfill gas mitigation measures would be required to be incorporated into the proposed development
	P2: Inhalation of dust and/or vapours and explosive risk (methane)	R1: Construction and maintenance workers R2: Current users R3: Adjacent users (residents)	
	P3 – Surface water run-off	R4: Water bodies (former dredge ponds and Georges River)	
	P5: Lateral migration of groundwater directly to the former dredge ponds adjacent Georges River	R5: Water Ecology (within former dredge ponds and Georges River)	
	P4 – Leaching of contaminants and vertical migration into groundwater	R6: Groundwater	



8. Data Quality Objectives for Investigation of Area 2

8.1 Introduction

The PSI with limited sampling was devised with reference to the seven step data quality objective (DQO) process which is provided in Appendix B, Schedule B2 of NEPC (2013). The DQO process adopted for DP (2016) has been used for the current investigation and has been modified accordingly (i.e. excludes surface water and groundwater).

The DQO process is outlined as follows:

8.2 State the Problem

The site is proposed to be redeveloped as a residential subdivision. Previous investigations have identified potential sources of soil contamination and groundwater contamination associated with the sites history as a landfill. The "problem" to be addressed is that the extent and nature of potential contamination on site is not fully understood; it is unclear whether the site is suitable for the proposed redevelopment and if contamination poses a risk to human health or the environment during and after the redevelopment works. The objective of the investigation is therefore to further characterise the nature and extent of contamination at the site and make recommendations for further targeted investigations and remediation to render the site suitable for the proposed redevelopment works.

8.3 Identify the Decision / Goal of the Study

Based on the site history of landfilling, it is considered that the contaminants of concern are various organic and inorganic compounds (refer to the CSM in Section 7) for various media including soil, soil gas, groundwater and surface water. As such, the analysis focused on those contaminants relevant to the media of this investigation, (i.e. soil contamination and hazardous ground gases).

The analytical data for soil was compared to relevant SAC including HIL, HSL, EIL and ESL for residential land use land use as per Tables 1A and 1B in Schedule B1, NEPC (2013). The analytical data for soil gas was compared to relevant gas screening value (GSV) and characteristic gas situation (CGS) as per EPA (2012) or other relevant guidance, as appropriate.

The suitability of the site for the proposed residential development was based on a comparison of the analytical results for all contaminants of concern to the adopted SAC and, if necessary, compared to the 95% UCL of the mean concentrations (relevant to soil contamination under certain circumstances).

The following specific decisions were made, as appropriate:

- What is the conceptual site model (i.e. sources, receptors, migration pathways, exposure)?
- Do the existing fill materials and/or natural soils pose a potential risk to identified receptors?
- Does the existing soil gas beneath the site pose a potential risk (toxic, explosion or asphyxiation) to identified receptors?
- Is the data sufficient to make a decision regarding the abovementioned risks, the compatibility of the site for the proposed development or are additional investigations required?



- Does contamination at the site, if encountered, trigger the Duty to Report requirements under the *Contaminated Land Management Act 1997* (NSW)?
- Are there any off-site migration issues that need to be considered?
- Is the data sufficient to enable the preparation of a RAP and/or Environmental Management Plan (EMP) should the data suggest these are required?

8.4 Identify Inputs to the Decision

Inputs into the decisions were as follows:

- Collection and review of site history information presented in previous investigations undertaken as summarised in Section 4.3, including information regarding previous and current activities undertaken on the site and the surrounding areas;
- Regional geology, topography, ASS risk mapping and hydrogeology;
- Soil samples and landfill gas readings were collected from accessible and relevant areas and analysed for the identified contaminants of concern;
- The lithology of the site as described in the test bore and pit logs;
- If site conditions suggest additional contaminants of concern e.g. if the condition of subsurface material encountered whilst drilling encounter particular odours, further analysis was undertaken;
- Field and laboratory QA/QC data to assess the suitability of the environmental data for the assessment;
- All analysis was undertaken at a NATA accredited laboratory; and
- The results were compared with the SAC, GSV and CGS criteria discussed in Section 10.

8.5 Define the Study Boundaries

The site is identified as Area 2 which is part (generally the south-western portion) of Lot 7 in Deposited Plan 1065574. The site is shown on Drawing 1, Appendix B. Area 2 is rectangular shaped and cover an area of approximately 3 ha, with above water portion estimated to be approximately 0.8 ha. The vertical boundary of the study is the vertical extent of any identified contamination.

8.6 Develop an Analytical Approach (or Decision Rule)

The information obtained during the assessment has been used to characterise the site in terms of contamination issues and risk to human health and/or the environment. The decision rules used in characterising the site were as follows:

- Laboratory test results for fill/soil were assessed individually or statistically, if considered appropriate, to determine the 95% UCL of the mean concentration for each analyte or analyte group (of like materials);
- Laboratory test results for targeted locations were assessed individually;



- The adopted SAC, GSV and CGS are from EPA endorsed guidelines;
- Where such criteria are not available, other recognised national or international standards were used;
- The contaminant concentrations in fill/soil should meet the following criteria, or further investigation or remedial action is required if:
 - o The concentration of the contaminant in soil is more than 2.5 times the SAC. Any location more than 2.5 times the adopted site criteria is classified as a 'hotspot', requiring further assessment / management;
 - o The calculated 95% UCL for a relevant area and discrete impacted fill/soil stratum (excluding any 'hotspot' concentrations) exceeds the adopted SAC;
 - o The standard deviation of the results is greater than 50% of the SAC;
- Further investigation, remediation and/or management to be recommended where the site was found to be contaminated or containing contamination 'hotspots'; and
- The landfill gas data has been evaluated in the context of relevant GSV and CGS and the degree of impact will inform the proposed gas mitigations that may be required for the proposed development.

Field and laboratory test results was considered useable for the assessment after evaluation against the following data quality indicators (DQIs):

- Precision – a measure of variability or reproducibility of data;
- Accuracy – a measure of closeness of the data to the 'true' value;
- Representativeness – the confidence (qualitative) of data representativeness of media present on site;
- Completeness – a measure of the amount of usable data from a data collection activity; and
- Comparability – the confidence (qualitative) that data may be considered to be equivalent for each sampling and analytical event.

8.7 Specify Limits on the Decision Error

Considering that the future site use/development will involve residential land use, decision errors for the respective contaminants of concern for fill/soil were:

1. Deciding that the site's fill/soil exceeds the SAC when they truly do not; and
2. Deciding that the site's fill/soils are within the SAC when they are truly not.

Decision errors for the proposed assessment were minimised and measured by the following:

- Compare new data with available previous investigations to determine the possible range of the parameters of interest;
- The sampling regime targeted key strata identified to account for site variability;
- Sample collection and handling techniques was with reference to DP's *Field Procedures Manual*;



- Samples were prepared and analysed by a NATA accredited laboratory with the acceptance limits for laboratory QA/QC parameters based on the laboratory reported acceptance limits and those stated in NEPC (2013);
- The analyte selection was based on the available site history, past site activities, site features and the findings of the previous investigations. The potential for contaminants other than those proposed to be analysed is currently considered to be low based on the current CSM;
- The SAC, GSV and CGS were adopted from established and EPA endorsed guidelines where available. The SAC, GSV and CGS have risk probabilities already incorporated; and
- Only NATA accredited laboratories using NATA endorsed methods were used to perform laboratory analysis. Where NATA endorsed methods are not used, the reasons have been stated. The effect of using non-NATA methods (if relevant) on the decision making process has been explained.

8.8 Optimise the Design for Obtaining Data

Sampling design and procedures that were implemented to optimise data collection for achieving the DQOs included the following:

- Only NATA accredited laboratories using NATA endorsed methods were used to perform laboratory analysis whenever possible;
- Targeted soil sampling (within access constraints) was generally used to provide indicative coverage of the site;
- To optimise the selection of soil samples for chemical analysis, all samples collected were screened using a PID allowing for site assessment and sample selection. In addition, additional soil samples were collected but kept 'on hold' pending details of initial analysis and were analysed if further delineation was required; and
- Adequately experienced environmental scientists conducted fieldwork and sample analysis interpretation.

9. Rationale and Methodology

The following provides a summary of the basis on which sampling was undertaken to meet the objectives of this PSI. It is noted that groundwater and surface water assessment was outside the purview of this investigation and has been addressed by EMM (2016b).

9.1 Soil Contamination Sampling Rationale

The intrusive investigation was undertaken as a preliminary investigation to identify the likelihood of significant or widespread soil contamination or landfill gas impacts within Area 2. Given Area 1 is already being addressed by the RAP (DP, 2017b), the majority of Area 2 is submerged, and has been previously tested by EMM, soil sampling from two locations (TP101 and TP102) within the above



water portion of Area 2 was considered suitable for this preliminary investigation. Focus was also on landfill gas and asbestos in soil as these were omitted from previous investigations on Area 2.

Table A of NSW EPA (1995) recommends a minimum of for site characterisation based on the detection of circular hot spots using a systemic grid sampling pattern. For a site of 3 ha (entire Area 2), the recommended number of test locations is 40 and for a site of 0.8 ha (current above water footprint) the recommended number of test locations is 19. Previous soil and sediment test locations reported by EMM include five test pits (above water land) and seven sediment samples (submerged land). The two test pits by DP and the previous five by EMM gives a total of seven test locations over a 0.8 ha area which is approximately 40% of the recommended sampling density. This overall sampling density is considered appropriate given the preliminary nature of the current investigation. Whilst sediment sample results have been interpreted as soils samples for the remainder of the land, there remains a significant amount of land forming earthworks required for the currently submerged land.

9.2 Landfill Gas Sampling Rationale

As remediation, including landfill gas, within Area 1 is being addressed by the RAP (DP, 2017b), assessment of this area was not considered warranted. With respect to Area 2, landfill gas monitoring was located in the area which was reasonably accessible and where ground gas was most likely to be present, viz. in the land forming the western portion of the site.

10. Site Assessment Criteria

10.1 Soil

The proposed use for the site after development is residential, including terraces, the most sensitive land use (i.e. residential with accessible soils) and flats (i.e. residential with minimal opportunities for soil access with fully and permanently paved yard space). The relevant SAC have been selected accordingly.

The analytical results from the laboratory testing have been assessed (as a Tier 1 assessment) against the investigation and screening levels in Schedule B1 of NEPC (2013). This guideline has been endorsed by the NSW EPA under the *Contaminated Land Management Act 1997*. The Schedule provides investigation and screening levels for commonly encountered contaminants which are applicable to generic land uses and include consideration of, where relevant, the soil type and the depth of contamination.

10.1.1 Health Investigation and Screening Levels

The HILs and HSLs are scientifically-based, generic assessment criteria designed to be used in the first stage (Tier 1) of an assessment of potential risks to human health from chronic exposure to contaminants. HILs are applicable to assessing health risks arising from direct contact to a range of contaminants. HSLs are used to assess selected petroleum compounds and fractions to assess the risk to human health via inhalation and direct contact with affected soils and groundwater.



HSLs have been developed for a range of petroleum hydrocarbons as either petrol or diesel mixtures, and for different land uses, media, pathways, soil types and depths to contamination.

The investigation and screening levels are not intended to be used as clean up levels. They establish concentrations above which further appropriate investigation (e.g. Tier 2) should be undertaken. They are intentionally conservative and are based on a reasonable worst-case scenario for four generic land uses.

Potential exposure pathways considered were:

- Soil vapour intrusion (for hydrocarbon contamination); and
- Direct contact.

Soil types considered were:

- Sand (conservative), given the general variability of soil types at the site.

Depth to contamination considered was:

- 0 to <1 m for soil HSLs have been adopted as an initial conservative screen; and
- HILs apply generally to the top 3 m of soil for residential land use.

Relevant land use criteria considered were:

- **HIL-A** – Residential with garden/accessible soils; and
- **HSL-A** – Residential with garden/accessible soils.

For petroleum hydrocarbons, the exposure scenario for an intrusive maintenance worker has also been considered and these criteria are extracted from the CRC CARE Technical Reports on which the NEPC (2013) HSLs are based.

Only those contaminants common to both Table 1A(1) (NEPC, 2013) and the list of potential contaminants applied to samples from the proposed analyte list have been included. The adopted soil HILs and HSLs are shown on Table 4.

Table 4: Health Investigation and Screening Levels (HILs/HSLs) in mg/kg

Contaminants		Direct Contact		Vapour Intrusion	
		Resident /Site user HIL/HSL-A	Intrusive Worker	Resident /Site user (sand) HSL-A	Intrusive Worker
Heavy Metals	Arsenic	100	-	-	-
	Cadmium	20	-	-	-
	Chromium (VI)	100	-	-	-
	Copper	6000	-	-	-
	Lead	300	-	-	-
	Mercury (inorganic)	40	-	-	-
	Nickel	400	-	-	-
	Zinc	7400	-	-	-
PAH	Benzo(a)pyrene TEQ ¹	3	-	-	-
	Total PAH	300	-	-	-
	Naphthalene	1400	29,000	3	NL
TRH	C ₈ – C ₁₀ (less BTEX) [F1]	4,400	82,000	40 (silt)	NL
	>C ₁₀ -C ₁₆ (less Naphthalene) [F2]	3300	62,000	110	NL
	>C ₁₆ -C ₃₄	4500	85,000	-	-
	>C ₃₄ -C ₄₀	6300	120,000	-	-
BTEX	Benzene	100	1100	0.5	77
	Toluene	14,000	120,000	160	NL
	Ethyl Benzene	4500	85,000	55	NL
	Xylene	12,000	130,000	40	NL
OCP/ OPP	Aldrin + Dieldrin	6	-	-	-
	Chlordane	50	-	-	-
	DDT+DDE+DDD	240	-	-	-
	Endosulfan	270	-	-	-
	Endrin	10	-	-	-
	Heptachlor	6	-	-	-
	HCB	10	-	-	-
	Methoxychlor	300	-	-	-

Contaminants	Direct Contact		Vapour Intrusion	
	Resident /Site user HIL/HSL-A	Intrusive Worker	Resident /Site user (sand) HSL-A	Intrusive Worker
Chlorpyrifos	160	-	-	-
PCB	1	-	-	-
Phenols	3000	-	-	-
Cyanide	250	-	-	-

Notes to Table 4:

1 - sum of carcinogenic PAH

NL - The soil saturation concentration (Csat) is defined as the soil concentration at which the pore water phase cannot dissolve any more of an individual chemical. The soil vapour that is in equilibrium with the pore water will be at its maximum. If the derived soil HSL exceeds Csat, a soil vapour source concentration for a petroleum mixture could not exceed a level that would result in the maximum allowable vapour risk for the given scenario. For these scenarios, no HSL is presented for these chemicals and the HSL is shown as 'not limited' or 'NL'.

10.1.2 Ecological Investigation and Screening Levels

Ecological Investigation Levels (EILs) have been developed and discussed in NEPC (2013) for selected metals and organic compounds and are applicable for assessing risk to terrestrial ecosystems. EILs depend on specific soil physiochemical properties and land use scenarios and generally apply to the top 2 m of soil, which essentially corresponds to the root zone and habitation zone of many species. The EIL is determined for a contaminant using the following formula:

$EIL = ABC + ACL$, where

ABC = Ambient Background Concentration

ACL = Added Contaminant Limit

The ABC of a contaminant is the soil concentration in a specific locality that is the sum of naturally occurring background levels and the contaminants levels that have been introduced from diffuse or non-point sources (e.g. motor vehicle emissions). The ABC is determined through direct measurement at an appropriate reference site (preferred) or through the use of methods defined by Olszowy et al. (1995) or Hamon et al. (2004) (NEPC, 2013).

ACLs are based on the soil characteristics of estimated pH, CEC and clay content.

EILs (and ACLs where appropriate) have been derived for only a short list of contaminants including As, Cu, Cr (III), DDT, naphthalene, Ni, Pb and Zn. An *Interactive (Excel) Calculation Spreadsheet* may be used for calculating site-specific EILs, and has been provided in the ASC NEPM Toolbox.

EILs were calculated based on the results from previous investigations by DP and EIS on the residential estate that covers the northern portion of the property (and includes Area 1). These EILs were adopted for this investigation and are as follows:



- Average pH 9 (range 7.1 to 10.7) based on 15 soil pH sample results within the upper 2.0 m of the soil profile;
- Average CEC 23 (range 4.3 to 39) based on 14 soil CEC sample results within the upper 2.0 m of the soil profile;
- Clay content 14% (EIS, 2013); and
- NSW traffic and 'low' traffic volume.

Table 5: Ecological Investigation Levels (EILs) in mg/kg

Analyte		EIL
Metals	Arsenic	100
	Cadmium	NC
	Chromium (III)	450
	Copper	230
	Lead	1100
	Mercury (inorganic)	NC
	Nickel	300
	Zinc	850
OCP	DDT	180
PAH	Naphthalene	170

Notes to Table 5:

NC - No Criteria

Ecological Screening Levels (ESLs) are used to assess the risk of selected petroleum hydrocarbon compounds, BTEX and benzo(a)pyrene to terrestrial ecosystems. ESLs apply to the top 2 m of the soil profile, which essentially corresponds to the root zone and habitation zone of many species.

ESLs have been derived in NEPC (2013) for the same four petroleum fractions as the HSLs (F1 to F4) as well as BTEX and Benzo(a)pyrene. The ESLs are shown on the following table. The following site specific data and assumptions have been used to determine the ESLs:

- The ESLs will apply to the top 2 m of the soil profile;
- The ESLs for urban residential and public open space apply; and
- A "coarse" soil texture (conservative) has been adopted as an initial screen given the general variability of soil types at the site.

Table 6: Ecological Screening Levels (ESLs) in mg/kg

Analyte		ESL	Comments
TRH	C ₆ – C ₁₀ (less BTEX) [F1]	180*	All ESLs are low reliability apart from those marked with * which are moderate reliability
	>C ₁₀ -C ₁₆ (less Naphthalene) [F2]	120*	
	>C ₁₆ -C ₃₄ (F3)	300	
	>C ₃₄ -C ₄₀ (F4)	2800	
BTEX	Benzene	50	
	Toluene	85	
	Ethyl Benzene	70	
	Xylenes	105	
PAH	B(a)P	0.7	

10.1.3 Management Limits for Petroleum Hydrocarbons

In addition to appropriate consideration and application of the HSLs, there are additional considerations which reflect the nature and properties of petroleum hydrocarbons, including:

- Formation of observable light non-aqueous phase liquids (LNAPL);
- Fire and explosion hazards; and
- Effects on buried infrastructure e.g. penetration of, or damage to, in-ground services.

Management Limits to avoid or minimise these potential effects have been adopted in NEPC (2013) as interim Tier 1 guidance. Management Limits have been derived for the same four petroleum fractions as the HSLs (F1 to F4). The adopted Management Limits are shown on the following table. The following site specific data and assumptions have been used to determine the Management Limits:

- The Management Limits will apply to any depth within the soil profile;
- The Management Limits for residential, parkland and open space apply; and
- A “coarse” soil texture (conservative) has been adopted as an initial screen given the general variability of soil types at the site.

Table 7: Management Limits in mg/kg

Analyte		Management Limit
TRH	C ₆ – C ₁₀ (F1)	700
	>C ₁₀ -C ₁₆ (F2)	1000
	>C ₁₆ -C ₃₄ (F3)	2500
	>C ₃₄ -C ₄₀ (F4)	10,000

Notes to Table 7: Separate management limits for BTEX and naphthalene are not available hence these should not be subtracted from the relevant fractions to obtain F1 and F2



10.2 Landfill Gas

According to the NSW EPA (2012), methane (CH_4) is a flammable gas that is explosive in the concentration range 5% to 15% v/v in air (somewhat different ranges may apply in atmospheres with enhanced or reduced oxygen concentrations). Methane is also a potential asphyxiant if its presence displaces oxygen thereby resulting in an environment with low oxygen concentration. It is less dense than air.

Carbon dioxide (CO_2) is an asphyxiant and toxic gas that is significantly denser than air. Carbon monoxide (CO) is an acutely toxic gas that is also flammable and potentially explosive. It has neutral buoyancy in air. Hydrogen is a flammable, potentially explosive gas that is much less dense than air. Hydrogen sulphide (H_2S) is a flammable and acutely toxic gas that is denser than air. It is highly odorous, and a nuisance, at low concentrations.

Trace gases may also be present depending on the nature of the source material, particularly if landfilled wastes are involved, including volatile organic compounds.

SAC from CIRIA (2007) and as adopted by NSW EPA (2012) (originally modified from Wilson and Card (2007)) for the GSV and CGS have been used to evaluate landfill gas. The GSV and CGS are summarised in the table reproduced from NSW EPA (2012), below.

Table 8: Modified Wilson and Card Classification (NSW EPA, 2012)

Gas screening value threshold (L/hr)	Characteristic gas situation	Risk classification	Additional factors	Typical sources
<0.07	1	Very low risk	Typically methane <1% v/v and/or carbon dioxide <5% v/v, otherwise consider increase to Situation 2	Natural soils with low organic content Typical fill
<0.7	2	Low risk	Borehole flow rate not to exceed 70 L/hr, otherwise consider increase to Situation 3	Natural soils with high organic content Fill
<3.5	3	Moderate risk		Old inert waste landfill Flooded mine workings
<15	4	Moderate to high risk	Consider need for Level 3 risk assessment	Mine workings susceptible to flooding Closed putrescible waste landfill
<70	5	High risk	Level 3 risk assessment required	Shallow, un-flooded abandoned mine workings
>70	6	Very high risk		Recent putrescible waste landfill

Notes:

1. Site characterisation should be based on gas monitoring of concentrations and borehole flow rates for the minimum periods defined in Section 3.4.
2. Source of gas and generation potential must be identified in the conceptual site model.
3. Soil gas investigation should be in accordance with the guidance provided in Section 3.4.
4. Where there is no detectable flow, the lower measurement limit of the instrument should be used.
5. To determine a GSV of <0.07, instruments capable of making accurate concentration measurement to 0.5% v/v and flow measurement to 0.1 L/hr are recommended.



11. Fieldwork

11.1 Drilling and Soil Sampling

A DP Environmental Scientist conducted the fieldwork. A 35T excavator was used to excavate two test pits (TP101 and TP102) to a depth of 3.0 m bgl. Samples were collected at regular depth intervals and based on observed changes in strata and upon obvious sign of contamination such as fibrous material.

Environmental sampling was performed according to standard operating procedures outlined in the DP *Field Procedures Manual*. All sampling data was recorded on DP chain of custody sheets. The general sampling and sample management procedures comprised:

- Collection of samples from the test pit walls and the excavator bucket (for depths below 1 m). Samples were placed into laboratory-prepared glass jars with Teflon lined lids by hand, capping immediately and ensuring headspace within the sample jar is minimised;
- Collection of a replicate sample in a zip-lock bag for PID screening;
- A new disposable nitrile glove was worn by the field scientist / engineer for each sample collected thereby precluding potential cross-contamination;
- Collection of 10% replicate samples for QC purposes;
- Labelling of sample containers with individual and unique identification details, including project number, sample location and sample depth (where applicable); and
- Placement of the sample jars into a cooled, insulated and sealed container for transport to the laboratory.

The headspace in the zip-lock bag sample was allowed to equilibrate and was screened using the PID. The PID had a 10.6eV lamp and was calibrated with isobutylene gas at 100 ppm and with fresh air.

Test pit locations are shown on Drawing 2, Appendix B.

11.2 Drilling and Installation of Landfill Gas Monitoring Wells

A Geoprobe with an auger was utilised for the drilling of the three boreholes (MW101, MW102 and MW103) to depths between 4.0 and 5.5 m bgl. Wells were installed in these three boreholes for landfill gas monitoring.

Wells were constructed using class 18 uPVC machine slotted screen and blank sections. The screened section of each well was backfilled with a washed sand filter pack to approximately 0.5 m above the screened interval. Each well was completed with a hydrated bentonite plug generally 0.4 m thick and concrete at the surface with a 0.5 to 1.0 m stick-up and well cap with gas sampling nipple.

Monitoring well locations are shown on Drawing 2, Appendix B.



11.3 Landfill Gas Monitoring

Monitoring of gas concentrations and flow rates was undertaken using a calibrated GA5000 on two occasions, 20 March and 9 April 2018. The monitoring was conducted according to the following procedure:

- Atmospheric pressure was recorded prior to monitoring;
- The inlet hose of a GAG000 was connected to the well gas cap using a 'quick connect' fitting; and
- Peak and stabilised readings of carbon dioxide, methane, hydrogen sulphide, carbon monoxide and oxygen were recorded upon stabilisation of parameters and at 30 second intervals for a period of five minutes.

12. Results

12.1 Field Observations

Details of the subsurface conditions encountered in the boreholes and test pits are provided in the logs included in Appendix E. Logs should be read in conjunction with the accompanying standard notes defining classification methods and descriptive terms.

The subsurface conditions at Area 2 are broadly summarised as follows:

FILLING:	Silty sand, clayey sand and clay filling with some gravel to a depth of 4.0 m bgl (MW103) or test pit / borehole termination (>3.0 m at TP101 and TP102 and >4.0 m at MW101, MW102). Anthropogenic inclusions including brick, glass, tile, wood, fragments of fibre cement were present within the filling at some of the test locations;
CLAY:	Clay from a depth of 4.0 m to 5.0 m bgl at MW103; and
SANDY CLAY:	Sandy clay from 5.0 m to 5.5 m bgl (borehole termination) at MW103.

Free groundwater was observed in all three boreholes whilst augering at depths of between at 2.7 m (MW102) and 5.5 m (MW103) bgl.

Fragments of fibre cement (potential bonded asbestos containing material (ACM)) were observed in TP101 and TP 102. This is consistent with other areas of the property and the observed presence of building waste in the fill.

Photographs depicting the typical profile of filling at TP101 and TP102 are included in Appendix D.

12.2 Field Screening Results for Soil

Replicate soil samples collected in zip-lock plastic bags were allowed to equilibrate under ambient temperatures before screening for total photoionisable compounds (i.e. VOC) using a calibrated PID.



Results of sample screening are shown on the test pit logs presented in Appendix E. The PID readings were all generally low ranging between 6 ppm to 13 ppm. The screening results suggest the general absence of gross VOC contamination.

12.3 Landfill Gas Monitoring

Landfill gas monitoring was undertaken on 20 March 2018 and 9 April 2018. Table 9 provides a summary of the results and calculated GSV and CGS for the two monitoring events. Atmospheric pressure readings were between 1017 and 1021 mb during the monitoring events.

Table 9: Landfill Gas Monitoring Results

MW	Date	Flow Rate Peak (L/h) ¹	Methane Peak %	CO ₂ Peak %	GSV= flow x highest Methane or CO ₂	CGS ²
MW101	20/3/2018	<0.1	0.1	11.1	0.011	2
	9/4/2018	-0.1	0.0	10.9	0.011	2
MW102	20/3/2018	<0.1	2.1	4.2	0.004	2
	9/4/2018	<0.1	0.0	4.6	0.005	1
MW103	20/3/2018	<0.1	0.1	4.8	0.005	1
	9/4/2018	0.1	0.0	4.5	0.005	1

Notes to table:

1. The flow rate used to calculate the GSV was the detection limit of the instrument for <0.1 L/h readings and negative readings were assumed as the equivalent positive reading as recommended in NSW EPA (2012)
2. Where methane >1% or CO₂ >5% CGS was increased to Situation 2 as per Table 6 of NSW EPA (2012)

The maximum recorded concentration of methane was 2.1% at MW102 on 20 March 2018 and the maximum recorded concentration of CO₂ was 11.1% at MW101 on 20 March 2018. The landfill gas results indicate generally low concentration and flow readings with a calculated CGS of 1 for all three monitoring wells. However, as per Table 6 of NSW EPA (2012), consideration should be given to raising the CGS to 2 where methane exceeds 1% and/or CO₂ exceeds 5%. The concentrations of landfill gas are comparatively lower than that on the northern part of the site comprising a proposed residential estate (i.e. encompassing Area 1). This may be due to Area 2 having been subject to more sand mining and less subsequent landfilling compared to the land to the north of the former dredge ponds. It should be noted however that this monitoring is only preliminary in nature (i.e. two monitoring events) and hence further monitoring would be required to confirm (or otherwise) these CGS values.

The landfill gas management approach adopted by the NSW EPA (2012) guidelines was based on British Standard BS 8485:2007, which was superseded by the 2015 version. BS 8495:2015 Code of Practice for Design of Protective Measures for Ground Gases (note: this guideline is not listed as being made or endorsed under S.105 of the CLMA) resulted in some changes to the required gas protection guidance values and scoring system for protection measures that were provided in Tables 7 and 8 of the NSW EPA (2012) guideline. If continued monitoring indicates that a CGS of 2 is appropriate for the site, then relevant measure(s) or system element(s) required to achieve a score consistent with what is required based on the CGS of 2 which is 3.5 points.



Field sampling records are included in Appendix F. A copy of the GA5000 calibration certificate is also included in Appendix F.

12.4 Analytical Laboratory Results

Summary results tables including analytical results and relevant SAC are summarised in Table C1, Appendix C. The results summary includes previous soil and sediment test locations that fall within the Area 2 boundary as summarised in EMM (2016b). Given that the ponds will be filled to create a new landform (building foundation) within the Area 2 residential use envelope, sediment samples have been interpreted as soil samples and have not been compared against sediment quality guidelines as they were in EMM (2016b).

Six samples were tested for a range of organic and inorganic contaminants as part of the current investigation (i.e. TP101 and TP102). Detectable concentrations of metals and PAH were well below the adopted SAC. The results for TRH, BTEX, OCP, OPP, PCB and phenols were below the laboratory reporting limit in all six samples.

One fragment of fibre cement from each test pit was tested for asbestos and each was confirmed to contain chrysotile and amosite asbestos.

Laboratory reports with associated chain of custody documentation are also presented in Appendix H.

Five samples collected from five test pits within Area 2 (i.e. TP3, TP5, TP6, TP13 and TP14) were tested for a range of organic and inorganic contaminants as part of the previous EMM investigations. Seven sediment samples were also collected and tested from within the Area 2 footprint for a range of organic and inorganic contaminants as part of the previous EMM investigations. These results were compared against the relevant SAC and as discussed above, the sediment samples have been interpreted as soil samples as that is what the sediment will ultimately become under the proposed development.

The EMM results for soil and sediment samples collected from within Area 2 are summarised as follows:

- Concentrations of metals in the 12 samples tested were all below the adopted SAC;
- Concentrations of TRH in the 12 samples tested were all below the adopted SAC with the exception of two sediment samples which exceeded the adopted ESL;
- Concentrations of BTEX in the 12 samples tested were below the laboratory reporting limit and were therefore below the adopted SAC;
- Concentrations of PAH in the 12 samples tested were all below the adopted SAC with the exception of three sediment samples and one soil sample which exceeded the adopted ESL;
- Concentrations of OCP in the three samples tested were below the laboratory reporting limit and were therefore below the adopted SAC;
- Concentrations of OPP in the two samples tested were below the laboratory reporting limit and were therefore below the adopted SAC; and
- Concentrations of PCB in the two samples tested were below the laboratory reporting limit and were therefore below the adopted SAC.



The previous EMM results which exceed the ESL are not considered to be of concern as although the final landform of the site has yet to be established their location is highly unlikely to support a terrestrial ecology (i.e. some are currently submerged at the base of the pond). Moreover, any landscaped areas within Area 2 are likely to be formed using imported materials.

12.5 Data Quality Assurance and Quality Control

Field and laboratory quality assurance and quality control (QA/QC) procedures formed an integral part of the assessment. The QA/QC procedures and results are included in Appendix G. Overall, the standard operating procedures (SOPs) were complied with in the field, and the field and laboratory QC samples were generally within the acceptance criteria. On this basis, it is considered that an acceptable level of field and laboratory precision and consistency was achieved and that the laboratory data sets are reliable, accurate and useable for this assessment.

13. Conclusions and Recommendations

Area 1 has previously been investigated by DP and is within the remediation area for the northern portion of the property (DP 2017b). These remedial works are currently being undertaken and will result in land suitable for the proposed medium density R3 residential estate (i.e. northern part of the site, including Area 1). By extension, Area 1 is therefore considered suitable for rezoning to allow medium density R3 residential land use as per the current planning proposal (including residential land use with no accessible soils and/or with some accessible soils, as appropriate).

Concentrations of contaminants within Area 2 were all below the adopted SAC with the exception of some minor exceedances of the ESL, however, the exceedances are not considered to be of concern. Bonded ACM was encountered in the fill at the two test pits TP101 and TP102. A full asbestos investigation would be required to quantify the concentration of bonded ACM and fibrous asbestos and asbestos fines (FA and AF) in filling against relevant Tier 1 screening criteria for asbestos. Alternatively, the development could adopt a cap and contain strategy in relation to asbestos in filling and this would require a long-term environmental management plan (EMP).

It is noted that any potential impacts on surface water in the dredge ponds and adjacent Georges River from groundwater and the soils and sediments is being addressed by EMM (2016b) and hence is outside the purview of this investigation. Further to this, DP notes that the filling of the ponds is going to introduce new material (fill) into direct contact with the pond surface water body. Any filling should be conducted so as not to adversely affect water quality.

A suitable filling protocol should therefore be implemented for the ponds and Area 2 more broadly. This would essentially comprise an addendum to the EMM (2016b) RAP. On completion of the final landform, a Detailed Site Investigation (DSI) of Area 2 is recommended in order to confirm the placed fill meets the SAC for use as residential (terrace houses and residential flat buildings). This should involve a sampling density which meets the recommended minimum density for site characterisation as per Table A in NSW EPA (1995) Sampling Design Guidelines. Alternatively, a rigorous testing programme on the fill used to create the final landform under the filling protocol could go some way to



negating the need for a post-placement / post-filling DSI. A primary consideration in the selection of fill to place in the ponds would be to minimise the risk of surface water contamination.

Whilst the initial screening for landfill gas has indicated a generally low risk, given the results across the rest of the property, the final gas risk profile would need to be confirmed through additional monitoring events and on completion of the final landform. If ultimately it was deemed that landfill gas protection systems were required in Area 2, it is anticipated that such measures could be addressed in a similar way that has been adopted for the residential properties across the northern portion of property as another addendum to the EMM (2016b) RAP in the proposed marina (Area 2).

In summary, based on the findings of the current investigation it is considered that Area 2 is suitable for residential land use to allow residential terraces and residential flat buildings, as per the current planning proposal, as per the current planning proposal, provided that:

- An asbestos investigation is undertaken to verify whether asbestos is present at concentrations exceeding the relevant Tier 1 screening criteria;
- Additional groundwater investigations are undertaken to evaluate whether per- and poly-fluoroalkyl substances (PFAS) is present in groundwater at concentrations which may adversely impact surface water;
- Further gas monitoring is undertaken and demonstrates that mitigation systems can be suitably installed and operated within the proposed building designs. Preliminary landfill gas monitoring indicates that the residential use envelope may require landfill gas mitigations. If continued monitoring indicates that mitigations are required, an addendum to the EMM (2016b) RAP must be prepared to address this specific issue. Further to this, it is understood that buildings currently being proposed involves suspended slabs under which mitigation systems could be readily incorporated into the design, if necessary;
- An addendum to the EMM (2016b) RAP is prepared that deals with asbestos issues (if required based on the outcome of dot-point one) and the filling of the ponds and addresses:
 - o a) protection of human health of future residents; and
 - o b) protection of surface water quality in the dredge ponds, in particular, if there is a plan to open the dredge ponds to the Georges River in the future;
- A post-filling DSI is completed across Area 2 that addresses:
 - o a) protection of human health of future residents (i.e. testing of soil within the residential use envelope);
 - o b) protection of surface water quality in the dredge ponds, in particular, if there is a plan to open the dredge ponds to the Georges River in the future;
 - o c) based on the results of the DSI, if required, an addendum to the EMM (2016b) RAP is completed to outline the additional remediation requirements associated with:
 - The residential use envelope and protection of human health of future residents, including gas mitigation;
 - Protection of surface water quality, in particular, if there is a plan to open the dredge ponds to the Georges River in the future; and
 - o d) site remediation is undertaken and completed with reference to the EMM (2016b) RAP and any addendums to the RAP as described above. The remediation must be validated in



line with relevant NSW EPA endorsed guidelines including NSW OEH (2011) Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites.

14. References

- BSI 8485 (2015) Code of Practice for Design of Protective Measures for Ground Gases
- CIRIA (2007) C665 Assessing Risks Posed by Hazardous Ground Gases to Buildings
- Dames & Moore (1994) Report on Groundwater Sampling
- Dames & Moore (2000) Landfill Groundwater and Surface Water Monitoring and Assessment Program
- DP (1999) Proposed Environmental Monitoring Program, Sorting, Recovery and Transfer (SRT) Facility, 146 Newbridge Road, Moorebank
- DP (2002a) Preliminary Geotechnical Assessment, 146 Newbridge Road, Moorebank
- DP (2002b) Report on Preliminary Contamination Assessment, Proposed Residential Development, 146 Newbridge Road, Moorebank
- DP (2002c) Geotechnical Assessment, 146 Newbridge Road, Moorebank
- DP (2005) Proposed Mixed Commercial / Residential Development, 146 Newbridge Road, Moorebank
- DP (2008) Preliminary Desktop Review, Benedict Sand and Gravel, Moorebank
- DP (2009a) Desktop Review, Benedict Sand and Gravel, Moorebank
- DP (2009b) Environmental and Geotechnical Advice, Benedict Sand and Gravel, 146 Newbridge Road, Moorebank
- DP (2009c) Review of Foundation Options, Proposed Residential Development, 146 Newbridge Road, Moorebank
- DP (2009d) Compaction and Grading, 146 Newbridge Road, Moorebank
- DP (2014a) Initial Comments on the Design of Landfill Gas Mitigation Measures 146 Newbridge Road, Moorebank Stage 1
- DP (2014b) Draft Concept Design for Landfill Gas Mitigation Measures, 146 Newbridge Road, Moorebank Stage 1
- DP (2015a) Construction Environmental Management Plan, Proposed Retaining Wall, 146 Newbridge Road, Moorebank, NSW



DP (2015b) Sampling and Analysis Quality Plan, Proposed Residential Subdivision, 146 Newbridge Road, Moorebank, NSW

DP (2015c) Report on Geotechnical Investigation, Proposed Residential Subdivision, 146 Newbridge Road, Moorebank

DP (2015d) Report on Geotechnical Investigation, Retaining Wall, 146 Newbridge Road, Moorebank

DP (2016) Detailed Site Investigation, Proposed Residential Development, 146 Newbridge Road, Moorebank (Rev1)

DP (2017a) Groundwater Data Review, Proposed Residential Development, 146 Newbridge Road, Moorebank

DP (2017b) Remediation Action Plan, Proposed Residential Development, 146 Newbridge Road, Moorebank (Rev5)

EIS (2013) Stage 1 Environmental Site Assessment for Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW

EIS (2014a) Preliminary Hazardous Ground Gas Screening for the Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW

EIS (2014b) Hazardous Ground Gas (HGG) Screening Results (Round 2), Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW

EIS (2014c) Hazardous Ground Gas (HGG) Screening Results (Round 3), Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW

EIS (2014d) Hazardous Ground Gas (HGG) Screening Results (Round 4), Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW

EIS (2014e) Hazardous Ground Gas (HGG) Screening Results (Round 5), Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW

EMM (2015) Preliminary Investigation of Contamination, Proposed Georges Cove Marina

EMM (2016a) Supplementary Preliminary Investigation, Proposed Georges Cove Marina

EMM (2016b) Remediation Action Plan, Proposed Georges Cove Marina

J&K (2013) Geotechnical Investigation for Proposed Residential Development at 146 Newbridge Road, Moorebank, NSW

J&K (2016) Geotechnical Evaluation for Proposed Residential Subdivision at 146 Newbridge Road, Moorebank, NSW

J&K (2017) Geotechnical Evaluation for Proposed Residential Subdivision at 146 Newbridge Road, Moorebank, NSW



J&K (2016b) Response to RAP Comments (ref: 26903Zemail3)

NEPC (2013) National Environment Protection (Assessment of Site Contamination) Measure 1999 amended 2013

NSW EPA (2012) Guidelines for the Assessment and Management of Sites Impacted by Hazardous Ground Gases

NSW OEH (2011) Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites

15. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report for this project at 146 Newbridge Road (Areas 1 and 2 rezoning) in accordance with DP's proposal SYD180001 (Rev1) dated 17 January 2018 and acceptance received from Mirvac Homes NSW Pty Ltd. The work was carried out under the agreed contract. This report is provided for the exclusive use of Mirvac Homes NSW Pty Ltd and Tanlane Pty Ltd for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This



design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life. This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of potential hazards, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the environmental components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

Douglas Partners Pty Ltd

Appendix A

About This Report

About this Report

Douglas Partners



Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

This report is the property of Douglas Partners Pty Ltd. The report may only be used for the purpose for which it was commissioned and in accordance with the Conditions of Engagement for the commission supplied at the time of proposal. Unauthorised use of this report in any form whatsoever is prohibited.

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;

- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

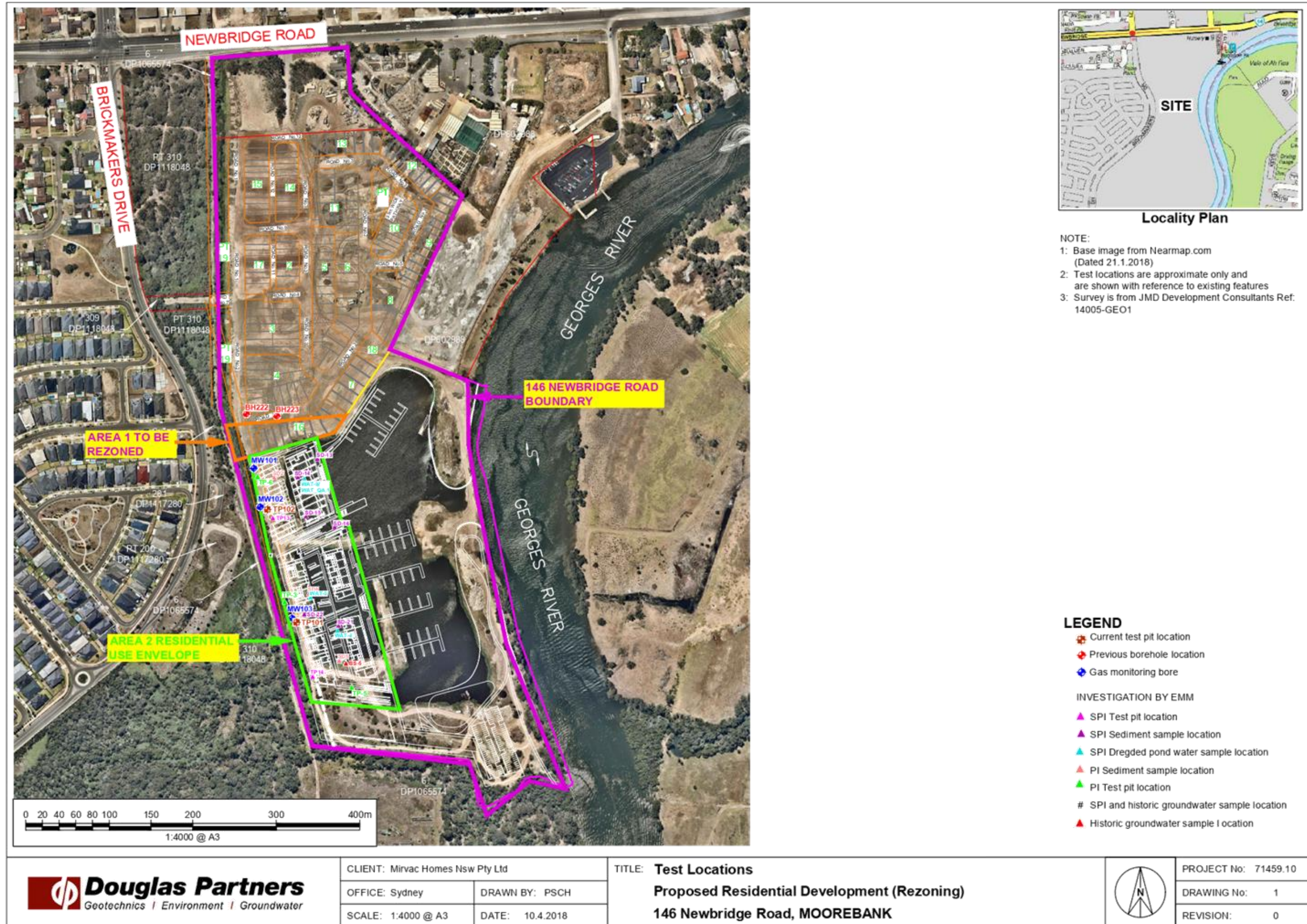
Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

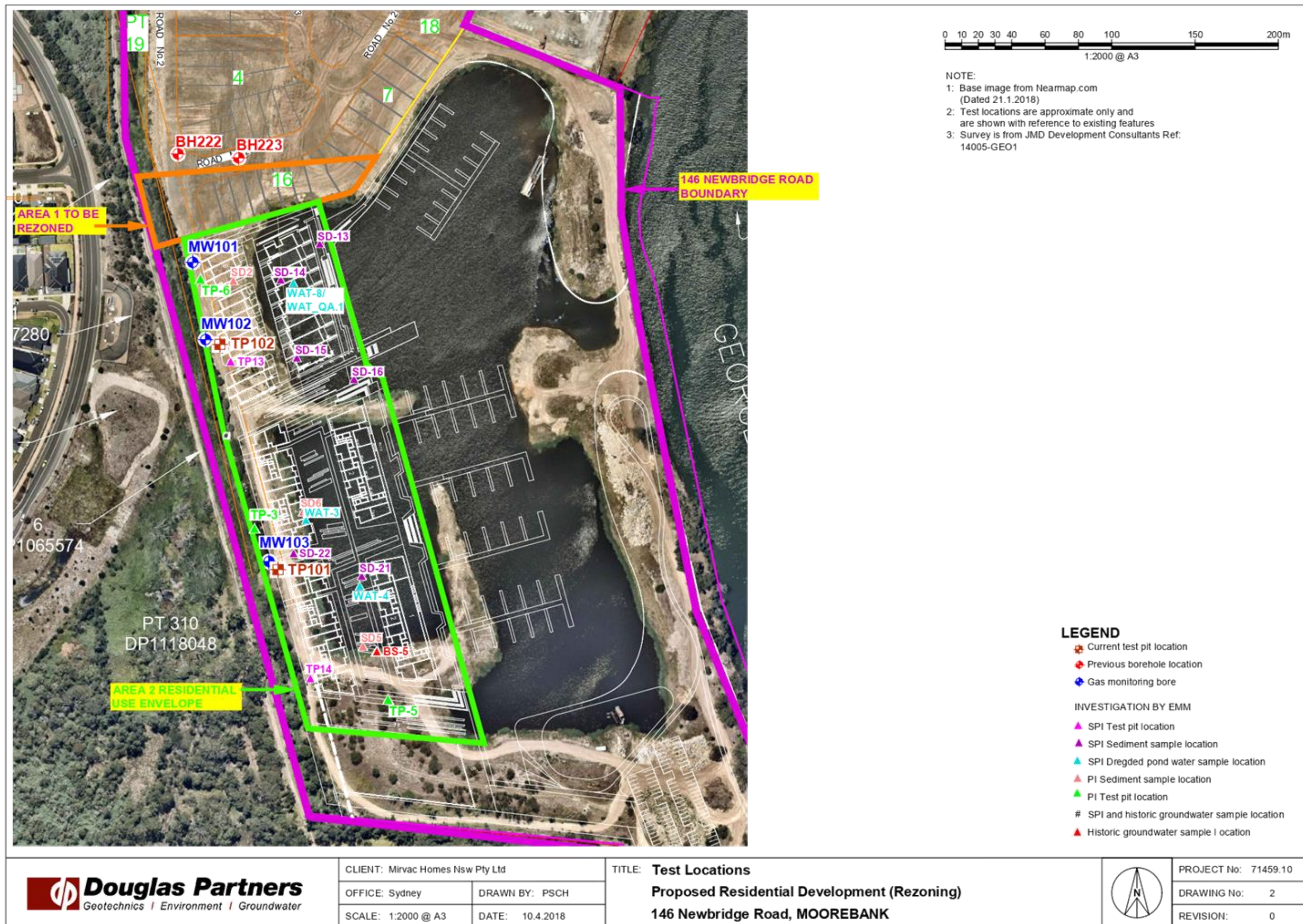
Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

Appendix B

Drawings





Appendix C

Table C1: Summary of Laboratory Results



Table C1: Summary of Laboratory Results

[illegible]



Table C1: Summary of Laboratory Results

[illegible]

Appendix D

Site Photographs



Photo 1 - Area 1, facing east.



Photo 2 - Area 1, facing west.

	Site Photographs	PROJECT:	71459.10
		PLATE No:	D1
	146 Newbridge Road, Moorebank	REV:	A
		DATE:	26-Apr-18
	CLIENT: Mirvac Homes NSW Pty Ltd		



Photo 3 - Area 2, facing south



Photo 4 - Area 2, facing south

 Douglas Partners <small>Geotechnics Environment Groundwater</small>	Site Photographs	PROJECT:	71459.10
		PLATE No:	D2
	146 Newbridge Road, Moorebank	REV:	A
		DATE:	26-Apr-18
	CLIENT: Mirvac Homes NSW Pty Ltd		



Photo 5 - Area 2, facing north



Photo 6 - Area 2, facing north, with MW102

 Douglas Partners <small>Geotechnics Environment Groundwater</small>	Site Photographs	PROJECT:	71459.10
		PLATE No:	D3
	146 Newbridge Road, Moorebank	REV:	A
	CLIENT: Mirvac Homes NSW Pty Ltd	DATE:	26-Apr-18



Photo 7 - Area 2, facing south east



Photo 8 - TP101 (typical filling profile)

 Douglas Partners <small>Geotechnics Environment Groundwater</small>	Site Photographs	PROJECT:	71459.10
		PLATE No:	D4
	146 Newbridge Road, Moorebank	REV:	A
		DATE:	26-Apr-18
	CLIENT: Mirvac Homes NSW Pty Ltd		



Photo 9 - TP102 (typical filling profile)

 Douglas Partners <small>Geotechnics Environment Groundwater</small>	Site Photographs	PROJECT: 71459.10
		PLATE No: D5
	146 Newbridge Road, Moorebank	REV: A
	CLIENT: Mirvac Homes NSW Pty Ltd	DATE: 26-Apr-18

Appendix E

Test Pit and Borehole Logs



July 2010

Sampling Methods

The results of the SPT tests can be related empirically to the engineering properties of the soils.

Dynamic Cone Penetrometer Tests /

Perth Sand Penetrometer Tests

Dynamic penetrometer tests (DCP or PSP) are carried out by driving a steel rod into the ground using a standard weight of hammer falling a specified distance. As the rod penetrates the soil the number of blows required to penetrate each successive 150 mm depth are recorded. Normally there is a depth limitation of 1.2 m, but this may be extended in certain conditions by the use of extension rods. Two types of penetrometer are commonly used.

- Perth sand penetrometer - a 16 mm diameter flat ended rod is driven using a 9 kg hammer dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands and is mainly used in granular soils and filling.
- Cone penetrometer - a 16 mm diameter rod with a 20 mm diameter cone end is driven using a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). This test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various road authorities.

Soil Descriptions

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Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard AS 1726-1993, Geotechnical Site Investigations Code. In general, the descriptions include strength or density, colour, structure, soil or rock type and inclusions.

Soil Types

Soil types are described according to the predominant particle size, qualified by the grading of other particles present:

Type	Particle size (mm)
Boulder	>200
Cobble	63 - 200
Gravel	2.36 - 63
Sand	0.075 - 2.36
Silt	0.002 - 0.075
Clay	<0.002

The sand and gravel sizes can be further subdivided as follows:

Type	Particle size (mm)
Coarse gravel	20 - 63
Medium gravel	6 - 20
Fine gravel	2.36 - 6
Coarse sand	0.6 - 2.36
Medium sand	0.2 - 0.6
Fine sand	0.075 - 0.2

The proportions of secondary constituents of soils are described as:

Term	Proportion	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	20 - 35%	Sandy Clay
Slightly	12 - 20%	Slightly Sandy Clay
With some	5 - 12%	Clay with some sand
With a trace of	0 - 5%	Clay with a trace of sand

Definitions of grading terms used are:

- Well graded - a good representation of all particle sizes
- Poorly graded - an excess or deficiency of particular sizes within the specified range
- Uniformly graded - an excess of a particular particle size
- Gap graded - a deficiency of a particular particle size with the range

Cohesive Soils

Cohesive soils, such as clays, are classified on the basis of undrained shear strength. The strength may be measured by laboratory testing, or estimated by field tests or engineering examination. The strength terms are defined as follows:

Description	Abbreviation	Undrained shear strength (kPa)
Very soft	vs	<12
Soft	s	12 - 25
Firm	f	25 - 50
Stiff	st	50 - 100
Very stiff	vst	100 - 200
Hard	h	>200

Cohesionless Soils

Cohesionless soils, such as clean sands, are classified on the basis of relative density, generally from the results of standard penetration tests (SPT), cone penetration tests (CPT) or dynamic penetrometers (PSP). The relative density terms are given below:

Relative Density	Abbreviation	SPT N value	CPT qc value (MPa)
Very loose	vl	<4	<2
Loose	l	4 - 10	2 - 5
Medium dense	md	10 - 30	5 - 15
Dense	d	30 - 50	15 - 25
Very dense	vd	>50	>25

Soil Descriptions

Soil Origin

It is often difficult to accurately determine the origin of a soil. Soils can generally be classified as:

- Residual soil - derived from in-situ weathering of the underlying rock;
- Transported soils - formed somewhere else and transported by nature to the site; or
- Filling - moved by man.

Transported soils may be further subdivided into:

- Alluvium - river deposits
- Lacustrine - lake deposits
- Aeolian - wind deposits
- Littoral - beach deposits
- Estuarine - tidal river deposits
- Talus - scree or coarse colluvium
- Slopewash or Colluvium - transported downslope by gravity assisted by water. Often includes angular rock fragments and boulders.

Symbols & Abbreviations

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Introduction

These notes summarise abbreviations commonly used on borehole logs and test pit reports.

Drilling or Excavation Methods

C	Core drilling
R	Rotary drilling
SFA	Spiral flight augers
NMLC	Diamond core - 52 mm dia
NQ	Diamond core - 47 mm dia
HQ	Diamond core - 63 mm dia
PQ	Diamond core - 81 mm dia

Water

▷	Water seep
▽	Water level

Sampling and Testing

A	Auger sample
B	Bulk sample
D	Disturbed sample
E	Environmental sample
U ₅₀	Undisturbed tube sample (50mm)
W	Water sample
pp	Pocket penetrometer (kPa)
PID	Photo ionisation detector
PL	Point load strength Is(50) MPa
S	Standard Penetration Test
V	Shear vane (kPa)

Description of Defects in Rock

The abbreviated descriptions of the defects should be in the following order: Depth, Type, Orientation, Coating, Shape, Roughness and Other. Drilling and handling breaks are not usually included on the logs.

Defect Type

B	Bedding plane
Cs	Clay seam
Cv	Cleavage
Cz	Crushed zone
Ds	Decomposed seam
F	Fault
J	Joint
Lam	Lamination
Pt	Parting
Sz	Sheared Zone
V	Vein

Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

h	horizontal
v	vertical
sh	sub-horizontal
sv	sub-vertical

Coating or Infilling Term

cln	clean
co	coating
he	healed
inf	infilled
stn	stained
ti	tight
vn	veneer

Coating Descriptor

ca	calcite
cbs	carbonaceous
cly	clay
fe	iron oxide
mn	manganese
slt	silty

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

Other

fg	fragmented
bnd	band
qtz	quartz

Symbols & Abbreviations

Graphic Symbols for Soil and Rock

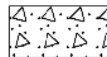
General



Asphalt



Road base



Concrete



Filling

Soils



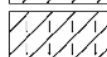
Topsoil



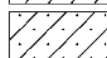
Peat



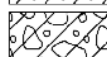
Clay



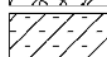
Silty clay



Sandy clay



Gravelly clay



Shaly clay



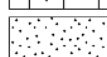
Silt



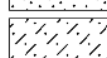
Clayey silt



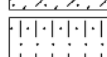
Sandy silt



Sand



Clayey sand



Silty sand



Gravel



Sandy gravel



Cobbles, boulders



Talus

Sedimentary Rocks



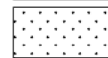
Boulder conglomerate



Conglomerate



Conglomeratic sandstone



Sandstone



Siltstone



Laminite



Mudstone, claystone, shale

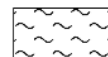


Coal

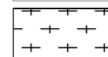


Limestone

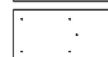
Metamorphic Rocks



Slate, phyllite, schist

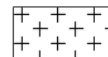


Gneiss

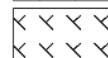


Quartzite

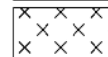
Igneous Rocks



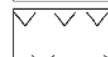
Granite



Dolerite, basalt, andesite



Dacite, epidote



Tuff, breccia



Porphyry

BOREHOLE LOG

CLIENT: Mirvac Homes NSW Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: 146 Newbridge Road, Moorebank

SURFACE LEVEL: 7.45 AHD*
EASTING: 311832
NORTHING: 6243373
DIP/AZIMUTH: 90°/-

BORE No: MW101
PROJECT No: 71459.10
DATE: 16/3/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details
				Type	Depth	Sample	Results & Comments		
		FILLING - dark brown silty sand filling with some fine to medium igneous gravel with a trace of charcoal							Concrete 0.0-0.1m Bentonite 0.1-0.5m
1									
2	2.0	FILLING - dark brown clay filling with some fine igneous gravel. - moist below 2.5m							Gravel 0.5-4.0m Machine slotted PVC screen 1.0-4.0m
3									
4	4.0	- wet at 4.0m Bore discontinued at 4.0m							End cap
5									
6									
7									
8									
9									

RIG: Geoprobe

DRILLER: Terratest

LOGGED: NW

CASING: Uncased

TYPE OF BORING: Solid flight auger to 4.0m

WATER OBSERVATIONS: Free groundwater observed at 4.0m

REMARKS: Stick up 1.0m*. Interpolated by JMD from their site survey completed 2 November 2017

SAMPLING & IN SITU TESTING LEGEND			
A Auger sample	G Gas sample	PID Photo ionisation detector (ppm)	
B Bulk sample	P Piston sample	PL(A) Point load axial test Is(50) (MPa)	
BLK Block sample	U Tube sample (x mm dia.)	PL(D) Point load diametral test Is(50) (MPa)	
C Core drilling	W Water sample	pp Pocket penetrometer (kPa)	
D Disturbed sample	D Water seep	S Standard penetration test	
E Environmental sample	W Water level	V Shear vane (kPa)	

BOREHOLE LOG

CLIENT: Mirvac Homes NSW Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: 146 Newbridge Road, Moorebank

SURFACE LEVEL: 7.45 AHD*
EASTING: 311840
NORTHING: 6243327
DIP/AZIMUTH: 90°/-

BORE No: MW102
PROJECT No: 71459.10
DATE: 16/3/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details
				Type	Depth	Sample	Results & Comments		
		FILLING - brown silty sand filling with some fine igneous gravel, glass and brick fragments							Concrete 0.0-0.1m Bentonite 0.1-0.5m
	1								
	2	- dark brown below 2m							Gravel 0.5 - 2.7m Machine slotted PVC screen 0.7-2.7m
	3	- becoming wet at 2.5m - collapsed below 2.7m							End cap
	4.0	- in dark brown sandy clay filling Bore discontinued at 4.0m							
	5								
	6								
	7								
	8								
	9								

RIG: Geoprobe

DRILLER: Terratest

LOGGED: NW

CASING: Uncased

TYPE OF BORING: Solid flight auger to 4.0m

WATER OBSERVATIONS: Free groundwater observed at 2.7m

REMARKS: Stick up 0.7m*. Interpolated by JMD from their site survey completed 2 November 2017





SAMPLING & IN SITU TESTING LEGEND			
A Auger sample	G Gas sample	PID Photo ionisation detector (ppm)	
B Bulk sample	P Piston sample	PL(A) Point load axial test Is(50) (MPa)	
BLK Block sample	U Tube sample (x mm dia.)	PL(D) Point load diametral test Is(50) (MPa)	
C Core drilling	W Water sample	pp Pocket penetrometer (kPa)	
D Disturbed sample	W Water seep	S Standard penetration test	
E Environmental sample	W Water level	V Shear vane (kPa)	

BOREHOLE LOG

CLIENT: Mirvac Homes NSW Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: 146 Newbridge Road, Moorebank

SURFACE LEVEL: 7.45 AHD*
EASTING: 311878
NORTHING: 6243194
DIP/AZIMUTH: 90°/-

BORE No: MW103
PROJECT No: 71459.10
DATE: 16/3/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details
				Type	Depth	Sample	Results & Comments		
		FILLING - brown silty sand filling with some fine to medium igneous gravel, glass fragments							Concrete 0.0-0.1m Bentonite 0.1-0.4m
	1								
	1.5	FILLING - brown clay sand filling with fine to coarse igneous gravel and some brick fragments							
	2								
	3								Gravel 0.4-5.5m
	4	CLAY - dark brown, mottled grey clay							Machine slotted PVC screen 0.5-5.5m
	5	SANDY CLAY - dark grey sandy clay							
	5.5	Bore discontinued at 5.5m							End Cap
	6								
	7								
	8								
	9								

RIG: Geoprobe

DRILLER: Terratest

LOGGED: NW

CASING: Uncased

TYPE OF BORING: Solid flight auger to 5.5m

WATER OBSERVATIONS: Free groundwater observed at 5.5m

REMARKS: Stick up 0.5m*. Interpolated by JMD from their site survey completed 2 November 2017

SAMPLING & IN SITU TESTING LEGEND			
A Auger sample	G Gas sample	PID Photo ionisation detector (ppm)	
B Bulk sample	P Piston sample	PL(A) Point load axial test Is(50) (MPa)	
BLK Block sample	U Tube sample (x mm dia.)	PL(D) Point load diametral test Is(50) (MPa)	
C Core drilling	W Water sample	pp Pocket penetrometer (kPa)	
D Disturbed sample	W Water seep	S Standard penetration test	
E Environmental sample	W Water level	V Shear vane (kPa)	



Douglas Partners
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BOREHOLE LOG

CLIENT: Mirvac Homes NSW Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: 146 Newbridge Road, Moorebank

SURFACE LEVEL: 7.45 AHD*
EASTING: 311846
NORTHING: 6243323
DIP/AZIMUTH: 90°/-

BORE No: TP102
PROJECT No: 71459.10
DATE: 16/3/2018
SHEET 1 OF 1

[illegible]

RIG: 35T Excavator - 500mm wide bucket **DRILLER:**

LOGGED: NW

CASING:

TYPE OF BORING:

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: BD2/20180316 taken from 0.2-0.3m*. Interpolated by JMD from their site survey completed 2 November 2017

SAMPLING & IN SITU TESTING LEGEND					
A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test (s/50) (MPa)
BLK	Block sample	U	Tube sample (x mm dia.)	PL(D)	Point load diametral test (s/50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	W	Water seep	S	Standard penetration test
E	Environmental sample	W	Water level	V	Shear vane (kPa)

BOREHOLE LOG

CLIENT: Mirvac Homes NSW Pty Ltd
PROJECT: Proposed Residential Development
LOCATION: 146 Newbridge Road, Moorebank

SURFACE LEVEL: 7.45 AHD*
EASTING: 311881
NORTHING: 6243188
DIP/AZIMUTH: 90°/-

BORE No: TP101
PROJECT No: 71459.10
DATE: 16/3/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing			Water	Well Construction Details	
				Type	Depth	Sample			
	0.6	FILLING - dark brown silty sand filling with some fine to medium igneous gravel, glass fragments, wood fragments and a trace of shell fragments. asbestos observed		D	0.2		PID = 7		
				D	0.3		PID = 8		
				D	0.4				
				D	0.5				
	1	FILLING - brown, red clay filling with some brick fragments, fine to coarse igenous gravel, with a trace of wood and tile fragments		D	0.9		PID = 7		1
				D	1.0				
	2			D	1.9		PID = 8		2
				D	2.0				
	3	- fragment of fibre cement observed at 2.8m	D	2.9		PID = 6		3	
	3.0	Bore discontinued at 3.0m Target depth reached	D	3.0					
	4							4	
	5							5	
	6							6	
	7							7	
	8							8	
	9							9	

RIG: 35T Excavator - 500mm wide bucket **DRILLER:**

LOGGED: NW

CASING:

TYPE OF BORING:

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: BD1/20180316 taken from 0.2-0.3m*. Interpolated by JMD from their site survey completed 2 November 2017

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	W	Water seep
E	Environmental sample	W	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test (s/50) (MPa)
		PL(D)	Point load diametral test (s/50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)

Appendix F

Landfill Gas Field Results



Landfill Gas Monitoring

Client: Benedict

Date: 20/3/18

Project: Landfill Gas Monitoring

Project Number: 71459.10

Location: 146 Newbridge Road, Moorebank

Well ID: MW101

Time: 12.10

Pressure Mb: 102.1

1018 mb

Time (sec)	Concentration (% v/v)			CO (ppm)	H ₂ S (ppm)	Flow (l/h)
	CH ₄	CO ₂	O ₂			
0	0.0	1.7	12.8	0	0	0.0
30	0.0	9.3	3.4	0	0	0.0
60	0.1	9.4	3.1	0	0	-0.1
90	0.1	9.5	2.9	0	0	-0.1
120	0.1	9.7	2.5	0	0	0.0
150	0.1	10.1	1.9	0	0	0.0
180	0.1	10.5	1.4	0	0	0.0
210	0.1	10.8	0.9	0	0	0.0
240	0.0	11.0	0.6	0	0	0.0
270	0.0	11.1	0.3	0	0	0.0
300	0.0	11.1	0.1	0	0	0.0

Well ID: MW102

Time: 12.25

Pressure Mb: 102.1

Time (sec)	Concentration (% v/v)			CO (ppm)	H ₂ S (ppm)	Flow (l/h)
	CH ₄	CO ₂	O ₂			
0	0.0	2.5	18.8	0	0	0.0
30	0.0	4.2	15.0	0	0	0.0
60	0.0	4.1	15.0	0	0	0.0
90	0.0	4.1	14.9	0	0	0.0
120	0.0	4.1	14.9	0	0	0.0
150	0.1	4.1	14.9	0	0	0.0
180	0.5	4.1	14.8	0	0	0.0
210	0.8	4.0	14.9	0	0	0.0
240	1.2	3.9	15.1	0	0	0.0
270	1.5	3.7	15.2	0	0	0.0
300	1.8	3.5	15.5	0	0	0.0
360	2.1	3.3	15.7	0	0	0.0
390	2.0	3.1	15.9	0	0	0.0



Landfill Gas Monitoring

Client: Benedict

Date: 20/3/18

Project: Landfill Gas Monitoring

Project Number: 71459.10

Location: 146 Newbridge Road, Moorebank

Well ID: MW103

Time: 12:30

Pressure Mb: 1021

1018mb

Time (sec)	Concentration (% v/v)			CO (ppm)	H ₂ S (ppm)	Flow (l/h)
	CH ₄	CO ₂	O ₂			
0	0.0	3.2	15.1	0	0	0.0
30	0.0	4.7	11.9	0	0	0.0
60	0.0	4.8	11.9	1	0	0.0
90	0.1	4.7	12.0	1	0	0.0
120	0.1	4.7	12.0	1	0	0.0
150	0.1	4.7	12.1	0	0	0.0
180	0.1	4.6	12.2	0	0	0.0
210	0.1	4.5	12.3	1	0	0.0
240	0.1	4.5	12.4	0	0	0.0
270	0.1	4.4	12.5	0	0	0.0
300	0.1	4.4	12.5	0	0	0.0

Well ID:

Time:

Pressure Mb:

Time (sec)	Concentration (% v/v)			CO (ppm)	H ₂ S (ppm)	Flow (l/h)
	CH ₄	CO ₂	O ₂			
0						
30						
60						
90						
120						
150						
180						
210						
240						
270						
300						



Landfill Gas Monitoring

Client: Benedict

Date: 9/4/18

Project: Landfill Gas Monitoring

Project Number: 71459-10

Location: 146 Newbridge Road, Moorebank

Well ID: MW101

Time: 8:30am

Pressure Mb: 1017mb

9am 1017mb

Time (sec)	Concentration (% v/v)			CO (ppm)	H ₂ S (ppm)	Flow (l/h)
	CH ₄	CO ₂	O ₂			
0	0.0	10.2	14.1	2	0	-0.1
30	0.0	10.5	3.4	2	0	-0.1
60	0.0	10.5	3.2	2	0	-0.1
90	0.0	10.5	3.1	3	0	-0.1
120	0.0	10.5	3.1	3	0	-0.1
150	0.0	10.5	3.0	3	0	-0.1
180	0.0	10.6	2.8	4	0	-0.1
210	0.0	10.6	2.7	4	0	-0.2
240	0.0	10.7	2.5	4	0	-0.2
270	0.0	10.8	2.4	4	0	-0.2
300	0.0	10.9	2.2	5	0	-0.2

Well ID: MW102

Time: 8:40am

Pressure Mb: 1017mb

9:05am 1017mb

Time (sec)	Concentration (% v/v)			CO (ppm)	H ₂ S (ppm)	Flow (l/h)
	CH ₄	CO ₂	O ₂			
0	0.0	0.1	19.6	3	0	0.0
30	0.0	4.5	15.4	1	0	-0.0
60	0.0	4.6	15.3	1	0	0.0
90	0.0	4.6	15.3	1	0	-0.1
120	0.0	4.6	15.3	1	0	-0.1
150	0.0	4.6	15.3	0	0	-0.1
180	0.0	4.6	15.3	0	0	-0.1
210	0.0	4.4	15.4	0	0	-0.1
240	0.0	4.3	15.5	0	0	-0.2
270	0.0	4.2	15.6	0	0	-0.2
300	0.0	4.0	15.8	0	0	-0.2



Landfill Gas Monitoring

Client: Benedict

Date: 9/4/18

Project: Landfill Gas Monitoring

Project Number: 71459.10

Location: 146 Newbridge Road, Moorebank

Well ID: MN103

Time: 8.50am

Pressure Mb: 1017mb

9:15am 1017mb

Time (sec)	Concentration (% v/v)			CO (ppm)	H ₂ S (ppm)	Flow (l/h)
	CH ₄	CO ₂	O ₂			
0	0.0	0.2	19.9	2	0	0.1
30	0.0	4.5	13.7	0	0	-0.1
60	0.0	4.5	13.7	0	0	-0.0
90	0.0	4.5	13.6	0	0	-0.0
120	0.0	4.5	13.6	0	0	-0.0
150	0.0	4.5	13.6	0	0	0.0
180	0.0	4.5	13.5	0	0	0.0
210	0.0	4.5	13.5	1	0	-0.0
240	0.0	4.5	13.5	1	0	0.0
270	0.0	4.5	13.5	1	0	-0.0
300	0.0	4.5	13.5	1	0	-0.0

Well ID:

Time:

Pressure Mb:

Time (sec)	Concentration (% v/v)			CO (ppm)	H ₂ S (ppm)	Flow (l/h)
	CH ₄	CO ₂	O ₂			
0						
30						
60						
90						
120						
150						
180						
210						
240						
270						
300						

SERVICE OR REPAIR: GA5000

COMPANY	Douglas Partners Pty Ltd				
CONTACT	David Holden				
SERIAL NO.	G500665	CALL NO.	158541	RECEIVED	07/02/2018


REQUEST/PROBLEM DESCRIPTION
Service & Calibration

This equipment has been calibrated to the manufacturer's specifications, using the standards shown below:

SENSOR	STANDARD	TRACEABILITY LOT NO.	PRE CALIBRATION READING	POST CALIBRATION READING
CH ₄	0 %	785304 Cyl: 53	-	0 %
	60 %	591518 Cyl: 18	-	60.0 %
CO ₂	40 %	591518 Cyl: 18	-	40.0 %
O ₂	0 %	785304 Cyl: 53	-	0 %
	20.9 %	Fresh air	-	20.9 %
CO	0 ppm	785304 Cyl: 53	-	0 ppm
	100 ppm	633347 Cyl: 3	-	100 ppm
H ₂ S	0 ppm	785304 Cyl: 53	-	0 ppm
	25 ppm	867669 Cyl: 49	-	25 ppm

- ✓ Instrument examined, firmware: the latest version
- ✓ Filters replaced
- ✓ Checked the pump
- ✓ Checked battery condition
- ✓ Calibrated and tested OK

COMMENTS/ADDITIONAL REPAIRS/SERVICES PERFORMED
Note: Next Factory service is due on 13/08/2018.

SERVICED BY	Milenko	COMPLETED	13/02/2017
SIGNATURE			

"We do more than give you great equipment... We give you great solutions!"

Phone: (Free Call) 1300 735 295		Environmental Assessment Technologies	Fax: (Free Call) 1800 675 123	
Melbourne Branch 5 Corbison Drive, Scoresby 3179 Email: RentalsEnviroVIC@thermofisher.com	Sydney Branch Level 1, 4 Taavata Road, North Ryde 2113 Email: RentalsEnviroNSW@thermofisher.com	Adelaide Branch 27 Beulah Road, Norwood, South Australia 5067 Email: RentalsEnviroSA@thermofisher.com	Brisbane Branch Unit 2/5 Ross St, Newstead 4006 Email: RentalsEnviroQLD@thermofisher.com	Perth Branch 121 Derinpara Ave, Melaka WA 0060 Email: RentalsEnviroWA@thermofisher.com

Appendix G

QAQC



DATA QUALITY ASSESSMENT

Q1. FIELD AND LABORATORY QUALITY CONTROL

The field and laboratory quality control (QC) procedures and results are summarised in Tables Q1 and Q2. Reference should be made to the fieldwork and analysis procedures in the report and the laboratory results certificates in Appendix C for further details.

Table Q1: Field QC

Item	Frequency	Acceptance Criteria	Achievement
Intra-laboratory replicates	5% primary samples	RPD <30% inorganics), <50% (organics)	yes ¹
Inter-laboratory replicates	5% primary samples	RPD <30% inorganics), <50% (organics)	No
Trip Spikes	1 per field batch	60-140% recovery	yes
Trip Blanks	1 per field batch	<PQL/LOR	yes
Rinsates	1 per day	<PQL/LOR	No

NOTES: 1 qualitative assessment of RPD results overall; refer Section Q2.1

Given the small number of samples (i.e. four primary samples recorded) inter-laboratory analysis was not considered warranted. Moreover, as samples were collected either directly from the test pit walls or from the middle of the soil in the excavator bucket, a rinsate sample was also not considered warranted.

Table Q2: Laboratory QC

Item	Frequency	Acceptance Criteria	Achievement
Analytical laboratories used		NATA accreditation	yes
Holding times		In accordance with NEPC (2013) which references various Australian and international standards	yes
Laboratory / Reagent Blanks	1 per lab batch	<PQL	yes
Laboratory duplicates	10% primary samples	Laboratory specific ¹	
Matrix Spikes	1 per lab batch	70-130% recovery (inorganics); 60-140% (organics); 10-140% (SVOC, speciated phenols)	yes
Surrogate Spikes	organics by GC	70-130% recovery (inorganics); 60-140% (organics); 10-140% (SVOC, speciated phenols)	yes
Control Samples	1 per lab batch	70-130% recovery (inorganics); 60-140% (organics); 10-140% (SVOC, speciated phenols)	yes

NOTES: 1 ELS: <5xPQL – any RPD; >5xPQL – 0-50%RPD



In summary, the QC data is considered to be of sufficient quality to be acceptable for the assessment.

Intra-Laboratory Replicates

An intra-laboratory replicate was analysed as an internal check of the reproducibility within the primary laboratory ELS and as a measure of consistency of sampling techniques. The comparative results of analysis between original and intra-laboratory replicate samples are summarised in Table Q3.

Note that, where both samples are below laboratory reporting limit (LRL) the difference and RPD has been given as zero. Where one sample is reported below LRL, but a concentration is reported for the other, the LRL value has been used for calculation of the RPD for the less than LRL sample.

Table Q3: Relative Percentage Difference Results – Intra-laboratory Replicates

Lab	Sample ID	Date Sampled	Media	Units	Metals								PAH				TRH				BTEX			
					As	Cd	Cr	Cu	Pb	Hg	Ni	Zn	total	BaP TEQ	BaP	Naphthalene	C6-C10	>C10-C16	>C16-C34	>C34-C40	Benzene	Toluene	Ethylbenzene	xylene
ELS	TP101/0.2-0.3	16/03/2018	filling	mg/kg	6	<0.4	15	41	100	0.1	10	240	2.7	0.5	0.3	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<1
ELS	BD1/20180316	16/03/2018	filling	mg/kg	6	0.4	16	43	110	0.1	10	220	5.4	0.8	0.5	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<1
Difference					0	0	1	2	10	0	0	20	2.7	0.3	0.2	0	0	0	0	0	0	0	0	0
RPD					0	0	6	5	10	0	0	9	66	47	50	0	0	0	0	0	0	0	0	0

Notes: - not applicable, not tested



The calculated RPD values were within the acceptable range of ± 30 for inorganic analytes and $\pm 50\%$ for organics with the exception of those highlighted yellow and bold. However, this is not considered to be significant because:

- The typically low actual differences in the concentrations of the replicate pairs where some RPD exceedances occurred. High RPD values reflect the small differences between two small numbers;
- The replicate pairs being collected from fill soils which were heterogeneous in nature;
- Soil replicates, rather than homogenised soil duplicates, were used to minimise the risk of possible volatile loss, hence greater variability can be expected;
- Most of the recorded concentrations were less than five times the LRL and hence RPD were not considered relevant;
- The majority of RPDs within a replicate pair being within the acceptable limits; and
- All other QA/QC parameters met the DQIs.

Overall, the intra-laboratory replicate comparisons indicate that the sampling techniques were generally consistent and repeatable.

Q2. Data Quality Indicators

The reliability of field procedures and analytical results was assessed against the following data quality indicators (DQIs):

- Completeness – a measure of the amount of usable data from a data collection activity;
- Comparability – the confidence (qualitative) that data may be considered to be equivalent for each sampling and analytical event;
- Representativeness – the confidence (qualitative) of data representativeness of media present on-site;
- Precision – a measure of variability or reproducibility of data; and
- Accuracy – a measure of closeness of the data to the 'true' value.

The DQIs were assessed as outlined in the following Table Q4.

Table Q4: Data Quality Indicators

Data Quality Indicator	Method(s) of Achievement
Completeness	Planned selected target locations sampled (within the site and investigation limitations); Preparation of field logs, sample location plan and chain of custody (COC) records; Laboratory sample receipt information received confirming receipt of samples intact and appropriateness of the chain of custody;

	<p>Samples analysed for contaminants of potential concern (COPC) identified in the Conceptual Site Model (CSM);</p> <p>Completion of COC documentation;</p> <p>NATA endorsed laboratory certificates provided by the laboratory;</p> <p>Satisfactory frequency and results for field and laboratory QC samples as discussed in Section Q1.</p>
Comparability	<p>Using appropriate techniques for sample recovery, storage and transportation, which were the same for the duration of the project;</p> <p>Works undertaken by appropriately experienced and trained DP environmental scientist;</p> <p>Use of NATA registered laboratories, with test methods the same or similar between laboratories;</p> <p>Satisfactory results for field and laboratory QC samples.</p>
Representativeness	<p>Target media sampled;</p> <p>Spatial and temporal distribution of sample locations;</p> <p>Sample numbers recovered and analysed are considered to be representative of the target media and complying with DQOs;</p> <p>Samples were extracted and analysed within holding times;</p> <p>Samples were analysed in accordance with the analysis request.</p>
Precision	<p>Acceptable RPD between original samples and replicates;</p> <p>Satisfactory results for all other field and laboratory QC samples.</p>
Accuracy	<p>Satisfactory results for all field and laboratory QC samples.</p>

Based on the above, it is considered that the DQIs have been complied with. As such, it is concluded that the field and laboratory test data obtained are reliable and useable for this assessment.

Appendix H

Laboratory Certificate of Analysis and Chain of Custody



Envirolab Services Pty Ltd

ABN 37 112 535 645

12 Ashley St Chatswood NSW 2067

ph 02 9910 6200 fax 02 9910 6201

customerservice@envirolab.com.au

www.envirolab.com.au

SAMPLE RECEIPT ADVICE

Client Details

Client	Douglas Partners Pty Ltd
Attention	John Russell, Nicola Warton

Sample Login Details

Your reference	71459.10, Moorebank
Envirolab Reference	187468
Date Sample Received	16/03/2018
Date Instructions Received	16/03/2018
Date Results Expected to be Reported	23/03/2018

Sample Condition

Samples received in appropriate condition for analysis	YES
No. of Samples Provided	10 Soil, 2 Material
Turnaround Time Requested	Standard
Temperature on Receipt (°C)	15.2
Cooling Method	Ice Pack
Sampling Date Provided	YES

Comments

Nil

Please direct any queries to:

Aileen Hie	Jacinta Hurst
Phone: 02 9910 6200	Phone: 02 9910 6200
Fax: 02 9910 6201	Fax: 02 9910 6201
Email: ahie@envirolab.com.au	Email: jhurst@envirolab.com.au

Analysis Underway, details on the following page:

**Envirolab Services Pty Ltd**

ABN 37 112 535 645

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Sample ID	vTRH(C6-C10)/BTEN in Soil	svTRH (C10-C40) in Soil	PAHs in Soil	Organochlorine Pesticides in soil	Organophosphorus Pesticides	PCBs in Soil	Acid Extractable metals in soil	Total Phenolics (as Phenol)	Asbestos ID - soils	Asbestos ID - materials	Asbestos ID - soils NEPM
TP101-0.2-0.3	✓	✓	✓	✓	✓	✓	✓	✓	✓		
TP101-1.9-2.0	✓	✓	✓				✓				
TP102-0.2-0.3	✓	✓	✓	✓	✓	✓	✓	✓	✓		
TP102-0.9-1.0	✓	✓	✓				✓				
BD1/20180316	✓	✓	✓				✓				
TP101-2.8-2.9											✓
TP102-0.2-0.3											✓
TP102-0.4-0.5											✓
TP101 A1										✓	
TP102 A1										✓	
Trip Spike	✓										
Trip Blank	✓										

The '✓' indicates the testing you have requested. **THIS IS NOT A REPORT OF THE RESULTS.**

Additional Info

Sample storage - Waters are routinely disposed of approximately 1 month and soils approximately 2 months from receipt.

Requests for longer term sample storage must be received in writing.

**Envirolab Services Pty Ltd**

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CERTIFICATE OF ANALYSIS 187468**Client Details**

Client	Douglas Partners Pty Ltd
Attention	John Russell, Nicola Warton
Address	96 Hermitage Rd, West Ryde, NSW, 2114

Sample Details

Your Reference	71459.10, Moorebank
Number of Samples	10 Soil, 2 Material
Date samples received	16/03/2018
Date completed instructions received	16/03/2018

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Please refer to the last page of this report for any comments relating to the results.

Report Details

Date results requested by	23/03/2018
Date of Issue	23/03/2018
NATA Accreditation Number 2901. This document shall not be reproduced except in full.	
Accredited for compliance with ISO/IEC 17025 - Testing. Tests not covered by NATA are denoted with *	

Asbestos Approved By

Analysed by Asbestos Approved Identifier: Jessica Hie, Lucy Zhu

Authorised by Asbestos Approved Signatory: Lucy Zhu

Results Approved By

Dragana Tomas, Senior Chemist

Jeremy Faircloth, Organics Supervisor

Long Pham, Team Leader, Metals

Lucy Zhu, Asbestos Analyst

Nick Sarlamis, Inorganics Supervisor

Authorised By

David Springer, General Manager

Client Reference: 71459.10, Moorebank

VTRH(C6-C10)/BTEXN in Soil						
Our Reference		187468-1	187468-2	187468-3	187468-4	187468-5
Your Reference	UNITS	TP101	TP101	TP102	TP102	BD1/20180316
Depth		0.2-0.3	1.9-2.0	0.2-0.3	0.9-1.0	-
Date Sampled		16/03/2018	16/03/2018	16/03/2018	16/03/2018	16/03/2018
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	19/03/2018	19/03/2018	19/03/2018	19/03/2018	19/03/2018
Date analysed	-	19/03/2018	19/03/2018	19/03/2018	19/03/2018	19/03/2018
TRH C ₆ - C ₉	mg/kg	<25	<25	<25	<25	<25
TRH C ₆ - C ₁₀	mg/kg	<25	<25	<25	<25	<25
vTPH C ₆ - C ₁₀ less BTEX (F1)	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1	<1
naphthalene	mg/kg	<1	<1	<1	<1	<1
Total +ve Xylenes	mg/kg	<1	<1	<1	<1	<1
Surrogate aaa-Trifluorotoluene	%	113	112	110	114	111

VTRH(C6-C10)/BTEXN in Soil			
Our Reference		187468-11	187468-12
Your Reference	UNITS	Trip Spike	Trip Blank
Depth		-	-
Date Sampled		16/03/2018	16/03/2018
Type of sample		Soil	Soil
Date extracted	-	19/03/2018	19/03/2018
Date analysed	-	19/03/2018	19/03/2018
Benzene	mg/kg	103%	<0.2
Toluene	mg/kg	100%	<0.5
Ethylbenzene	mg/kg	104%	<1
m+p-xylene	mg/kg	104%	<2
o-Xylene	mg/kg	103%	<1
Surrogate aaa-Trifluorotoluene	%	97	120

Client Reference: 71459.10, Moorebank

svTRH (C10-C40) in Soil						
Our Reference		187468-1	187468-2	187468-3	187468-4	187468-5
Your Reference	UNITS	TP101	TP101	TP102	TP102	BD1/20180316
Depth		0.2-0.3	1.9-2.0	0.2-0.3	0.9-1.0	-
Date Sampled		16/03/2018	16/03/2018	16/03/2018	16/03/2018	16/03/2018
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	19/03/2018	19/03/2018	19/03/2018	19/03/2018	19/03/2018
Date analysed	-	19/03/2018	19/03/2018	19/03/2018	19/03/2018	19/03/2018
TRH C ₁₀ - C ₁₄	mg/kg	<50	<50	<50	<50	<50
TRH C ₁₅ - C ₂₈	mg/kg	<100	<100	<100	<100	<100
TRH C ₂₉ - C ₃₆	mg/kg	<100	<100	<100	<100	<100
TRH >C ₁₀ -C ₁₆	mg/kg	<50	<50	<50	<50	<50
TRH >C ₁₀ - C ₁₆ less Naphthalene (F2)	mg/kg	<50	<50	<50	<50	<50
TRH >C ₁₆ -C ₃₄	mg/kg	<100	<100	<100	<100	<100
TRH >C ₃₄ -C ₄₀	mg/kg	<100	<100	<100	<100	<100
Total +ve TRH (>C ₁₀ -C ₄₀)	mg/kg	<50	<50	<50	<50	<50
Surrogate o-Terphenyl	%	84	84	83	83	84

Client Reference: 71459.10, Moorebank

PAHs in Soil						
Our Reference		187468-1	187468-2	187468-3	187468-4	187468-5
Your Reference	UNITS	TP101	TP101	TP102	TP102	BD1/20180316
Depth		0.2-0.3	1.9-2.0	0.2-0.3	0.9-1.0	-
Date Sampled		16/03/2018	16/03/2018	16/03/2018	16/03/2018	16/03/2018
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	19/03/2018	19/03/2018	19/03/2018	19/03/2018	19/03/2018
Date analysed	-	19/03/2018	19/03/2018	19/03/2018	19/03/2018	19/03/2018
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	<0.1	0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	0.1	<0.1	0.1	0.1	0.4
Anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	0.2
Fluoranthene	mg/kg	0.4	0.2	0.3	0.3	0.9
Pyrene	mg/kg	0.5	0.2	0.3	0.3	0.9
Benzo(a)anthracene	mg/kg	0.3	0.1	0.1	0.2	0.5
Chrysene	mg/kg	0.2	<0.1	0.1	0.1	0.4
Benzo(b,j+k)fluoranthene	mg/kg	0.5	<0.2	0.3	0.3	0.8
Benzo(a)pyrene	mg/kg	0.3	0.1	0.2	0.2	0.53
Indeno(1,2,3-c,d)pyrene	mg/kg	0.2	<0.1	<0.1	<0.1	0.2
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	0.2	<0.1	0.1	0.1	0.3
Total +ve PAH's	mg/kg	2.7	0.58	1.5	1.5	5.4
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5	<0.5	<0.5	<0.5	0.7
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5	<0.5	<0.5	<0.5	0.8
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	0.5	<0.5	<0.5	<0.5	0.8
Surrogate p-Terphenyl-d14	%	105	111	99	101	102

Client Reference: 71459.10, Moorebank

Organochlorine Pesticides in soil			
Our Reference		187468-1	187468-3
Your Reference	UNITS	TP101	TP102
Depth		0.2-0.3	0.2-0.3
Date Sampled		16/03/2018	16/03/2018
Type of sample		Soil	Soil
Date extracted	-	19/03/2018	19/03/2018
Date analysed	-	21/03/2018	21/03/2018
HCB	mg/kg	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1
Total +ve DDT+DDD+DDE	mg/kg	<0.1	<0.1
Surrogate TCMX	%	114	88

Client Reference: 71459.10, Moorebank

Organophosphorus Pesticides			
Our Reference		187468-1	187468-3
Your Reference	UNITS	TP101	TP102
Depth		0.2-0.3	0.2-0.3
Date Sampled		16/03/2018	16/03/2018
Type of sample		Soil	Soil
Date extracted	-	19/03/2018	19/03/2018
Date analysed	-	21/03/2018	21/03/2018
Azinphos-methyl (Guthion)	mg/kg	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1
Chlorpyrifos	mg/kg	<0.1	<0.1
Chlorpyrifos-methyl	mg/kg	<0.1	<0.1
Diazinon	mg/kg	<0.1	<0.1
Dichlorvos	mg/kg	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1
Malathion	mg/kg	<0.1	<0.1
Parathion	mg/kg	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1
Surrogate TCMX	%	114	88

Client Reference: 71459.10, Moorebank

PCBs in Soil			
Our Reference		187468-1	187468-3
Your Reference	UNITS	TP101	TP102
Depth		0.2-0.3	0.2-0.3
Date Sampled		16/03/2018	16/03/2018
Type of sample		Soil	Soil
Date extracted	-	19/03/2018	19/03/2018
Date analysed	-	21/03/2018	21/03/2018
Aroclor 1016	mg/kg	<0.1	<0.1
Aroclor 1221	mg/kg	<0.1	<0.1
Aroclor 1232	mg/kg	<0.1	<0.1
Aroclor 1242	mg/kg	<0.1	<0.1
Aroclor 1248	mg/kg	<0.1	<0.1
Aroclor 1254	mg/kg	<0.1	<0.1
Aroclor 1260	mg/kg	<0.1	<0.1
Total +ve PCBs (1016-1260)	mg/kg	<0.1	<0.1
Surrogate TCLMX	%	114	88

Client Reference: 71459.10, Moorebank

Acid Extractable metals in soil						
Our Reference		187468-1	187468-2	187468-3	187468-4	187468-5
Your Reference	UNITS	TP101	TP101	TP102	TP102	BD1/20180316
Depth		0.2-0.3	1.9-2.0	0.2-0.3	0.9-1.0	-
Date Sampled		16/03/2018	16/03/2018	16/03/2018	16/03/2018	16/03/2018
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	19/03/2018	19/03/2018	19/03/2018	19/03/2018	19/03/2018
Date analysed	-	22/03/2018	22/03/2018	22/03/2018	22/03/2018	22/03/2018
Arsenic	mg/kg	6	4	5	5	6
Cadmium	mg/kg	<0.4	<0.4	<0.4	<0.4	0.4
Chromium	mg/kg	15	16	9	9	16
Copper	mg/kg	41	14	15	15	43
Lead	mg/kg	100	42	24	28	110
Mercury	mg/kg	0.1	<0.1	<0.1	<0.1	0.1
Nickel	mg/kg	10	6	10	6	10
Zinc	mg/kg	240	47	41	54	220

Client Reference: 71459.10, Moorebank

Misc Soil - Inorg			
Our Reference		187468-1	187468-3
Your Reference	UNITS	TP101	TP102
Depth		0.2-0.3	0.2-0.3
Date Sampled		16/03/2018	16/03/2018
Type of sample		Soil	Soil
Date prepared	-	20/03/2018	20/03/2018
Date analysed	-	20/03/2018	20/03/2018
Total Phenolics (as Phenol)	mg/kg	<5	<5

Client Reference: 71459.10, Moorebank

Moisture						
Our Reference		187468-1	187468-2	187468-3	187468-4	187468-5
Your Reference	UNITS	TP101	TP101	TP102	TP102	BD1/20180316
Depth		0.2-0.3	1.9-2.0	0.2-0.3	0.9-1.0	-
Date Sampled		16/03/2018	16/03/2018	16/03/2018	16/03/2018	16/03/2018
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	19/03/2018	19/03/2018	19/03/2018	19/03/2018	19/03/2018
Date analysed	-	20/03/2018	20/03/2018	20/03/2018	20/03/2018	20/03/2018
Moisture	%	9.1	11	12	11	9.0

Client Reference: 71459.10, Moorebank

Asbestos ID - soils			
Our Reference		187468-1	187468-3
Your Reference	UNITS	TP101	TP102
Depth		0.2-0.3	0.2-0.3
Date Sampled		16/03/2018	16/03/2018
Type of sample		Soil	Soil
Date analysed	-	22/03/2018	22/03/2018
Sample mass tested	g	Approx. 15g	Approx. 10g
Sample Description	-	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks
Asbestos ID in soil	-	No asbestos detected at reporting limit of 0.1g/kg	No asbestos detected at reporting limit of 0.1g/kg
		Organic fibres detected	Organic fibres detected
Trace Analysis	-	No asbestos detected	No asbestos detected

Client Reference: 71459.10, Moorebank

Asbestos ID - materials			
Our Reference		187468-9	187468-10
Your Reference	UNITS	TP101 A1	TP102 A1
Depth		-	-
Date Sampled		16/03/2018	16/03/2018
Type of sample		Material	Material
Date analysed	-	21/03/2018	21/03/2018
Mass / Dimension of Sample	-	50x45x5mm	28x25x5mm
Sample Description	-	Beige compressed fibre cement material	Beige compressed fibre cement material
Asbestos ID in materials	-	Chrysotile asbestos detected	Chrysotile asbestos detected Amosite asbestos detected

Client Reference: 71459.10, Moorebank

Asbestos ID - soils NEPM				
Our Reference		187468-6	187468-7	187468-8
Your Reference	UNITS	TP101	TP102	TP102
Depth		2.8-2.9	0.2-0.3	0.4-0.5
Date Sampled		16/03/2018	16/03/2018	16/03/2018
Type of sample		Soil	Soil	Soil
Date analysed	-	20/03/2018	20/03/2018	20/03/2018
Sample mass tested	g	997.6	1,141.8	1,242.1
Sample Description	-	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks
Asbestos ID in soil (AS4964) >0.1g/kg	-	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected
Trace Analysis	-	No asbestos detected	No asbestos detected	No asbestos detected
Total Asbestos ^{#1}	g/kg	<0.1	<0.1	<0.1
Asbestos ID in soil <0.1g/kg*	-	No visible asbestos detected	No visible asbestos detected	No visible asbestos detected
ACM >7mm Estimation*	g	—	—	—
FA and AF Estimation*	g	—	—	—
FA and AF Estimation*#2	%(w/w)	<0.001	<0.001	<0.001

Client Reference: 71459.10, Moorebank

Method ID	Methodology Summary
ASB-001	Asbestos ID - Qualitative identification of asbestos in bulk samples using Polarised Light Microscopy and Dispersion Staining Techniques including Synthetic Mineral Fibre and Organic Fibre as per Australian Standard 4964-2004.
ASB-001	<p>Asbestos ID - Identification of asbestos in soil samples using Polarised Light Microscopy and Dispersion Staining Techniques. Minimum 500mL soil sample was analysed as recommended by "National Environment Protection (Assessment of site contamination) Measure, Schedule B1 and "The Guidelines from the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia - May 2009" with a reporting limit of 0.1g/kg (0.01% w/w) as per Australian Standard AS4964-2004.</p> <p>Results reported denoted with * are outside our scope of NATA accreditation.</p> <p>NOTE #1 Total Asbestos g/kg was analysed and reported as per Australian Standard AS4964 (This is the sum of ACM >7mm, <7mm and FA/AF)</p> <p>NOTE #2 The screening level of 0.001% w/w asbestos in soil for FA and AF only applies where the FA and AF are able to be quantified by gravimetric procedures. This screening level is not applicable to free fibres.</p> <p>Estimation = Estimated asbestos weight</p> <p>Results reported with "-" is equivalent to no visible asbestos identified using Polarised Light microscopy and Dispersion Staining Techniques.</p>
Inorg-008	Moisture content determined by heating at 105+/-5 °C for a minimum of 12 hours.
Inorg-031	Total Phenolics by segmented flow analyser (in line distillation with colourimetric finish). Solids are extracted in a caustic media prior to analysis.
Metals-020	Determination of various metals by ICP-AES.
Metals-021	Determination of Mercury by Cold Vapour AAS.
Org-003	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis.

Client Reference: 71459.10, Moorebank

Method ID	Methodology Summary
Org-003	<p>Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID.</p> <p>F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis.</p> <p>Note, the Total +ve TRH PQL is reflective of the lowest individual PQL and is therefore "Total +ve TRH" is simply a sum of the positive individual TRH fractions (>C10-C40).</p>
Org-005	<p>Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.</p>
Org-005	<p>Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.</p> <p>Note, the Total +ve reported DDD+DDE+DDT PQL is reflective of the lowest individual PQL and is therefore simply a sum of the positive individually report DDD+DDE+DDT.</p>
Org-006	<p>Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD.</p>
Org-006	<p>Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD.</p> <p>Note, the Total +ve PCBs PQL is reflective of the lowest individual PQL and is therefore "Total +ve PCBs" is simply a sum of the positive individual PCBs.</p>
Org-008	<p>Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.</p>
Org-012	<p>Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013.</p> <p>For soil results:-</p> <ol style="list-style-type: none"> 1. 'EQ PQL' values are assuming all contributing PAHs reported as <PQL are actually at the PQL. This is the most conservative approach and can give false positive TEQs given that PAHs that contribute to the TEQ calculation may not be present. 2. 'EQ zero' values are assuming all contributing PAHs reported as <PQL are zero. This is the least conservative approach and is more susceptible to false negative TEQs when PAHs that contribute to the TEQ calculation are present but below PQL. 3. 'EQ half PQL' values are assuming all contributing PAHs reported as <PQL are half the stipulated PQL. Hence a mid-point between the most and least conservative approaches above. <p>Note, the Total +ve PAHs PQL is reflective of the lowest individual PQL and is therefore "Total +ve PAHs" is simply a sum of the positive individual PAHs.</p>
Org-014	<p>Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS.</p>
Org-016	<p>Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.</p>
Org-016	<p>Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.</p> <p>Note, the Total +ve Xylene PQL is reflective of the lowest individual PQL and is therefore "Total +ve Xylenes" is simply a sum of the positive individual Xylenes.</p>

Client Reference: 71459.10, Moorebank

QUALITY CONTROL: vTRH(C6-C10)/BTEXN in Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-3	[NT]
Date extracted	-			19/03/2018	[NT]	[NT]	[NT]	[NT]	19/03/2018	[NT]
Date analysed	-			19/03/2018	[NT]	[NT]	[NT]	[NT]	19/03/2018	[NT]
TRH C ₆ - C ₉	mg/kg	25	Org-016	<25	[NT]	[NT]	[NT]	[NT]	115	[NT]
TRH C ₆ - C ₁₀	mg/kg	25	Org-016	<25	[NT]	[NT]	[NT]	[NT]	115	[NT]
Benzene	mg/kg	0.2	Org-016	<0.2	[NT]	[NT]	[NT]	[NT]	93	[NT]
Toluene	mg/kg	0.5	Org-016	<0.5	[NT]	[NT]	[NT]	[NT]	109	[NT]
Ethylbenzene	mg/kg	1	Org-016	<1	[NT]	[NT]	[NT]	[NT]	122	[NT]
m+p-xylene	mg/kg	2	Org-016	<2	[NT]	[NT]	[NT]	[NT]	125	[NT]
o-Xylene	mg/kg	1	Org-016	<1	[NT]	[NT]	[NT]	[NT]	124	[NT]
naphthalene	mg/kg	1	Org-014	<1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Surrogate aaa-Trifluorotoluene	%		Org-016	114	[NT]	[NT]	[NT]	[NT]	121	[NT]

Client Reference: 71459.10, Moorebank

QUALITY CONTROL: svTRH (C10-C40) in Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-3	[NT]
Date extracted	-			19/03/2018	[NT]	[NT]	[NT]	[NT]	19/03/2018	[NT]
Date analysed	-			19/03/2018	[NT]	[NT]	[NT]	[NT]	19/03/2018	[NT]
TRH C ₁₀ - C ₁₄	mg/kg	50	Org-003	<50	[NT]	[NT]	[NT]	[NT]	109	[NT]
TRH C ₁₅ - C ₂₈	mg/kg	100	Org-003	<100	[NT]	[NT]	[NT]	[NT]	95	[NT]
TRH C ₂₉ - C ₃₆	mg/kg	100	Org-003	<100	[NT]	[NT]	[NT]	[NT]	92	[NT]
TRH >C ₁₀ - C ₁₆	mg/kg	50	Org-003	<50	[NT]	[NT]	[NT]	[NT]	109	[NT]
TRH >C ₁₆ - C ₃₄	mg/kg	100	Org-003	<100	[NT]	[NT]	[NT]	[NT]	95	[NT]
TRH >C ₃₄ - C ₄₀	mg/kg	100	Org-003	<100	[NT]	[NT]	[NT]	[NT]	92	[NT]
Surrogate o-Terphenyl	%		Org-003	85	[NT]	[NT]	[NT]	[NT]	92	[NT]

Client Reference: 71459.10, Moorebank

QUALITY CONTROL: PAHs in Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-3	[NT]
Date extracted	-			19/03/2018	[NT]	[NT]	[NT]	[NT]	19/03/2018	[NT]
Date analysed	-			19/03/2018	[NT]	[NT]	[NT]	[NT]	19/03/2018	[NT]
Naphthalene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	95	[NT]
Acenaphthylene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Acenaphthene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Fluorene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	96	[NT]
Phenanthrene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	101	[NT]
Anthracene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Fluoranthene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	97	[NT]
Pyrene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	102	[NT]
Benzo(a)anthracene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Chrysene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	92	[NT]
Benzo(b,j+k)fluoranthene	mg/kg	0.2	Org-012	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Benzo(a)pyrene	mg/kg	0.05	Org-012	<0.05	[NT]	[NT]	[NT]	[NT]	106	[NT]
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Dibenzo(a,h)anthracene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Benzo(g,h,i)perylene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Surrogate p-Terphenyl-d14	%		Org-012	112	[NT]	[NT]	[NT]	[NT]	114	[NT]

Client Reference: 71459.10, Moorebank

QUALITY CONTROL: Organochlorine Pesticides in soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-7	[NT]
Date extracted	-			19/03/2018	[NT]	[NT]	[NT]	[NT]	19/03/2018	[NT]
Date analysed	-			21/03/2018	[NT]	[NT]	[NT]	[NT]	21/03/2018	[NT]
HCB	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
alpha-BHC	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	109	[NT]
gamma-BHC	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
beta-BHC	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	104	[NT]
Heptachlor	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	103	[NT]
delta-BHC	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Aldrin	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	102	[NT]
Heptachlor Epoxide	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	105	[NT]
gamma-Chlordane	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
alpha-chlordane	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Endosulfan I	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
pp-DDE	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	110	[NT]
Dieldrin	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	117	[NT]
Endrin	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	106	[NT]
pp-DDD	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	109	[NT]
Endosulfan II	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
pp-DDT	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Endrin Aldehyde	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Endosulfan Sulphate	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	117	[NT]
Methoxychlor	mg/kg	0.1	Org-005	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Surrogate TCMX	%		Org-005	105	[NT]	[NT]	[NT]	[NT]	111	[NT]

Client Reference: 71459.10, Moorebank

QUALITY CONTROL: Organophosphorus Pesticides					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-7	[NT]
Date extracted	-			19/03/2018	[NT]	[NT]	[NT]	[NT]	19/03/2018	[NT]
Date analysed	-			21/03/2018	[NT]	[NT]	[NT]	[NT]	21/03/2018	[NT]
Azinphos-methyl (Guthion)	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Bromophos-ethyl	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Chlorpyrifos	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	[NT]	[NT]	86	[NT]
Chlorpyrifos-methyl	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Diazinon	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Dichlorvos	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	[NT]	[NT]	91	[NT]
Dimethoate	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Ethion	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	[NT]	[NT]	90	[NT]
Fenitrothion	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	[NT]	[NT]	96	[NT]
Malathion	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	[NT]	[NT]	94	[NT]
Parathion	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	[NT]	[NT]	108	[NT]
Ronnel	mg/kg	0.1	Org-008	<0.1	[NT]	[NT]	[NT]	[NT]	94	[NT]
Surrogate TCMX	%		Org-008	105	[NT]	[NT]	[NT]	[NT]	100	[NT]

Client Reference: 71459.10, Moorebank

QUALITY CONTROL: PCBs in Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-7	[NT]
Date extracted	-			19/03/2018	[NT]	[NT]	[NT]	[NT]	19/03/2018	[NT]
Date analysed	-			21/03/2018	[NT]	[NT]	[NT]	[NT]	21/03/2018	[NT]
Aroclor 1016	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Aroclor 1221	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Aroclor 1232	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Aroclor 1242	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Aroclor 1248	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Aroclor 1254	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NT]	[NT]	100	[NT]
Aroclor 1260	mg/kg	0.1	Org-006	<0.1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Surrogate TCLMX	%		Org-006	105	[NT]	[NT]	[NT]	[NT]	100	[NT]

Client Reference: 71459.10, Moorebank

QUALITY CONTROL: Acid Extractable metals in soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-3	[NT]
Date prepared	-			19/03/2018	[NT]	[NT]	[NT]	[NT]	19/03/2018	[NT]
Date analysed	-			22/03/2018	[NT]	[NT]	[NT]	[NT]	22/03/2018	[NT]
Arsenic	mg/kg	4	Metals-020	<4	[NT]	[NT]	[NT]	[NT]	113	[NT]
Cadmium	mg/kg	0.4	Metals-020	<0.4	[NT]	[NT]	[NT]	[NT]	104	[NT]
Chromium	mg/kg	1	Metals-020	<1	[NT]	[NT]	[NT]	[NT]	110	[NT]
Copper	mg/kg	1	Metals-020	<1	[NT]	[NT]	[NT]	[NT]	113	[NT]
Lead	mg/kg	1	Metals-020	<1	[NT]	[NT]	[NT]	[NT]	110	[NT]
Mercury	mg/kg	0.1	Metals-021	<0.1	[NT]	[NT]	[NT]	[NT]	97	[NT]
Nickel	mg/kg	1	Metals-020	<1	[NT]	[NT]	[NT]	[NT]	110	[NT]
Zinc	mg/kg	1	Metals-020	<1	[NT]	[NT]	[NT]	[NT]	111	[NT]

Client Reference: 71459.10, Moorebank

QUALITY CONTROL: Misc Soil - Inorg					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-3	[NT]
Date prepared	-			20/03/2018	[NT]	[NT]	[NT]	[NT]	20/03/2018	[NT]
Date analysed	-			20/03/2018	[NT]	[NT]	[NT]	[NT]	20/03/2018	[NT]
Total Phenolics (as Phenol)	mg/kg	5	Inorg-031	<5	[NT]	[NT]	[NT]	[NT]	99	[NT]

Client Reference: 71459.10, Moorebank

Result Definitions	
NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions	
Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.
Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E. Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.	

Client Reference: 71459.10, Moorebank

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Client Reference: 71459.10, Moorebank

Report Comments

Asbestos-ID in soil: NEPM

This report is consistent with the reporting recommendations in the National Environment
Protection (Assessment of Site Contamination) Measure, Schedule B1, May 2013.

This is reported outside our scope of NATA accreditation.



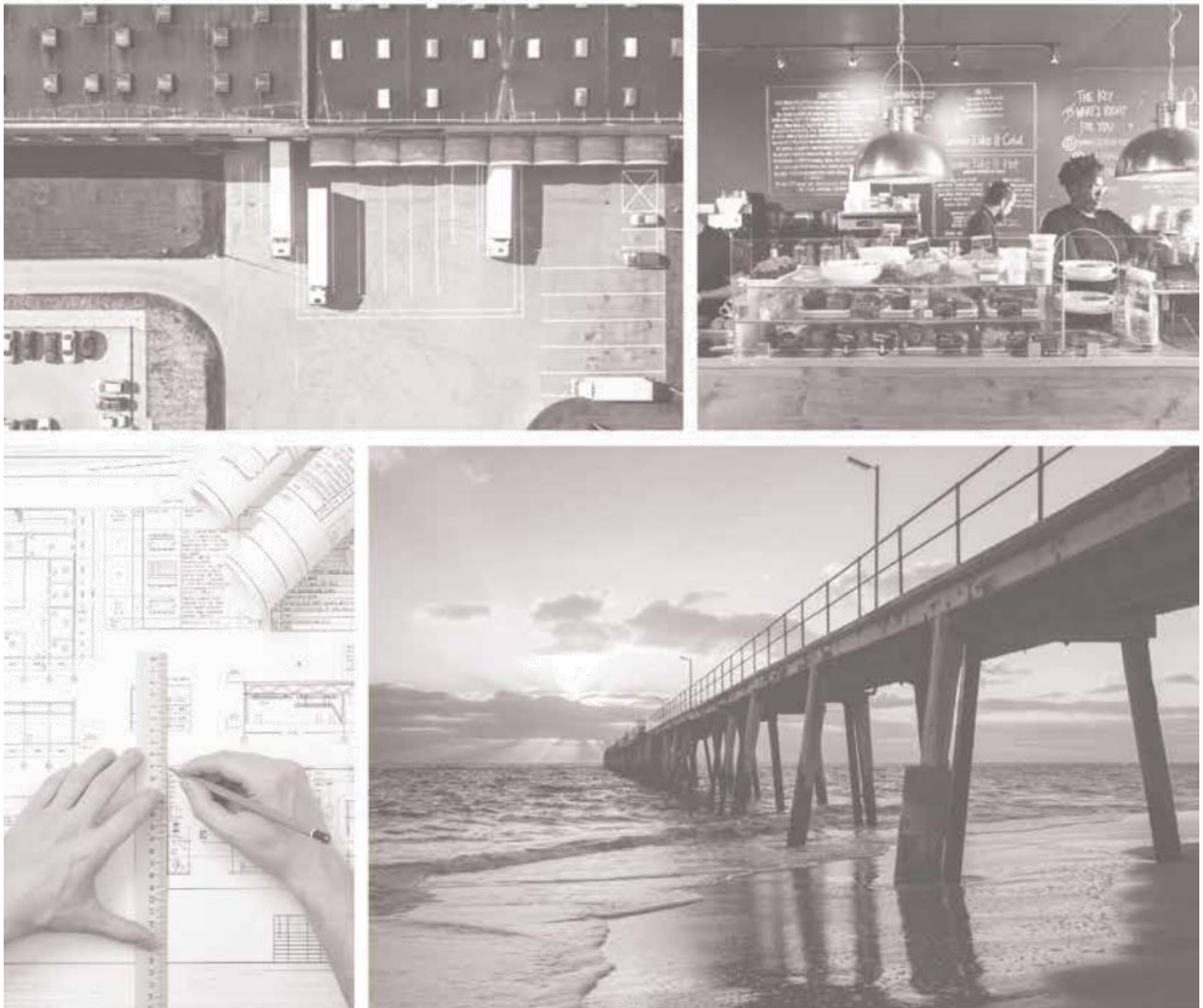
CHAIN OF CUSTODY DESPATCH SHEET

Project No: 71459.10		Suburb: Moorebank		To: EnviroLab							
Project Name: Proposed Residential development		Order Number									
Project Manager: John Russell		Sampler: NW		Attn: Aileen Hie							
Emails: John.Russell@douglaspartners.com.au		nicola.warnton@douglaspartners.com.au		Phone:							
Date Required: Standard				Email:							
Prior Storage: <input type="checkbox"/> Esky		Do samples contain 'potential' HBM? Yes <input type="checkbox"/> No <input type="checkbox"/> (If YES, then handle, transport and store in accordance with FPM HAZID)									
Sample ID	Depth	Lab ID	Date Sampled	Sample Type	Container Type	Analytes				Notes/preservation	
						Combo 8a	Combo 3	Asbestos (fragment ID)	Asbestos AFFA		BTEX
TP101	0.2-0.3	1	16/03/18	S	G/P	X					
TP101	1.9-2.0	2	16/03/18	S	G/P		X				
TP102	0.2-0.3	3	16/03/18	S	G/P	X					
TP102	0.9-1.0	4	16/03/18	S	G/P	X					
BD1/20180316		5	16/03/18	S	G/P	X					
TP101	2.8-2.9	6	16/03/18	S	P			X			
TP102	0.2-0.3	7	16/03/18	S	P			X			
TP102	0.4-0.5	8	16/03/18	S	P			X			
TP101 A1		9	16/03/18	Fragment	P						
TP102 A1		10	16/03/18	Fragment	P		X				
Trip Spike		11							X		
Trip Blank		12							X		
PQL (S) mg/kg											
PQL = practical quantitation limit. If none given, default to Laboratory Method Detection Limit											
Metals to Analyse: 8HM unless specified here:											
Total number of samples in container:											
Send Results to: Douglas Partners Pty Ltd											
Signed: <i>MM</i>											
Received by: <i>EDS</i>											
Address: <i>100/100</i>											
Reinquired by:											
Transported to laboratory by:											
Lab Report/Reference No:											
ANZECC PQLs req'd for all water analytes <input type="checkbox"/>											
Date Received: 16/3/18											
Time Received: 14:30											
Received by: <i>MM</i>											
Temp: <i>20°C</i>											
Cooling: <i>Ice/coolpack</i>											
Security: <i>Attach/Clacker/None</i>											
Phone:											
Date & Time: 16/3/18 17:30											
Fax:											



Appendix C

Biodiversity assessment





30 April 2018

Mr Craig Cosier
Assistant Development Manager
Masterplanned Communities
Residential Development
Mirvac Homes Pty Ltd
Level 28, 200 George Street
Sydney NSW 2000

Dear Craig

Re: Biodiversity assessment for the planning proposal at 146 Newbridge Road, Moorebank
Project no. 26419

Biosis Pty Ltd was commissioned by Mirvac Homes Pty Ltd (Mircvac) to complete a biodiversity assessment to support a planning proposal for the planning proposal at 146 Newbridge Road, Moorebank. The purpose of the biodiversity assessment is to describe the biodiversity values associated with the proposed development.

This report has been prepared to support the planning proposal for the subject site to allow a residential use in two parts. The first part being a rezoning of a portion of residue land from RE2 Private Open Space to R3 Residential to join the existing zoned R3 residential area subject to development under an application with Liverpool City Council. The second part is for the approval of an enabling clause for terraces and residential flat buildings over part of the existing zoned RE2

The objective of this biodiversity assessment is to determine the presence of any threatened flora, fauna, populations or ecological communities (biota) within the study area and, where applicable, assess the impacts of the project on any such species or their habitats, listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), *NSW Biodiversity Conservation Act 2016* (BC Act) and *Fisheries Management Act 1994* (FM Act).

Background

The study area is approximately 11.8 hectares and is defined as 146 Newbridge Road, Moorebank (Lot DP1065574).

The study area is within the City of Liverpool Local Government Area (LGA) and is currently zoned RE1 – Public Recreation and RE2 – Private Recreation under the Liverpool Local Environmental Plan 2008.

The surrounding land use is dominated by residential development to the north and east, with semi-rural and areas of remnant bushland along the Georges River to the south. The site itself is bordered on the eastern margin of the study area by the Georges River.



Method

Database and literature review

Prior to completing the field investigation, information provided by Mirvac as well as other key information was reviewed, including:

- Commonwealth Department of the Environment and Energy (DEE) Protected Matters Search Tool for matters protected by the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
- NSW Office of Environment and Heritage (OEH) BioNet Atlas of NSW Wildlife, for items listed under the BC Act.
- The NSW Department of Primary Industries (DPI) Spatial Data Portal for FM Act listed threatened species, populations and communities.
- NSW DPI WeedWise database for *Biosecurity Act, 2015* listed Priority listed weeds for the Liverpool Local Land Services (LLS) area within the Greater Sydney region.
- OEH Vegetation Information System (VIS) mapping through the OEH data portal, defining the legislative framework for assessment.

The implications for the project were assessed in relation to key biodiversity legislation and policy including:

- *Environment Protection and Biodiversity Conservation Act 1999*.
- *Environmental Planning and Assessment Act 1979* (EP&A Act).
- *Biodiversity Conservation Act 2016*.
- *Fisheries Management Act 1994*
- *Local Land Services Act 2016*.
- *Biosecurity Act 2015* (Biosecurity Act).

Field investigation

A field investigation of the study area was undertaken on (11/01/2018) by Tony Cable (Senior Ecologist), Luke Stone (Field Aquatic Ecologist), Matthew Hyde (Field Zoologist). Vegetation within the study area was surveyed using the random meander technique (Cropper 1993) over 6 person hours.

A habitat-based assessment was completed to determine the presence of suitable habitat for threatened species previously recorded (OEH 2017) or predicted to occur (Commonwealth of Australia 2017) within 10 kilometres. This list was filtered according to species descriptions, life history, habitat preference and soil preference to determine those species most likely to be present within the study area.

An aquatic habitat assessment was conducted across the single large dredge pond that covers the majority of the study area. High levels of electrical conductivity recorded within the dredge pond precluded survey by backpack electrofishing. Fish community survey was instead conducted using seine netting across an approximately 890 m² section of the dredge pond to provide an indicative sample of aquatic fauna present within the dredge pond. Surface water quality readings were recorded within the dredge pond and within the Georges River using a Horiba U-52 multiparameter water quality probe. Water quality samples were also collected, both within the dredge pond and within the Georges River and transferred to a NATA accredited laboratory for analysis of a standard suite of nutrients, dissolved metals, standard and volatile hydrocarbons.



Previous assessment

Several ecological assessments have been undertaken for the study area on behalf of Benedict Industries Pty Ltd, the outcomes of these assessments are summarised below. A detailed summary of the previous assessments is provided in EMM (2015)

Total Earth Care completed a flora and fauna assessment of the study area in 2006 to support a rezoning application. The assessment included background research within a five kilometre radius of the study area and two days of field survey. No threatened species under the *Threatened Species Conservation Act 1995* (TSC Act) or EPBC Act were recorded. The report concluded that the ecological values within the study area presented low to moderate constraints to the proposed development.

Total Earth Care completed an updated flora and fauna assessment of the study area in 2011 to support a rezoning application. The updated background research and field survey identified areas of River Flat Eucalypt Forest and Swamp Oak Floodplain Forest, consistent with descriptions endangered ecological communities under the TSC Act. Assessment of Significance assessments under Section 5A of the EP&A Act were not undertaken for these communities. No threatened flora or fauna species were recorded during the field assessment. Potential habitat for seven threatened species was identified within the riparian zone of the study area. These species included the Cumberland Plain Land Snail *Meridolum corneovirens*, Eastern Bentwing Bat *Miniopterus schreibersii oceanensis*, Eastern Freetail bat *Mormopterus norfolkensis*, Greyheaded Flying Fox *Pteropus poliocephalus*, Southern Myotis *Myotis macropus* and Yellow-bellied Sheath-tail-Bat *Saccolaimus flaviventris*. An assessment of significance assessments were undertaken for these species and concluded that any potential impacts to these species as a result of the proposed development would not be significant. The updated flora and fauna assessment made recommendations to reduce potential impacts resulting from the planning proposal, concluding that the proposed development would not have a significant impact upon native flora and fauna within the study area.

EMM (2015) undertook an assessment of gaps within the previous ecological assessments and carried out updated background searches within a 10 kilometre radius of the study area. EMM (2015) undertook Assessment of Significance assessments for both the River flat Eucalypt Forest and Swamp Oak Floodplain Forest, concluding that no significant impacts to the communities were considered likely as a result of the proposed development. EMM (2015) concluded that the planning proposal would result in overall improvements to the condition and degree of available habitat within the study area.

Marine Pollution Research undertook an aquatic ecological assessment of the planning proposal in 2010. Marine Pollution Research (2010) concluded that no threatened aquatic species had been recorded in the locality or were expected to occur and that the proposed development could be constructed and operated without significant impacts to the water quality of the Georges River. Marine Pollution Research also provided an update to the report in 2015 following a further site assessment reporting that the while minor changes in conditions had occurred at the site, the conclusions of the 2010 report remain valid.

Results

Regional soil landscape mapping indicates that the majority of the study area occurs on the Richmond soil landscape, with parts of the northern and southern extent of the study area occurring on the Berkshire Park soil landscape Bannerman and Hazelton 1990. The Richmond soils landscape is a fluvial soil landscape comprised of quaternary terraces of both the Nepean and Georges Rivers. The soils within the landscape are characterised broadly by clay loams, clays and sands. The majority of trees have been cleared within the landscape, prior to clearing the vegetation of this landscape would have consisted of dry sclerophyll low open woodland. The Berkshire Park soil landscape is also a fluvial soil landscape comprised of low rises on the Tertiary terraces of the Hawkesbury Nepean River systems. Soils within this soil landscape comprise of clays and clay sandy clays and clay loams. The majority of trees within this soil landscape have been subject



to land clearing, however the Castlereagh State Forest contains substantial numbers of trees. The composition of the soil is highly influential on the vegetation communities observed.

The site is currently in a highly modified state and has been subject to extensive historical vegetation clearing and works within the dredge pond, associated with the prior land use as a sand and gravel quarry. At the time of the field investigations the dredge was inundated, and received the majority of water during flooding in June 2016, with prior aerial images (TEC 2011; Nearmap 2015) indicating that the dredge pond changes in depth and shape associated with active dredging and water levels vary, dependent on local flooding.

The area of land, which is the subject of the planning proposal, is devoid of native vegetation and contains no terrestrial ecological value. The dredge pond has been inundated in recent flooding, with common fish species of the Georges River having recently colonised the site.

Ecological values within the site are limited to riparian vegetation to the north of the study area and the south, along the Georges River. This is the only remnant native vegetation within the study, which occurs as a narrow strip 20 metres wide although this is patchy and is void of native vegetation for 130 metres.

Threatened species

Background searches identified 47 threatened flora species and 115 threatened fauna species recorded (OEH 2017) or predicted to occur (DEE 2017) within 10 kilometres of the study area.

Flora

Background research highlighted 46 threatened flora species as coming within a 10 kilometres radius of the site. This list reduced based on species' habitat requirements and broad habitat types assessed known to be present within the study area. Threatened flora species considered most likely to have suitable habitat present within the study area, include:

- Downy Wattle *Acacia pubescens* (Vulnerable EPBC Act and BC Act).
- Nettle Bottle Brush *Callistemon linearifolius* (Vulnerable BC Act).

A field assessment of the habitat values present within the study area was undertaken for the above listed species. Throughout the study area high densities of exotic vegetation was found to occur, predominantly present in the ground-layer, as a result of significant past soil disturbance. This dense exotic vegetation, and soil disturbance, precludes the occurrence of the above species, along with those remaining species highlighted during background research. However riparian habitats along the Georges River hold some habitat value for the above listed species, which are more robust, and do tolerate some level of site disturbance.

These species were searched for throughout all patches of remnant native vegetation within the study area. None of the threatened species identified above, or during background research, were identified during the field investigations. Based on the size of the study area and growth form of the target species, the survey effort is considered comprehensive for the flora species outlined above. Taking all of these factors into consideration, there is a low likelihood of occurrence for the above listed species.

Fauna

Threatened fauna species considered under previous assessments as likely to have habitat within the study area are:

- Cumberland Plain Land Snail *Meridolum corneovirens* (Endangered, BC Act).
- Grey-headed Flying-fox *Pteropus poliocephalus* (Vulnerable, EPBC Act and BC Act).



- Eastern Bentwing-bat *Miniopterus schreibersii oceanensis* (Vulnerable, BC Act).
- Eastern Freetail bat *Mormopterus norfolkensis* (Vulnerable, BC Act).
- Southern Myotis *Myotis macropus* (Vulnerable, BC Act).
- Yellow-bellied Sheath-tail-Bat *Saccolaimus flaviventris* (Vulnerable, BC Act).

Total Earth Care (2006, 2011) and EMM (2015) undertook background research for the study area, identifying a number of other species that have been recorded within five and 10 kilometres respectively. These other species are not considered likely to occur, which is largely consistent with the background research undertaken by Biosis with this assessment. While River-flat Eucalypt Forest typically provides suitable habitat for Cumberland Plain Land Snail, the highly disturbed vegetation and prevalence of Kikuyu precludes the occurrence of the species. Additional threatened fauna species identified during the background research for this assessment considered likely to occur are:

- White-bellied Sea-Eagle *Haliaeetus leucogaster* (Vulnerable, BC Act).
- Osprey *Pandion cristatus* (Vulnerable, BC Act and Migratory, EPBC Act).
- Spotted Harrier *Circus assimilis* (Vulnerable, BC Act).
- Eastern Great Egret *Ardea modesta* (Migratory, EPBC Act).
- Latham's Snipe *Gallinago hardwickii* (Migratory, EPBC Act).
- Common Sandpiper *Actitis hypoleucos* (Migratory, EPBC Act).
- Marsh Sandpiper *Tringa stagnatilis* (Migratory, EPBC Act).
- Sharp-tailed Sandpiper *Calidris acuminata* (Migratory, EPBC Act).
- Common Greenshank *Tringa nebularia* (Migratory, EPBC Act).

Table 1 Assessment of habitat for threatened fauna species

Habitat feature	Threatened fauna association	Likelihood of occurrence or impact
Feed trees	Angophoras, Eucalypts and other flowering perennial species recorded in the study area may provide nectar resources suitable for a range of arboreal and flying fauna (such as gliders, Grey-headed Flying-fox and nectivorous bird species) whilst in flower.	Based on the transient nature of these species and surrounding resources within the landscape there is not likely to be an impact to the Grey-headed Flying-fox and Little Lorikeet.
Hollow-bearing trees	Six hollow-bearing trees and one stag were recorded in the study area (Appendix 1; Figure 1) These hollows may provide potential roosting and/or nesting habitat for microbats but is unlikely to provide roosting habitat for the Powerful Owl due to large hollow dimensions required by this species (at least 50 cm deep).	It is recommended that if possible, the hollow-bearing tree be retained as an important habitat feature in the landscape that may be used by threatened microbats, small avifauna such as the Little Lorikeet and Black-chinned Honeyeater as well as providing feeding and perching habitat for other common avifauna.



Habitat feature	Threatened fauna association	Likelihood of occurrence or impact
Riparian woodland	Angophoras, Eucalypts, Swamp Oak and other tree species recorded in the study area may provide sheltering, foraging and roosting habitat for avifauna including the Varied Sittella, Black-chinned Honeyeater and Dusky Woodswallow.	It is recommended that native vegetation be retained along the margin of the Georges River, with this section of vegetation providing the only patch of suitable vegetation for threatened bird species considered to likely to occur within the study area.
Waterbodies	Reed beds and shallow water sections fringing the dredge pond within the study area provide potential foraging habitat for a number of bird species, particularly waders or species with habitat associations including reed beds, freshwater and estuarine wetlands.	Migratory waders are considered as likely to occur on occasion within the study area potentially utilising the shallow northern section of the dredge pond for foraging during seasonal migrations. Productivity and habitat value within this section is marginal and utilisation of these habitats is considered to be minimal and sporadic, therefore the potential impact to these species is considered low.

The range of habitats present within the study area, although generally of low condition support potential hunting habitat for birds of prey, such as the White-bellied Sea-Eagle which was recorded during the field assessment. Given the birds of prey considered likely to occur within the study area are transient, the species are considered unlikely to be impacted by the proposed development.

Based on the size of the study area, the survey effort is considered comprehensive to assess habitat presence for the species outlined in Table 2. Taking all of these factors into consideration, there is a low likelihood of impact for the above listed transient species.

Vegetation communities

Prior to the field investigation, Biosis confirmed that various native vegetation communities Swamp Oak Floodplain Forest, River Flat Eucalypt Forest and Cumberland Plain Woodland have been mapped in the broader landscape (OEH 2013), these include:

- *Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions, endangered ecological community (Swamp Oak Floodplain Forest [TSSC 2004]).*
- *River-flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions, endangered ecological community (River-flat Eucalypt Forest [TSSC 2011]).*
- *Cumberland Plain Woodland in the Sydney basin Bioregion, endangered ecological community (Cumberland Plain Woodland [TSSC 2008]).*

A key focus of the field investigation was to assess the vegetation of the study area against the final determinations for the above listed TECs to determine presence or absence.

The vegetation of the study area comprises three (PCTs); Cumberland Swamp Oak Riparian Forest (equivalent to River-flat Eucalypt Forest TEC), Estuarine Swamp Oak Forest (equivalent to Swamp Oak Floodplain Forest TEC), and Highly disturbed weeds and exotics. The structure, floristic composition and condition of these communities are described in Table 3, and a figure illustrating their distribution within



the study area is contained in Appendix 1. A list of flora and fauna recorded within the study area as well as associated plates are provided in Appendix 2 and Appendix 3.

Table 2 Threatened Ecological Communities within the study area

Community	Description
River-flat Eucalypt Forest	This vegetation community within the study area was characterised by Blue Box <i>Eucalyptus baueriana</i> , Rough-barked Apple <i>Angophora floribunda</i> , Swamp Oak <i>Casuarina glauca</i> and <i>Eucalyptus botryoides</i> x <i>saligna</i> dominating the canopy with scattered Prickly-leaved Tea Tree <i>Melaleuca styphelioides</i> . Some scattered Blackthorn <i>Bursaria spinosa</i> and juvenile Swamp Oak contributed to a sparse and patchy mid stratum, with a predominantly weedy ground cover and understorey comprised of Kikuyu <i>Pennisetum clandestinum</i> , Cobblers Pegs <i>Bidens pilosa</i> and African Lovegrass <i>Eragrostis curvula</i> .
Swamp Oak Floodplain Forest	This vegetation community within the study area is characterised by dense homogeneous stands of Swamp Oak bordering the Georges River estuary with scattered juvenile Grey Mangrove <i>Avicenna marina</i> on the margins abutting Georges River.

Hollow bearing trees

Six hollow bearing trees and one stag were recorded during the field assessment, shown in Appendix 1: Figure 1. A total of thirteen hollows were recorded among the six hollow bearing trees and stag recorded. Some hollows observed were small enough to provide potential roosting habitat for microbats, which may occur within the study area, however most hollows are considered more suitable for common fauna species including Common Brushtail Possum *Trichosurus vulpecula*. Moderate levels of coarse woody debris were also identified throughout the areas of River flat Eucalypt Forest EEC.

Priority weeds

The *Biosecurity Act 2015* (Biosecurity Act) came into effect as of 1 July 2017 and repeals the *Noxious Weeds Act 1993*. The Biosecurity Act outlines biosecurity risks and impacts, which in relation to the current assessment includes those risks and impacts associated with weeds. A biosecurity risk is defined as the risk of a biosecurity impact occurring, which for weeds includes:

- The introduction, presence, spread or increase of a pest into or within the State or any part of the State.
- A pest plant has the potential to:
 - Out-compete other organisms for resources, including food, water, nutrients, habitat and sunlight.
 - Harm or reduce biodiversity.

Three Priority Weeds for the Greater Sydney LLS Region, which includes the City of Liverpool Council LGA, that have been recorded in the study area are listed in Table 1, along with their associated Duty.



Table 3 Priority weeds within the study area

Scientific name	Common name	Biosecurity duty
-	All plants	<i>All plants are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.</i>
<i>Asparagus aethiopicus</i>	Ground Asparagus	Prohibition on dealings <i>Must not be imported into the State or sold</i>
<i>Lantana camara</i>	Lantana	Prohibition on dealings <i>Must not be imported into the State or sold</i>

Riparian corridors

The Georges River is a seventh order stream and runs along the eastern margin of the study area,. In addition, a single large man-made dredge pond associated with the Georges River is located in the southern half of the study area. An additional unnamed first order tributary is mapped as flowing into the dredge pond before running into the Georges River. No evidence of this tributary was observed on site. It is expected that this tributary no longer exists on site as a result of historic flow modification, water storage construction and earthworks.

The Riparian corridors within the study area have been assessed in relation to the *Water Management Act 2000* (WM Act). The Department of Primary Industries (DPI) Water recommends riparian widths based on watercourse order under the Strahler method. The watercourse within the study area was classified as a seventh order stream, which requires a riparian corridor width of 40 metres from the 'top of bank' on either side respectively.

The section of land identified as the subject site of the planning proposal does not occur within 40 metres of the Georges River, and as such a controlled activity permit would not be required.

The overall condition of the riparian area was determined to be moderately poor. The foreshore of the study is subject to bank in a limited number of sections, with anthropogenic materials (bricks, concrete slabs, piping) placed as bank armouring along the foreshore to protect against erosion. Approximately 50 scattered mangrove individuals, less the 1 metre in height are located along the riparian corridor of the study area. The riparian vegetation occurs in two strips of the Georges River at the northern and southern ends of the study area, broken in the middle by clearing associated with a dirt track across the closed entrance of the dredge pond to the Georges River. The riparian vegetation is comprised of three vegetation communities.

Aquatic habitat values

A large dredge pond 5.7 hectares, closed to the Georges River under base flow conditions, covers the majority of the study area. Anecdotal evidence indicate the dredge pond becomes connected to the Georges River during high flow periods. The northern section of the dredge pond edge is fringed by beds of Common Reed *Phragmites australis*. Where the Common Reed is absent the dredge pond margins are generally vegetated by terrestrial understory species rather than emergent macrophytes.

Water quality results recorded from the dredge pond and the Georges River during field are provided in Appendix 3:Table 5. Also presented are the NSW Water Quality and River Flow Objectives for the Georges River catchment, based on the ANZECC (2000) guidelines. The ANZECC (2000) guidelines 80% protection criteria are presented to identify exceedances for dissolved metals and hydrocarbons. No criteria have been



developed for estuarine systems, therefore the freshwater values have been used given the linear nature of the Georges River.

The fish community survey within the dredge pond recorded the presence of Sea Mullet *Mugil cephalus*, Sand Mullet *Myxus elongates*, Sandy Sprat *Hyperlophus vittatus* and Eastern Long-necked Turtle *Chelodina longicollis*. A number of fish species were observed from the bank schooling within the Georges River, including Sea Mullet, Black Bream *Acanthopagrus butcheri*, Luderick *Girella tricuspidata* and Longfin Eel *Anguilla reinhardtii*. No threatened aquatic species were observed within the study area. Eastern Gambusia *Gambusia hobbrookii* were observed in vegetated shallows within the dredge pond. The fish species recorded from the dredge pond are typical of the estuarine fish community expected to occur within the Georges River and are indicative of colonisation of the dredge pond by species from the Georges River, when the waterbodies are connected during high flows. These species are now disconnected from the Georges River and are unable to complete their life cycles, therefore the ongoing viability of this fish community is very poor.

Ecological values

The ecological values within the study area are provided in Figure 1. These constraints are ranked as high, moderate or low, based on the criteria outlined in Table 4.

Table 4: Ecological constraints in the study area

Constraint	Value	Justification	Recommendations
High	<ul style="list-style-type: none"> Low condition River-flat Eucalypt Forest, listed under the BC Act. Low condition Swamp Oak Floodplain Forest. 	<ul style="list-style-type: none"> Vegetation communities listed as critically endangered under BC Act. Contains hollow bearing trees. Provides potential roosting and foraging habitat for threatened fauna species. 	<ul style="list-style-type: none"> Impact to these areas should be avoided where feasibly possible. Impacts to River-flat Eucalypt Forest or Swamp Oak Floodplain Forest, listed under the BC Act hectares must be offset. Clearing of this vegetation would also require a permit to undertake a controlled activity on waterfront land from DPI Water.
Moderate	<ul style="list-style-type: none"> Man-made dredge ponds and remaining riparian corridor. 	<ul style="list-style-type: none"> Provides potential roosting and foraging habitat for threatened fauna species. Does not provide potential habitat for threatened flora. Habitat for a range of estuarine fish species. 	<ul style="list-style-type: none"> Impacts to areas should be minimised where possible. Assess feasibility of maintaining shallow wetland environment within northern section of dredge pond.
Low	<ul style="list-style-type: none"> Disturbed weeds and exotics. 	<ul style="list-style-type: none"> Does not form part of an ecological community. Does not contain any hollow bearing trees. Is unlikely to provide potential habitat for threatened flora or fauna. 	<ul style="list-style-type: none"> Development suitable in these areas.



Conclusion and recommendations

The flora and fauna constraints assessment has highlighted limited values and constraints within the study area and subject site. Due to the nature and location of these constraints the following recommendations have been made regarding the potential impact area for the project, with the proposed rezoning considered to result in no impact to ecological values occurring within the subject site.:

- The rezoning of the land from RE2 to R3, and subsequent developments, will not result in any ecological impacts as the subject site is highly disturbed and devoid of native vegetation and fauna habitat features.
- River-flat Eucalypt Forest and Swamp Oak Floodplain Forest occurring along the foreshore of the Georges River is to be the subject of a voluntary planning agreement (VPA) with Council and as such any impacts to these vegetation communities is not proposed by Mirvac. If impacts to these vegetation communities are proposed in the future, a 5-part test is required for each, would be subject to offset requirements during the application for Development Approval phase and a permit to undertake a controlled activity.
- No ecological values occur within the area that is the subject of the planning proposal, except the now inundated dredge pond following from recent flooding which now contains landlocked estuarine fish populations.
- Consider the preparation of a weed management plan to reduce the spread of weed propagules during the proposed development, which and should be prepared during the application for Development Approval or be incorporated into a vegetation management plan.
- All but one of the hollow bearing trees occur within patches of TEC, and are recommended to be retained. The single hollow-bearing tree occurs on the foreshore is also to be subject of the VPA with Council.

Following the observation of two White-bellied Sea Eagles within the study area during the field assessment. A five-part test is recommended to be undertaken for this species during the application for development approval to comply with the BC Act.

I trust that this advice is of assistance to you however please contact me if you would like to discuss any elements of this ecological advice further.

Yours sincerely

A handwritten signature in black ink, appearing to read "Anthony Cable", with a stylized flourish at the end.

Anthony Cable

Senior Ecologist



References

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Marine Pollution Research 2015. Aquatic ecology aspects & environmental assessment of marina concept design. Author: Paul Anink.

Marine Pollution Research 2015. Update of aquatic ecology impact report for Georges Cove Marina. Author: Paul Anink.

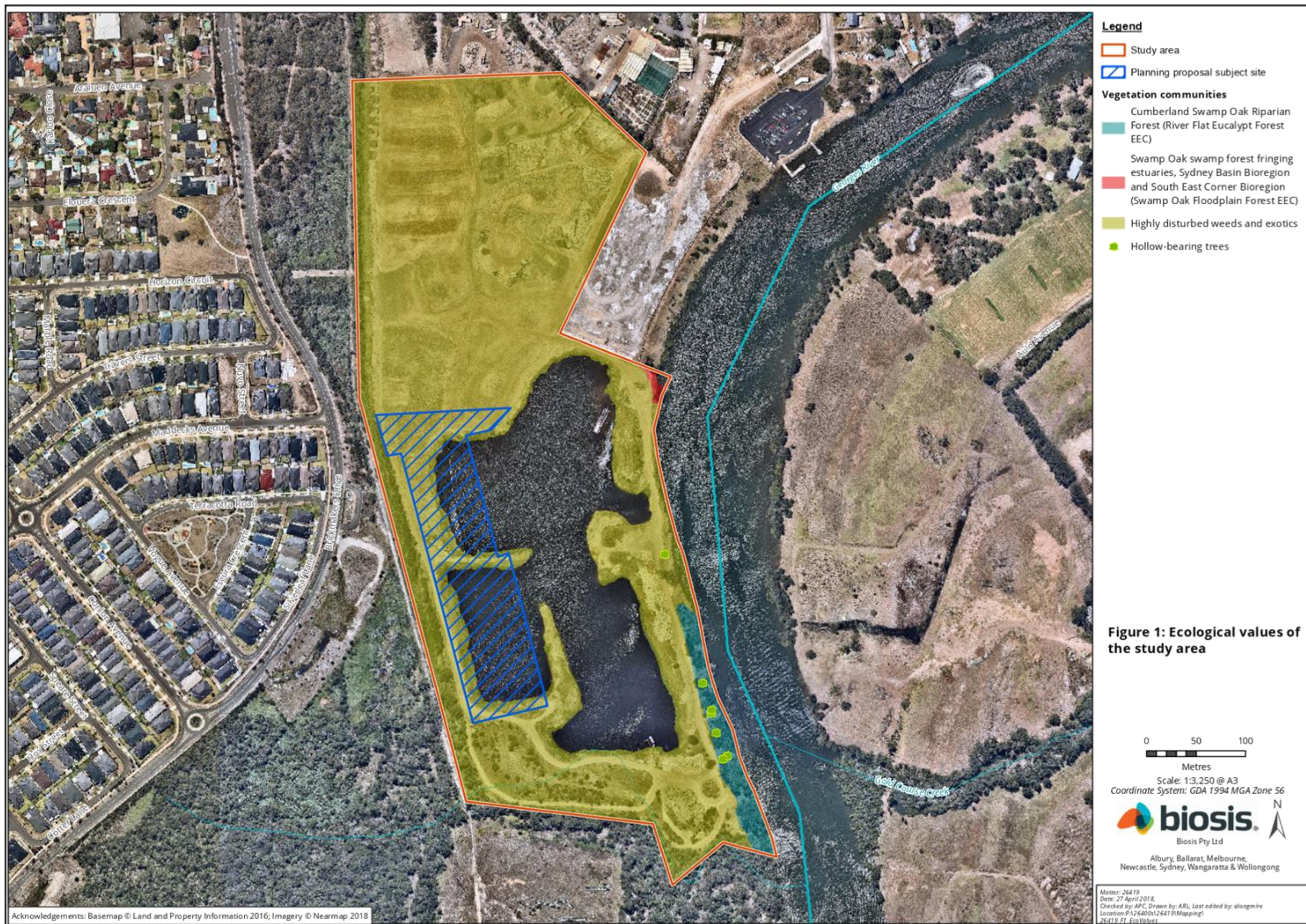
OEH 2018. OEH Vegetation Information System (VIS) mapping through the OEH data portal.



Appendices



Appendix 1 Figure 1





Appendix 2 Plates



Plate 1: Swamp Oak Floodplain Forest



Plate 2: River flat Eucalypt Forest



Plate 3: Hollow bearing tree



Plate 4: Juvenile mangrove plants



Plate 5: Dredge pond facing north



Plate 6: Dredge pond facing south



Plate 7: *Phragmites australis* beds within the dredge pond



Plate 8: Coarse woody debris



Plate 9: Bank of the Georges River along the study area facing north



Plate 10: Sand Mullet captured during fish community survey



Appendix 3 Water quality data



Table 5 Water quality results recorded by Biosis

Physicochemical parameter	NSW Water Quality and River Flow Objectives: Lowland rivers	NSW Water Quality and River Flow Objectives: Freshwater lakes and reservoirs	NSW Water Quality and River Flow Objectives: Estuaries	80% trigger values for freshwater (µg/L)	Georges River	Dredge pond edge (breach point) Dredge pond	Dredge pond edge (eastern centre) Dredge pond
Field measurements							
pH (pH units)	6.5-5.5	6.5-8.0	7.0-8.5	-	7.89	7.94	7.90
Dissolved Oxygen (% Saturation)	85-110	90-110	80-110	-	135.3	132.6	145.0
Electrical Conductivity (µS/cm)	125-2200	-	-	-	23400	19300	9100
Temperature (°C)				-	27.0	26.6	25.8
Turbidity (NTU)	6-50	1-20	0.5-10	-	8.4	16.3	10.7
Nutrients (µg/L)							
Total Phosphorous	25	10	30	-	20	60	-
Total Nitrogen	350	350	300	-	300	400	-
Total Kjeldahl Nitrogen	-	-	-	-	300	300	-
Total Ammonia as N	-	-	-	2300 (Ammonia)	20	80	-
Total Nitrite and Nitrate as N	-	-	-	1700 (Nitrate only)	20	140	-
Dissolved metals (µg/L)							
Sulfate as SO4	-	-	-	-	920000	999000	-
Aluminium	-	-	-	150	10	<10	-
Arsenic	-	-	-	140 (Arsenic as V)	3	<1	-
Cadmium	-	-	-	0.8	<0.1	<0.1	-
Copper	-	-	-	2.5	<1	<1	-
Lead	-	-	-	9.4	<1	<1	-
Manganese	-	-	-	3600	212	93	-



Physicochemical parameter	NSW Water Quality and River Flow Objectives: Lowland rivers	NSW Water Quality and River Flow Objectives: Freshwater lakes and reservoirs	NSW Water Quality and River Flow Objectives: Estuaries	80% trigger values for freshwater (µg/L)	Georges River	Dredge pond edge (breach point) Dredge pond	Dredge pond edge (eastern centre) Dredge pond
Selenium	-	-	-	34	<10	<10	-
Zinc	-	-	-	31	<5	5	-
Iron	-	-	-	-	<50	<50	-
Mercury	-	-	-	5.4 (inorganic Mercury)	<0.1	<0.1	-
BTEXN (µg/L)							
Benzene	-	-	-	2000	<1	<1	-
ortho-Xylene	-	-	-	640	<2	<2	-
Naphthalene	-	-	-	85	<5	<5	-



Appendix 4 Flora and fauna species recorded

Flora species recorded from the study area

– Flora species recorded by Biosis, 11/01/2018

Status	Scientific name	Common name
Native species		
	<i>Acacia pycnantha</i>	Golden Wattle
	<i>Angophora floribunda</i>	Rough-barked Apple
	<i>Avicennia marina</i>	Grey Mangrove
	<i>Acacia decurrens</i>	Black Wattle
	<i>Bursaria spinosa</i>	Blackthorn
	<i>Casuarina glauca</i>	Swamp Oak
	<i>Eucalyptus botryoides</i> <--> <i>saligna</i>	
	<i>Eucalyptus baueriana</i>	Blue Box
	<i>Eucalyptus tereticornis</i>	Forest Red Gum
	<i>Melaleuca styphelioides</i>	Prickly-leaved Paperbark
Exotic species		
	<i>Araujia sericifera</i>	Moth Vine
	<i>Asparagus aethiopicus</i>	Asparagus Fern
	<i>Bidens pilosa</i>	Cobbler's Pegs
	<i>Brassica</i> sp.	Mallow
	<i>Cardiospermum grandiflorum</i>	Balloon Vine
	<i>Cirsium vulgare</i>	Spear Thistle
	<i>Cynodon dactylon</i>	Couch
	<i>Eragrostis curvula</i>	African Lovegrass
	<i>Lantana camara</i>	Lantana
	<i>Malva parviflora</i>	Small-flowered Mallow
	<i>Pennisetum clandestinum</i>	Kikuyu Grass
	<i>Ricinus communis</i>	Castor Oil Plant
	<i>Verbena bonariensis</i>	Purpletop



Fauna species recorded from the study area

Terrestrial fauna species recorded by Biosis, 11/01/2018

Status	Scientific name	Common name
Birds		
	<i>Acanthiza pusilla</i>	Brown Thornbill
	<i>Acrocephalus stentoreus</i>	Clamorous Reed Warbler
	<i>Anas castanea</i>	Chestnut Teal
	<i>Anas gracilis</i>	Grey Teal
	<i>Anas superciliosa</i>	Pacific Black Duck
	<i>Anhinga novaehollandiae</i>	Australasian Darter
	<i>Aythya australis</i>	Hardhead
	<i>Cacatua galerita</i>	Sulphur-crested Cockatoo
	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo Shrike
	<i>Corvus coronoides</i>	Australian Raven
	<i>Fulica atra</i>	Australasian Coot
V	<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle
	<i>Malarus cyaneus</i>	Superb fairy Wren
	<i>Malarus lamberti</i>	Variegated Fairy Wren
	<i>Nymphicus hollandicus</i>	Cockatiel
	<i>Pelecanus conspicillatus</i>	Australian Pelican
	<i>Phalacrocorax carbo</i>	Great Cormorant
	<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant
	<i>Podiceps cristatus</i>	Great Crested Grebe
	<i>Porphyrio porphyrio</i>	Purple Swamphen
	<i>Sturnus tristis</i>	Common Myna
	<i>Todiramphus sanctus</i>	Sacred Kingfisher
	<i>Vanellus miles</i>	Masked Lapwing
	<i>Zosterops lateralis</i>	Silvereye
Reptiles		
	<i>Chelodina longicollis</i>	Eastern long-necked turtle
Fish		
	<i>Acanthopagrus butcheri</i>	Black Bream
	<i>Anguilla reinhardtii</i>	Long-finned Eel
	<i>Girella tricuspidata</i>	Luderick



Status	Scientific name	Common name
	<i>Hyperlophus vittatus</i>	Sandy Sprat
	<i>Mugil cephalus</i>	Sea Mullet
	<i>Myxus elongatus</i>	Sand Mullet



Appendix D

Transport planning impact assessment





Georges Cove Marina Residential Planning Proposal

Transport Planning Assessment Report

Prepared for Mirvac | 10 April 2018

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Georges Cove Marina Residential Planning Proposal

Final

Report J16077 RPT2 | Prepared for Mirvac | 10 April 2018

Prepared by	Dr Tim Brooker	Approved by	Allan Young
Position	Associate – Transport Planner	Position	Planning Service Leader
Signature		Signature	
Date	10 April 2018	Date	10 April 2018

This report has been prepared in accordance with the brief provided by the client and has relied upon the information collected at the time and under the conditions specified in the report. All findings, conclusions or recommendations contained in the report are based on the aforementioned circumstances. The report is for the use of the client and no responsibility will be taken for its use by other parties. The client may, at its discretion, use the report to inform regulators and the public.

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1 Introduction

1.1 Overview

This transport planning assessment report has been prepared by EMM Consulting Pty Limited (EMM) for Mirvac Homes (NSW) Pty Ltd to review the transport and access impacts of a planning proposal to include 374 dwellings within the Georges Cove Marina development (353 apartments and 21 terraces) as an additional permitted use on this site. The new residential development will primarily be constructed in lieu of sections of the previously proposed marina commercial premises (with reductions in the floor areas for the marina commercial uses) at part of the subject land which is Lot 7 DP 1065574, 146 Newbridge Road, Moorebank (the site).

This Transport Planning Assessment Report considers the impacts of the additional future traffic generated by the additional permitted use, the subject of the planning proposal, in comparison to the future marina commercial and recreational development and incorporates consideration of the future traffic changes from the other known proposed or approved developments in the Moorebank East locality which are shown in Figure 1.1.

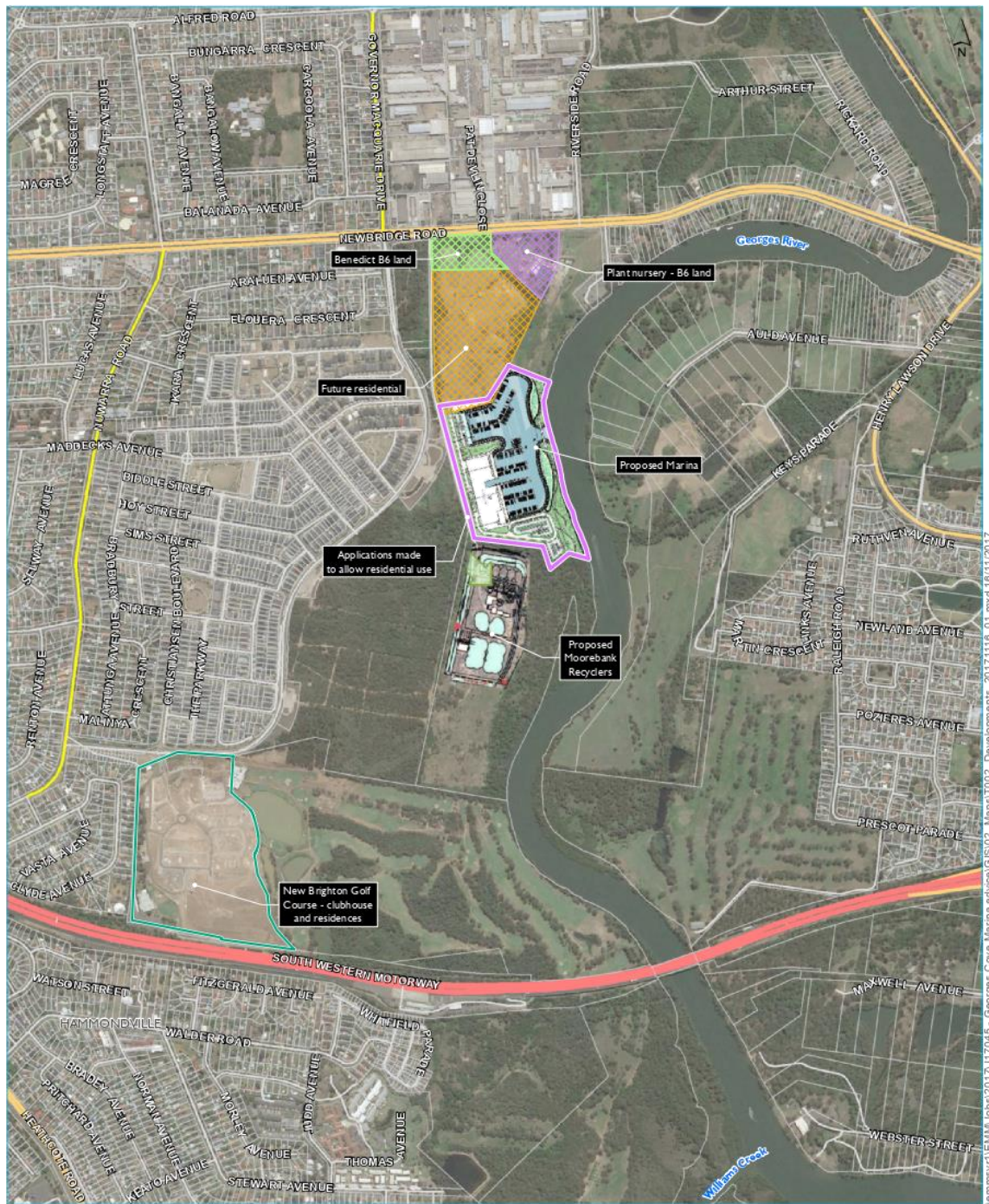
This report also responds to the traffic related submissions from the NSW Government Transport Agencies (letter from RMS dated 14 June 2017 and letter from Transport for NSW dated 9 May 2017), although it should be noted that these submissions relate to an earlier planning proposal for 108 apartments and 17 terraces at the marina site (125 dwellings in total).

The following known proposed, approved or completed developments are included in the future adjusted baseline traffic volumes for the two intersections on Brickmakers Drive at Newbridge Road and the proposed Link Road, on which the planning proposal traffic analysis in this report is based:

- The completion in October 2016 of the Georges Fair residential estate with over 1,000 dwellings;
- The future completion of the approved Brighton Lakes residential estate (310 dwellings) and clubhouse redevelopment;
- The commencement of traffic operations for the approved Moorebank Recyclers development
- The future Georges Cove Marina (as assessed by the EMM transport planning report in July 2015);
- The proposed Moorebank Cove Residential Estate (179 dwellings), and
- The proposed new mixed use commercial (7,310 sq m GFA) and residential (171 dwellings) development on the Benedict-owned B6 Enterprise Corridor zoned land fronting Newbridge Road.

The future adjusted baseline traffic volumes in this report do not include the future potential traffic from any higher density residential developments proposal on the Plant Nursery B6 land (Figure 1.1), as that land can potentially utilise other vehicle access routes via Davy Robinson Drive or Newbridge Road.

In this transport planning assessment report, the updated traffic impact analysis for the potential marina residential development is based on the most recent 2016 locality traffic volume surveys and the Benedict B6 land development traffic volumes documented in the Ason traffic impact assessment report (Ason, 2017), which was prepared in October 2017. The Benedict B6 land (Figure 1.1) is also part of the same subject land, Lot 7 DP 1065574, 146 Newbridge Road, Moorebank as the future Georges Cove Marina and Moorebank Cove residential estate.



Source: EMM (2017); DFSI (2017); MFA (2015); DPE (2015)

KEY

Proposed and approved developments

Future residential

Benedict B6 land

Plant nursery B6 land

Marina site (investigation site boundary)

Existing environment

Cadastral boundary

Motorway

Arterial road (RMS)

Regional road (RMS)

Other road

Proposed and approved developments in the locality

Morebank Cove residential estate and proposed marina residential uses

Addendum traffic report

Figure 1.1



This transport planning assessment report and its access recommendations for the subject land should be read in conjunction with the related traffic study analysis and future access recommendations which are contained in the Ason traffic report (Ason, 2017) for the Benedict B6 Enterprise Corridor land.

1.2 Assessment scope for RMS and TfNSW requirements

The traffic impacts analysis in this transport planning report responds to the requests for further information in the letter from RMS dated 14 June 2017 and the letter from Transport for NSW (TfNSW) dated 9 May 2017, as follows. The letters are included in Appendix A.

The key items of additional traffic information which have been requested by RMS and TfNSW in these submissions are as follows:

Traffic volume considerations

- TfNSW recommends that this traffic study should take into consideration the cumulative traffic impact from the adjoining properties including but not limited to the Mirvac residential estate (Moorebank Cove), potential redevelopment of the plant nursery site and the proposed recycling facilities.
- TfNSW recommends the use of updated survey data (as opposed to 2013 data used in previous traffic reports) on the traffic volumes of Brickmakers Drive to account for the largely completed Georges Fair development.

Intersection modelling

- The proposed traffic signals at Brickmakers Drive/Link Road intersection should be modelled in conjunction with Newbridge Road/Governor Macquarie Drive/Brickmakers Drive intersection by using SIDRA 7.
- A 140 seconds cycle time should be used in these models.
- An updated electronic copy of the SIDRA models should be provided to the Council.

Intersection layout design

- Council prefers two through traffic lanes with a right turn lane provided on the southern approach of the proposed signalised intersection. A design plan with the associated turning path should be provided to Council.
- If the preferred design is not provided, the developer should submit justifications to Council, demonstrating why the preferred design is not achievable.

Public Transport Access

- TfNSW recommends that a 3.0 metre wide pedestrian and cycle path between Brickmakers Drive and Newbridge Road be provided to connect the development enabled by the planning proposal to public transport on Newbridge Road.

1.3 Liverpool City Council requirements

The proposed local road network within the 146 Newbridge Road site is specified in general terms by the Liverpool City Council *Moorebank East Development Control Plan 2008* (Clause 2.10) which is shown in Figure 1.2. An updated traffic signal warrant assessment report has also been requested by Liverpool City Council for the proposed Brickmakers Drive/Link Road intersection traffic signals using the standard RMS template.

The previous traffic signal warrant report which was prepared by EMM for the proposed traffic signals at this location in June 2016 identified that due to the current high imbalance between the peak hour northbound and southbound traffic flows at this location on Brickmakers Drive (which is expected to continue with the additional traffic from future developments in the Moorebank East DCP area) it will be very difficult for the future traffic volumes using Brickmakers Drive in both directions to meet the formal RMS warrant requirement for installing traffic signals at the Brickmakers Drive/Link Road intersection.

However, the future traffic volumes using Brickmakers Drive would meet the RMS traffic signal warrant requirement if the averages of the peak hourly northbound and southbound traffic flows were considered instead of the actual peak directional traffic flows.

In practice the gaps in the peak hour two-way traffic flow on a major local “distributor” road such as Brickmakers Drive will determine the traffic capacity for unsignalised right turn access from other collector roads such as the proposed Link Road. These gaps are independent of the actual direction in which the Brickmakers Drive traffic flow is occurring, so the need for the traffic signals is really determined by the total two way traffic flow on Brickmakers Drive, regardless of the directions in which traffic is actually travelling.

It was also identified in the EMM traffic reports for both the future Georges Cove Marina (EMM, 2015) and the proposed Moorebank Cove residential estate (EMM, 2016) that the proposed future traffic signals at the Brickmakers Drive/Link Road intersection were generally necessary for the following reasons, independently of the RMS traffic signal warrant analysis:

- Initial SIDRA intersection analysis showed either Level of Service E or F for the future intersection operations with an unsignalised intersection using either give way or stop signs;
- The adjoining land ownership constraints prevent any alternative roundabout design being constructed at this location, which could accommodate the required large trucks travelling from the Moorebank Recyclers site, and
- There is no continuous footpath along the eastern side of Brickmakers Drive, so pedestrians cannot safely walk along the eastern side of Brickmakers Drive to reach another safer location to cross the road, so the traffic signals are required at the Link Road intersection to provide a minimum safe pedestrian crossing facility for pedestrians from the Link Road, which is a primary pedestrian access route for the future residential and other developments in the Moorebank East DCP area.



Figure 1.2 Liverpool Moorebank East DCP extract showing the future local road network

1.4 Details of the development traffic impact scenarios considered

This transport planning report reviews the future effect of the development which would be enabled by the planning proposal on the locality traffic during weekdays for the main morning and afternoon commuter peak traffic hours on Brickmakers Drive and Newbridge Road, in combination with the traffic from other known or approved developments in the locality in the following future cumulative development traffic impact scenarios:

- The future baseline development traffic (from Ason, 2017) which includes:
 - existing (2016) base traffic volumes using Brickmakers Drive and Newbridge Road;
 - future locality traffic growth from the completion of the Georges Fair and Brighton Lakes developments;
 - The future Georges Cove Marina (as assessed by the EMM transport planning report in July 2015);
 - traffic growth from the approved Moorebank Recyclers Development;
 - traffic growth from the low density Moorebank Cove Residential Estate (conservatively assumed by Ason to be 190 rather than 179 dwellings), and
 - Benedict B6 development traffic volumes (as identified by Ason, 2017) for traffic generated by proposed seniors housing and other residential development totalling 171 dwellings, and commercial and retail development totalling 7,310 sq m GLFA.
- These future baseline traffic volumes are then assessed with the marina residential planning proposal traffic including corresponding reductions in the future commercial floor areas at the marina as follows:
 - 374 residential dwellings comprising 353 apartments and 21 terraces;
 - a reduction in the marina commercial floor areas from 4,938 sq m to 1,243 sq m; and
 - the removal of the boat sales showrooms and boat repair workshops.

This report also reviews the future pedestrian, cycleway and public transport access requirements for the new marina planning proposal residential units and 179 dwelling residential estate including the potential daytime visitor access requirements to public parkland and the Georges River foreshore by considering:

- The requirements for through-site pedestrian and cycleway access;
- The use of the M90 bus route as the primary public transport route serving the area; and
- The influence of public transport accessibility on vehicle traffic generation rates for residential and other traffic.

2 Existing traffic conditions

2.1 Location

The planning proposal sites and the related development sites which are also considered by this transport planning report are shown on Figure 1.1. These sites will all primarily utilise vehicle access via Brickmakers Drive and the new Link Road but will also potentially utilise Newbridge Road for some stages of their development, primarily for some construction stage access, via the existing driveway on Newbridge Road.

The location of the new Link Road traffic signal controlled intersection with Brickmakers Drive is approximately 300 m south of Newbridge Road, which provides approximately 300 m future separation distance for traffic queuing on Brickmakers Drive, between the two traffic signal controlled intersections.

2.2 Site access

The former Benedict industrial operations on the subject land have historically been accessed by vehicle traffic directly from Newbridge Road. The continuing use of this vehicular access will generally only be required for the construction stage access for the Moorebank Cove residential estate (179 dwellings), the future Georges Cove Marina development, and the potential additional 374 dwellings which are the subject of this report.

The future operational stage access for all these developments would use the new vehicular access which has been approved to be constructed: via Brickmakers Drive and the new Link Road. However in the traffic report for the current planning proposal for the Benedict B6 land development (Ason, 2017) some continuing future use of the Newbridge Road access is also proposed for the longer term operational access.

2.3 Road network

The major roads and the planned local roads which provide access to the subject land are shown in Figure 1.1 and Figure 1.2. The wider local area network includes a number of other major roads such as the M5 Motorway, Governor Macquarie Drive, Nuwarra Road, Heathcote Road and Henry Lawson Drive.

This transport planning report primarily assesses the effects of the additional Moorebank East locality development traffic on the main access route via the two intersections at Brickmakers Drive/Link Road and Newbridge Road/Governor Macquarie Drive/Brickmakers Drive.

The M5 West Motorway between Heathcote Road and King Georges Road now has significantly improved traffic carrying capacity, since the Motorway widening was completed in December 2014. There have been some corresponding traffic reductions since 2015 on Newbridge Road and the other parallel east-west traffic routes through the Moorebank East locality.

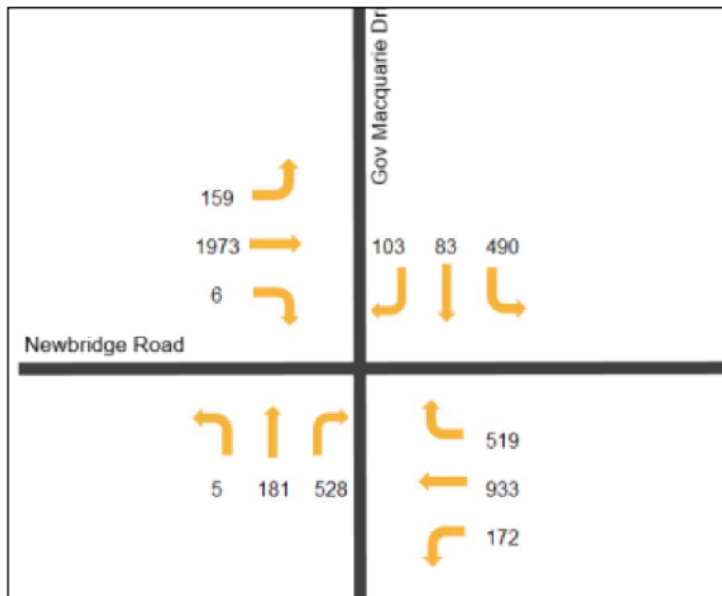
Newbridge Road is generally at least six lanes wide with a minimum of three traffic lanes in each direction and has additional turning traffic lanes at the major intersections. Brickmakers Drive has four traffic lanes at the intersection with Newbridge Road, but this reduces to three lanes potentially near the proposed Link Road intersection (where the two marked lanes with wide sealed shoulders can provide one additional traffic lane if required). Further to the south, Brickmakers Drive has a series of traffic management devices and roundabouts which have been installed to control traffic speeds and physically restrict the use of the route by larger trucks or articulated semi-trailers.

2.4 Traffic volumes

The existing peak hourly traffic volumes for Newbridge Road and Brickmakers Drive were determined by the peak hourly intersection counts undertaken for the Ason traffic report in 2016.

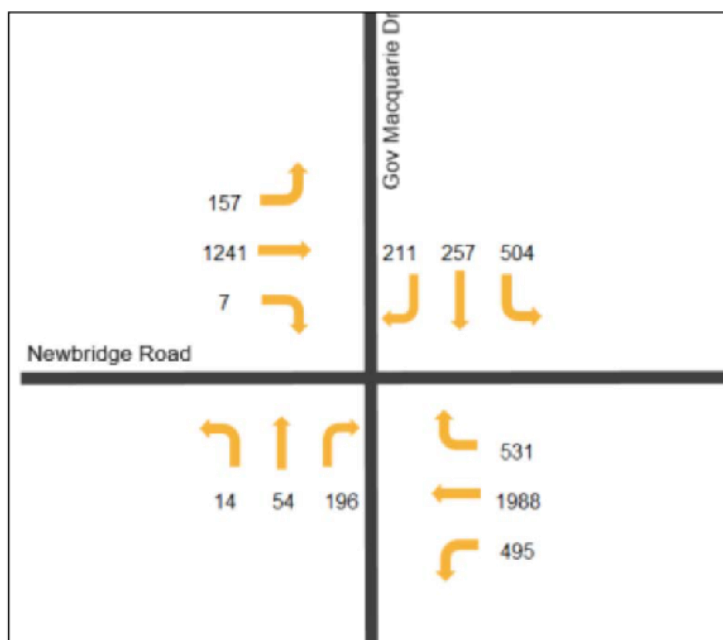
These morning and afternoon peak hour traffic counts are shown in Figure 2.1 and Figure 2.2 below. The corresponding peak hourly two way traffic flows for Brickmakers Drive at the northern end near Newbridge Road are as follows:

- Morning peak hour volumes using Brickmakers Drive
 - 714 vehicles per hour northbound, and
 - 261 vehicles per hour southbound.
- Afternoon peak hour volumes using Brickmakers Drive
 - 264 vehicles per hour northbound, and
 - 759 vehicles per hour southbound.



Source: Ason (2017)

Figure 2.1 Existing morning peak hour volumes using Newbridge Road at Brickmakers Drive



Source: Ason (2017)

Figure 2.2 Existing afternoon peak hour volumes using Newbridge Road at Brickmakers Drive

2.5 Existing Intersection Performance

From the other recent development traffic studies for the Moorebank East area which were prepared during 2011 and 2014 for the Mirvac Brighton Lakes developments (GHD, 2011 and GHD, 2014) it was concluded that the Newbridge Road/Governor Macquarie Drive/Brickmakers Drive intersection was operating with congested peak hour traffic conditions which were recorded or predicted to be either peak hour Level of Service E or F during both the morning and afternoon traffic peak hours.

However more recently, as a result of the M5 West Motorway widening which was completed in December 2014, the most recent existing situation SIDRA intersection analysis which has been undertaken by the Benedict B6 Traffic Report (Ason, 2017), indicates there has been some recent improvement in the peak hour operating traffic conditions at the intersection, to Level of Service C or D.

The existing situation SIDRA intersection analysis results from the Ason report are included in Appendix B of this report for the intersection operating as a “stand alone” isolated intersection, which is a reasonable operating assumption for the existing traffic situation analysis, as the maximum intersection traffic queue lengths were less than 400 m and would not generally have affected the operations of any other nearby traffic signal controlled intersection.

The RMS SIDRA intersection Level of Service (LOS) vs delay standards for traffic signal controlled intersections which are specified in the RTA-RMS Guide to Traffic Generating Developments (RTA 2002) are summarised in Table 2.1. In addition to LOS, the existing operation of the intersection is also described in terms of the following factors:

- Degree of Saturation (DOS) which is the ratio of the traffic volume to the capacity of the intersection;
- the Average Vehicle Delay (AVD) in seconds per vehicle for all traffic movements at the intersection; and
- the length of the maximum traffic queue (95th percentile traffic queue) for any traffic movement at the intersection.

Table 2.1 Intersection Level of Service definitions (RTA/RMS)

Description	LOS (RMS definition)	Average Vehicle Delay (s)
Very Good	A	<14.5
Good	B	14.5 to ≤28.5
Satisfactory	C	28.5 to ≤42.5
Near Capacity	D	42.5 to ≤56.5
At Capacity	E	56.5 to ≤70.5
Over Capacity	F	≥70.5

The SIDRA intersection results for the existing traffic situation at the Newbridge Road/Governor Macquarie Drive/ Brickmakers Drive intersection which were determined by the Ason traffic report (Ason 2017) are summarised in Table 2.2. The existing intersection is operating in the near capacity (LOS D) or satisfactory (LOS C) congestion ranges during the morning and afternoon peak traffic hours. This shows the intersection has some spare traffic capacity to accommodate additional peak hour traffic growth from new residential and other developments in the Moorebank East locality as is assessed in this report.

Table 2.2 Existing Newbridge Road and Brickmakers Drive intersection performance

Peak hour and traffic scenario analysed	Operation	Intersection performance
Existing surveyed traffic	DOS	0.904
	LOS	D
Weekday am peak hour (8.00 to 9.00 am)	Average delay	52.5 s
	Maximum queue length (approach)	383 m (Newbridge Road west)
Existing surveyed traffic	DOS	0.900
	LOS	C
Weekday pm peak hour (4.00 to 5.00 pm)	Average delay	36.3 s
	Maximum queue length (approach)	284 m (Newbridge Road east)

No existing situation intersection capacity analysis has been undertaken for the Brickmakers Drive and Link Road intersection as there are no existing turning traffic volumes to consider in an intersection capacity analysis.

2.6 Car parking

On-street car parking is generally not permitted on most of the major roads in the locality such as Newbridge Road, Nuwarra Road or on Brickmakers Drive due to the peak hour traffic capacity requirements for these roads. However, some on-street parking is permitted along a short 100 m length

on the western side of Brickmakers Drive, between approximately 150 to 250 m south of the Newbridge Road intersection. From direct observations, this on-street parking is rarely used.

2.7 Pedestrian and cycling access

Brickmakers Drive only has continuous pedestrian footpaths along the western side, north of the proposed Link Road intersection. On the eastern side, pedestrian and cycling access is only generally feasible to the Georges River foreshore in the Moorebank East locality from Davy Robinson Drive currently.

2.8 Public transport access and services

The East Moorebank area near Newbridge Road is currently well serviced by public transport, in particular by the M90 high frequency bus route. This route provides the main connection by public transport from the Newbridge Road area to other connecting bus services and train services at the Liverpool, Bankstown and Burwood rail stations.

The most accessible eastbound and westbound bus stops to the site are located on Newbridge Road, about 100 m west of the Brickmakers Drive intersection. There are also other eastbound and westbound bus stops located on Newbridge Road near the Plant Nursery, approximately 400 m east of the Brickmakers Drive intersection, but there are no facilities for pedestrians to cross Newbridge Road there.

As the walking distances from future residential development on the Georges Cove Marina site will be generally further than the optimum (up to 400 metres) walking distance for easy and convenient access to bus services, this accessibility constraint should be reflected in the assumed future traffic generation rates for residential development on the site which will be more consistent with the traditional RTA/RMS Guide (2002) traffic generation rates for medium density residential development, than other more recently published RMS (2013) rates for higher density residential development, which would not be generally applicable in this locality.

2.9 Other developments in the locality

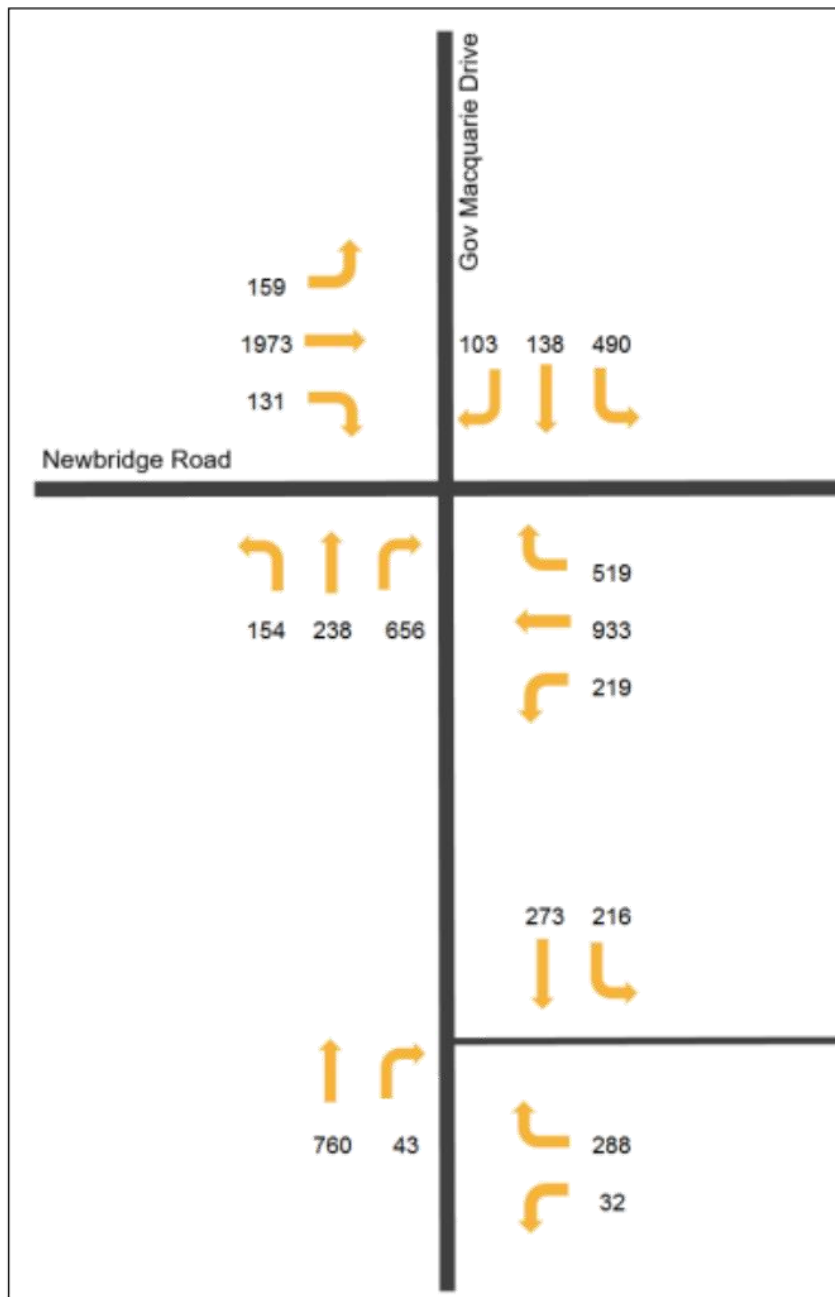
As has been noted in the introduction (Section 1.1), in addition to the Georges Cove marina planning proposal for residential development, a number of other known and approved developments in the Moorebank East locality are considered in this transport planning assessment report. These developments are:

- The completion in October 2016 of the Georges Fair residential estate with over 1,000 dwellings;
- The future completion of the approved Brighton Lakes residential estate (310 dwellings) and clubhouse redevelopment;
- The future Georges Cove Marina Development (as assessed by the EMM transport planning report in July 2015);
- The commencement of traffic operations for the approved Moorebank Recyclers development south of the proposed Georges Cove Marina (which generates mainly truck traffic);
- The proposed new mixed use commercial (7,310 sqm GFA) and residential (171 dwellings) developments on the B6 Enterprise Corridor zoned land which is owned by Benedict and has frontage to Newbridge Road, and.

- The proposed Moorebank Cove Residential Estate (179 dwellings).

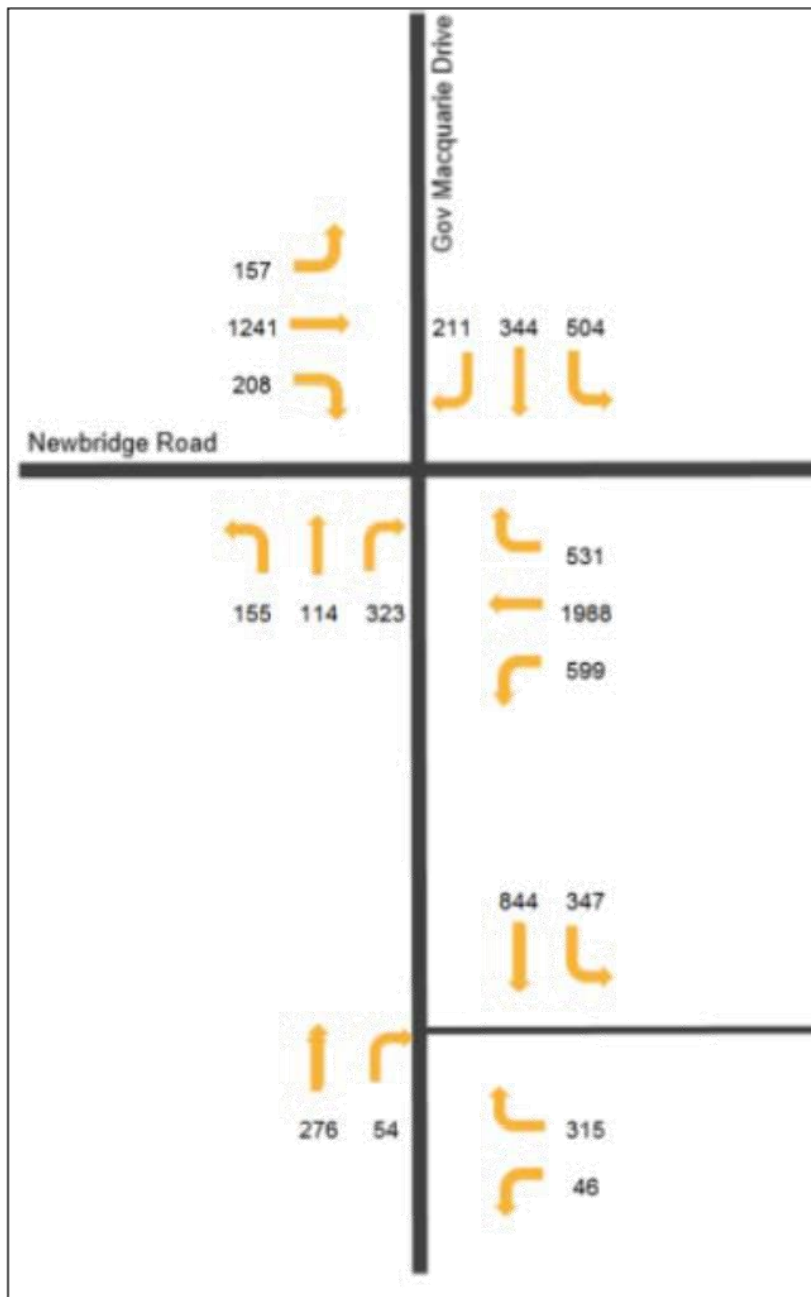
The estimated future peak hourly baseline traffic movements from all these developments (*except for the future Marina residential apartments with reduced commercial uses which is the subject of this planning proposal*) have been determined by (Ason, 2017) from the respective development application and planning proposal traffic reports for each development.

The future baseline traffic flows within the locality including these developments (but *excluding the future Marina residential traffic associated with this planning proposal*) are summarised in Figures 2.3 and 2.4.



Source: Ason (2017)

Figure 2.3 Future adjusted baseline morning peak hour traffic flows



Source: Ason (2017)

Figure 2.4 Future adjusted baseline afternoon peak hour traffic flows

3 Planning proposal

3.1 Site layout and DCP road network

The local road and footpath/cycleway network within and through the future Georges Cove Marina site are shown in Figure 3.1. The vehicle access to the main basement car parking area will be via driveways on the western and southern sides of the building. The proposed site car parking areas are shown in Figure 3.2.

The proposed local road layout for the future Georges Cove Marina continues on from the recommended DCP road layout, extending the 'collector street' south from the alignment which is shown in Figure 1.2. Minor changes to the other DCP recommended local road layout in Figure 1.2 are also proposed as part of the adjacent Moorebank Cove residential estate.



Source: Mirvac

Figure 3.1 Proposed site building layout plan



Source: Mirvac

Figure 3.2 Proposed location of car parking areas

The proposed changes to the DCP recommended local road layout are addressed in more detail in the Moorebank Cove Residential Estate Addendum Traffic Report (November 2017), as these are more closely related to that proposal. However, the principal changes relevant to the marina development are as follows:

- A three-way intersection is proposed by Mirvac at the eastern end of the Link Road Bridge instead of a four-way intersection.
- The main site 'collector road' along the western site boundary is proposed to be modified to accommodate a 3 metre wide service road along the drainage easement at the lower level and the angled face of the retaining wall between the two levels. This additional requirement changes the standard 20 metre wide DCP corridor road cross section to the following configuration:
 - 3.0 m wide service road easement at the lower level;
 - 1.0 m wide angled face and top of retaining wall including guardrail;
 - 2.5 m wide parking lane along the western side of the roadway;
 - 3.5 m wide travel lane in the northbound direction;
 - 3.5 m wide travel lane in the southbound direction;
 - 2.5 m wide parking lane along the eastern side of the roadway; and
 - 4.0 m wide verge including cycleway/footpath along the eastern side of the roadway.

3.2 Link road and access intersection to Brickmakers Drive

The proposed intersection design for the Link Road intersection on Brickmakers Drive includes provision for traffic signals. The locations of the traffic signal posts, the intersection signage and line markings will be determined as part of detailed design of the intersection.

The future performance of the intersection including traffic signals has been assessed in this report for both the future locality baseline traffic and the future predicted total traffic (*including the marina residential planning proposal*) traffic scenarios, as defined in Section 1.4. For both these traffic scenarios, the combined future peak hourly traffic movements which would be generated at the Brickmakers Drive/Link Road intersection and the Newbridge Road/Governor Macquarie Drive/Brickmakers Drive intersection have been assessed using the SIDRA 7 linked intersection model with a 140 second cycle time for both intersections, as has been requested by the RMS submission in Section 1.2. The full submission is included in Appendix A.

3.3 Collector road intersection

The main new 'collector road' intersection, via which all the future Georges Cove Marina site traffic will access the new Link Road and Brickmakers Drive is now proposed to be a three way T-intersection instead of the four way roundabout which is shown in the DCP road network, Figure 1.2.

The future operating performance for this intersection has been assessed in more detail in the Moorebank Cove Residential Estate Addendum Traffic Report (November 2017), for both roundabout and T-Intersection operations, using the SIDRA 7 intersection model. The analysis has shown the proposed intersection operating as either a roundabout or a T-intersection has adequate traffic capacity for the

future total traffic generated by all the assessed locality developments (*including the future residential apartments and terraces in the Georges Cove marina which would be enabled by this planning proposal*).

3.4 Pedestrian and cycling access

The proposed future pedestrian and cycleway routes for access through and within the future Georges Cove Marina development (including proposed residential sections) are shown on Figure 3.1.

To the north of the Marina site, a combined pedestrian and cycle access path will be constructed along the northern side of the proposed Link Road bridge for access to and from Brickmakers Drive. This route will be the primary pedestrian and cycle access route connecting between the residential estate, Brickmakers Drive and Newbridge Road.

The proposed traffic signals at the Brickmakers Drive/Link Road intersection will also assist pedestrians to safely and easily cross Brickmakers Drive at this location to reach Newbridge Road by walking along the footpath which is on the western side of Brickmakers Drive, between the future Link Road intersection and Newbridge Road.

Additionally, a future foreshore pedestrian and cycleway path will extend south from Davy Robinson Drive along the Georges River foreshore, linking with the Moorebank Cove residential estate, the Georges Cove Marina and other areas along the foreshore further to the south. The future proposed network of pedestrian and cycle paths will connect the marina (and residential estate) with Newbridge Road at multiple locations, which will provide good pedestrian and cycle access connections for access to public transport at Newbridge Road and for local pedestrian access to the Georges River foreshore, where this access is currently not available.

3.5 Access to public transport

Depending on the walking route used, most parts of the Georges Cove Marina site will be approximately 700 to 900 m walking distance from the nearest existing M90 bus route stops on the southern side of Newbridge Road. The route up Brickmakers Drive is a relatively easy walk – it is flat and is provided with a good footpath on the western side and road barriers on the eastern side.

The M90 route provides high frequency bus services for the Moorebank area with a weekday service frequency of about 10 minutes during peak hours and about 20 minutes during daytime off-peak hours on weekdays, Saturdays, Sundays and public holidays. The M90 bus route also provides connections to other bus routes and train services via the Liverpool, Bankstown and Burwood railway stations, which connect to other destinations throughout the Sydney metropolitan area, including the Sydney central business district.

The M90 bus route will provide adequate public transport accessibility for the Georges Cove Marina site and there will be no additional requirement for any existing bus services or new bus route to be extended to connect directly to the site to serve future residential apartments and terraces there.

Another bus route in the locality also connects to the Liverpool CBD and railway station (route 902) passes through other areas of East Moorebank (through the Georges Fair and adjacent to the Brighton Lakes residential estates). However, the nearest bus stops on this route are at least 1 km walking distance from the Georges Cove Marina site so this bus route will not generally be usable for the future residents of the potential Marina residential apartments and terraces.

4 Traffic assessment at intersections

4.1 Traffic generation and distribution

The adjacent Moorebank Cove residential estate traffic volumes and the traffic volumes for the other proposed and approved developments which are included in the future baseline traffic analysis for this report have been determined from a combination of previous EMM and Ason Group traffic report calculations (EMM, 2015) (EMM, 2016) (Ason, 2017) and are summarised in Table 4.1.

Table 4.1 Daily and peak hourly traffic generation for related baseline developments

Land use	Time Period	Traffic generation rate	Proposed development land use units and floor areas	Daily vehicle movements
Georges Cove Marina commercial uses	Daily	EMM Estimate	As per report	1,289
As proposed (EMM 2015)	Morning Peak Hour	Varies	As per report	98
	Afternoon Peak Hour	Varies	As per report	197
Moorebank Recyclers Development	Daily	EMM Estimate	As per report	360
	Morning Peak Hour	Varies	As per report	43
	Afternoon Peak Hour	Varies	As per report	29
Moorebank Cove residential estate	Daily	9.0 per dwelling	179 dwellings	1,610
	Morning Peak Hour	0.85 per dwelling	179 dwellings	152
	Afternoon Peak Hour	0.85 per dwelling	179 dwellings	152
Benedict B6 Land mixed use development (for traffic access via Brickmakers Drive)	Daily	EMM Estimate	As per report	3,410
	Morning Peak Hour	Varies	As per report	296
	Afternoon Peak Hour	Varies	As per report	386

Source: EMM (2015); Ason (2017).

For the daily traffic volumes and the weekday peak hour traffic volumes for the future Georges Cove marina residential planning proposal and the corresponding reductions in the previously proposed marina commercial land uses, the future traffic volumes have been calculated using NSW standard traffic generation rates for the relevant residential densities (RTA, 2002).

The corresponding net additional daily and peak hourly traffic volumes are listed in Table 4.2.

Table 4.2 Daily and peak hourly traffic generation for the planning proposal changes

Land use	Time Period	Traffic generation rate	Proposed development land use units and floor areas	Daily vehicle movements
Reduction in the Georges Cove Marina commercial uses	Daily	EMM Estimate	As per report	-734
	Morning Peak Hour	Varies	As per report	-61
	Afternoon Peak Hour	Varies	As per report	-86
Potential additional Georges Cove Marina residential uses	Daily	4.83 per dwelling	374 dwellings	1,810
	Morning Peak Hour	0.483 per dwelling	374 dwellings	181
	Afternoon Peak Hour	0.483 per dwelling	374 dwellings	181

Source: EMM (2015); EMM (2016); RTA (2002).

This transport planning assessment report specifically provides additional traffic analysis in response to the RMS and Transport for NSW requirements (Appendix A) which have requested more detailed “linked” intersection analysis for the future operation of the two Brickmakers Drive intersections.

Also, the combined additional daily traffic volumes from all the potential and approved developments which are listed in Table 4.1 and Table 4.2 provides a useful basis for the future apportionment of the construction costs for the installation of traffic signals at the Brickmakers Drive/Link Road intersection, whereby each development could contribute financially in the future based on their respective daily traffic movements using this access route.

The future baseline developments in Table 4.1 are all included in the Ason traffic report (Ason, 2017) from which the traffic flow plots are shown in Figures 2.3 and 2.4 of this report. These plots include all the future development traffic from:

- the future Georges Cove Marina Development (as assessed by the EMM transport planning report in July 2015);
- the approved Moorebank Recyclers Development, and
- the proposed low density Moorebank Cove Residential Estate (which was conservatively assumed by Ason to be 190 rather than 179 dwellings), and
- the Benedict B6 land developments which were the primary focus of the Ason report.

The net future additional traffic volumes from the Georges Cove Marina planning proposal for 374 dwellings (which is the subject of this report) and the corresponding reduction in the future marina commercial land uses, are shown on Figure 4.1 and Figure 4.2. The actual additional morning and afternoon peak hourly residential traffic movements which are shown on Figure 4.1 and Figure 4.2 are based on 376 rather than 374 new dwellings, but there is a difference of only one vehicle between the peak hourly generated traffic volumes for both situations, which is minimal.

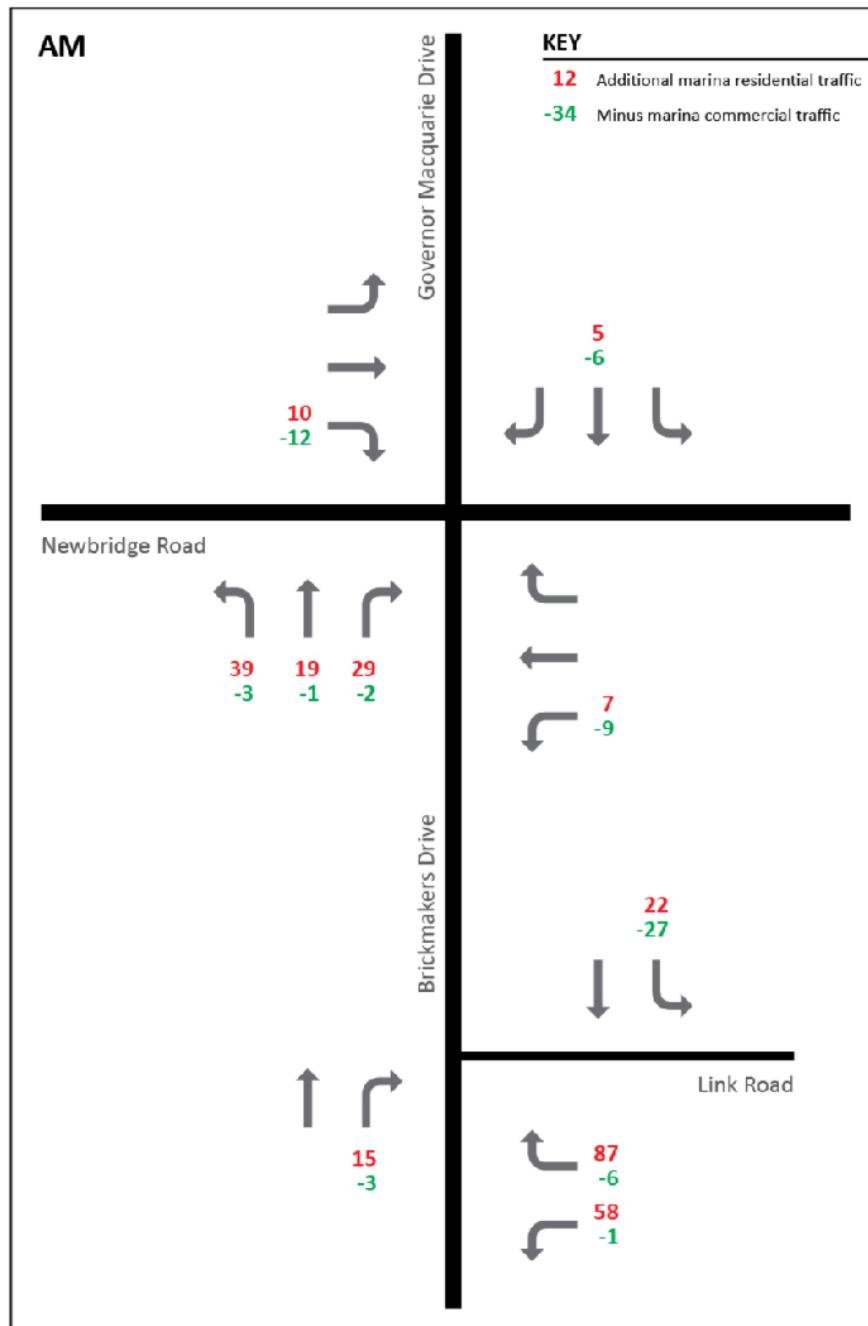


Figure 4.1 Proposed future marina residential traffic and reduced commercial traffic (am peak hr)

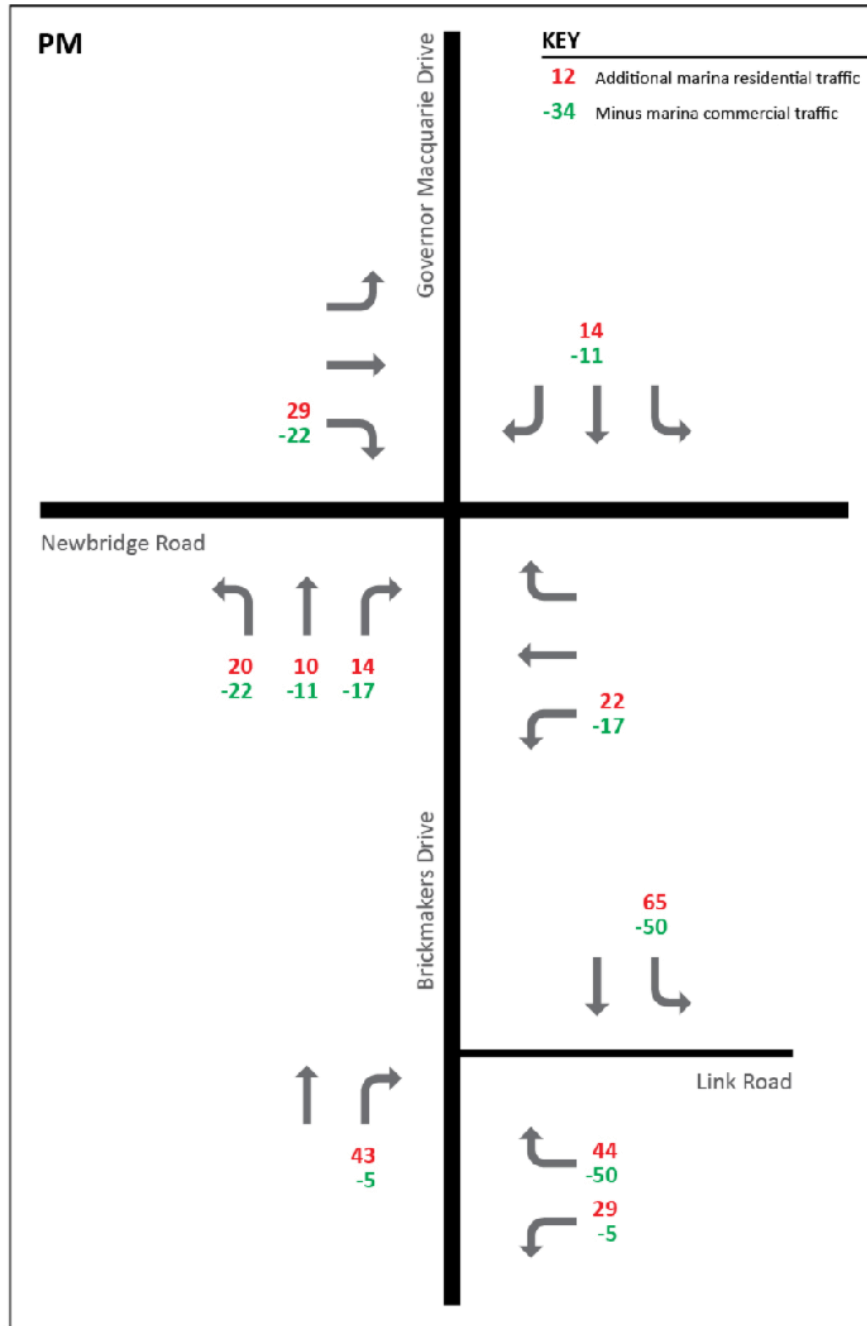


Figure 4.2 Proposed future marina residential traffic and reduced commercial traffic (pm peak hr)

4.2 Impacts at intersections

The future linked intersection operating performance of the two intersections at Brickmakers Drive/Link Road and Newbridge Road/Governor Macquarie Drive/Brickmakers Drive has been assessed using the SIDRA 7 model with a 140 second cycle time for both intersections.

The primary modified feature of the new linked intersection design, which is shown in Figure 4.3, is that two continuous traffic lanes are required in the future on Brickmakers Drive northbound, between the two intersections, which are 300 m apart. Provisionally, it is considered that this change to the road configuration could be achieved by re-line-marking the existing road carriageway.

The two future traffic generation scenarios for the locality which have been assessed are described in Section 1.4. The first scenario (future baseline traffic) assesses the future additional baseline traffic volumes for the locality incorporating the range of other developments for which the traffic details are summarised in Table 4.1. The second scenario (future total traffic) represents a cumulative analysis of the surrounding developments' traffic generation with the future Georges Cove Marina residential planning proposal traffic which is calculated in Table 4.2.

The existing SIDRA 'unlinked' intersection results for the existing intersection operation for the Newbridge Road/Governor Macquarie Drive/Brickmakers Drive intersection are shown in Appendix B. The full future SIDRA 'linked' intersection output results for the two future traffic generation scenarios considered are shown for the two linked Brickmakers Drive intersections in Appendices C and D.

4.3 Brickmakers Drive and Link Road intersection

The intersection analysis results for the Brickmakers Drive and Link Road intersection for the two future traffic generation scenarios are presented in Table 4.3.

Table 4.3 Brickmakers Drive/Link Road intersection performance

Peak hour	Operation	(Future base traffic) Intersection performance	(Future total traffic) Intersection performance
Weekday am peak hour (8.00 to 9.00 am)	DOS	0.891	0.888
	LOS	C	C
	Average delay	31.4 s	35.0 s
	Maximum queue length (approach)	159 m (Link Road east)	196 m (Link Road east)
Weekday pm peak hour (4.00 to 5.00 pm)	DOS	1.036	1.144
	LOS	D	D
	Average delay	42.7 s	55.5 s
	Maximum queue length (approach)	343 m (Brickmakers Drive north)	349 m (Brickmakers Drive north)

The results in Table 4.3 show the future Link Road traffic signal controlled intersection operation will be at the same Level of Service (either C or D) for both future traffic scenarios. The proposed future Link Road intersection design is considered to be suitable for both these future locality traffic generation scenarios.

With the highest future peak hour traffic generation scenario, which includes the Marina residential planning proposal traffic, the future intersection operation will be at Level of Service C during the morning traffic peak hour, but will deteriorate to Level of Service D (average traffic delay 55.5 seconds per vehicle) during the afternoon traffic peak hour.

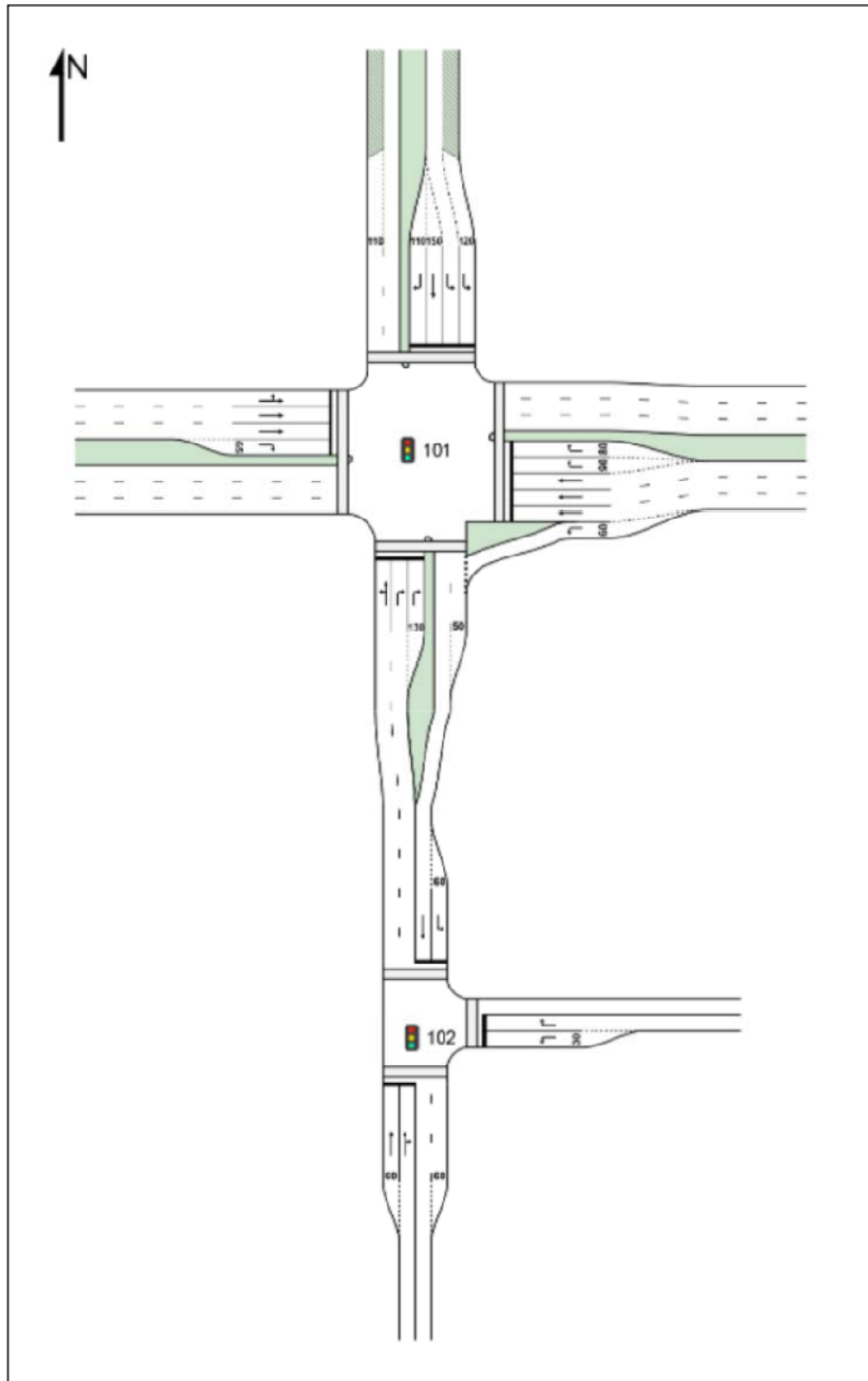


Figure 4.3 Proposed Link Road and Newbridge Road connections at Brickmakers Drive

The maximum future intersection traffic queue lengths which are shown in Table 4.3 will typically occur on either the Brickmakers Drive (north) or the Link Road (east) intersection approaches. During the future morning peak traffic periods, the maximum intersection traffic queue will typically occur on the Link Road (east) intersection approach and may reach 200 m. During the future afternoon peak traffic periods, the maximum intersection traffic queue will typically occur on the Brickmakers Drive (north) intersection approach and may exceed 340 m.

Further details of the predicted intersection maximum (95 percentile) traffic queue lengths for all the intersection approaches for all the morning and afternoon peak hour traffic scenarios considered are included in the detailed SIDRA intersection analysis results for each scenario in Appendices C and D.

4.4 Newbridge Road, Governor Macquarie and Brickmakers Drives intersection

The intersection analysis results for the Newbridge Road/Governor Macquarie Drive/Brickmakers Drive intersection for the two traffic generation scenarios considered are presented in Table 4.4.

Table 4.4 Newbridge Road/Governor Macquarie/Brickmakers Drive intersection performance

Peak hour	Operation	(Future base traffic) Intersection performance	(Future total traffic) Intersection performance
Weekday am peak hour (8.00 to 9.00 am)	DOS	1.125	1.168
	LOS	F	F
	Average delay	124.2 s	137.8 s
	Maximum queue length (approach)	707 m (Newbridge Road west)	772 m (Newbridge Road west)
Weekday pm peak hour (4.00 to 5.00 pm)	DOS	1.042	1.043
	LOS	F	F
	Average delay	84.9 s	85.8 s
	Maximum queue length (approach)	647 m (Newbridge Road east)	648 m (Newbridge Road east)

The results in Table 4.4 show that this intersection will be operating at relatively congested traffic conditions, with a consistent future Level of Service F for the intersection operations during both the morning and afternoon peak hour traffic conditions for the two traffic scenarios considered.

With the highest future peak hour traffic generation scenario, which includes the Marina residential planning proposal traffic, the future intersection operation will be at Level of Service F during both the morning and the afternoon traffic peak hour traffic conditions, and the average traffic delays will be 138 and 86 seconds per vehicle respectively during the morning and afternoon traffic peak hour periods,

These high predicted future intersection delays, when all the predicted future development traffic is included in the analysis, are not exceptionally high when compared with other high traffic queuing delays which can occur at many other large four way traffic signal controlled intersections on the major arterial road routes through the Sydney Region, during both the morning and afternoon traffic peak hours.

At the Newbridge Road/Brickmakers Drive intersection the predicted future intersection traffic delays in Table 4.4, although high, are still considered to be acceptable as within a short term future period, additional vehicle access routes are likely to be established to Newbridge Road in the Moorebank East locality (either via the adjoining B6 development land or via Davy Robinson Drive) which will then reduce these high predicted average intersection delays and generally improve the future peak hour levels of service at Newbridge Road/Brickmakers Drive intersection.

In the interim period the predicted future intersection traffic queue lengths which are shown in Table 4.4, will typically occur on either the Newbridge Road (west) or the Newbridge Road (east) intersection approaches. During the future morning peak hour the maximum traffic queue will occur on the Newbridge Road (west) intersection approach and may exceed 770 m. During the future afternoon peak hour the maximum intersection traffic queue will occur on the Newbridge Road (east) intersection approach and may exceed 640 m.

Further details of the predicted future maximum (95 percentile) intersection traffic queue lengths for each intersection approach, for all the morning and afternoon peak hour traffic scenarios considered, are provided in the detailed SIDRA intersection analysis results for each scenario in Appendices C and D.

4.5 Car parking

The future layout of proposed car parking areas on the site will provide a total of 624 car parking spaces in three separate areas of the site as follows (these areas are shown on the map in Figure 3.2):

- 532 car parking spaces in the main basement car parking areas (Area A)
- 30 car parking spaces provided in surface car parking for the residential terraces (Area B)
- 62 car parking spaces in the southern surface car parking area (Area C)

Taken collectively, these areas will potentially provide adequate car parking capacity for all the predicted future residential, marina and commercial employee and visitor car parking for the overall marina site, which has been calculated by EMM as summarised in Table 4.4 below. The calculation is based on the various car parking rates for the various development components which are contained in the RTA/RMS Guide to Traffic Generating Developments, 2002.

Table 4.3 Analysis of overall Marina site recommended parking requirements and provisions

Function	Description	Requirement ^{1,2,3,4,5}	Spaces Required
353 apartment dwellings	96 x 1 bedroom	0.5 space per apartment ¹	48
	189 x 2 bedroom	1.0 spaces per apartment ²	189
	68 x 3 bedroom	1.3 spaces per apartment ¹	88
Residential visitor parking	353 dwellings	0.2 spaces per dwelling ³	71
21 terrace dwellings	Combination of Types	Either 1 or 2 spaces per terrace ³	30
Marina wet berths	186 boats	0.6 spaces per berth ⁴	111
Marina dry Berths	250 boats	0.2 spaces per berth ⁴	50
Commercial development	1,243 m ²	1 space per 40 m ² ⁵	32
Total	All areas	Various	620

Notes: 1. Based on RMS Guide rate for higher density residential developments.
 2. Based on RMS Guide rate between medium and higher density for medium density residential developments.
 3. Based on RMS Guide rate for medium density residential development
 4. Based on RMS Guide rates for marina wet berths and dry boat storage
 5. Based on RMS Guide rate for commercial development

4.6 Pedestrian and cycling access

The combined pedestrian and cycle access path which is proposed along the northern side of the Link Road overbridge connection to Brickmakers Drive will be 2.5 m wide, which will meet the Liverpool DCP 2008 (Part 2.10) pedestrian and cycle path design requirements.

The future local street footpath widths within the marina development will be adequate for the anticipated future levels of pedestrian movement and circulation within the residential area, including cycling access through the marina development, between the Brickmakers Drive Link Road connection and the Georges River foreshore.

Future bicycle parking, where this is required in the streets of the marina development will be designed in accordance with the applicable Council, RMS, Austroads and Australian Standard design requirements.

4.7 Public transport services

The future site dwellings will typically be 700 to 900 m walking distance from the nearest existing bus stops on Newbridge Road for the M90 bus route, which will also provide connections to rail services and other bus services at a number of major metropolitan railway stations, such as Liverpool, Bankstown and Burwood.

The M90 bus route provides adequate public transport accessibility for the future planning proposal residential uses. This is reflected by the use of the historic RTA/RMS Guide traffic generating rates from 2002 for medium density residential development, in assessing the future development traffic generation and car parking rates for the future Marina site residential uses, in preference to the other more recent (but lower) traffic generation rates which were recommended by RMS in 2013 for use with proposed higher density residential developments in the more urbanised areas of Sydney, which have more direct access to existing rail services.

5 Summary and conclusions

5.1 Site access and traffic circulation

The proposed vehicle access route for the assessed Georges Cove Marina residential additions (374 dwellings with reductions to the future Georges Cove Marina commercial uses) will be the same as for the approved Georges Cove Marina development, which is via the DCP Link Road and bridge from Brickmakers Drive.

This transport planning assessment report has analysed the future planning proposal for residential development in conjunction with the surrounding proposed, approved and completed projects in the locality, which are:

- The Georges Fair residential estate with over 1,000 dwellings (completed in October 2016);
- The future completion of the approved Brighton Lakes residential estate (310 dwellings) and clubhouse redevelopment;
- The future Georges Cove Marina (as assessed by the EMM transport planning report in July 2015):
- The commencement of traffic operations for the approved Moorebank Recyclers development south of the Marina site (which will generate mainly truck traffic);
- The proposed Moorebank Cove Residential Estate (179 dwellings).
- The proposed new mixed use commercial (7,310 sq m GFA) and residential (171 dwellings) developments on the Benedict-owned B6 Enterprise Corridor zoned land fronting Newbridge Road; and

The proposed DCP Link Road will cross over a drainage channel and access easement to the Moorebank Recyclers site, which are at lower levels to the surrounding land, and will intersect with Brickmakers Drive at a location approximately 300 m south of the Newbridge Road/Governor Macquarie Drive/Brickmakers Drive intersection. During construction, the Marina site developments may also utilise temporary vehicle access via the existing Benedict site Newbridge Road access driveway, but all the longer term operations stage access is proposed to utilise the DCP Link Road route.

The primary purpose of this transport planning assessment report has been to undertake a cumulative traffic impacts assessment of the future potential additional Marina site apartments and terrace houses from this planning proposal, with consideration of the other relevant surrounding developments.

Further, the report specifically addresses the traffic impact assessment requirements which have been requested by the NSW Government transport agencies, which primarily require:

- A detailed linked intersection traffic analysis of the proposed traffic signals at Brickmakers Drive/Link Road intersection in conjunction with Newbridge Road/Governor Macquarie Drive/Brickmakers Drive intersection using the SIDRA 7 intersection model and a 140 seconds intersection cycle time for both these intersections;
- A detailed cumulative traffic impacts analysis of the proposed Georges Cove residential component in conjunction with the latest information which is known in relation to other proposed and approved developments in the Moorebank East DCP area; and

- An assessment of the proposed locality public transport and pedestrian/ cycleway access routes, in conjunction with the assumed future traffic generation rates and the availability of public transport access utilising the M90 bus route services for the future residents of new residential developments in the Moorebank East DCP area.

5.2 Assessment of traffic impacts on intersections

There have been significant recent traffic changes in the Moorebank East locality since the M5 West Motorway Widening which was completed in December 2014, which have reduced the previously higher regionally based east-west traffic flows which were using Newbridge Road in this locality.

In this transport planning assessment report, the adjusted future baseline traffic volumes from the surrounding traffic generating developments have been assessed, and the effects of the Georges Cove Marina planning proposal for additional residential development (374 dwellings with reductions in the future Marina Commercial uses) have been assessed in a cumulative traffic impact assessment scenario for the planning proposal.

At the Brickmakers Drive/Link Road intersection, which has been assumed to have traffic signal controlled operations for all the future development traffic scenarios considered, the future intersection operations will remain at or below Level of Service C during the morning peak hour, but will increase to Level of Service D during the afternoon traffic peak hour, under the highest (cumulative) future traffic generation scenario.

The existing Newbridge Road/Governor Macquarie Drive/Brickmakers Drive intersection operations have been determined by Ason (2017). The intersection is currently operating in the near capacity (LOS D) or satisfactory (LOS C) traffic congestion ranges during the morning and afternoon peak traffic hours. This shows the intersection has some spare traffic capacity to accommodate additional peak hour traffic growth from new residential and other developments in the Moorebank East locality as is assessed in this report.

Under both these future traffic scenarios, the future Newbridge Road/Governor Macquarie Drive/Brickmakers Drive intersection operations will be a consistent Level of Service F during both the morning and afternoon peak hour traffic periods. However, these future intersection delays would be no worse than the delays which previously occurred prior to 2015, when there were higher traffic volumes using Newbridge Road prior to the recent M5 West motorway widening.

Also, the predicted future Level of Service F intersection delays, when all the predicted future development traffic is included in the analysis, are not exceptionally high when compared with the other high traffic queuing delays which can also occur at many other large four way traffic signal controlled intersections on the major arterial road routes through the Sydney Region, during both the morning and afternoon traffic peak hours on most weekdays.

Within a short term future period, additional vehicle access routes are likely to be established to Newbridge Road in the Moorebank East locality (either via the adjoining B6 development land or via Davy Robinson Drive) which will then reduce these high predicted average intersection delays and generally improve the future peak hour levels of service at Newbridge Road/Brickmakers Drive intersection.

It is not recommended that any further intersection widening be undertaken on the Brickmakers Drive route as the required future additional traffic capacity within the local Moorebank East DCP area should preferably be provided via the additional future DCP road connection to Davy Robinson Drive, which can then provide additional access to Newbridge Road for the developments east of Brickmakers Drive.

This future additional access to Newbridge Road requirement utilising Davy Robinson Drive has always been foreshadowed since the original 2008 Moorebank East DCP road network was proposed and has also now been identified by the Benedict owned B6 land planning proposal traffic report (Ason, 2017) which has identified that the additional vehicle access via Davy Robinson Drive will need to be provided to fully accommodate the predicted future generated traffic volumes from that site.

5.3 Assessment of car parking

There will be sufficient car parking area available for the maximum future Marina site combined car parking demand with the proposed combination of one basement level and two surface car parking areas which would provide the required total number of car parking spaces (at least 620) for the future potential combined residential, commercial and marina recreational uses at the site, in accordance with the standard RTA/RMS guideline car parking rates for the identified development components.

The residential visitor car parking capacity will generally also be provided in the underground parking area and the other marina and general commercial visitor car parking demand will mainly utilise the additional surface car park which is proposed in the southern portion of the site.

5.4 Assessment of pedestrian and cycling access needs

The proposed local street footpath widths within the marina development and the waterside paths will be adequate for the anticipated future levels of pedestrian movement and circulation within the marina area, and on the Georges River foreshore on the eastern boundary.

For the external pedestrian and cycleway route connections, appropriate connections will be provided to the marina development, including access to Brickmakers Drive west of the site.

5.5 Assessment of public transport access

The majority of the future Georges Cove marina residential dwellings lots will be within 700 to 900 m level walking distance from the nearest existing bus stops on Newbridge Road for the M90 bus route.

There is appropriate existing public transport access currently available via the M90 bus route, for the future site residents and other visitors.

References

Ason (2017) Traffic Impact Assessment; Planning Proposal; Benedict Sands, 146 Newbridge Road, Moorebank. 9 October 2017.

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EMM (2016) Moorebank Cove Residential Estate, Traffic Assessment Version 3, report prepared for Mirvac Pty Ltd, 14 December 2016.

GHD (2011), *New Brighton Golf Club, Transport Assessment*, report prepared for New Brighton Golf Club, June 2011.

GHD (2014), *New Brighton Golf Club, Proposed Clubhouse, Traffic Impact Assessment*, report prepared for Mirvac Homes (NSW) Pty Ltd, March 2014.

Roads and Traffic Authority (2002), *Guide to Traffic Generating Developments*.

Appendix A

NSW Transport Agency Submissions

EGROW 03 Planning proposal request to rezone land from RE2 (Private Recreation) to R3 (Medium Density
Residential) at 146 Newbridge Road, Moorebank
Attachment 1 Planning Proposal Request



14 March 2017

Our Reference: SYD17/00257/01 (A16540016)
Council Ref: DA-24/2017

The General Manager
Liverpool City Council
Locked Bag 7064
LIVERPOOL BC NSW 1871

Attention: **Marcus Jennejohn**

**STAGE 1 SUPERLOT SUBDIVISION, STAGE 2 RESIDENTIAL SUBDIVISION AND
INFRASTRUCTURE WORKS
146 NEWBRIDGE ROAD, MOOREBANK**

Dear Sir/Madam,

Reference is made to Council's letter dated 16 February 2017, regarding the abovementioned application which was referred to Roads and Maritime Services (Roads and Maritime) for comment

Roads and Maritime has reviewed the development application and the following issues are to be addressed prior to the determination of the application:

1. The submitted Environmental Impact Statement indicates that the construction stage is likely to have heavy vehicle movements for deliveries associated with import of road base, asphalt, and concrete kerb work, as well as heavy vehicle movements for the importation of fill. The heavy vehicle movements will therefore be more than 13 truck movements per hour.

The submitted traffic report should address the expected light and heavy vehicle movements for all construction activities at this site, and not just for the importation of fill.

2. Roads and Maritime requests a copy of the traffic volume survey for 1 March 2016.
3. The proponent should carry out traffic modelling to determine the likely traffic impacts on the Newbridge Road/ Brickmakers Drive/Governor Macquarie Drive intersection.
4. Further information is requested from the applicant regarding the proposed 3m wide concrete service vehicle maintenance path arrangement and movements. It is not clear what access arrangements are being provided at the existing Newbridge Road access for service vehicles and pedestrians. It is also not clear whether the proposed service vehicle maintenance path will still be located underneath the elevated road bridge.

Roads and Maritime Services

27-31 Argyle Street, Parramatta NSW 2150 |
PO Box 973 Parramatta NSW 2150 |

www.rms.nsw.gov.au | 131 782

It is understood that all future vehicular access will be via Brickmakers Drive as per previous Roads and Maritime comments dated 18 February 2012 (see attached).

The applicant is advised that the above information is requested to allow Roads and Maritime to complete the assessment of this application. Roads and Maritime may also request further information once the assessment is carried out.

Any inquiries in relation to this Application can be directed to Malgy Coman on 8849 2413 or development.sydney@rms.nsw.gov.au.

Yours sincerely



Rachel Cumming
Senior Land Use Assessment Coordinator
Network and Safety Section



Transport
Roads & Maritime
Services

14 June 2017

Roads and Maritime Reference: SYD17/00547/01 (A17867832)
Council Ref: RZ-2/2015

The General Manager
Liverpool City Council
Locked Bag 7064
LIVERPOOL BC, NSW 1871

Attention: Peter Pham

Dear Sir/Madam,

**PLANNING PROPOSAL TO AMEND LIVERPOOL LOCAL ENVIRONMENTAL PLAN 2008
(AMENDMENT NO. 66)**

I refer to Council's correspondence dated 19 April 2017 regarding the planning proposal to amend Liverpool LEP 2008 (Amendment No. 66) which was referred to Roads and Maritime Services (Roads and Maritime) for comment in accordance with Section 56 (2) (d) of the *Environmental Planning and Assessment Act 1979*. Roads and Maritime appreciates the opportunity to provide comment and apologise for the delay in providing a response.

Roads and Maritime has reviewed the information provided and notes that this planning proposal seeks to amend Liverpool LEP 2008 (Draft Amendment No. 66) at 146 Newbridge Road, Moorebank to allow the following:

- a. An additional permitted residential use within land zoned RE2 Private Recreation; and
- b. A zone boundary adjustment to R3 Medium Density Residential from RE2 Private Recreation for a portion of the land. .

This planning proposal is to include a residential component of 108 apartments and 17 terraced townhouses in addition to the currently approved development mix of marina wet and dry storage berths, clubhouse and bar, function centre with café/kiosk/restaurant uses, boat sales showroom and workshop area. There will be total of 851 car parking at the Marine development site and access would be provided via a link road connecting with Brickmakers Drive with a traffic signal.

Roads and Maritime Services

27-31 Argyle Street, Parramatta NSW 2150 |
PO Box 973 Parramatta NSW 2150 |

www.rms.nsw.gov.au | 13 22 13

Roads and Maritime supports the comments received from the Transport for NSW (TfNSW) in their letter dated 9 May 2017 (copy attached). Roads and Maritime provides the following comments in addition to the issues raised by the TfNSW for Council's consideration:

1. From the submitted traffic impact report it was noticed that only New Link Road & Brickmakers Drive intersection has been analysed. However, due to the proposed development and other adjoining developments there would be a potential impact at Newbridge Road & Brickmakers Drive signalised intersection. Therefore, it is requested to analyse this intersection with cumulative impact from other adjoining developments. The traffic report should identify road infrastructure improvements required (if any) and funding mechanism (such as; VPA).
2. New signalised intersection: the new signalised intersection at New Link Road/Brickmakers Drive should be linked/ connected with existing Newbridge Road/Brickmakers Drive signalised intersection. The new intersection at New Link Road/Brickmakers Drive would need to be modelled at 140 seconds during peak hours.

Thank you for the opportunity to comment on the subject proposal. If you require clarification on the above matter, please contact Ahsanul Amin, A/Senior Strategic Land Use Planner on 8849 2762 or e-mail at development.sydney@rms.nsw.gov.au.

Yours sincerely



Greg Flynn
Program Manager – Land Use



Mr Peter Pham
Strategic Planner
Liverpool City Council
Locked Bag 7064
Liverpool BC
NSW 1871

Dear Mr Pham

Draft Liverpool Local Environment Plan 2008 (Amendment No. 66)

Thank you for your letter dated 19 April 2017 inviting Transport for NSW (TfNSW) to review and comment on the above. Roads and Maritime Services (RMS) may provide a separate response.

Transport for NSW has reviewed the documentation submitted in support of the subject proposal and provides the following comments. Detailed comments on the traffic study in support of the proposal are provided in the attached annexure.

- TfNSW notes that the proposal's access to public transport is outside the 400m catchment. The only public transport available to service the site is route M90, which operates at approximately 650m to 800m from the site via Newbridge Road. It is recommended that appropriate pedestrian and cycle links be provided between Brickmakers Drive and Newbridge Road and to be integrated with the public transport network. Any such link should be at a width of 3.0m.
- The Council's Development Control Plan (Part 2.10) has proposed a road network in conjunction with the land uses listed in the Local Environment Plan. The proposal seeks to permit residential use of 108 apartments and 17 terraced townhouse in addition to the approved Marina site development (land zoned RE2). The traffic study in support of this proposal indicates the traffic generation of these added residential components shall not pose significant traffic impact. TfNSW recommends that the traffic study should take into consideration of the cumulative traffic impact from the adjoining properties including but not limited to the Mirvac residential estate, potential redevelopment of the plant nursery site and the proposed concrete recycling facilities.

If you require further clarification regarding this matter, please contact Billy Yung, Senior Transport Planner on 8202 3291 or via email at Billy.Yung@transport.nsw.gov.au.

Yours sincerely

A handwritten signature in black ink, appearing to read "Mark Ozinga".

9/5/17

Mark Ozinga
Principal Manager, Land Use Planning and Development
Freight Strategy and Planning

Objective Reference CD17/04662

Transport for NSW

18 Lee Street, Chippendale NSW 2008 | PO Box K659, Haymarket NSW 1240
T 02 8202 2200 | F 02 8202 2209 | W transport.nsw.gov.au | ABN 18 804 239 602

Annexure – Detailed Comments on Transport Planning Assessment Report**Background traffic data**

The traffic study is based on traffic survey data obtained in 2013 with an adjustment to account for approximated additional residential traffic movements using Brickmakers Drive from the completion of the George Fair residential estate development. It is recommended to obtain updated traffic survey data to more realistically reflect the current traffic condition with the largely completed George Fair development. It is essential to understand the current traffic condition at the intersection of Newbridge Road with Governor Macquarie Drive and Brickmakers Drive which is the primary access to the Marina site.

Cumulative traffic impact from adjoining properties

The traffic study had identified the adjoining properties including the Mirvac residential estate, potential redevelopment of the plant nursery site and the proposed concrete recycling facilities which would potentially share their vehicular access with the Marina site via the link road intersection. It is recommended that the traffic impact assessment should take into consideration the cumulative traffic impact from these adjoining properties to understand the overall traffic implication to the link road intersection and Brickmakers Drive. It is noted that the intersection performance indicates a maximum traffic peak hour queue length of 199m in the southbound direction on Brickmakers Drive with consideration of traffic generated by the Marina site. A longer queue length might occur with the inclusion of traffic generated by the adjoining properties and affect the traffic operation at the intersection of Newbridge Road with Governor Macquarie Drive and Brickmakers Drive. Similarly a longer queue might occur on the link road and affect the traffic operation of the proposed roundabout located approximately 110m to the east of the link road intersection.

Appendix B

Existing Intersection SIDRA Analysis Results

EGROW 03 Planning proposal request to rezone land from RE2 (Private Recreation) to R3 (Medium Density
Residential) at 146 Newbridge Road, Moorebank
Attachment 1 Planning Proposal Request

LANE SUMMARY

Site: 101 [GMD/Newbridge AM Existing]

Newbridge Road / Gov Macquarie Drive / Brickmakers Drive
 Signals - Fixed Time Isolated Cycle Time = 150 seconds (Practical Cycle Time)
 Variable Sequence Analysis applied. The results are given for the selected output sequence.

Lane Use and Performance													
	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Brickmakers Drive													
Lane 1	186	5.0	302	0.615	100	63.4	LOS E	12.8	93.4	Short	120	0.0	NA
Lane 2	264	5.0	299	0.883	100	82.9	LOS F	21.4	156.4	Short	140	0.0	NA
Lane 3	264	5.0	299	0.883	100	82.9	LOS F	21.4	156.4	Full	500	0.0	0.0
Approach	714	5.0		0.883		77.8	LOS F	21.4	156.4				
East: Newbridge Road													
Lane 1	172	5.0	1570	0.110	100	7.4	LOS A	1.1	8.4	Short	70	0.0	NA
Lane 2	311	5.0	1032	0.301	100	19.4	LOS B	12.1	88.0	Full	500	0.0	0.0
Lane 3	311	5.0	1032	0.301	100	19.4	LOS B	12.1	88.0	Full	500	0.0	0.0
Lane 4	311	5.0	1032	0.301	100	19.4	LOS B	12.1	88.0	Full	500	0.0	0.0
Lane 5	260	5.0	287	0.904	100	89.7	LOS F	21.8	158.9	Short	95	0.0	NA
Lane 6	260	5.0	287	0.904	100	89.7	LOS F	21.8	158.9	Short	80	0.0	NA
Approach	1624	5.0		0.904		40.6	LOS C	21.8	158.9				
North: Gov Macquarie Drive													
Lane 1	245	5.0	514	0.477	100	52.9	LOS D	14.7	107.6	Short	125	0.0	NA
Lane 2	245	5.0	514	0.477	100	52.9	LOS D	14.7	107.6	Full	500	0.0	0.0
Lane 3	83	5.0	164	0.507	100	74.1	LOS F	6.0	43.8	Short	145	0.0	NA
Lane 4	103	5.0	167	0.615	100	78.7	LOS F	7.5	54.9	Short	75	0.0	NA
Approach	676	5.0		0.615		59.5	LOS E	14.7	107.6				
West: Newbridge Road													
Lane 1	711	5.0	803	0.885	100	51.5	LOS D	52.3	382.0	Full	500	0.0	0.0
Lane 2	713	5.0	806	0.885	100	50.4	LOS D	52.5	383.1	Full	500	0.0	0.0
Lane 3	708	5.0	800	0.885	100	50.4	LOS D	52.0	379.6	Full	500	0.0	0.0
Lane 4	6	5.0	72	0.084	100	85.0	LOS F	0.4	3.2	Short	60	0.0	NA
Approach	2138	5.0		0.885		50.8	LOS D	52.5	383.1				
Intersection	5152	5.0		0.904		52.5	LOS D	52.5	383.1				

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Lane LOS values are based on average delay per lane.

Intersection and Approach LOS values are based on average delay for all lanes.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

¹ Reduced capacity due to a short lane effect. Short lane queues may extend into the full-length lanes. Some upstream delays at entry to short lanes are not included.

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LANE SUMMARY

Site: 101 [GMD/Newbridge PM Existing]

Newbridge Road / Gov Macquarie Drive / Brickmakers Drive
 Signals - Fixed Time Isolated Cycle Time = 90 seconds (Practical Cycle Time)
 Variable Sequence Analysis applied. The results are given for the selected output sequence.

Lane Use and Performance													
	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Brickmakers Drive													
Lane 1	68	5.0	156	0.437	100	45.5	LOS D	3.0	22.0	Short	120	0.0	NA
Lane 2	98	5.0	120	0.820	100	56.8	LOS E	4.9	35.5	Short	140	0.0	NA
Lane 3	98	5.0	120	0.820	100	56.8	LOS E	4.9	35.5	Full	500	0.0	0.0
Approach	264	5.0		0.820		53.9	LOS D	4.9	35.5				
East: Newbridge Road													
Lane 1	495	5.0	1326	0.373	100	9.7	LOS A	6.2	45.4	Short	70	0.0	NA
Lane 2	562	5.0	624 ¹	0.900	100	39.9	LOS C	27.2	198.4	Full	500	0.0	0.0
Lane 3	755	5.0	839	0.900	100	39.1	LOS C	39.0	284.4	Full	500	0.0	0.0
Lane 4	671	5.0	746 ¹	0.900	100	39.1	LOS C	33.4	244.2	Full	500	0.0	0.0
Lane 5	266	5.0	339	0.784	100	48.7	LOS D	12.2	89.0	Short	95	0.0	NA
Lane 6	266	5.0	339	0.784	100	48.7	LOS D	12.2	89.0	Short	80	0.0	NA
Approach	3014	5.0		0.900		36.1	LOS C	39.0	284.4				
North: Gov Macquarie Drive													
Lane 1	252	5.0	737	0.342	100	25.1	LOS B	7.6	55.4	Short	125	0.0	NA
Lane 2	252	5.0	737	0.342	100	25.1	LOS B	7.6	55.4	Full	500	0.0	0.0
Lane 3	257	5.0	294	0.875	100	51.8	LOS D	13.0	95.2	Short	145	0.0	NA
Lane 4	211	5.0	259	0.815	100	52.3	LOS D	10.1	73.8	Short	75	0.0	NA
Approach	972	5.0		0.875		38.1	LOS C	13.0	95.2				
West: Newbridge Road													
Lane 1	472	5.0	618	0.764	100	32.7	LOS C	19.5	142.3	Full	500	0.0	0.0
Lane 2	465	5.0	609	0.764	100	31.8	LOS C	19.4	141.4	Full	500	0.0	0.0
Lane 3	461	5.0	604 ¹	0.764	100	31.7	LOS C	19.2	140.1	Full	500	0.0	0.0
Lane 4	7	5.0	120	0.059	100	51.2	LOS D	0.3	2.2	Short	60	0.0	NA
Approach	1405	5.0		0.764		32.2	LOS C	19.5	142.3				
Intersection	5655	5.0		0.900		36.3	LOS C	39.0	284.4				

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Lane LOS values are based on average delay per lane.

Intersection and Approach LOS values are based on average delay for all lanes.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

¹ Reduced capacity due to a short lane effect. Short lane queues may extend into the full-length lanes. Some upstream delays at entry to short lanes are not included.

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Appendix C

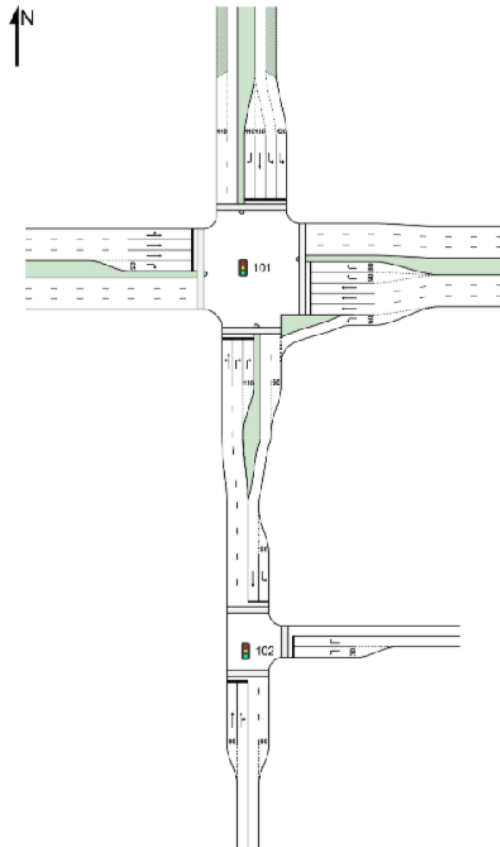
SIDRA Analysis results for Adjusted Future Baseline

EGROW 03 Planning proposal request to rezone land from RE2 (Private Recreation) to R3 (Medium Density Residential) at 146 Newbridge Road, Moorebank
Attachment 1 Planning Proposal Request

NETWORK LAYOUT

Network: N101 [Network1]

AM Peak Network

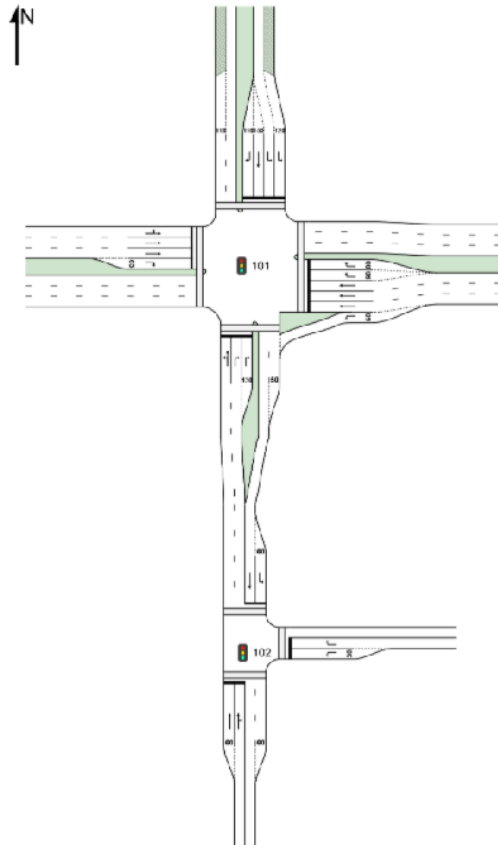


SITES IN NETWORK		
Site ID	CCG ID	Site Name
101	NA	Newbridge Road & Brickmakers intersection B6 Baseline AM Peak
102	NA	Brickmakers Drive & Link Road B6 Baseline Am Peak

NETWORK LAYOUT

Network: N102 [Network2]

Pm Peak Network



SITES IN NETWORK		
Site ID	CCG ID	Site Name
101	NA	Newbridge Road & Brickmakers intersection B6 Baseline PM Peak
102	NA	Brickmakers Drive & Link Road B6 Baseline Pm Peak

MOVEMENT SUMMARY

 Site: 101 [Newbridge Road & Brickmakers intersection B6]  Network: N101 [Network1]
 Baseline AM Peak]

Existing Four Way Intersection

Signals - Fixed Time Coordinated Cycle Time = 140 seconds (Network Cycle Time - User-Given)

Movement Performance - Vehicles													
Mov ID	OD Mov	Demand Flows		Arrival Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
		Total	HV	Total	HV				Vehicles	Distance		per veh	km/h
		veh/h	%	veh/h	%	v/c	sec		veh	m			
South: Brickmakers Drive													
1	L2	154	5.0	154	5.0	0.824	62.2	LOS E	26.8	196.0	1.00	0.93	26.4
2	T1	238	5.0	238	5.0	0.824	57.6	LOS E	26.8	196.0	1.00	0.93	26.8
3	R2	656	5.0	656	5.0	0.915	81.0	LOS F	24.6	179.4	1.00	0.96	22.4
Approach		1048	5.0	1048	5.0	0.915	72.9	LOS F	26.8	196.0	1.00	0.95	23.8
East: Newbridge Road													
4	L2	219	5.0	219	5.0	0.161	9.4	LOS A	3.0	22.2	0.26	0.65	51.8
5	T1	933	5.0	933	5.0	0.483	37.8	LOS C	16.9	123.4	0.83	0.72	40.8
6	R2	519	5.0	519	5.0	1.122	148.1	LOS F	40.3	294.0	1.00	1.12	17.5
Approach		1671	5.0	1671	5.0	1.122	68.3	LOS E	40.3	294.0	0.81	0.83	28.6
North: Governor Macquarie Drive													
7	L2	490	5.0	490	5.0	1.125	200.2	LOS F	31.1	227.4	1.00	1.29	13.6
8	T1	138	5.0	138	5.0	0.602	65.7	LOS E	9.2	66.8	1.00	0.80	19.7
9	R2	103	5.0	103	5.0	0.893	89.1	LOS F	8.0	58.4	1.00	0.98	24.6
Approach		731	5.0	731	5.0	1.125	159.2	LOS F	31.1	227.4	1.00	1.15	15.2
West: Newbridge Road													
10	L2	159	5.0	159	5.0	1.122	190.4	LOS F	95.8	699.2	1.00	1.59	14.7
11	T1	1973	5.0	1973	5.0	1.122	184.5	LOS F	96.8	706.6	1.00	1.64	15.2
12	R2	131	5.0	131	5.0	0.465	65.2	LOS E	8.3	60.3	0.96	0.80	20.4
Approach		2263	5.0	2263	5.0	1.122	178.0	LOS F	96.8	706.6	1.00	1.59	15.3
All Vehicles		5713	5.0	5713	5.0	1.125	124.2	LOS F	96.8	706.6	0.94	1.19	19.0

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 0.1 %

Number of Iterations: 5 (maximum specified: 10)

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow	Average Delay	Level of Service	Average Back of Queue	Prop. Queued	Effective Stop Rate	
		ped/h	sec		Pedestrian		per ped	
					ped	m		
P1	South Full Crossing	21	40.2	LOS E	0.1	0.1	0.76	0.76
P2	East Full Crossing	11	64.2	LOS F	0.0	0.0	0.96	0.96
P3	North Full Crossing	21	41.7	LOS E	0.1	0.1	0.77	0.77
P4	West Full Crossing	53	55.0	LOS E	0.2	0.2	0.89	0.89
All Pedestrians		105	50.3	LOS E			0.85	0.85

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

 Site: 101 [Newbridge Road & Brickmakers intersection B6]  Network: N102 [Network2]
 Baseline PM Peak]

Existing Four Way Intersection

Signals - Fixed Time Coordinated Cycle Time = 140 seconds (Network Cycle Time - User-Given)

Movement Performance - Vehicles													
Mov ID	OD Mov	Demand Flows		Arrival Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Brickmakers Drive													
1	L2	155	5.0	152	5.0	0.917	84.5	LOS F	21.0	153.1	1.00	1.05	21.8
2	T1	114	5.0	112	5.0	0.917	79.9	LOS F	21.0	153.1	1.00	1.05	22.1
3	R2	323	5.0	317	5.0	0.884	85.3	LOS F	11.8	85.9	1.00	0.92	21.7
Approach		592	5.0	581 ^{N1}	5.0	0.917	84.1	LOS F	21.0	153.1	1.00	0.98	21.8
East: Newbridge Road													
4	L2	599	5.0	599	5.0	0.544	23.5	LOS B	17.9	130.4	0.62	0.86	37.4
5	T1	1988	5.0	1988	5.0	1.042	124.6	LOS F	88.6	646.7	1.00	1.38	20.6
6	R2	531	5.0	531	5.0	0.902	72.0	LOS F	24.3	177.6	0.98	0.91	28.4
Approach		3118	5.0	3118	5.0	1.042	96.2	LOS F	88.6	646.7	0.92	1.20	22.9
North: Governor Macquarie Drive													
7	L2	504	5.0	504	5.0	0.787	69.0	LOS E	17.4	127.1	1.00	0.88	28.2
8	T1	344	5.0	344	5.0	1.020	121.0	LOS F	34.3	250.3	1.00	1.30	12.4
9	R2	211	5.0	211	5.0	0.969	103.3	LOS F	18.4	134.4	1.00	1.07	22.5
Approach		1059	5.0	1059	5.0	1.020	92.7	LOS F	34.3	250.3	1.00	1.06	21.4
West: Newbridge Road													
10	L2	157	5.0	157	5.0	0.794	52.5	LOS D	31.8	232.0	0.97	0.88	34.4
11	T1	1241	5.0	1241	5.0	0.794	45.4	LOS D	32.2	235.3	0.94	0.86	37.4
12	R2	208	5.0	208	5.0	1.031	138.0	LOS F	21.5	157.0	1.00	1.14	11.2
Approach		1606	5.0	1606	5.0	1.031	58.1	LOS E	32.2	235.3	0.95	0.90	31.9
All Vehicles		6375	5.0	6364 ^{N1}	5.0	1.042	84.9	LOS F	88.6	646.7	0.95	1.08	24.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 2.4 %

Number of Iterations: 10 (maximum specified: 10)

^{N1} Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

Movement Performance - Pedestrians									
Mov ID	Description	Demand Flow	Average Delay	Level of Service	Average Back of Queue	Distance	Prop. Queued	Effective Stop Rate	
		ped/h	sec		Pedestrian	m		per ped	
P1	South Full Crossing	21	33.6	LOS D	0.1	0.1	0.69	0.69	
P2	East Full Crossing	11	64.2	LOS F	0.0	0.0	0.96	0.96	
P3	North Full Crossing	21	42.5	LOS E	0.1	0.1	0.78	0.78	
P4	West Full Crossing	53	64.3	LOS F	0.2	0.2	0.96	0.96	
All Pedestrians		105	53.8	LOS E			0.87	0.87	

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

MOVEMENT SUMMARY

 Site: 102 [Brickmakers Drive & Link Road B6 Baseline Am Peak]  Network: N101 [Network1]

New Intersection with Traffic Signals

Signals - Fixed Time Coordinated Cycle Time = 140 seconds (Network Cycle Time - User-Given)

Movement Performance - Vehicles													
Mov ID	OD Mov	Demand Flows		Arrival Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Brickmakers Drive													
2	T1	760	5.0	760	5.0	0.314	8.5	LOS A	10.7	77.8	0.42	0.38	40.4
3	R2	43	5.0	43	5.0	0.314	14.7	LOS B	10.7	77.8	0.45	0.42	43.2
Approach		803	5.0	803	5.0	0.314	8.9	LOS A	10.7	77.8	0.42	0.38	40.7
East: Link Road													
4	L2	32	5.0	32	5.0	0.030	16.5	LOS B	0.9	6.3	0.43	0.63	40.4
6	R2	288	5.0	288	5.0	0.891	76.8	LOS F	21.8	159.3	1.00	0.97	16.2
Approach		320	5.0	320	5.0	0.891	70.8	LOS F	21.8	159.3	0.94	0.93	18.2
North: Brickmakers Drive													
7	L2	216	5.0	216	5.0	0.383	44.6	LOS D	11.6	84.9	0.84	0.79	28.2
8	T1	273	5.0	273	5.0	0.482	41.1	LOS C	15.1	110.1	0.87	0.74	29.4
Approach		489	5.0	489	5.0	0.482	42.7	LOS D	15.1	110.1	0.86	0.76	28.8
All Vehicles		1612	5.0	1612	5.0	0.891	31.4	LOS C	21.8	159.3	0.66	0.61	29.4

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 0.1 %

Number of Iterations: 5 (maximum specified: 10)

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow	Average Delay	Level of Service	Average Back of Queue	Prop. Queued	Effective Stop Rate	
		ped/h	sec		Pedestrian		per ped	
P1	South Full Crossing	11	54.1	LOS E	0.0	0.0	0.88	0.88
P2	East Full Crossing	21	37.9	LOS D	0.1	0.1	0.74	0.74
P3	North Full Crossing	53	54.2	LOS E	0.2	0.2	0.88	0.88
All Pedestrians		84	50.1	LOS E			0.84	0.84

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

 Site: 102 [Brickmakers Drive & Link Road B6 Baseline Pm]  Network: N102 [Network2] Peak]

New Intersection with Traffic Signals

Signals - Fixed Time Coordinated Cycle Time = 140 seconds (Network Cycle Time - User-Given)

Movement Performance - Vehicles													
Mov ID	OD Mov	Demand Flows		Arrival Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Brickmakers Drive													
2	T1	276	5.0	276	5.0	0.201	6.3	LOS A	5.8	42.5	0.34	0.30	42.7
3	R2	54	5.0	54	5.0	0.254	35.0	LOS C	2.6	18.9	0.74	0.75	33.5
Approach		330	5.0	330	5.0	0.254	11.0	LOS A	5.8	42.5	0.41	0.37	39.7
East: Link Road													
4	L2	46	5.0	46	5.0	0.095	45.2	LOS D	2.3	17.0	0.78	0.71	30.7
6	R2	315	5.0	315	5.0	1.036	135.7	LOS F	33.0	241.2	1.00	1.18	10.6
Approach		361	5.0	361	5.0	1.036	124.2	LOS F	33.0	241.2	0.97	1.12	12.4
North: Brickmakers Drive													
7	L2	347	5.0	344	5.0	0.298	16.9	LOS B	11.3	82.5	0.53	0.71	38.4
8	T1	844	5.0	836	5.0	0.900	30.7	LOS C	47.0	343.0	0.75	0.77	32.8
Approach		1191	5.0	1179 ^{N1}	5.0	0.900	26.6	LOS B	47.0	343.0	0.68	0.75	34.3
All Vehicles		1882	5.0	1870 ^{N1}	5.0	1.036	42.7	LOS D	47.0	343.0	0.69	0.75	27.4

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 2.4 %

Number of Iterations: 10 (maximum specified: 10)

^{N1} Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow	Average Delay	Level of Service	Average Back of Queue	Pedestrian Distance	Prop. Queued	Effective Stop Rate
		ped/h	sec		ped	m		per ped
P1	South Full Crossing	11	54.9	LOS E	0.0	0.0	0.89	0.89
P2	East Full Crossing	21	11.6	LOS B	0.0	0.0	0.41	0.41
P3	North Full Crossing	53	55.0	LOS E	0.2	0.2	0.89	0.89
All Pedestrians		84	44.2	LOS E			0.77	0.77

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

Appendix D

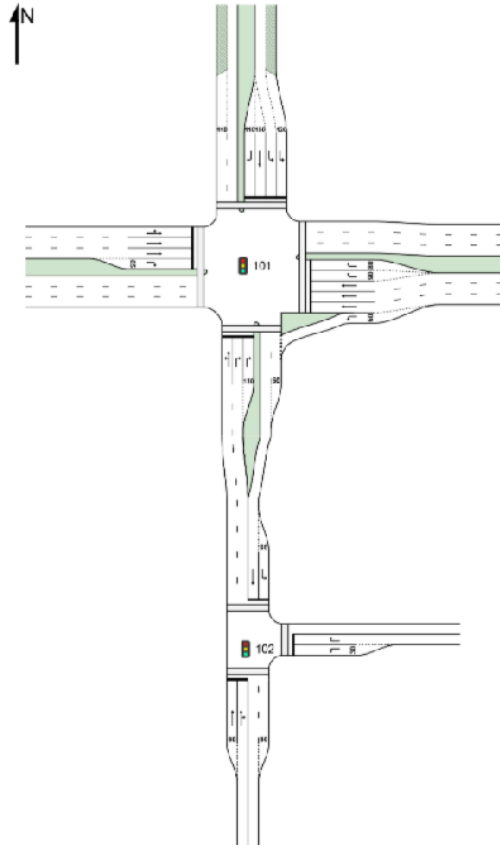
SIDRA Analysis results with Marina Residential Planning Proposal

EGROW 03 Planning proposal request to rezone land from RE2 (Private Recreation) to R3 (Medium Density
Residential) at 146 Newbridge Road, Moorebank
Attachment 1 Planning Proposal Request

NETWORK LAYOUT

Network: N101 [Network1]

AM Peak Network

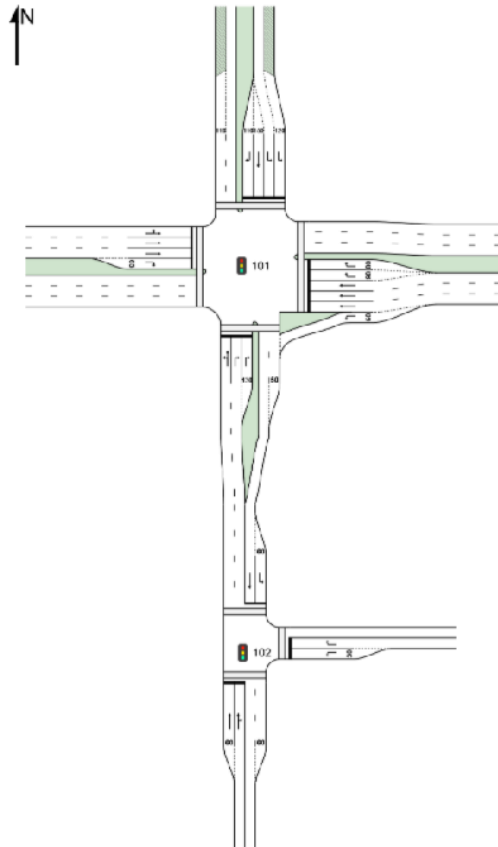


SITES IN NETWORK		
Site ID	CCG ID	Site Name
101	NA	Newbridge Road & Brickmakers with extra Marina Residences AM Peak
102	NA	Brickmakers Drive & Link Road with extra Marina Residences Am Peak

NETWORK LAYOUT


Network: N102 [Network2]

Pm Peak Network



SITES IN NETWORK		
Site ID	CCG ID	Site Name
101	NA	Newbridge Road & Brickmakers with extra Marina Residences PM Peak
102	NA	Brickmakers Drive & Link Road with extra Marina Residences Pm Peak

MOVEMENT SUMMARY

 Site: 101 [Newbridge Road & Brickmakers with extra Marina]  Network: N101 [Network1]
 Residences AM Peak]

Existing Four Way Intersection

Signals - Fixed Time Coordinated Cycle Time = 140 seconds (Network Cycle Time - User-Given)

Movement Performance - Vehicles													
Mov ID	OD Mov	Demand Flows		Arrival Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
		Total	HV	Total	HV				Vehicles	Distance		per veh	km/h
		veh/h	%	veh/h	%	v/c	sec		veh	m			
South: Brickmakers Drive													
1	L2	190	5.0	190	5.0	0.890	69.3	LOS E	33.3	243.3	1.00	1.00	24.8
2	T1	256	5.0	256	5.0	0.890	64.7	LOS E	33.3	243.3	1.00	1.00	25.1
3	R2	683	5.0	683	5.0	0.889	77.8	LOS F	24.9	181.9	1.00	0.93	22.9
Approach		1129	5.0	1129	5.0	0.890	73.4	LOS F	33.3	243.3	1.00	0.96	23.7
East: Newbridge Road													
4	L2	217	5.0	217	5.0	0.159	9.4	LOS A	3.0	22.0	0.26	0.65	51.9
5	T1	933	5.0	933	5.0	0.505	39.5	LOS C	17.4	126.7	0.85	0.73	40.0
6	R2	519	5.0	519	5.0	1.122	148.1	LOS F	40.3	294.0	1.00	1.12	17.5
Approach		1669	5.0	1669	5.0	1.122	69.3	LOS E	40.3	294.0	0.82	0.84	28.4
North: Governor Macquarie Drive													
7	L2	490	5.0	490	5.0	1.125	200.2	LOS F	31.1	227.4	1.00	1.29	13.6
8	T1	137	5.0	137	5.0	0.597	65.6	LOS E	9.1	66.3	1.00	0.80	19.7
9	R2	103	5.0	103	5.0	0.893	89.1	LOS F	8.0	58.4	1.00	0.98	24.6
Approach		730	5.0	730	5.0	1.125	159.3	LOS F	31.1	227.4	1.00	1.15	15.2
West: Newbridge Road													
10	L2	159	5.0	159	5.0	1.168	228.2	LOS F	104.7	764.0	1.00	1.73	12.7
11	T1	1973	5.0	1973	5.0	1.168	222.2	LOS F	105.8	772.3	1.00	1.78	13.0
12	R2	129	5.0	129	5.0	0.458	65.1	LOS E	8.1	59.3	0.96	0.80	20.4
Approach		2261	5.0	2261	5.0	1.168	213.6	LOS F	105.8	772.3	1.00	1.72	13.2
All Vehicles		5789	5.0	5789	5.0	1.168	137.8	LOS F	105.8	772.3	0.95	1.25	17.5

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 0.1 %

Number of Iterations: 5 (maximum specified: 10)

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow	Average Delay	Level of Service	Average Back of Queue	Prop. Queued	Effective Stop Rate	
		ped/h	sec		Pedestrian ped	Distance m	per ped	
P1	South Full Crossing	21	41.7	LOS E	0.1	0.1	0.77	0.77
P2	East Full Crossing	11	64.2	LOS F	0.0	0.0	0.96	0.96
P3	North Full Crossing	21	43.3	LOS E	0.1	0.1	0.79	0.79
P4	West Full Crossing	53	53.3	LOS E	0.2	0.2	0.87	0.87
All Pedestrians		105	50.0	LOS E			0.84	0.84

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

 Site: 101 [Newbridge Road & Brickmakers with extra Marina Residences PM Peak]  Network: N102 [Network2]

Existing Four Way Intersection

Signals - Fixed Time Coordinated Cycle Time = 140 seconds (Network Cycle Time - User-Given)

Movement Performance - Vehicles													
Mov ID	OD Mov	Demand Flows		Arrival Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Brickmakers Drive													
1	L2	153	5.0	143	5.0	0.862	76.1	LOS F	18.4	134.3	1.00	0.98	23.3
2	T1	113	5.0	106	5.0	0.862	71.5	LOS F	18.4	134.3	1.00	0.98	23.6
3	R2	320	5.0	299	5.0	0.897	86.5	LOS F	11.2	81.7	1.00	0.93	21.5
Approach		586	5.0	547 ^{N1}	5.0	0.897	80.9	LOS F	18.4	134.3	1.00	0.95	22.3
East: Newbridge Road													
4	L2	604	5.0	604	5.0	0.555	24.3	LOS B	18.3	133.9	0.64	0.87	36.8
5	T1	1988	5.0	1988	5.0	1.043	125.1	LOS F	88.8	648.5	1.00	1.39	20.5
6	R2	531	5.0	531	5.0	0.902	72.0	LOS F	24.3	177.6	0.98	0.91	28.4
Approach		3123	5.0	3123	5.0	1.043	96.6	LOS F	88.8	648.5	0.93	1.21	22.8
North: Governor Macquarie Drive													
7	L2	504	5.0	504	5.0	0.787	69.0	LOS E	17.4	127.1	1.00	0.88	28.2
8	T1	347	5.0	347	5.0	1.029	126.2	LOS F	35.4	258.2	1.00	1.32	12.0
9	R2	211	5.0	211	5.0	1.030	133.3	LOS F	21.2	155.0	1.00	1.17	18.8
Approach		1062	5.0	1062	5.0	1.030	100.5	LOS F	35.4	258.2	1.00	1.08	20.3
West: Newbridge Road													
10	L2	157	5.0	157	5.0	0.782	50.8	LOS D	31.3	228.5	0.96	0.87	35.0
11	T1	1241	5.0	1241	5.0	0.782	43.7	LOS D	31.7	231.7	0.93	0.84	38.0
12	R2	215	5.0	215	5.0	1.032	138.8	LOS F	22.4	163.3	1.00	1.15	11.2
Approach		1613	5.0	1613	5.0	1.032	57.1	LOS E	31.7	231.7	0.94	0.89	32.1
All Vehicles		6384	5.0	6345 ^{N1}	5.0	1.043	85.8	LOS F	88.8	648.5	0.95	1.08	24.1

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 8.3 %

Number of Iterations: 10 (maximum specified: 10)

^{N1} Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow	Average Delay	Level of Service	Average Back of Queue	Prop. Queued	Effective Stop Rate	
		ped/h	sec		Pedestrian ped	Distance m	per ped	
P1	South Full Crossing	21	33.6	LOS D	0.1	0.1	0.69	0.69
P2	East Full Crossing	11	64.2	LOS F	0.0	0.0	0.96	0.96
P3	North Full Crossing	21	41.7	LOS E	0.1	0.1	0.77	0.77
P4	West Full Crossing	53	64.3	LOS F	0.2	0.2	0.96	0.96
All Pedestrians		105	53.6	LOS E			0.87	0.87

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

MOVEMENT SUMMARY

 **Site: 102 [Brickmakers Drive & Link Road with extra Marina Residences Am Peak]**  **Network: N101 [Network1]**

New Intersection with Traffic Signals

Signals - Fixed Time Coordinated Cycle Time = 140 seconds (Network Cycle Time - User-Given)

Movement Performance - Vehicles													
Mov ID	OD Mov	Demand Flows		Arrival Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Brickmakers Drive													
2	T1	760	5.0	760	5.0	0.365	14.2	LOS A	13.8	100.5	0.54	0.48	35.9
3	R2	55	5.0	55	5.0	0.365	21.5	LOS B	13.8	100.5	0.59	0.53	39.9
Approach		815	5.0	815	5.0	0.365	14.7	LOS B	13.8	100.5	0.54	0.49	36.4
East: Link Road													
4	L2	89	5.0	89	5.0	0.078	14.8	LOS B	2.3	16.5	0.40	0.64	41.2
6	R2	369	5.0	369	5.0	0.888	68.9	LOS E	26.9	196.5	0.98	0.96	17.5
Approach		458	5.0	458	5.0	0.888	58.4	LOS E	26.9	196.5	0.87	0.90	21.5
North: Brickmakers Drive													
7	L2	211	5.0	211	5.0	0.422	48.9	LOS D	11.7	85.7	0.87	0.80	27.1
8	T1	273	5.0	273	5.0	0.558	45.6	LOS D	15.7	114.4	0.90	0.76	28.1
Approach		484	5.0	484	5.0	0.558	47.0	LOS D	15.7	114.4	0.88	0.78	27.7
All Vehicles		1757	5.0	1757	5.0	0.888	35.0	LOS C	26.9	196.5	0.72	0.67	28.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 0.1 %

Number of Iterations: 5 (maximum specified: 10)

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow	Average Delay	Level of Service	Average Back of Queue	Prop. Queued	Effective Stop Rate	
		ped/h	sec		Pedestrian		per ped	
P1	South Full Crossing	11	44.8	LOS E	0.0	0.0	0.80	0.80
P2	East Full Crossing	21	41.7	LOS E	0.1	0.1	0.77	0.77
P3	North Full Crossing	53	44.9	LOS E	0.2	0.2	0.80	0.80
All Pedestrians		84	44.1	LOS E			0.79	0.79

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

 Site: 102 [Brickmakers Drive & Link Road with extra Marina Residences Pm Peak]  Network: N102 [Network2]

New Intersection with Traffic Signals

Signals - Fixed Time Coordinated Cycle Time = 140 seconds (Network Cycle Time - User-Given)

Movement Performance - Vehicles													
Mov ID	OD Mov	Demand Flows		Arrival Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Brickmakers Drive													
2	T1	276	5.0	276	5.0	0.197	5.7	LOS A	5.5	40.2	0.32	0.28	43.4
3	R2	92	5.0	92	5.0	0.388	37.4	LOS C	4.9	35.7	0.82	0.79	32.8
Approach		368	5.0	368	5.0	0.388	13.6	LOS A	5.5	40.2	0.45	0.41	38.4
East: Link Road													
4	L2	70	5.0	70	5.0	0.144	45.8	LOS D	3.6	26.2	0.80	0.73	30.5
6	R2	309	5.0	309	5.0	1.144	214.3	LOS F	41.4	302.3	1.00	1.37	7.1
Approach		379	5.0	379	5.0	1.144	183.2	LOS F	41.4	302.3	0.96	1.25	9.3
North: Brickmakers Drive													
7	L2	362	5.0	357	5.0	0.310	17.0	LOS B	11.8	86.3	0.53	0.72	38.4
8	T1	844	5.0	833	5.0	0.906	32.5	LOS C	47.8	349.0	0.74	0.78	32.1
Approach		1206	5.0	1190 ^{N1}	5.0	0.906	27.9	LOS B	47.8	349.0	0.68	0.76	33.8
All Vehicles		1953	5.0	1937 ^{N1}	5.0	1.144	55.5	LOS D	47.8	349.0	0.69	0.79	24.2

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 8.3 %

Number of Iterations: 10 (maximum specified: 10)

^{N1} Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow	Average Delay	Level of Service	Average Back of Queue	Prop. Queued	Effective Stop Rate	
		ped/h	sec		Pedestrian		per ped	
					ped	m		
P1	South Full Crossing	11	56.7	LOS E	0.0	0.0	0.90	0.90
P2	East Full Crossing	21	11.6	LOS B	0.0	0.0	0.41	0.41
P3	North Full Crossing	53	56.8	LOS E	0.2	0.2	0.90	0.90
All Pedestrians		84	45.5	LOS E			0.78	0.78

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

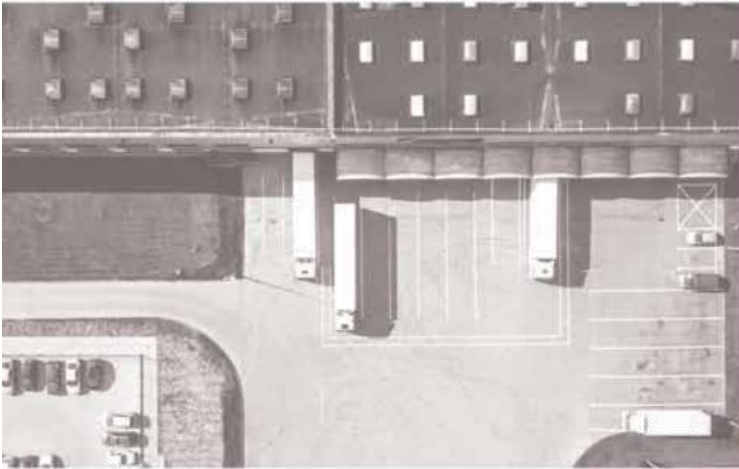
Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.



Appendix E

Flood impact assessment



Our Ref: 59916196:BCP/bcp
 Contact: Dr Brett C. Phillips



13th April 2018

The Development Manager
 Mirvac Masterplanned Communities
 Level 26, 60 Margaret Street
SYDNEY NSW 2000

Attention: Adam Perrott

Dear Arian,

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**UPDATE OF FLOOD IMPACT ASSESSMENT FOR MIRVAC DEVELOPMENT,
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Cardno has been requested to assess the flood impacts of the planned modification of the Georges Cove marina development (former Benedict's Sand and Gravel site) at Lot 7 DP 1065574, Newbridge Road, Moorebank. This assessment has been prepared to accompany a Planning Proposal to be submitted to Liverpool City Council.

1. BACKGROUND

1.1 Georges River Hydraulic Model Context

In 2012 Cardno prepared a detailed two-dimensional flood model of the Georges River floodplain in Moorebank within the Liverpool City Council Local Government Area (LGA). The model extended from upstream of the Newbridge Road crossing to downstream of the Western Highway crossing. The purpose of the model was to undertake a flood impact assessment of the proposed Georges Cove Marina development.

The establishment of the Georges River model for the Moorebank area is detailed in the report *Flood Impact Assessment for the Proposed Georges Cove Marina, Moorebank* (Cardno, dated 30 October 2014). This hydraulic model of the Georges River has been reviewed in detail by Liverpool City Council. The 20 year ARI and 100 year ARI events were established for the floodplain with the 36 hour duration event being critical for the floodplain based on flows extracted from the MIKE-11 models which were prepared as part of the 2004 *Georges River Flood Risk Management Study*.

1.2 Moorebank Cove

The Moorebank Cove site is a residential Mirvac development site lying on the portion of the elevated former Benedict's Sand and Gravel site at Newbridge Road, Moorebank. The site adjoins the Georges Cove site immediately to the south, with both sites being part of the same cadastral lot.

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The development of the site has been divided into a number of stages, with the following Development Applications previously submitted to Liverpool City Council:

- DA for Georges Cove site: A number of design iterations of the Georges Cove Marina site were prepared and submitted to Council, the first being prepared in October 2012. Cardno prepared a number of flood impact assessments for the Georges Cove site with impacts documented within a number of addendum reports, the last dated 3 August 2015.
- DA 1558/2006B – Site access bridge from Brickmakers Drive: A previous DA was submitted and approved by Liverpool Council for a 32 metre span bridge connecting Brickmakers Drive to the Moorebank Cove site and crossing over the access road to the Moorebank Recyclers site. The flood modelling of this bridge was incorporated in a Flood Impact Assessment Report dated 23 May 2014 (Cardno, 2014).
- DA 510/2016 for the initial works in the Moorebank Cove development site: The initial development of the Moorebank Cove site involved landform works on the elevated portions of the site, including a proposed retaining wall to be constructed along the western edge of the site. No flood impact assessments were prepared as part of the original DA, however in response to objections by neighbouring land owners during exhibition, a flood impact assessment was prepared for the retaining wall structure. The details of this assessment are summarised in the report dated 15 July 2016; *Flood Impact Assessment for Retaining Wall Construction, Moorebank Cove Development, Newbridge Road, Moorebank* (Cardno, 2016a)

DA 24/2017 is for the first residential development of the site as defined within the Plan of Works drawings prepared by JMD Development Consultants on behalf of Mirvac (drawings 14005E6-RevA, dated 15 June 2016). The following changes to the approved retaining wall works were proposed:

- Re-grading of the site to include local roads within the site. The majority of re-grading is proposed on the elevated portions of the site outside of the floodplain;
- Extension of the retaining wall on the western edge of the site from that proposed in DA 510/2016;
- Extension of the raised development platform to the south-west. This includes a temporary driveway connecting the two site at a grade of 1V: 6H.
- The north-eastern landscaped areas of the Georges Cove are to be raised to an elevation of 1.6m AHD to facilitate raingardens to service the Moorebank Cove development site.

The details of this assessment are summarised in the report dated 4 August 2016; *Flood Impact Assessment Stage 2 DA for Moorebank Cove Site, Newbridge Road, Moorebank* (Cardno, 2016b).

1.3 Planning Proposal

Cardno has been requested to assess the flood impacts of the planned modification of the Georges Cove marina development and the Moorebank Cove development in the following terms:

Mirvac are currently in the process of preparing a planning proposal for the Marina.

The preliminary model includes the finished ground surface of the entire site (Lot 7) including the marina, residential subdivision and B6 land. JMD have completed preliminary compensatory storage calculations based on this model compared to the base model. The base model was created following instructions from Mark Tooker (npc). Preliminary calculations show that the flood storage is balanced when the marina, B6 and residential subdivision are all combined.

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Key points to note are:

- The whole site has been modelling including the B6 land to the north in order to achieve the target compensatory storage.
- The B6 land to the north will be developed into a commercial / residential complex. The model adopts an estimated floor level of below ground carpark which will be allowed to flood (refer **Attachment B**).

The residential/commercial portion of the marina is proposed to sit on piers. The area contains a "tanked" carpark starting a RL3.6 m (refer Attachment A – Drawings SK_001, SK_002, SK_008, SK_013, SK_014, SK_015 and SK_018).

2. ASSESSMENT SCENARIO

2.1 Benchmark Scenario

The benchmark scenario model used to inform this assessment of the Planning Proposal includes:

- The approved post-development scenario of the Georges Cove Marina site as modelled within the report dated 3 August 2015. The approved Georges Cove site included:
 - A large marina located in the middle of the site with an assumed an invert level of -3.5m AHD for the marina;
 - A series of wetlands with a finished level of 0.6m AHD, and vegetated areas with a finished level of 1.9 m AHD located along the eastern side of the site located within the 40m buffer zone of the Georges River;
 - A portion of landscaped area in the north-west corner of the site raised to 4.6 m AHD;
 - A proposed 6 storey building on the western side of the site with car parking on the ground floor at 6.3m AHD with a portion of the building suspended above a 1.65 m AHD finished ground level at the southern end; and
 - A car park located on the southern side of the site with a ground level of at 1.65 m AHD.
- As per advice from Liverpool City Council as part of the original flood study for Georges Cove Marina (30 October 2012) the future finished levels of the Flower Power site, to the east of the Moorebank Cove site has been modelled at 6.3 m AHD in the benchmark scenario.
- The approved access bridge design has been accounted for in the benchmark scenario as modelled within the assessment dated 23 May 2014. The latest access bridge design includes a bridge abutment to the west of the bridge and a 32 metre span that passes over the existing access road to the Moorebank Recyclers site.

While these conditions may not represent the site and its surrounds under its existing state, all of the above conditions reflect site conditions that are expected prior to the development and that have been assessed to have negligible impact on existing flood behaviour and previously approved by Liverpool City Council.

2.2 Post-development Scenario

The modelling of the Planning Proposal landform was based on a post-development design of the Moorebank Cove site received from JMD on behalf of Mirvac on 23 January 2018. The extent of the landform was guided by advice received from JMD on 23 January 2018.

The revised post-development Digital Elevation Model (DEM) is shown in **Figure 1**.

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The major differences between the DEMs of benchmark conditions and the Planning Proposal are:

- (i) The residential/commercial portion of the marina is proposed to sit on piers. The area contains a "tanked" carpark starting a RL3.6 m (refer Attachment A – Drawings SK_001, SK_002, SK_008, SK_013, SK_014, SK_015 and SK_018). The proposed ground level beneath the suspended car park is 1.65 m AHD creating a 1.95 m high void under the complete footprint of the car park (refer Drawing SK_002 in Attachment A). It is proposed that the car park be supported by 750 mm x 750 mm square columns at 7.5 m spacings. In comparison under benchmark conditions the southern half of this development was elevated above the 100 yr ARI flood level while the northern half of the development was located on fill; and
- (ii) The B6 land to the north will be developed into a commercial / residential complex. The model adopts an estimated floor level of below ground carpark which will be allowed to flood in a 20 yr ARI event (refer **Attachment B**).

3. FLOOD IMPACT ASSESSMENT

The approach adopted to the representation of the key features of the development were as follows:

- (i) The void beneath the elevated car park was represented in the 2D domain using the "layered flow method". Hydraulic losses were represented by a form loss which reflects the proposed dimensions and spacing of the columns;
- (ii) The proposed boat storage facility located south of the elevated car park (refer "3" on Drawing SK_001 in Attachment A) was represented as a high roughness zone with a hydraulic roughness value of 0.08;
- (iii) While the level of the B6 land in the northeastern corner has been lowered it has also been modelled with a high roughness (0.12) which represents the planned building development.

The hydraulic model was run for the 20 year and 100 year ARI events. The model results are summarised in the following sections.

3.1 Flood Behaviour

The estimated 20 yr ARI flood levels, depths and velocities under the Planning Proposal are plotted in **Figures 2, 3 and 4** respectively.

The estimated 100 yr ARI flood levels, depths and velocities under the Planning Proposal are plotted in **Figures 5, 6 and 7** respectively.

3.2 Water Level Impacts

The estimated flood level differences under the Planning are plotted in in **Figures 8 and 9** for the 20yr ARI and 100yr ARI respectively.

In both the 20 yr ARI and 100yr ARI flood it was assessed that the Planning Proposal has nil adverse impact on water levels (less than 0.01 m) at any location in the floodplain in comparison to the benchmark conditions. Therefore the Planning Proposal results in no water level impacts off-site.

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3.3 Velocity Impacts

The estimated velocity differences under the Planning Proposal are plotted in in **Figures 10 and 11** for the 20yr ARI and 100yr ARI respectively.

In both the 20yr and 100yr ARI events the velocity impacts are modest west of the northern section of the elevated car park. This is because under benchmark conditions this area was filled and under the Planning Proposal this area is re-established as a flowpath (as existed prior to any development on the site). Notwithstanding these local changes in velocity the overall velocity remains much lower than 1 m/s and consequently does not pose a scour risk.

3.4 Flood Storage

The change in 100 yr ARI flood storage as a result of the works proposed under the Planning Proposal was also assessed. The 100 yr ARI flood storage under the Benchmark Scenario (refer Section 2.1) was estimated to be 499,200 m³. The 100 yr ARI flood storage under the Post-development Scenario (refer Section 2.2) was estimated to be 521,800 m³. This calculation accounted for the volume of floodwaters displaced by the proposed suspended car park and the columns which will support the car park.

It is concluded that the Planning Proposal would increase the 100 yr ARI flood storage by 22,600 m³ in comparison with the previous approved land form and development.

4. FLOOD RISKS

The flood risks on the site have been defined through 1D/2D flood modelling as described above in previous reports as described above.

4.1 Flood Levels, Depths and Velocities

Flood modelling was undertaken for the 20 yr ARI and 100 yr ARI floods

The estimated 100 yr ARI flood level on the site is 5.52 m AHD.

A PMF level of 10.4 m AHD in the study area has been previously reported in the 1991 Georges River Flood Study. The AEP of the PMP for a catchment of the size of the Georges River catchment recommended by the 2016 edition of Australian Rainfall and Runoff is 0.000005% AEP (2,000,000 yr ARI).

4.2 Pedestrian and Vehicular Stability in Floods

The latest edition of Australian Rainfall and Runoff released in 2016 provides guidance on both pedestrian and vehicle stability in floods.

4.2.1 Pedestrian Stability

As stated in ARR2016:

Cox et al., 2010 concluded that self-evacuation of the most vulnerable people in the community (typically small children, and the elderly) is limited to relatively placid flow conditions. Furthermore, a D.V as low as 0.4 m2s-1 would prove problematic for people in this category, i.e. the more vulnerable in the community.

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These hazard regimes for tolerable flow conditions ($D.V$) as related to the individual's physical characteristics ($H.M$) are presented in Figure 9.2.4

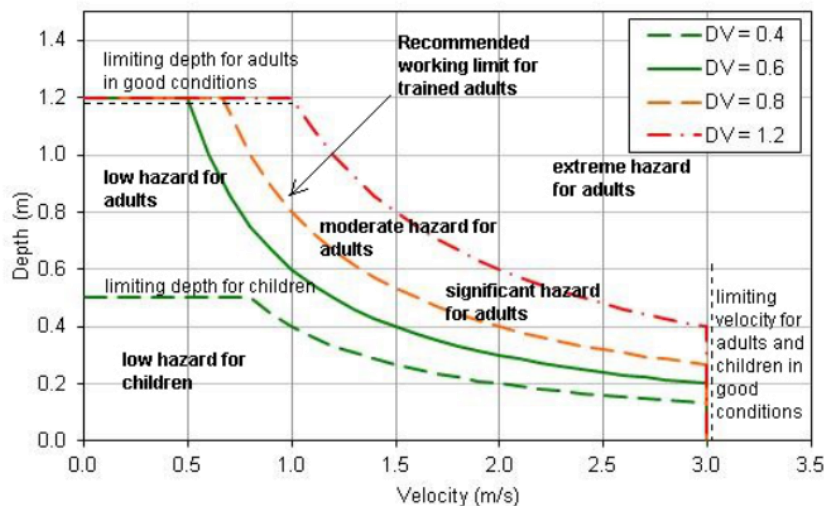


Figure 9.2.4. Safety Criteria for People in Variable Flow Conditions (After Cox et al, 2010)

4.2.2 Vehicle Stability

Determining safety criteria for vehicles requires an understanding of the physical characteristics of the vehicle along with the nature of the flow.

The measure of physical attributes for vehicle stability analysis is the vehicle classification as based on length (L , m), kerb weight (W , kg) and ground clearance (GC , m). Three vehicle classifications are suggested:

- Small passenger: $L < 4.3$ m, $W < 1250$ kg, $GC < 0.12$ m
- Large passenger: $L > 4.3$ m, $W > 1250$ kg, $GC > 0.12$ m
- Large 4WD: $L > 4.5$ m, $W > 2000$ kg, $GC > 0.22$ m

The measure of flow attributes for vehicle stability analysis is $D.V$ m^2s^{-1} , determined as the product of flow depth (D , m) and flow velocity (V , ms^{-1}).

Limiting conditions exist for each classification based on limited laboratory testing of characteristic vehicles. The upper tolerable velocity for moving water is defined based on the frictional limits, and is a constant 3.0 ms^{-1} for all vehicle classifications.

The upper tolerable depths within still water are defined by the floating limits:

- Small passenger vehicles: 0.3 m
- Large passenger vehicles: 0.4 m
- Large 4WD vehicles: 0.5 m

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The upper tolerable depths within high velocity water (at 3.0 ms^{-1}) are defined by the frictional limits:

- Small passenger vehicles: 0.1 m
- Large passenger vehicles: 0.15 m
- Large 4WD vehicles: 0.2 m

... Stability criteria based on the best available information for stationary small passenger cars, large passenger cars and large 4WD vehicles in various flow situations are presented in Figure 9.2.6

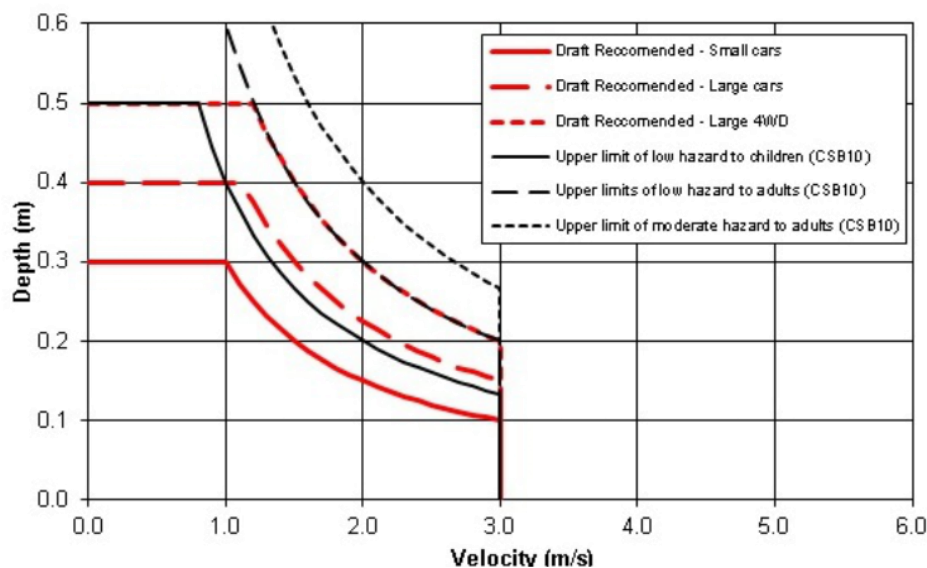


Figure 9.2.6. Interim Safety Criteria for Vehicles in Variable Flow Conditions
 (After Shand et al, 2011)

Shand et al (2011) concludes that the available datasets do not adequately account for the following factors and that more research is needed in these areas:

- Friction coefficients for contemporary vehicle tyres in flood flows;
- Buoyancy changes in modern cars;
- The effect of vehicle orientation to flow direction (including vehicle movement);
- Information for additional categories including small and large commercial vehicles and emergency service vehicles

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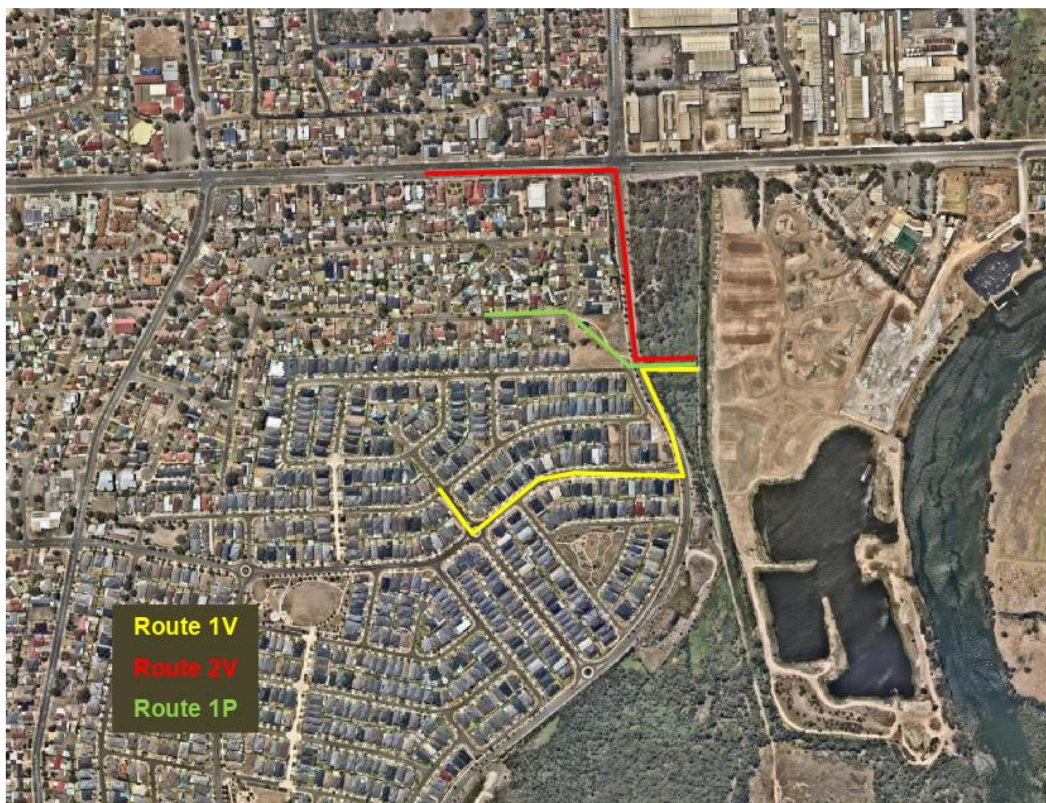
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4.3 Possible Evacuation Routes

A number of evacuation routes from the site are available across an already approved new bridge crossing. Two possible routes for vehicular evacuation and one possible pedestrian route to a level on the floodplain higher than the PMF are identified as follows.

- | | |
|----------|---|
| Route 1V | Cross the new access bridge to Brickmakers Drive, turn left onto Brickmakers Drive, turn right onto Maddecks Ave then turn right on to Conlon Ave. The advantage of this route is that it is flood-free in a 100 yr ARI flood. |
| Route 2V | Cross the new access bridge to Brickmakers Drive, turn right onto Brickmakers Drive, turn left onto Newbridge Road. The advantage of this route is that it is shorter than Route 1V but the major disadvantage is that Brickmakers Drive north of the access bridge and a section of Newbridge Road experience low hazard flooding in a 1% AEP flood. |
| Route 1P | Persons would cross the new access bridge to Brickmakers Drive, then cross Brickmakers Drive to walk northwest across the local park to Eluora Cres and then walk west along Eulora Ave. The advantage of this route is that it is flood-free in a 100 yr ARI flood. |



The times it would take to evacuate by vehicle or by foot from the site along these routes at different speeds are summarised in **Table 7**.

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**Table 7 Evacuation Times by Vehicle or by Foot**

	Route 1V	Route 2V	Route 1P
Indicative Distance to reach 10.5 m AHD (m)	689	590	370
	Time to reach 10.5 m AHD (mins)		
Vehicle Speed (km/hr)			
10	4.1	3.5	
20	2.1	1.8	
30	1.4	1.2	
40	1.0	0.9	
50	0.8	0.7	
60	0.7	0.6	
Walking Speed (km/hr)			
2	20.7	17.7	11.1
4	10.3	8.9	5.6

It is concluded that:

- (i) The advantage of Routes 1V and 1P are that they are flood-free in a 100 yr ARI flood;
- (ii) The time to evacuate by vehicle is less than 4 minutes;
- (iii) The time to evacuate by foot to higher ground is less than 12 minutes along Route 1P and would be shorter depending on the pace at which persons would walk;
- (iv) 6.0 m AHD is the indicative level at which access to the site at the intersection of the new access bridge and Brickmakers Drive become unsafe for vehicles. This equates to a 250 yr ARI flood level.

4.4 Rate of Rise of Floodwaters and Flood Warning Times

To understand the likely warning times and associated response times during extreme flood events it is necessary to estimate the expected rate of rise of floodwaters. In the vicinity of the site the estimated rate of rise of floodwaters in a 1% AEP flood and in the PMF are around 0.45 m/hr and up to 1.45 m/hr respectively.

Features of the planned development include:

- Proposed ground floor levels for the Georges Cove Marina is 7.60 m AHD which provides 2,080 mm freeboard above the estimated 100 year ARI flood level. The Ground Floor level equates to a 5,000 yr ARI flood level;
- Proposed Level 1 floor levels of the apartments at Georges Cove Marina is 11.6 m AHD which is higher than the PMF level;
- Likewise the proposed floor levels of apartments on Levels 2 to 9 are all higher than the PMF level;
- A crest level of 6.3 m AHD on the driveway access to the single-storey car parking level at the Marina complex which provides 780 mm freeboard above the 100 year ARI level. The driveway crest level equates to a 450 yr ARI flood level;

Incorporation of a 1.3 m flood barrier on the driveway crest to delay the ingress of floodwaters into the basement car park would provide the same level of protection as the Ground Floor.

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The time for floodwaters to reach the following key levels in a 500 yr ARI flood, 1,000 yr ARI flood, 10,000 yr ARI flood and the PMF are given in **Tables 1 – 4** respectively. The key levels include:

- 2 m AHD which could be viewed as an indicator of the potential for significant flooding;
- 5.5 m AHD as an indicator of the 1% AEP flood level;
- 6.0 m AHD which is the indicative level at which access to the site at the intersection of the new access bridge and Brickmakers Drive become unsafe for vehicles;
- 6.3 m AHD which is the proposed crest level of the driveway to the single-storey car park in Georges Cove Marina; and
- 7.6 m AHD which is the proposed Ground Floor level for the Georges Cove Marina.

The results for the 500 yr ARI flood, 1,000 yr ARI flood and 10,000 yr ARI flood were obtained by scaling the 36 hour 1% AEP stage hydrograph extracted from the floodplain model at the centre of the Georges River opposite to entry to the Marina.

The results for the PMF were obtained by correlating the stage frequency curve at the Georges Cove Marina with the stage frequency curve at the Liverpool Weir, then determining the equivalent flow at the Liverpool Weir using the weir rating table published in the 1991 Georges River Flood Study (Figure 16) and then determining the various times from the 36 hour extreme flood hydrograph plotted in Figure 13 of the 1991 Georges River Flood Study.

Table 1 Time for Floodwaters to reach Key Levels in a 500 yr ARI Flood

Key Level (m AHD)	Time from Start of 36 hr Storm Burst (hrs)	Elapsed Time from 2 m AHD		Elapsed Time from 1% AEP FL		Duration Flood Level Exceeds
		(hrs)	(mins)	(hrs)	(mins)	(hrs)
2	15.50					
5.5	22.75	7.25	435			
6	24.50	9.00	540	1.75	105	6.25
6.3	26.25	10.75	645	3.50	210	2.00
7.6	28.00	12.50	750	5.25	315	0.00

Table 2 Time for Floodwaters to reach Key Levels in a 1,000 yr ARI Flood

Key Level (m AHD)	Time from Start of 36 hr Storm Burst (hrs)	Elapsed Time from 2 m AHD		Elapsed Time from 1% AEP FL		Duration Flood Level Exceeds
		(hrs)	(mins)	(hrs)	(mins)	(hrs)
2	15.00					
5.5	21.75	6.75	405			
6	23.00	8.00	480	1.25	75	9.50
6.3	24.00	9.00	540	2.25	135	7.25
7.6	28.00	13.00	780	6.25	375	0.00

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**Table 3 Time for Floodwaters to reach Key Levels in a 10,000 yr ARI Flood**

Key Level (m AHD)	Time from Start of 36 hr Storm Burst (hrs)	Elapsed Time from 2 m AHD		Elapsed Time from 1% AEP FL		Duration Flood Level Exceeds
		(hrs)	(mins)	(hrs)	(mins)	(hrs)
2	14.00					
5.5	20.25	6.25	375			
6	21.00	7.00	420	0.75	45	14.50
6.3	21.50	7.50	450	1.25	75	13.25
7.6	24.50	10.50	630	4.25	255	6.25

Table 4 Time for Floodwaters to reach Key Levels in a PMF

Key Level (m AHD)	Time from Start of 36 hr Storm Burst (hrs)	Elapsed Time from 2 m AHD		Elapsed Time from 1% AEP FL		Duration Flood Level Exceeds
		(hrs)	(mins)	(hrs)	(mins)	(hrs)
2	4.00					
5.5	7.00	3.00	180			
6	7.33	3.33	200	0.33	20	30
6.3	7.50	3.50	210	0.50	30	29.2
7.6	8.50	4.50	270	1.50	90	26

While the warning times in a PMF are shorter than for major floods (500 yr ARI – 1,000 yr ARI) it is expected that the extreme weather required to generate a long duration PMP event across the Georges River catchment would be actively tracked by weather forecasters days ahead and that early warnings of extreme weather would be issued by the BoM.

It is concluded that in contrast to the short warning times available on other river system in metropolitan Sydney eg. Parramatta River, the warning times for major flooding in the Georges River are considerably longer and would give sufficient time for residents and visitors to evacuate if they did not want to shelter in place.

It is expected that any decision to shelter in place or to evacuate would be informed by the predicted severity of flooding, the likely duration of any closure of access via Brickmakers Drive and the access bridge and the likelihood that the single-storey car park and the ground floor of any buildings would be inundated.

The indicative depth of flooding in the single-storey car park at Georges Cover Marina was also estimated for the 500 yr ARI and 1,000 yr ARI flood for a single driveway entry which is 6 m, 8 m or 10 m wide. The indicative flood depths are summarised in **Table 5**.

Table 5 Indicative Maximum Depth (m) of Flooding in Car Park

ARI (yrs)	Driveway Width (m)		
	6	8	10
500	0.016	0.021	0.026
1,000	0.44	0.58	0.73

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The time it would take to fill the single-storey car park during a PMF to a depth of 0.3 m, 0.9 m and 2.5 m for a single driveway entry which is 6 m, 8 m or 10 m wide was also estimated using a simple hydraulic model of flows down the ramp. The estimated times to flood the car park to various depths from the commencement of overtopping of the driveway crest are given in **Table 6**.

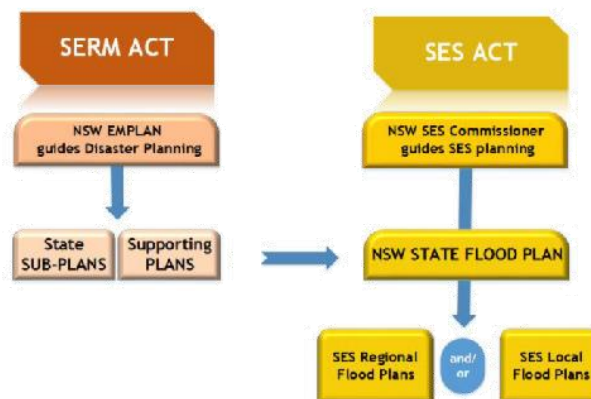
Table 6 Estimated Time (mins) to reach Various Depths in the Car Park in a PMF

	Driveway Width (m)		
	6	8	10
Reach 0.3 m depth	38	33	31
Reach 0.9 m depth	58	51	47
Reach 2.5 m depth	87	78	71

5 EMERGENCY PLANNING

The hierarchy of plans which guide the planning for floods in NSW is as follows:

NSW Hierarchy of Plans - Floods



5.1 2017 NSW State Flood Plan

The NSW State Flood Plan is a sub plan of the State Emergency Management Plan (EMPLAN). It has been prepared in accordance with the provisions of the State Emergency Service Act 1989 (NSW) and is authorised by the State Emergency Management Committee in accordance with the provisions of the State Emergency and Rescue Management Act 1989 (NSW).

The latest plan was provisionally endorsed by the State Emergency Management Committee at Meeting 107 held on 5 December 2017.

The purpose of this plan is to set out the arrangements for the emergency management of flooding in New South Wales

As described by the Plan:

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The Plan sets out the emergency management aspects of prevention; preparation; response and initial recovery arrangements for flooding and the responsibilities of individuals, agencies and organisations with regards to these functions.

The Plan recognises the existence of the problem of coastal inundation and erosion caused by severe weather. The management system for dealing with episodes of coastal erosion is described in the New South Wales State Storm Plan.

The Plan recognises the existence of the threat posed by tsunami to NSW coastal communities. The arrangements for the emergency management of tsunami are contained within the State Tsunami Emergency Sub Plan.

This Plan is intended to be read in conjunction with:

- (a) The New South Wales State Emergency Management Plan (EMPLAN), of which the State Flood Sub Plan is a sub-plan;*
- (b) The New South Wales State Storm Plan, which covers arrangements relating to severe storm events; and*
- (c) NSW Floodplain Development Manual.*

Volume 3 of the State Flood Plan outlines Flood Planning Arrangements and the Gauge Warning network. The information for the Georges River given in Table 8 was extracted from Table 1 in Volume 3. It is noted that Gauge 66168 is located only around 1.5 km from the site.

5.2 2017 South West Metropolitan Regional Emergency Management Plan

The 2017 South West Metropolitan Regional Emergency Management Plan details arrangements for, prevention of, preparation for, response to and recovery from emergencies within the South West Region. It encompasses arrangements for:

- emergencies controlled by combat agencies ;
- emergencies controlled by combat agencies and supported by the Regional Emergency Operations Controller (REOCON) ;
- emergency operations for which there is no combat agency;
- circumstances where a combat agency has passed control to the REOCON; and,
- demobilisation and transition of control from response to recovery.

As described by the Plan:

The objectives of this plan are to:

- *support Local Emergency Management Plans (EMPLANs) and augment them when required;*
- *identify trigger points for regional level activation, escalation and demobilisation;*
- *define participating organisation and Functional Area roles and responsibilities in preparation for, response to and recovery from emergencies;*
- *set out the control, co-ordination, support and liaison arrangements at the Regional level;*

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Table 8 The Provision and Requirements for Flood warning in the Georges River Catchment

Bureau number	AWRC number	Forecast location	Station owner	Gauge type	Flood classification (m)			Flood Warnings provided by the Bureau	Target warning lead time		70% of peak forecasts within	Local Flood Advises Provided by NSW SES
					Minor	Moderate	Major		Time (hours)	Trigger height (m)		
566054	213400	Liverpool *	NSW Office of Environment and Heritage – Manly Hydraulics Laboratory	Automatic	2.0	3.0	4.5	Quantitative	6 hrs	>2.0 m	+/- 0.3 m	
									12 hrs	>4.0 m		
66168	213405	Milperra *	NSW Office of Environment and Heritage – Manly Hydraulics Laboratory	Automatic	2.0	3.3	4.2	Quantitative	6 hrs	>2.0 m	+/- 0.3 m	
									12 hrs	>4.0 m		
566011	213410D	Picnic Point Downstream	NSW Office of Environment and Heritage – Manly Hydraulics Laboratory	Automatic	2.0	n/a	n/a	Quantitative	6 hrs	>2.0m	+/- 0.3 m	

^ = Small catchments described in 5.6.

* = key location for downstream predictions, critical for the provision of a quantitative flood forecasting service to downstream sites marked with +.

* = key locations for prediction which are based on a telemetered gauge proxy

All levels are in metres to local gauge datum unless indicated otherwise.

u/s refers to upstream levels acting as a trigger for forecasts at given location.

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- detail activation and alerting arrangements for involved agencies at the Regional level;
- detail arrangements for the acquisition and co-ordination of resources at the Regional level;
- maintain a governance over the Local Emergency Management Committees within its area of responsibility; and
- provide/facilitate emergency management training at a local and regional level

The plan describes the arrangements at Regional level to prevent, prepare for, respond to and recover from emergencies and also provides policy direction for the preparation of Sub Plans and Supporting Plans. Further:

- *This plan relies on effective implementation of the Governance framework for Emergency Management;*
- *Arrangements detailed in this plan are based on the assumption that the resources upon which the plan relies are available when required; and*
- *The effectiveness of arrangements detailed in this plan are dependent upon all involved agencies preparing, testing and maintaining appropriate internal instructions, and/or standing operating procedures.*

This plan is to be read in conjunction with the arrangements stipulated in the NSW State-EMPLAN

5.3 2015 Liverpool City Flood Emergency Sub Plan

The 2015 Liverpool City Flood Emergency Sub Plan is a sub plan of the Liverpool City Local Emergency Management Plan (EMPLAN). The plan covers preparedness measures, the conduct of response operations and the coordination of immediate recovery measures from flooding within the Liverpool Local Government Area (LGA). It covers operations for all levels of flooding within the council area.

As described by the Plan:

The area covered by the plan is the Liverpool City LGA.

The council area is in the NSW SES Sydney Southern Region and for emergency management purposes is part of the South West Metropolitan Emergency Management Region.

The Council area faces a number of flood threats including those from:

- The Georges River and its tributaries including the Cabramatta, Harris, Deadmans and William's Creeks.*
- South Creek and its tributaries including the Badgery's, Rileys and Kemp's Creeks.*
- The Upper Nepean River*

RESPONSIBILITIES

NSW SES Liverpool Local Controller. *The NSW SES Liverpool Local Controller is responsible for dealing with floods as detailed in the State Flood Plan, and will;*

Preparedness

- Maintain a Local Headquarters at 67 Pearce Street, Liverpool in accordance with the NSW SES Controllers' Guide and the NSW SES Operations Manual.*

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- (b) *Ensure that NSW SES members are trained to undertake operations in accordance with current policy as laid down in the NSW SES Controllers' Guide and the NSW SES Operations Manual.*
- (c) *Coordinate the development and operation of a flood warning service for the community.*
- (d) *Participate in floodplain risk management initiatives organised by the Liverpool City Council.*
- (e) *Coordinate a community engagement and capacity building program regarding local flood issues and associated risks to assist communities in building resilience to floods.*
- (f) *Identify and monitor people and/or communities at risk of flooding.*
- (g) *Ensure that the currency of this plan is maintained.*

Response

- (h) *Appoint an appropriate Incident Controller to undertake response roles. The Incident Controller will;*
 - *Control flood and storm response operations. This includes;*
 - *Directing the activities of the NSW SES units operating within the council area.*
 - *Coordinating the activities of supporting agencies and organisations and ensuring that liaison is established with them.*
 - *Contribute to preparation of Region IAP.*
 - *Coordinate the provision of an information service in relation to;*
 - *Flood heights and flood behaviour.*
 - *Road conditions and closures.*
 - *Advice on methods of limiting property damage.*
 - *Confirmation of evacuation warnings and evacuation orders.*
 - *Direct the conduct of flood rescue operations.*
 - *Direct the evacuation of people and/or communities.*
 - *Coordinate immediate welfare support for evacuated people.*
 - *Coordinate the provision of emergency food and medical supplies to isolated people and/or communities.*
 - *Coordinate operations to assist the community to protect property. This may include;*
 - *Arranging resources for sandbagging operations.*
 - *Lifting or moving household furniture.*
 - *Lifting or moving commercial stock and equipment.*
 - *Where possible, arrange for support (for example, accommodation and meals) for emergency service organisation members and volunteers assisting them.*
 - *If NSW SES resources are available, assist with emergency fodder supply operations conducted by Agriculture and Animal Services.*
 - *If NSW SES resources are available, assist the NSW Police Force, RMS and Council with road closure and traffic control operations.*
 - *Exercise financial delegations relating to the use of emergency orders as laid down in the NSW SES Controllers' Guide.*
 - *Coordinate the collection of flood information for development of intelligence.*

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- *Submit Situation Reports to the NSW SES Sydney Southern Region Headquarters and agencies assisting within the council area. These should contain information on;*
 - *Road conditions and closures.*
 - *Current flood behaviour.*
 - *Current operational activities.*
 - *Likely future flood behaviour.*
 - *Likely future operational activities.*
 - *Probable resource needs.*
- *Keep the Local Emergency Operations Controller advised of the flood situation and the operational response.*
- *Issue the 'All Clear' when flood operations have been completed.*

Recovery

- (i) *Ensure that appropriate After Action Reviews are held after floods.*
- (j) *Provide appropriate representation to the recovery committee for the duration of the response phase of an event and as agreed during the recovery phase.*

....

Australian Government Bureau of Meteorology (The Bureau)

- (a) *Provide Flood Watches for the Georges River and Hawkesbury-Nepean Basins.*
- (b) *Provide Flood Warnings, incorporating height-time predictions, for Liverpool Weir (AWRC No. 213400), Milperra (AWRC No. 213405), Camden Bridge (AWRC No. 212900), and Wallacia Bridge (AWRC No. 212202) gauges.*
- (c) *Provide severe weather warnings when flash flooding is likely to occur.*

6. FLOOD EMERGENCY RESPONSE

It is expected that Building Owners and Managers (in accordance with existing OH&S requirements, the Building Code of Australia and relevant City of Liverpool regulations) are to have a building Emergency Management Plan which complies with the provisions of AS 3745.

It is expected that the building Emergency Management Plan will contain a Flood Emergency Response Plan. It is also expected that all wardens trained under the building emergency plan are to be aware of the flood risks, routes to/from the site and how to liaise with the any building occupants on the site.

It is expected that the building Emergency Management Plan will contain details on how the information regarding any evacuation will be disseminated from the Chief Warden to occupants of the Marina.

6.1 Flood Warning

As outlined above that the Bureau of Meteorology provides:

- Flood Watches for the Georges River;
- Flood Warnings, incorporating height-time predictions, for Liverpool Weir (AWRC No. 213400), and Milperra (AWRC No. 213405),

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It is noted that the Milperra Gauge is located only around 1.5 km from the site.

While the warning times in a PMF are shorter than for major floods (500 yr ARI – 1,000 yr ARI) it is expected that the extreme weather required to generate a long duration PMP event across the Georges River catchment would be actively tracked by weather forecasters days ahead and that early warnings of extreme weather would be issued by the BoM.

It is concluded that in contrast to the short warning times available on other river system in metropolitan Sydney eg. Parramatta River, the warning times for major flooding in the Georges River are considerably longer and would give sufficient time for residents and visitors to evacuate if they did not want to shelter in place. It is noted that the BoM target warning lead time for flooding higher than 4.0 m on the gauge (3.045 m AHD) is 12 hours.

6.2 Flood Evacuation

In flood events up to the 100 yr ARI flood a flood-free vehicular evacuation route and a separate flood-free pedestrian evacuation route is available to residents, visitors and workers on the site.

6.0 m AHD is the indicative level at which access to the site at the intersection of the new access bridge and Brickmakers Drive become unsafe for vehicles. This equates to a 250 yr ARI flood level.

It is expected that any decision to shelter in place or to evacuate would be informed by the predicted severity of flooding, the likely duration of any closure of access via Brickmakers Drive and the access bridge and the likelihood that the single-storey car park and the ground floor of any buildings would be inundated.

6.3 Draft Flood Emergency Response Plan

Flood Threat

Features of the planned Georges Cove Marina development include:

- Proposed ground floor levels for the Georges Cove Marina is 7.60 m AHD which provides 2,080 mm freeboard above the estimated 100 year ARI flood level. The Ground Floor level equates to a 5,000 yr ARI flood level;
- Proposed Level 1 floor levels of the apartments at Georges Cove Marina is 11.6 m AHD which is higher than the PMF level;
- Likewise the proposed floor levels of apartments on Levels 2 to 9 are all higher than the PMF level;
- A crest level of 6.3 m AHD on the driveway access to the single-storey car parking level at the Marina complex which provides 780 mm freeboard above the 100 year ARI level. The driveway crest level equates to a 450 yr ARI flood level;

Incorporation of a 1.3 m flood barrier on the driveway crest to delay the ingress of floodwaters into the basement car park would provide the same level of protection as the Ground Floor.

The time for floodwaters to reach the following key levels in a 500 yr ARI flood, 1,000 yr ARI flood, 10,000 yr ARI flood and the PMF are given in **Tables 1 – 4** respectively. The key levels include:

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- 2 m AHD which could be viewed as an indicator of the potential for significant flooding;
- 5.5 m AHD as an indicator of the 1% AEP flood level;
- 6.0 m AHD which is the indicative level at which access to the site at the intersection of the new access bridge and Brickmakers Drive become unsafe for vehicles;
- 6.3 m AHD which is the proposed crest level of the driveway to the single-storey car park in Georges Cove Marina; and
- 7.6 m AHD which is the proposed Ground Floor level for the Georges Cove Marina.

The indicative depth of flooding in the single-storey car park at Georges Cove Marina was also estimated for the 500 yr ARI and 1,000 yr ARI flood for a single driveway entry which is 6 m, 8 m or 10 m wide. The indicative flood depths in a 500 yr ARI flood vary from 0.016 - 0.026 m while the flood depths in a 1,000 yr ARI flood vary from 0.44 - 0.74 m.

The time it would take to fill the single-storey car park during a PMF to a depth of 0.3 m, 0.9 m and 2.5 m for a single driveway entry which is 6 m, 8 m or 10 m wide was also assessed. Depending on the driveway width, the estimated times to flood the car park to 0.3 m are 31 - 38 mins and to 0.9 m are 47-51 mins from the commencement of overtopping of the driveway crest.

Responsibilities

While in a flood emergency the NSW State Emergency Service (SES) has responsibilities including to:

- Direct the evacuation of persons and/or communities at risk of flood inundation.
- Issue evacuation warnings for individual communities that describe possible local effects, suggested actions and evacuation arrangements.

it is expected that the building on-site manager or other designated person(s) will be responsible for implementing the actions defined in the Flood Emergency Response Plan and should not rely on the SES for any evacuation warnings. These actions would include liaising with the SES, monitoring any BoM flood warnings, maintaining regular communication with residents, visitors and workers and initiating actions as documented in the Plan.

Preparedness

Visitors and residents shall be advised of the potential flood threat in their locality, and recommended management and evacuation procedures in case of a major flood event. They will comply with all lawful directions.

It is recommended that a practice evacuation drill or meeting is organised by management for residents and workers annually.

Warning

While in a flood event, the SES will prepare, authorise and distribute evacuation warnings it is expected that the short warning times mean that in the case of extreme floods that there would be insufficient time to evacuate any residents and/or visitors from the site and that instead residents and/or visitors would need to shelter in place. The building on-site manager or other designated person(s) will be responsible for implementing the actions defined in the Flood Emergency Detailed Response Plan and should not rely on the SES for any evacuation warnings.

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Response

It is expected that any decision to shelter in place or to evacuate would be informed by the predicted severity of flooding, the likely duration of any closure of access via Brickmakers Drive and the access bridge and the likelihood that the single-storey car park and the ground floor of any buildings would be inundated.

In extreme floods residents and any visitors on the Ground Floor who decide to remain on site could retreat to Levels 1 - 9 in floods greater than a 5,000 yr ARI as all these levels are above the PMF level.

Recovery

The building on-site manager or other designated person(s) will issue an 'all clear' message when the immediate danger to life and property has passed.

7. OEH AND NSW SES ISSUES OF CONCERN

7.1 OEH Issues of Concern

OEH issues of concern are detailed in a letter dated 24 May 2017. A number of these issues are discussed as follows.

OEH is concerned that although the Georges Cove site ground levels have been raised to RL 6.3m AHD which is above the 100 year flood level of 5.6m AHD, the adjacent land falls away to RL 2.5m with the adjacent Newbridge Road flooded at levels 1.5 m to 3.0 m AHD. The proposed evacuation routes are inundated in frequent flood events such as the 5% AEP flood, which results in the site becoming isolated and preventing evacuation. OEH's concerns are also supported by Figures 4 and 7 of the Flood Impact Assessment Stage 2 prepared for DA24/2017 for the Moorebank Cove Site (Cardno, July 2016). Figures 4 and 7 provide a general overview on the scale of isolation and depict the depth of floodwaters surrounding the Georges Cove and Moorebank Cove proposed residential sites in the 5% and 1% AEP respectively.

As discussed in Section 4.3, a number of evacuation routes from the site are available across an already approved new bridge crossing. Two possible routes for vehicular evacuation and one possible pedestrian route to a level on the floodplain higher than the PMF are identified as follows.

- | | |
|----------|---|
| Route 1V | Cross the new access bridge to Brickmakers Drive, turn left onto Brickmakers Drive, turn right onto Maddecks Ave then turn right on to Conlon Ave. The advantage of this route is that it is flood-free in a 100 yr ARI flood. |
| Route 2V | Cross the new access bridge to Brickmakers Drive, turn right onto Brickmakers Drive, turn left onto Newbridge Road. The advantage of this route is that it is shorter than Route 1V but the major disadvantage is that Brickmakers Drive north of the access bridge and a section of Newbridge Road experience low hazard flooding in a 1% AEP flood. |
| Route 1P | Persons would cross the new access bridge to Brickmakers Drive, then cross Brickmakers Drive to walk northwest across the local park to Eluora Cres and then walk west along Eulora Ave. The advantage of this route is that it is flood-free in a 100 yr ARI flood. |

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In flood events up to the 100 yr ARI flood a flood-free vehicular evacuation route and a separate flood-free pedestrian evacuation route is available to residents, visitors and workers on the site.

6.0 m AHD is the indicative level at which access to the site at the intersection of the new access bridge and Brickmakers Drive become unsafe for vehicles. This equates to a 250 yr ARI flood level.

OEH has general concerns regarding the proposed use of shelter in place i.e. using access to floor levels above the PMF level. Shelter in place is not acceptable in the case of a mainstream flooding environment, characterised by deep flooding for extended period of time. The Australian Emergency Management Handbook 7 highlights that 'there is no safe duration of isolation' (Emergency Management Australia, 2013). Residents sheltering in place during a flood may be without basic services, need assistance with critical supplies, and need evacuation due to medical conditions and requirements. The isolation and proposed shelter in place situation in this site can cause significant risk to life for potential occupiers and for emergency personnel.

In Section 4.4, the time for floodwaters to reach the following key levels in a 500 yr ARI flood, 1,000 yr ARI flood, 10,000 yr ARI flood and the PMF are given in **Tables 1 – 4** respectively. The key levels include:

- 2 m AHD which could be viewed as an indicator of the potential for significant flooding;
- 5.5 m AHD as an indicator of the 1% AEP flood level;
- 6.0 m AHD which is the indicative level at which access to the site at the intersection of the new access bridge and Brickmakers Drive become unsafe for vehicles;
- 6.3 m AHD which is the proposed crest level of the driveway to the single-storey car park in Georges Cove Marina; and
- 7.6 m AHD which is the proposed Ground Floor level for the Georges Cove Marina.

As outlined in Section 5.3, the Bureau of Meteorology provides:

- Flood Watches for the Georges River;
- Flood Warnings, incorporating height-time predictions, for Liverpool Weir (AWRC No. 213400), and Milperra (AWRC No. 213405),

It is noted that the Milperra Gauge is located only around 1.5 km from the site.

While the warning times in a PMF are shorter than for major floods (500 yr ARI – 1,000 yr ARI) it is expected that the extreme weather required to generate a long duration PMP event across the Georges River catchment would be actively tracked by weather forecasters days ahead and that early warnings of extreme weather would be issued by the BoM.

It is concluded that in contrast to the short warning times available on other river system in metropolitan Sydney eg. Parramatta River, the warning times for major flooding in the Georges River are considerably longer and would give sufficient time for residents and visitors to evacuate if they did not want to shelter in place. It is noted that the BoM target warning lead time for flooding higher than 4.0 m on the gauge (3.045 m AHD) is 12 hours

It is expected that any decision to shelter in place or to evacuate would be informed by the predicted severity of flooding, the likely duration of any closure of access via Brickmakers Drive and the access bridge in floods greater than a 250 yr ARI flood and the likelihood that the single-storey car park and the ground floor of any buildings would be inundated.

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7.2 NSW SES Issues of Concern

NSW SES issues of concern are detailed in a letter dated 2 November 2017. A number of these issues are discussed as follows.

The site of the proposal is also in an area that is subject to flash flooding. Flash flooding is characterised by short warning time (an area that generally has less than 6 hours between rain falling and flooding) with often high hazard floodwater impacting a community that is built within proximity to the watercourses. During such flood events, roads that are used to convey flow or cross watercourses are potentially hazardous.

In Section 4.4 the time for floodwaters to reach the following key levels in a 500 yr ARI flood, 1,000 yr ARI flood, 10,000 yr ARI flood and the PMF are given in **Tables 1 – 4** respectively. The key levels include:

- 2 m AHD which could be viewed as an indicator of the potential for significant flooding;
- 5.5 m AHD as an indicator of the 1% AEP flood level;
- 6.0 m AHD which is the indicative level at which access to the site at the intersection of the new access bridge and Brickmakers Drive become unsafe for vehicles;
- 6.3 m AHD which is the proposed crest level of the driveway to the single-storey car park in Georges Cove Marina; and
- 7.6 m AHD which is the proposed Ground Floor level for the Georges Cove Marina.

As outlined in Section 5.3 the Bureau of Meteorology provides:

- Flood Watches for the Georges River;
- Flood Warnings, incorporating height-time predictions, for Liverpool Weir (AWRC No. 213400), and Milperra (AWRC No. 213405),

It is noted that the Milperra Gauge is located only around 1.5 km from the site.

It is unclear how this flooding regime would be classified as “flash” flooding.

Although the planning proposal states that ‘all residents would have internal access to floor levels above the PMF level’ and therefore the ability to ‘shelter in place’ if they cannot evacuate (Appendix D, p 1), there are additional hazards and risks in people being surrounded by high hazard floodwater. These include the potential for people to attempt to evacuate when it unsafe to do so or taking risks by crossing flooded roads in order to access their place of residence.

As discussed in Section 4.3 a number of evacuation routes from the site are available across an already approved new bridge crossing. Two possible routes for vehicular evacuation and one possible pedestrian route to a level on the floodplain higher than the PMF are identified.

In flood events up to the 100 yr ARI flood a flood-free vehicular evacuation route and a separate flood-free pedestrian evacuation route is available to residents, visitors and workers on the site. 6.0 m AHD is the indicative level at which access to the site at the intersection of the new access bridge and Brickmakers Drive become unsafe for vehicles. This equates to a 250 yr ARI flood level.

In contrast to the short warning times available on other river system in metropolitan Sydney eg. Parramatta River, the warning times for major flooding in the Georges River are considerably longer and would give sufficient time for residents and visitors to evacuate if they did not want to shelter in place. It is noted that the BoM target warning lead time for flooding higher than 4.0 m on the gauge (3.045 m AHD) is 12 hours.

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It is expected that any decision to shelter in place or to evacuate would be informed by the predicted severity of flooding, the likely duration of any closure of access via Brickmakers Drive and the access bridge in floods greater than a 250 yr ARI flood and the likelihood that the single-storey car park and the ground floor of any buildings would be inundated.

On an additional but related note, this application reflect the facts in Mercury Resources Pty Ltd v Parramatta City Council [2016] NSWLEC 1094. Mercury Resources proposed the development of a high rise building that was only accessible through high hazard floodwater. Mercury Resources proposed shelter in place as an appropriate strategy during a flood for safety of the future occupants (at [26]). Council refused to grant consent to the application. The Land and Environment Court Commissioner Sue Morris dismissed the applicant's appeal against Council's refusal to grant consent. She held that as the access to the site is through high hazard floodwater, and that the development would result in additional people being put at risk during a flood, it was an unacceptable flood risk and 'not compatible with the flood hazard of the land, (as it) may result in unsustainable social and economic costs to the community as a consequence of flooding' (at [112]).

The property which was the subject of NSWLEC 1094 was 32 Tramway Avenue, Parramatta. Council refused to grant consent because the only access to the property was via Arthur Street which is subject to high hazard flooding for a period of time in a 100 yr ARI flood ie. Council's concern was access to/from the property in events up to the 100 yr ARI flood. Council approved a development of three apartment towers on 2-8 River Road West which is closer to the Parramatta River and only 180 m from 32 Tramway Ave on the basis that flood free access was available to a corner of the development in a 100 yr ARI flood. This approved development also relies on shelter-in-place in events greater than a 100 yr ARI flood up to the PMF which is around 4.2 m higher than the 100 yr ARI flood level. The same level of high hazard is experienced on both properties in the PMF. It is concluded that the level of hazard in the PMF would not have been of concern to Council given its approval of residential apartment development (with a greater number of residents) on the nearby property.

The planning proposal states '(a)ll residents would have carparking flood protected to a level of RL 6.3m which is 200mm above the flood planning level.' (Appendix D, p 1). The proposal states there will be parking for 851 vehicles, made up of 201 parking spaces for residents and 650 for employees, customers and other visitors (p 1).

Although the crest level of the basement parking is proposed to be 200mm above the flood planning level, the basement will be flooded above this level. There is a height difference of 3.9m between the crest level and the PMF (Appendix D, p 1).

Above the crest level there is likely to be damage to property and risk to life of occupants who may become trapped in a basement carpark during a large enough flood. A recent paper by Collier et al. (2017) provides a thorough analysis of the risks to people and property associated with basement carparks when considering flooding up to the PMF. This is attached for consideration (Annexure 4). The analysis of the planning proposal should take into account these risks to future occupants.

In Section 4.4, the indicative depth of flooding in the single-storey car park at Georges Cover Marina is also estimated for the 500 yr ARI and 1,000 yr ARI flood for a single driveway entry which is 6 m, 8 m or 10 m wide. The indicative flood depths in a 500 yr ARI flood vary from 0.016 - 0.026 m while the flood depths in a 1,000 yr ARI flood vary from 0.44 - 0.74 m.

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The time it would take to fill the single-storey car park during a PMF to a depth of 0.3 m, 0.9 m and 2.5 m for a single driveway entry which is 6 m, 8 m or 10 m wide was also assessed. Depending on the driveway width, the estimated times to flood the car park to 0.3 m are 31 - 38 mins and to 0.9 m are 47-51 mins from the commencement of overtopping of the driveway crest.

It is considered that flooding of the proposed car park is not as rapid as may occur elsewhere and that there is sufficient time available for any residents, visitors or workers to evacuate to a level higher than the PMF once overtopping of the driveway commences in a PMF. It is noted that in the available time to evacuate the car park (30-45 mins) that the ground floor would not be already inundated by rising PMF floodwaters.

8. CONCLUSIONS

In conclusion the hydraulic modelling of the Planning Proposal shows the following:

- In both the 20 yr ARI and 100yr ARI flood it was assessed that the Planning Proposal has nil adverse impact on water levels (less than 0.01 m) at any location in the floodplain in comparison to the benchmark conditions; and
- While in the 20yr and 100yr ARI events there are modest velocity impacts west of the northern section of the elevated car park this is because under benchmark conditions this area was filled and under the Planning Proposal this area is re-established as a flowpath (as existed prior to any development on the site). Notwithstanding these local changes in velocity the overall velocity remains much lower than 1 m/s and consequently does not pose a scour risk.

The following additional issues have been considered beyond the previous flood impact assessments.

8.1 Flood Storage

The change in 100 yr ARI flood storage as a result of the works proposed under the Planning Proposal was also assessed. The 100 yr ARI flood storage under the Benchmark Scenario (refer Section 2.1) was estimated to be 499,200 m³. The 100 yr ARI flood storage under the Post-development Scenario (refer Section 2.2) was estimated to be 521,800 m³. This calculation accounted for the volume of floodwaters displaced by the proposed suspended car park and the columns which will support the car park.

It is concluded that the Planning Proposal would increase the 100 yr ARI flood storage by 22,600 m³ in comparison with the previous approved land form and development.

Possible Evacuation Routes

8.2 Possible Evacuation Routes

A number of evacuation routes from the site are available across an already approved new bridge crossing. Two possible routes for vehicular evacuation and one possible pedestrian route to a level on the floodplain higher than the PMF are identified. The times it would take to evacuate by vehicle or by foot from the site along these routes at different speeds was assessed. It is concluded that:

- (v) The advantage of Routes 1V and 1P are that they are flood-free in a 100 yr ARI flood;
- (vi) The time to evacuate by vehicle is less than 4 minutes;
- (vii) The time to evacuate by foot to higher ground is less than 12 minutes along Route 1P and would be shorter depending on the pace at which persons would walk;
- (viii) 6.0 m AHD is the indicative level at which access to the site at the intersection of the new access bridge and Brickmakers Drive become unsafe for vehicles. This equates to a 250 yr ARI flood level.

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8.3 Rate of Rise of Floodwaters and Flood Warning Times

Features of the planned development include:

- Proposed ground floor levels for the Georges Cove Marina is 7.60 m AHD which provides 2,080 mm freeboard above the estimated 100 year ARI flood level. The Ground Floor level equates to a 5,000 yr ARI flood level;
- Proposed Level 1 floor levels of the apartments at Georges Cove Marina is 11.6 m AHD which is higher than the PMF level;
- Likewise the proposed floor levels of apartments on Levels 2 to 9 are all higher than the PMF level;
- A crest level of 6.3 m AHD on the driveway access to the single-storey car parking level at the Marina complex which provides 780 mm freeboard above the 100 year ARI level. The driveway crest level equates to a 450 yr ARI flood level;

The time for floodwaters to reach the following key levels in a 500 yr ARI flood, 1,000 yr ARI flood, 10,000 yr ARI flood and the PMF are given in **Tables 1 – 4** respectively. The key levels include:

- 2 m AHD which could be viewed as an indicator of the potential for significant flooding;
- 5.5 m AHD as an indicator of the 1% AEP flood level;
- 6.0 m AHD which is the indicative level at which access to the site at the intersection of the new access bridge and Brickmakers Drive become unsafe for vehicles;
- 6.3 m AHD which is the proposed crest level of the driveway to the single-storey car park in Georges Cove Marina; and
- 7.6 m AHD which is the proposed Ground Floor level for the Georges Cove Marina.

As outlined in Section 5.3 the Bureau of Meteorology provides:

- Flood Watches for the Georges River;
- Flood Warnings, incorporating height-time predictions, for Liverpool Weir (AWRC No. 213400), and Milperra (AWRC No. 213405),

It is noted that the Milperra Gauge is located only around 1.5 km from the site.

While the warning times in a PMF are shorter than for major floods (500 yr ARI – 1,000 yr ARI) it is expected that the extreme weather required to generate a long duration PMP event across the Georges River catchment would be actively tracked by weather forecasters days ahead and that early warnings of extreme weather would be issued by the BoM.

It is concluded that in contrast to the short warning times available on other river system in metropolitan Sydney eg. Parramatta River, the warning times for major flooding in the Georges River are considerably longer and would give sufficient time for residents and visitors to evacuate if they did not want to shelter in place. It is noted that the target warning lead time for flooding higher than 4.0 m on the gauge (3.045 m AHD) is 12 hours

It is expected that any decision to shelter in place or to evacuate would be informed by the predicted severity of flooding, the likely duration of any closure of access via Brickmakers Drive and the access bridge and the likelihood that the single-storey car park and the ground floor of any buildings would be inundated.

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8.4 Flooding of the Car Park

In Section 4.4, the indicative depth of flooding in the single-storey car park at Georges Cover Marina is also estimated for the 500 yr ARI and 1,000 yr ARI flood for a single driveway entry which is 6 m, 8 m or 10 m wide. The indicative flood depths in a 500 yr ARI flood vary from 0.016 - 0.026 m while the flood depths in a 1,000 yr ARI flood vary from 0.44 - 0.74 m.

The time it would take to fill the single-storey car park during a PMF to a depth of 0.3 m, 0.9 m and 2.5 m for a single driveway entry which is 6 m, 8 m or 10 m wide was also assessed. Depending on the driveway width, the estimated times to flood the car park to 0.3 m are 31 - 38 mins and to 0.9 m are 47-51 mins from the commencement of overtopping of the driveway crest. It is considered that flooding of the proposed car park is not as rapid as may occur elsewhere and that there is sufficient time available for any residents, visitors or workers to evacuate to a level higher than the PMF once overtopping of the driveway commences in a PMF. It is noted that in the available time to evacuate the car park (30-45 mins) that the ground floor would not be already inundated by rising PMF floodwaters.

8.5 Emergency Planning

The hierarchy of plans which guide the planning for floods in NSW and in the Liverpool LGA are overviewed. These include the

- 2017 NSW State Flood Plan
- 2017 South West Metropolitan Regional Emergency Management Plan
- 2015 Liverpool City Flood Emergency Sub Plan

Flood Emergency Response

It is expected that the building Emergency Management Plan will contain a Flood Emergency Response Plan. It is also expected that all wardens trained under the building emergency plan are to be aware of the flood risks, routes to/from the site and how to liaise with the any building occupants on the site.

Flood Warning

It is concluded that in contrast to the short warning times available on other river system in metropolitan Sydney eg. Parramatta River, the warning times for major flooding in the Georges River are considerably longer and would give sufficient time for residents and visitors to evacuate if they did not want to shelter in place. It is noted that the BoM target warning lead time for flooding higher than 4.0 m on the gauge (3.045 m AHD) is 12 hours.

Flood Evacuation

In flood events up to the 100 yr ARI flood a flood-free vehicular evacuation route and a separate flood-free pedestrian evacuation route is available to residents, visitors and workers on the site.

6.0 m AHD is the indicative level at which access to the site at the intersection of the new access bridge and Brickmakers Drive become unsafe for vehicles. This equates to a 250 yr ARI flood level.

It is expected that any decision to shelter in place or to evacuate would be informed by the predicted severity of flooding, the likely duration of any closure of access via Brickmakers Drive and the access bridge and the likelihood that the single-storey car park and the ground floor of any buildings would be inundated.

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A Draft Flood Emergency Response Plan is also outlined.

8.6 OEH and NSW SES Issues of Concern

OEH issues of concern are detailed in a letter dated 24 May 2017. NSW SES issues of concern are detailed in a letter dated 2 November 2017. A number of these issues are discussed as follows.

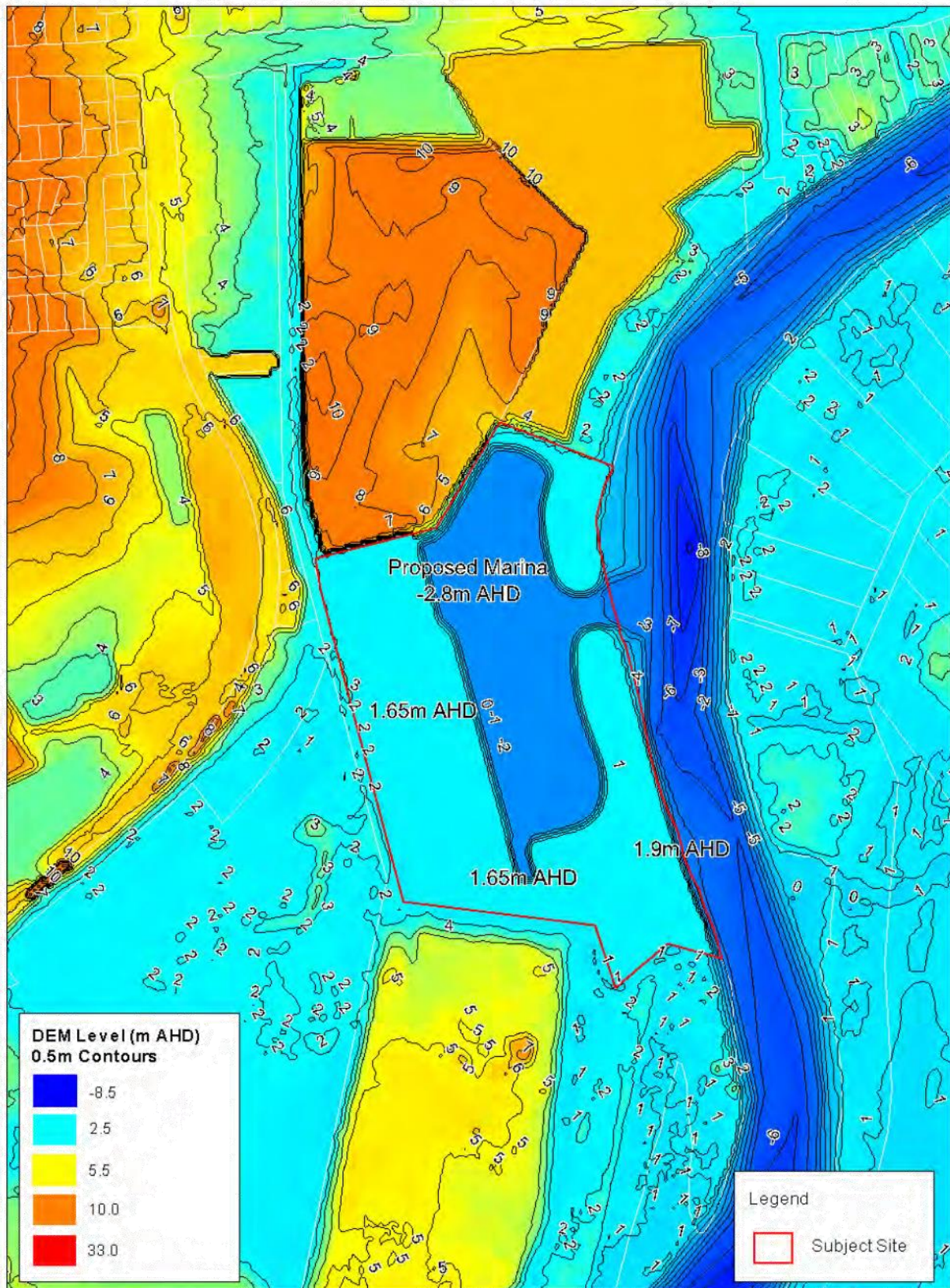
A number of these issues are discussed and responses are provided.

Should you have any questions regarding this assessment please do not hesitate to contact me on 9496 7700.

Yours faithfully

A handwritten signature in black ink that reads "Brett C. Phillips".

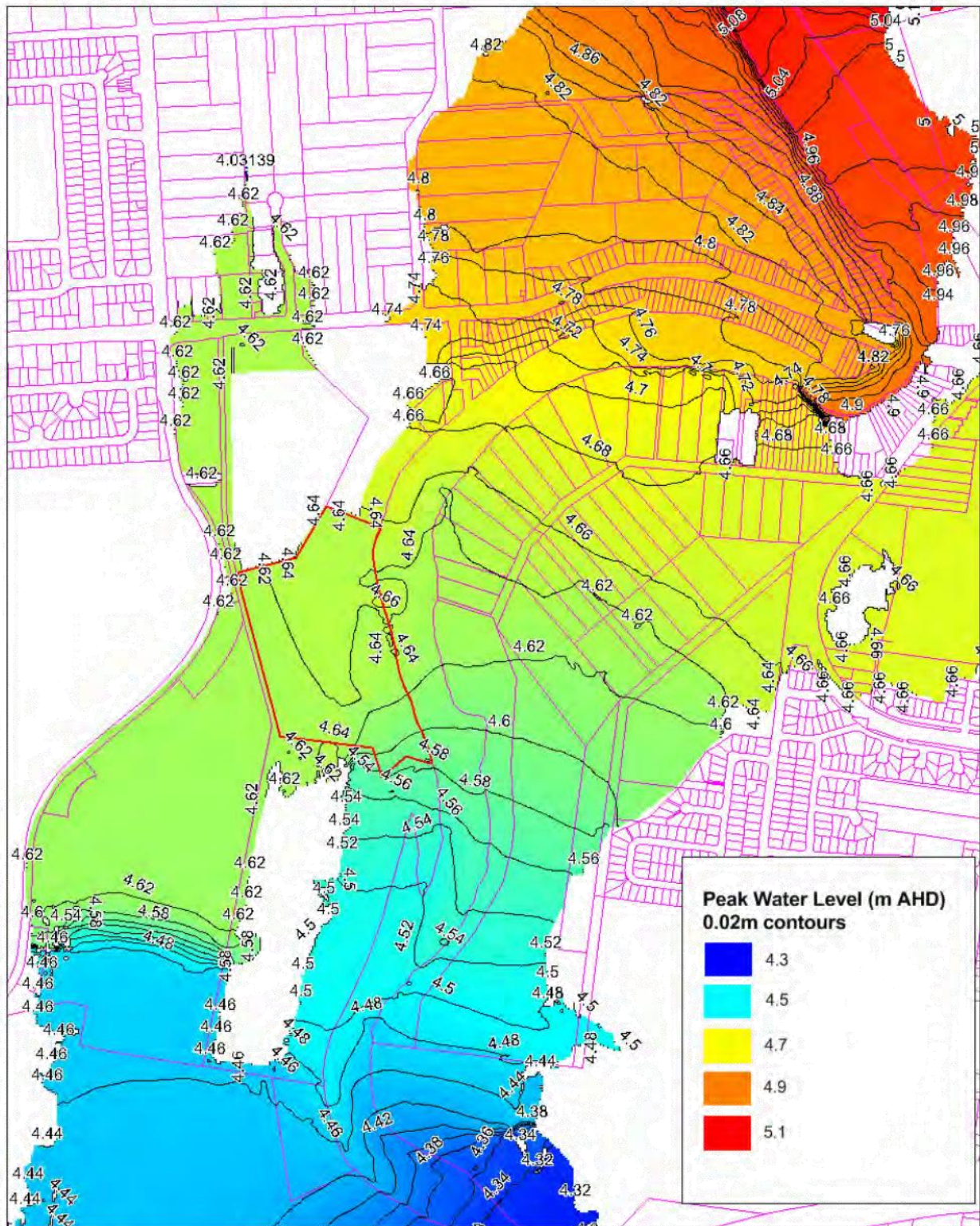
.....
Dr Brett C. Phillips
Director, Water Engineering
for **Cardno**



NA49913037
January 2018

Georges Cove
Flood Impact Assessment

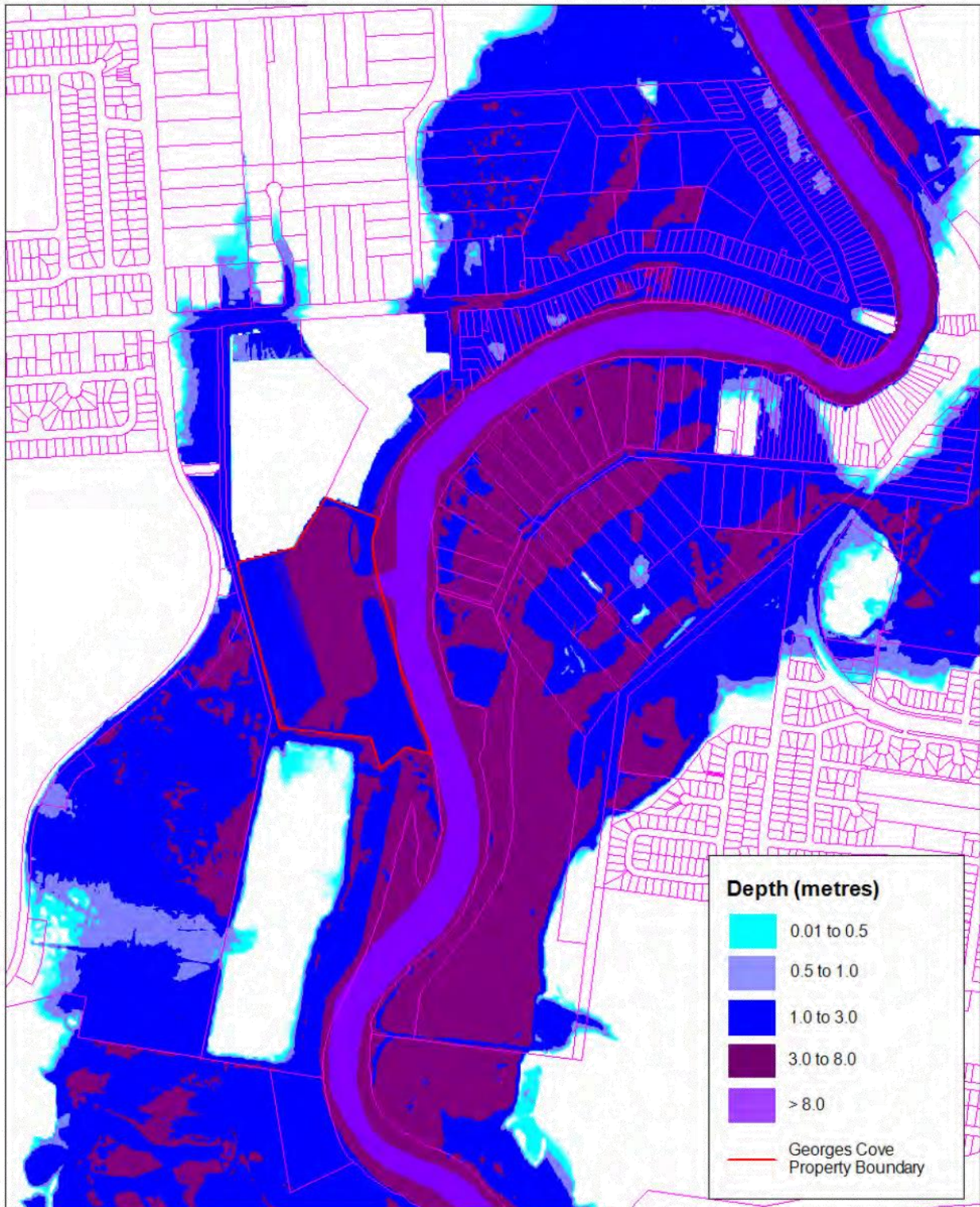
Figure 1
DEM
Post-Development Design (Jan18)



NA49913037
January 2018

Georges Cove
Flood Impact Assessment

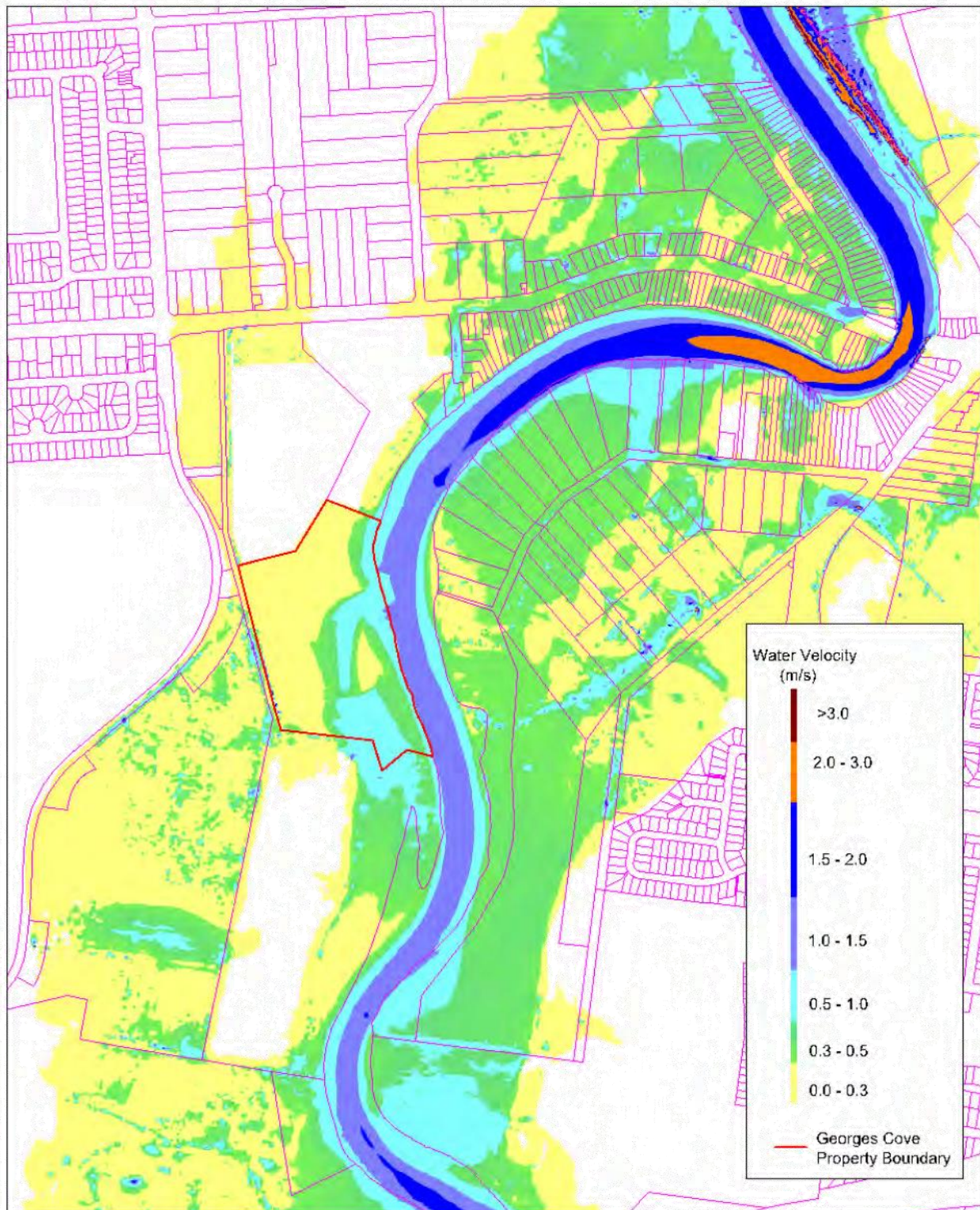
Figure 2
20 year ARI
Peak Water Level
Design (Jan18)



NA49913037
January 2018

Georges Cove
Flood Impact Assessment

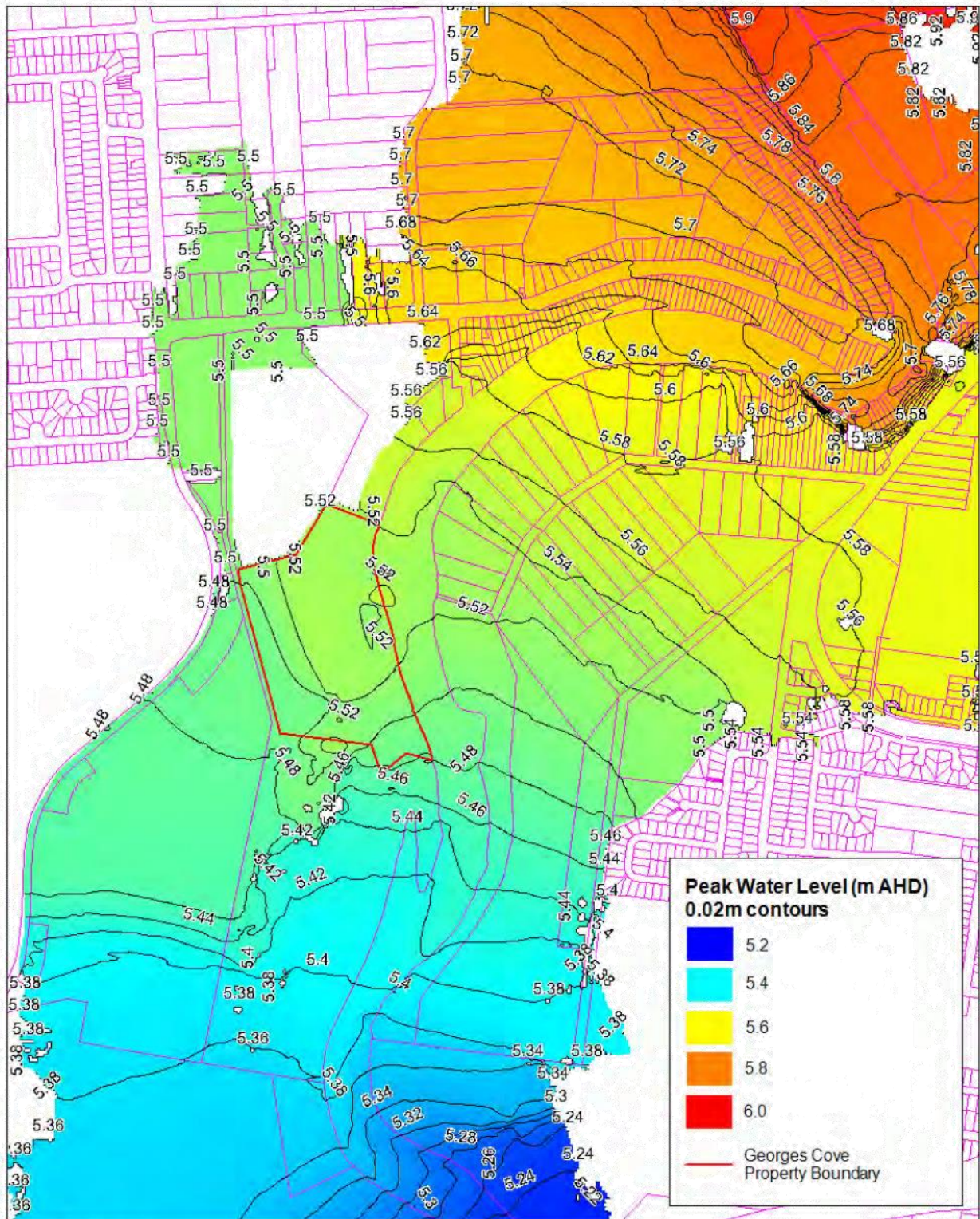
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20 year ARI
Peak Depth
Design (Jan18)



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 January 2018

Georges Cove
 Flood Impact Assessment

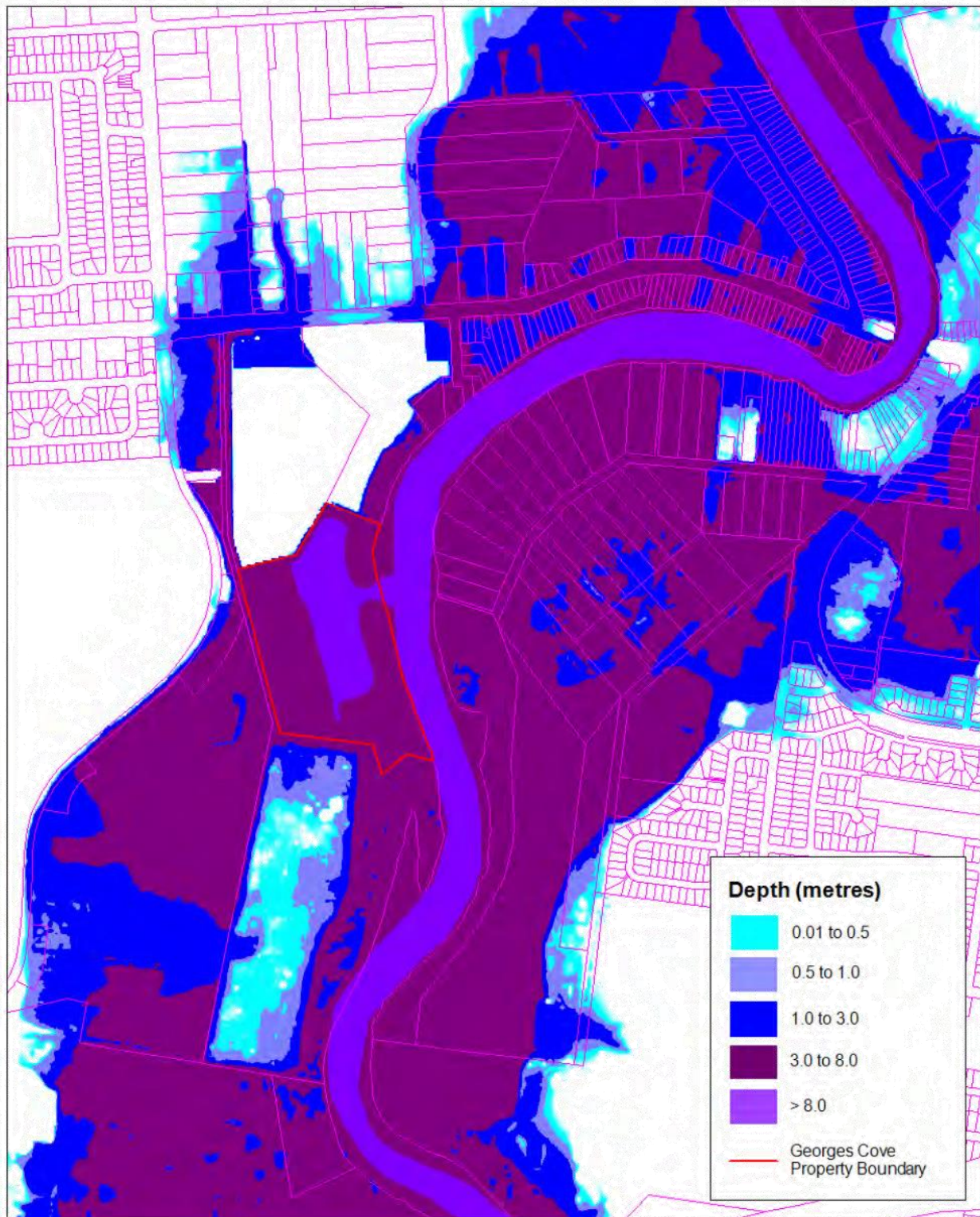
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 20 year ARI
 Peak Velocity
 Design (Jan18)



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January 2018

Georges Cove
Flood Impact Assessment

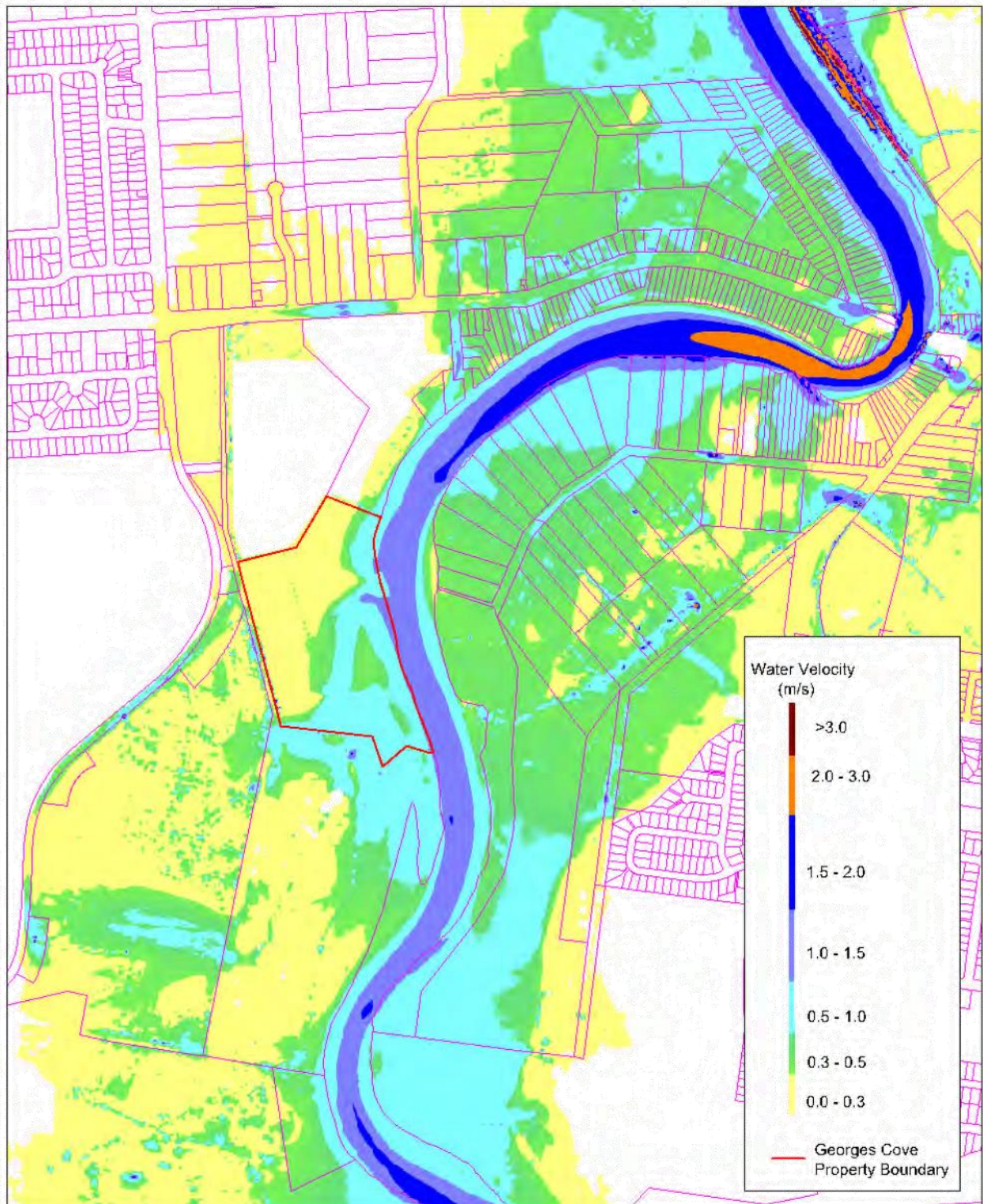
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100 year ARI
Peak Water Level
Design (Jan18)



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 January 2018

Georges Cove
 Flood Impact Assessment

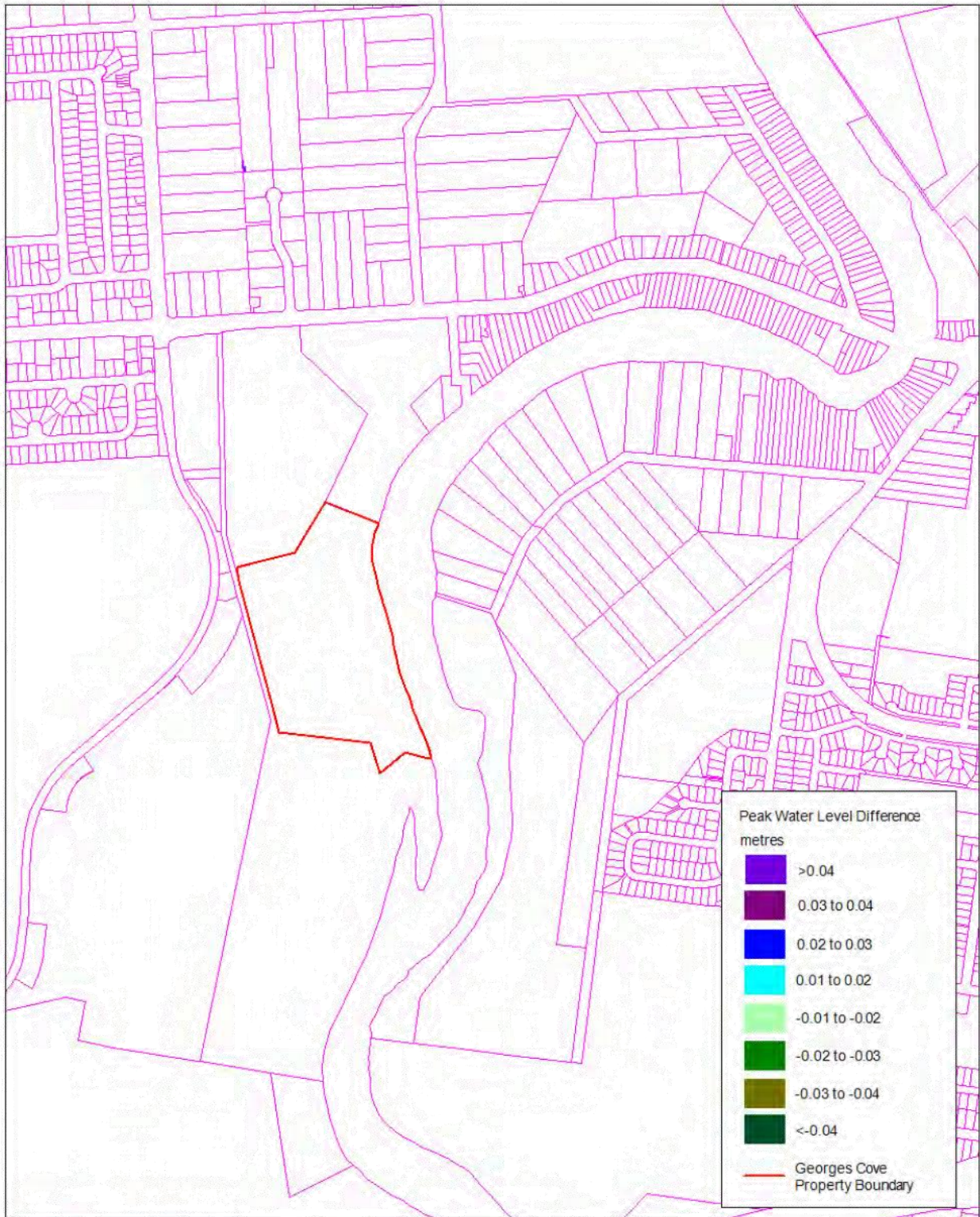
Figure 6
 100 year ARI
 Peak Depth
 Design (Jan18)



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January 2018

Georges Cove
Flood Impact Assessment

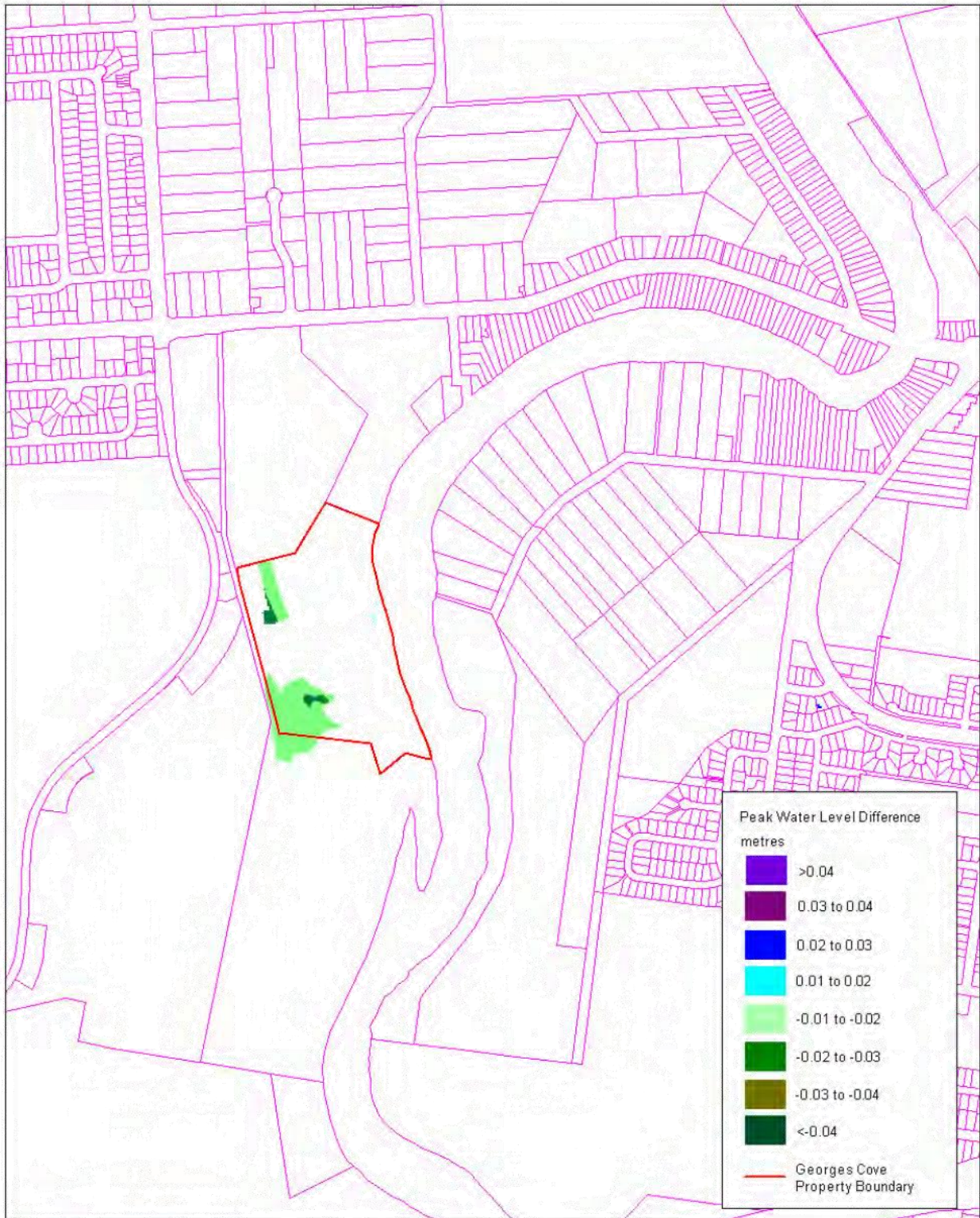
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100 year ARI
Peak Velocity
Design (Jan18)



NA49913037
 January 2018

Georges Cove
 Flood Impact Assessment

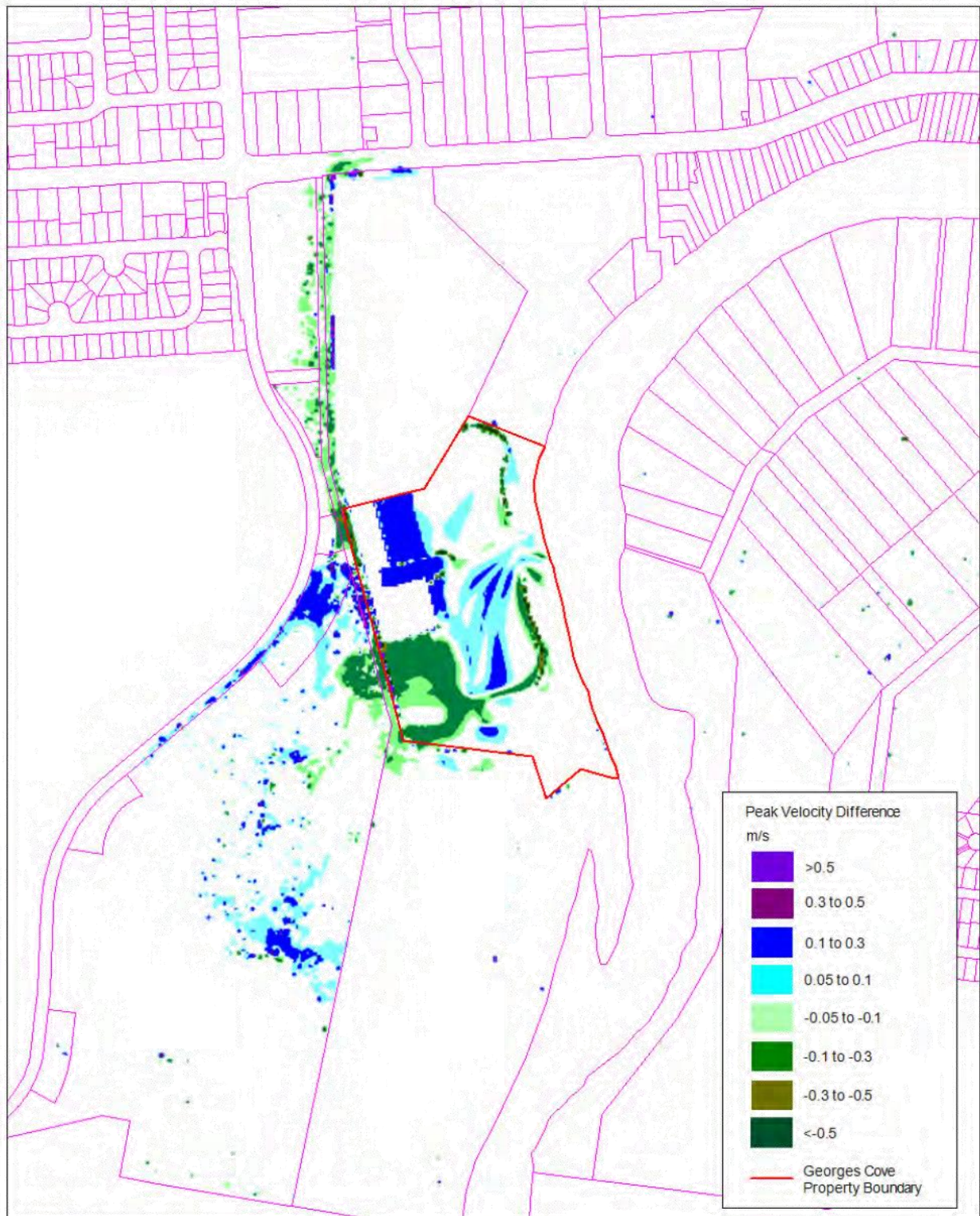
Figure
 20 year ARI
 Peak Water Level Difference
 Design (Jan18) Less Approved Design



NA49913037
January 2018

Georges Cove
Flood Impact Assessment

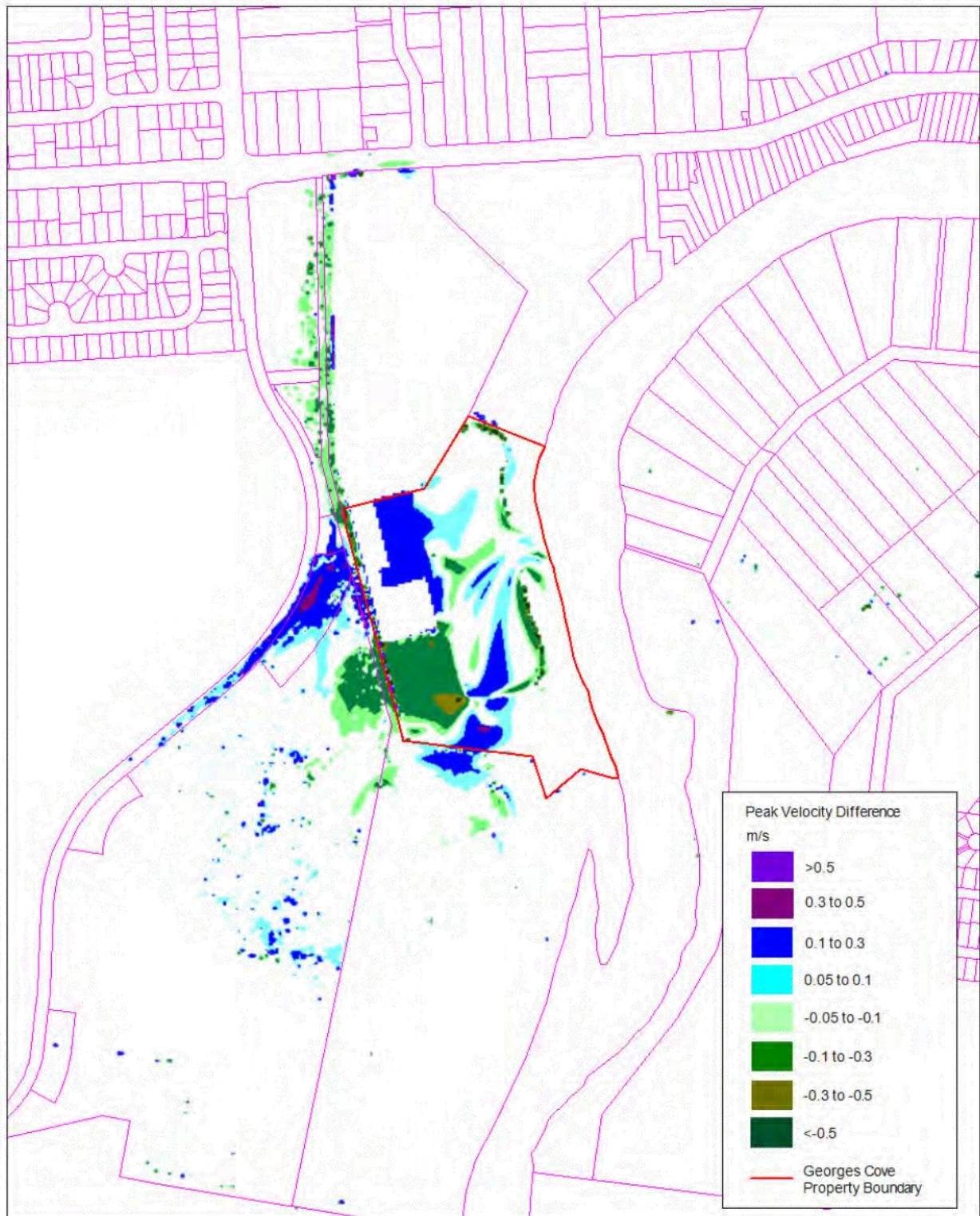
Figure
100 year ARI
Peak Water Level Difference
Design (Jan18) Less Approved Design



NA49913037
 January 2018

Georges Cove
 Flood Impact Assessment

Figure
 20 year ARI
 Peak Velocity Difference
 Design (Jan18) Less Approved Design



NA49913037
January 2018

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Figure
100 year ARI
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Design (Jan18) Less Approved Design

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SK003 LEVEL 1 (GROUND) PLAN

SK004 LEVEL 2-6 PLAN

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SK012 COMPLIANCE DIAGRAM (TYPICAL)

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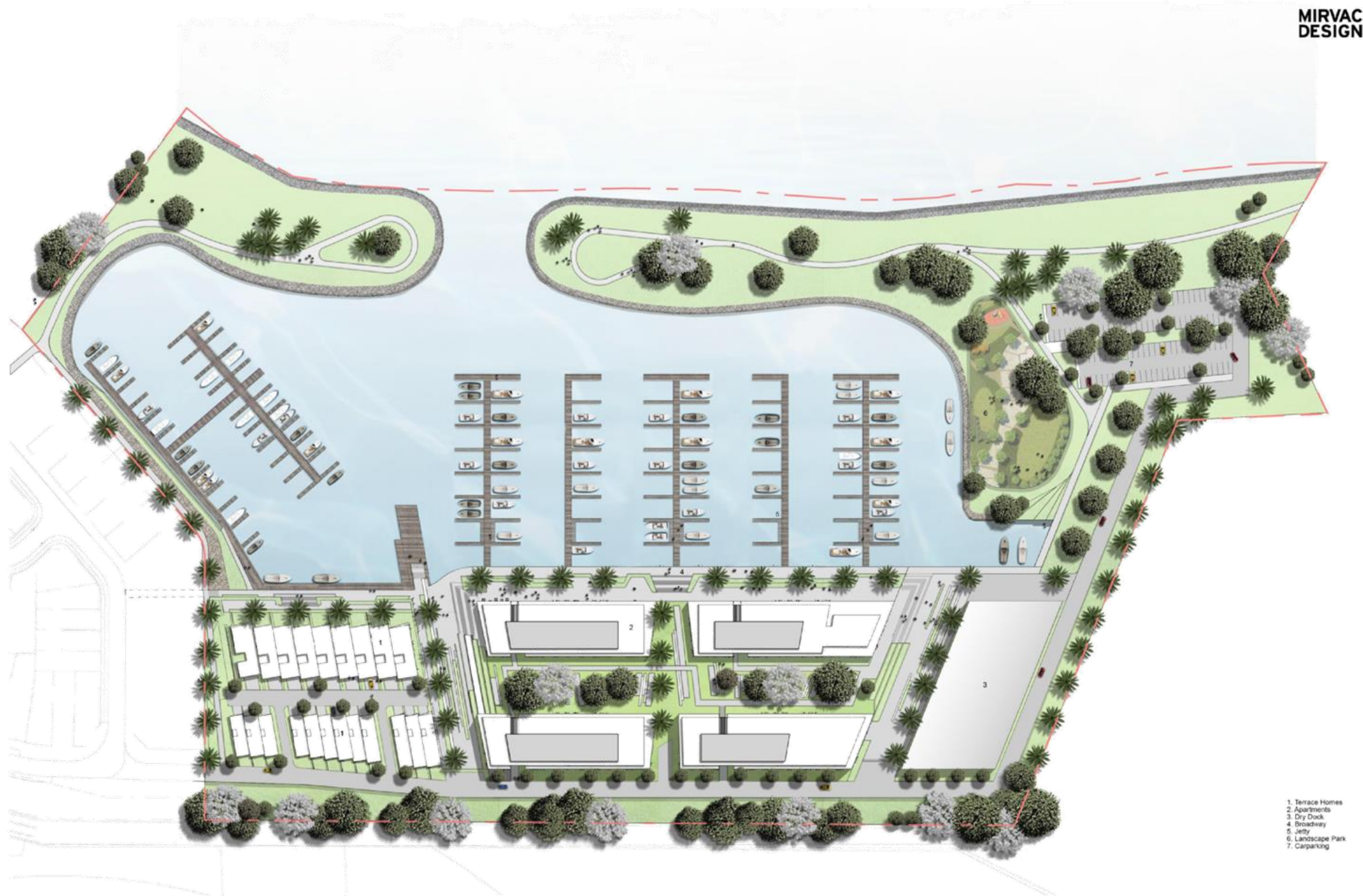
SK015 PERSPECTIVE

SK016 PERSPECTIVE

SK017 PERSPECTIVE

SK018 PERSPECTIVE

SK050 YIELD SCHEDULE



Georges Cove Marina

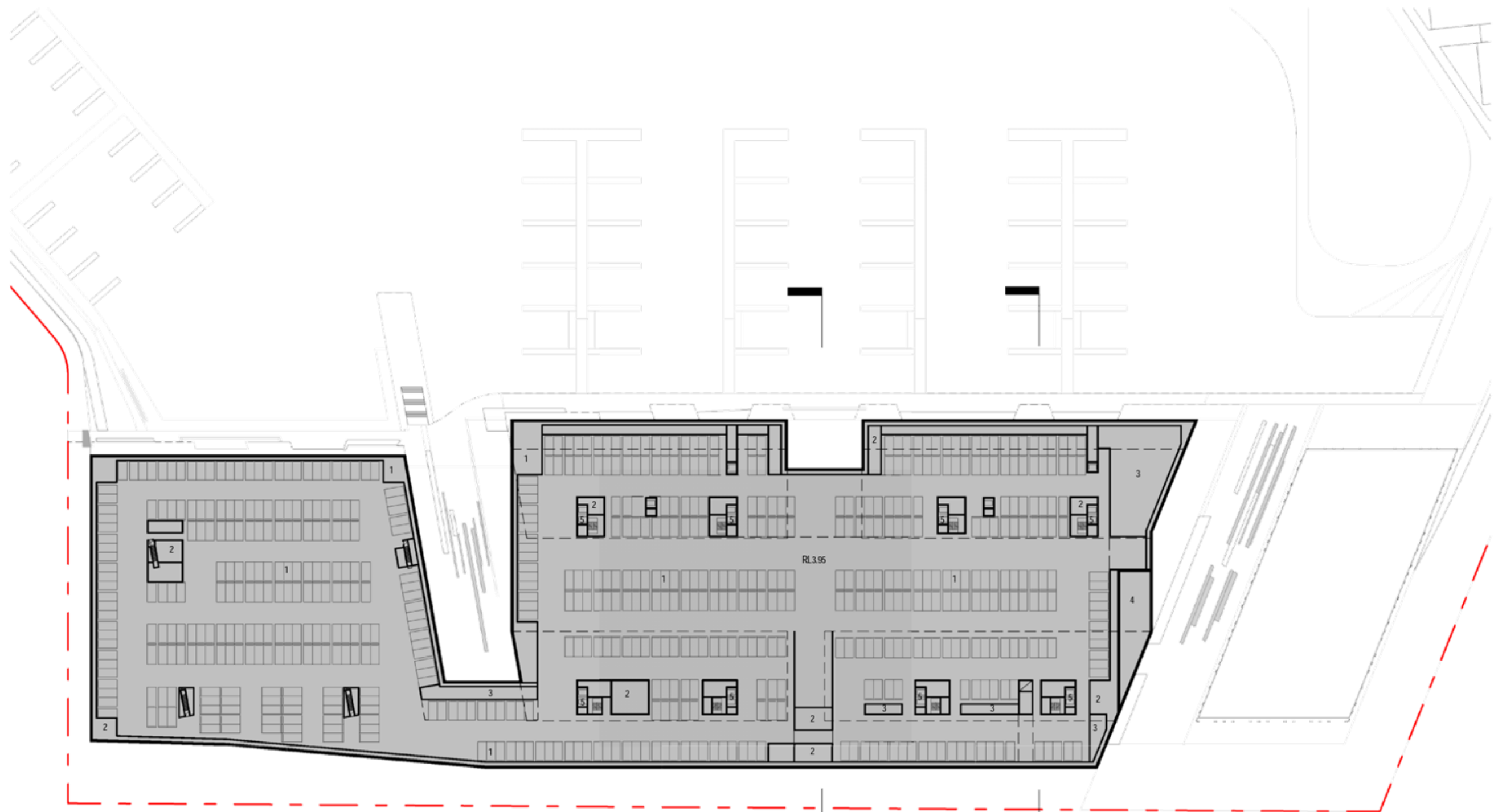
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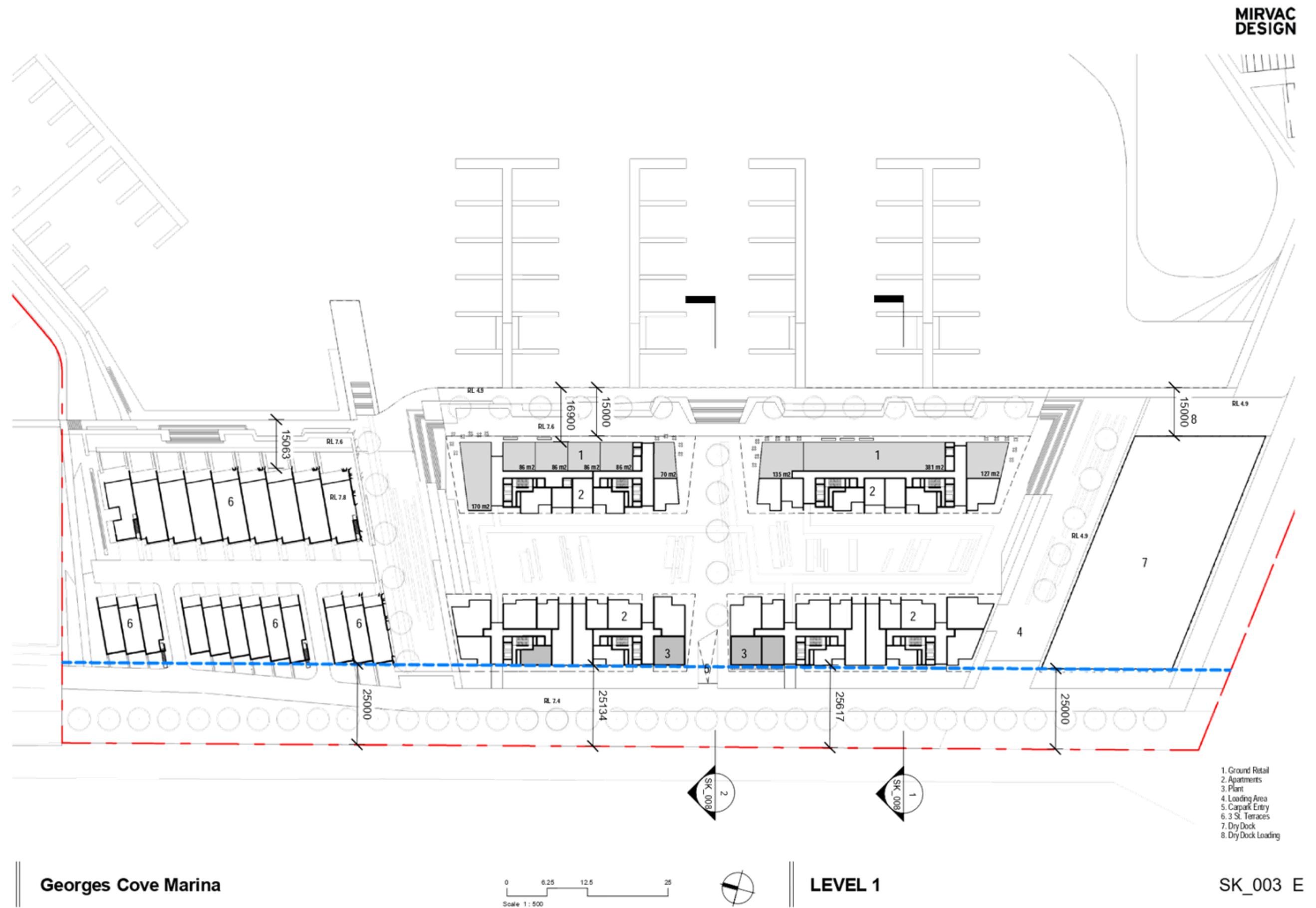
SITE PLAN

SK_001

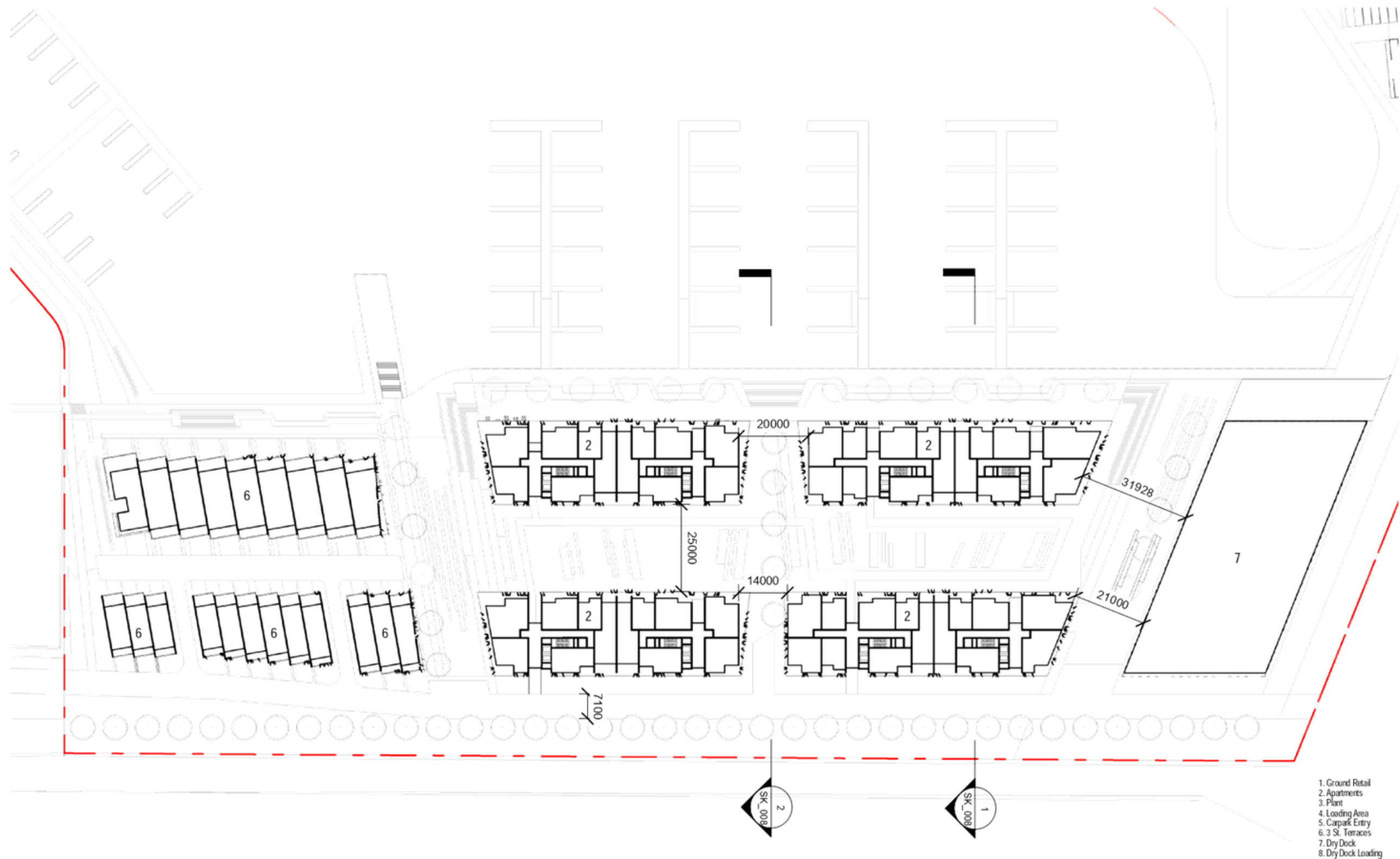
MIRVAC
DESIGN



- 1. Parking Bays
- 2. Plant/Services
- 3. Storage
- 4. Loading
- 5. Apt Lift Core



MIRVAC
DESIGN



Georges Cove Marina



LEVEL 2-6 (excl. Terraces)

SK_004 E

MIRVAC
DESIGN



- 1. Ground Retail
- 2. Apartments
- 3. Plant
- 4. Loading Area
- 5. Carpark Entry
- 6. 3 St. Terraces
- 7. Dry Dock
- 8. Dry Dock Loading

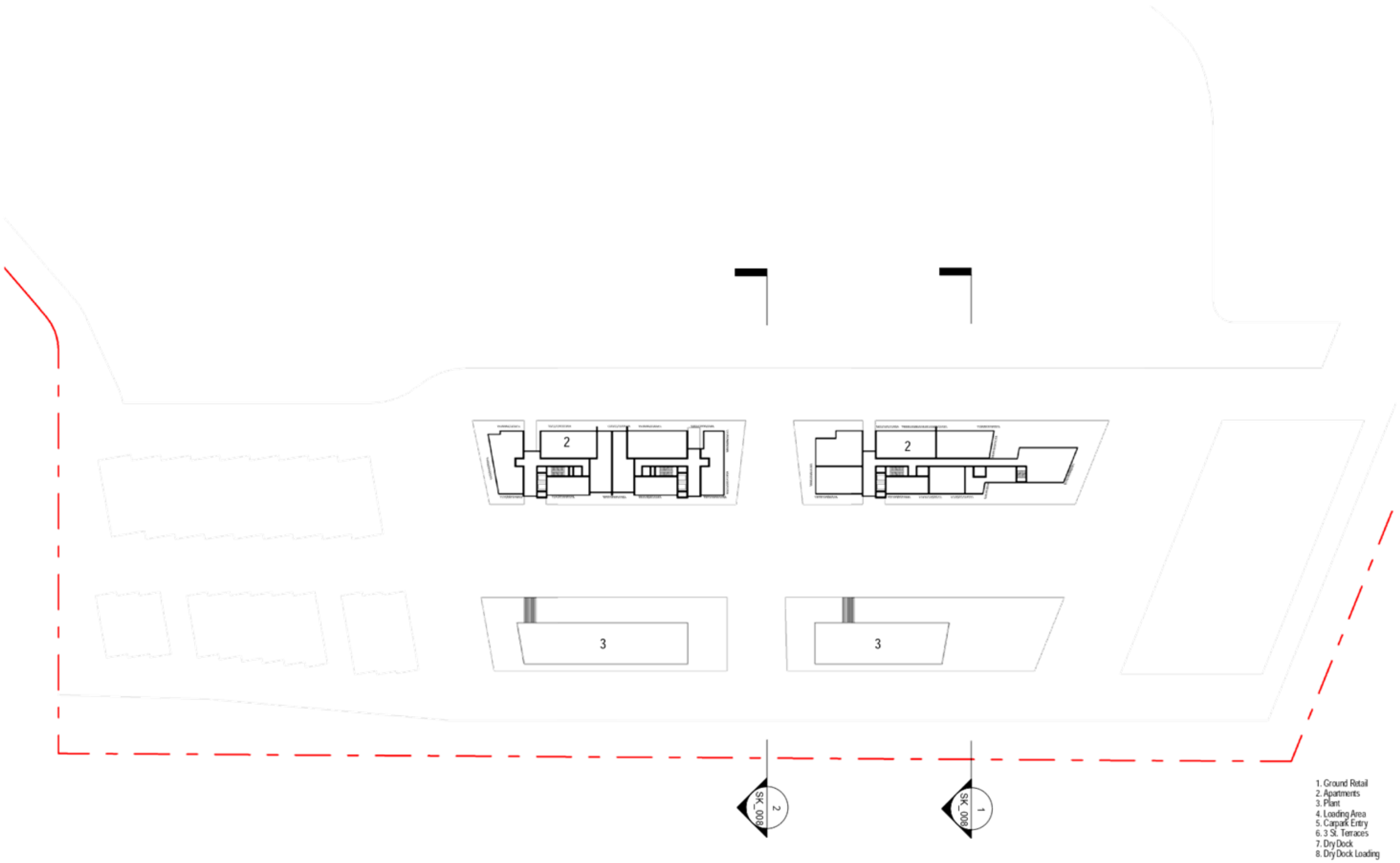
Georges Cove Marina



LEVEL 7

SK_005 E

MIRVAC
DESIGN



Georges Cove Marina

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Scale 1 : 500



LEVEL 8

SK_006 E

MIRVAC
DESIGN

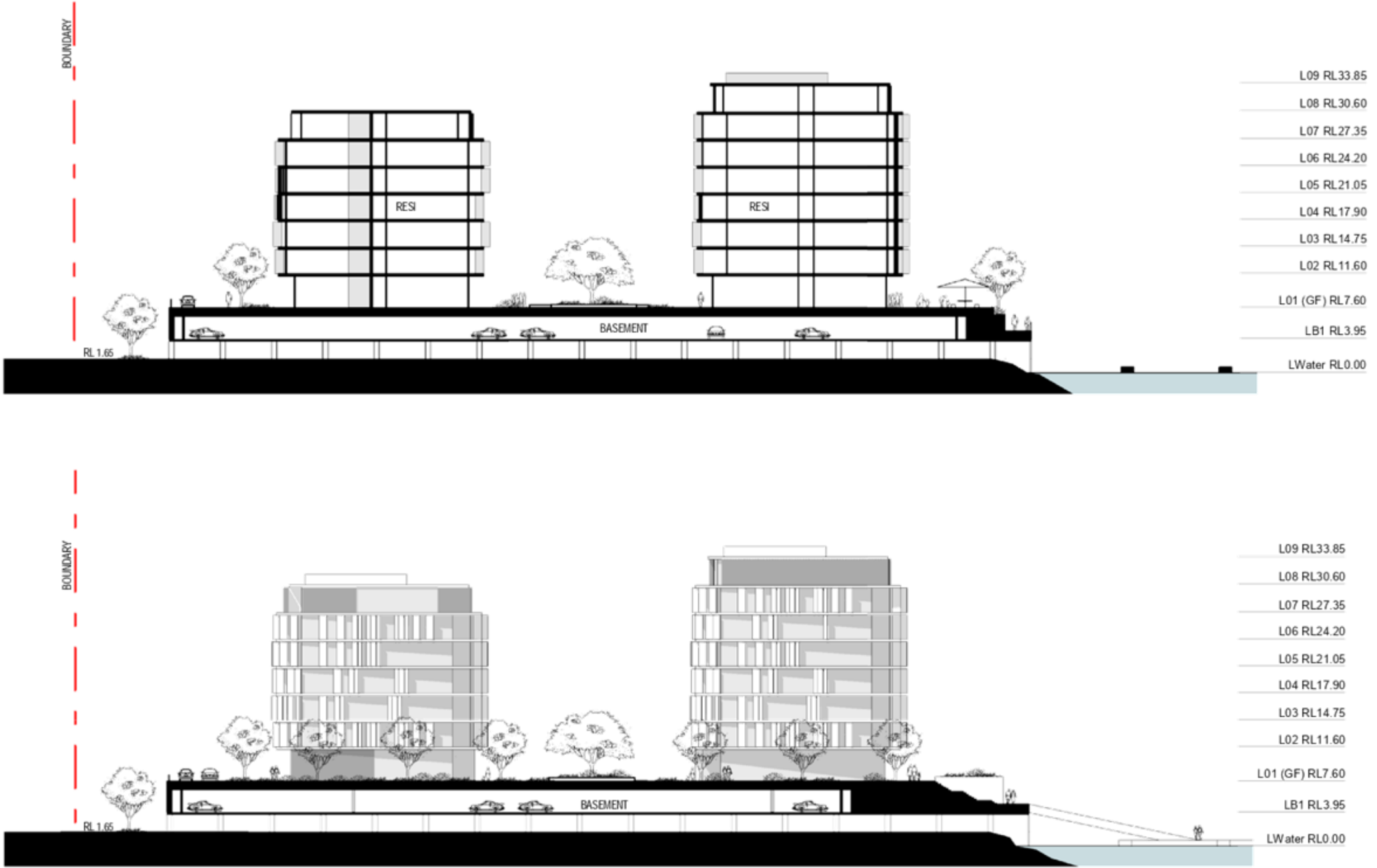


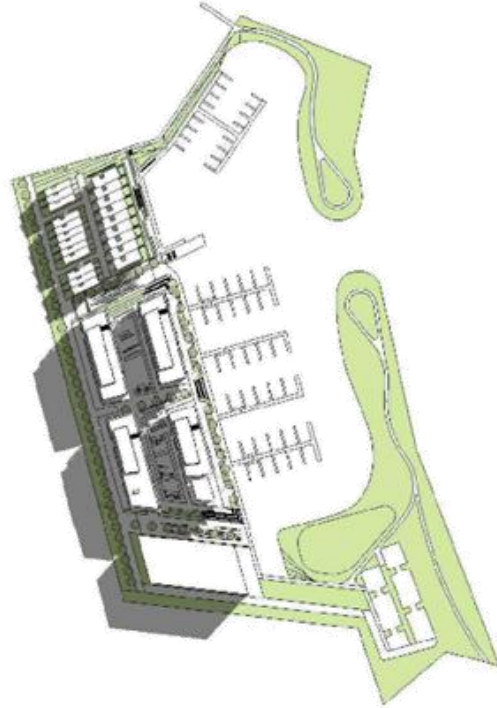
Georges Cove Marina



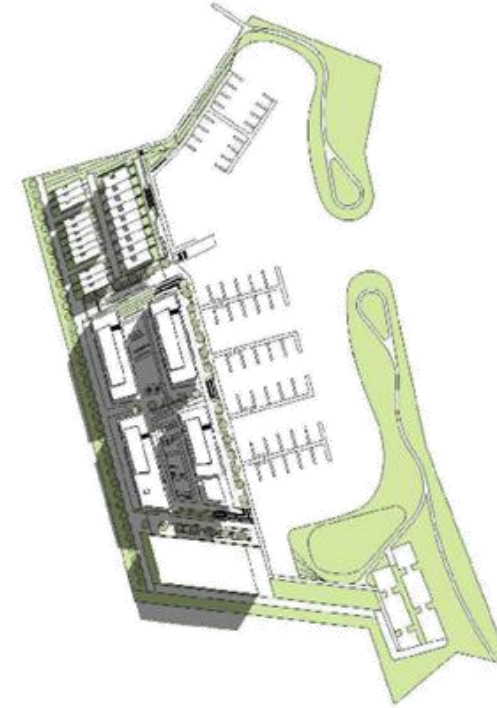
ELEVATIONS

SK_007 E





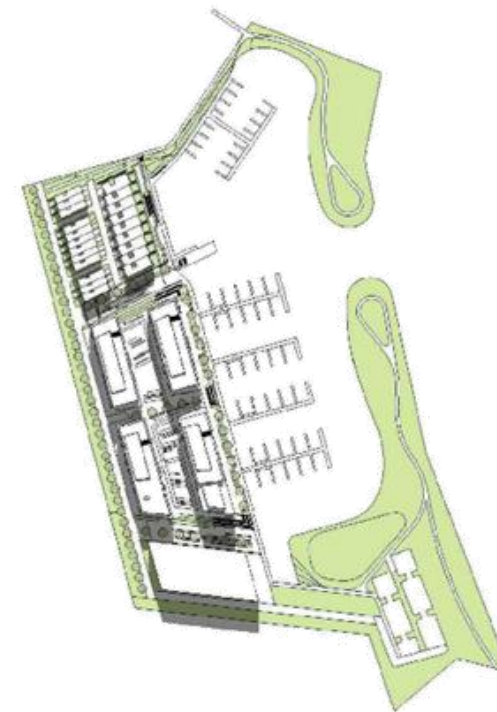
9am - 21st June



10am - 21st June



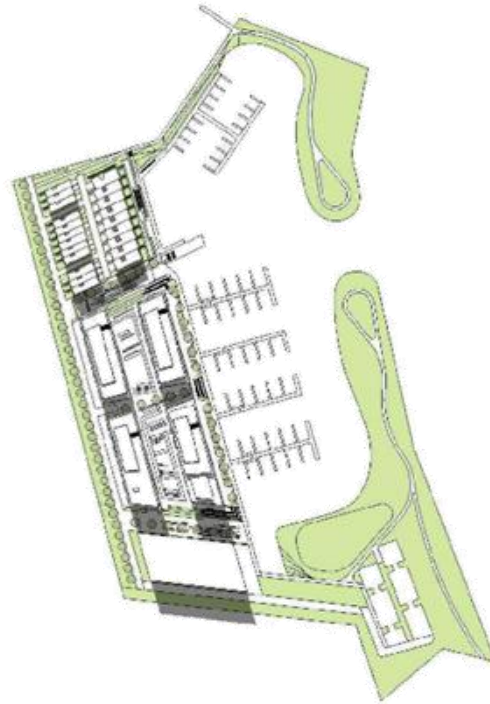
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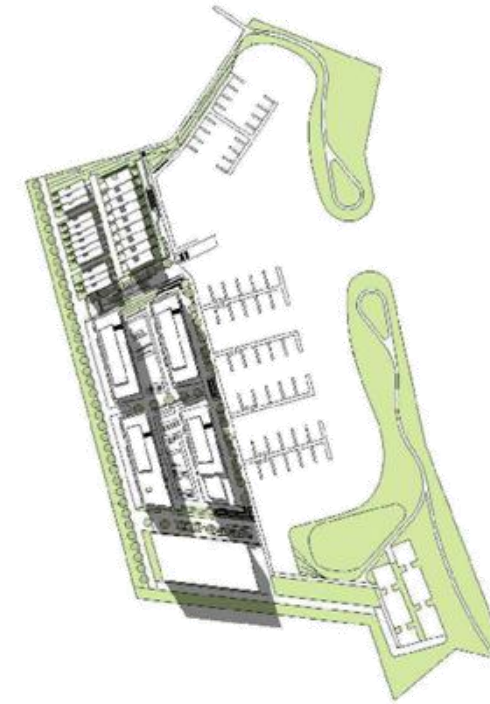
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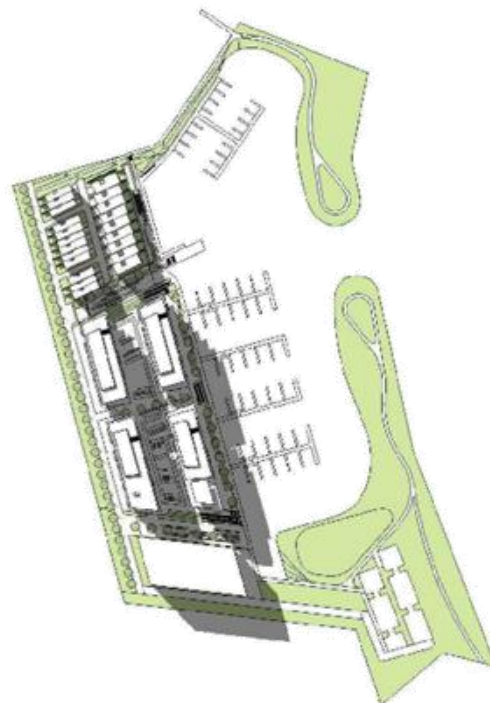
MIRVAC
DESIGN



1pm - 21st June



2pm - 21st June



3pm - 21st June

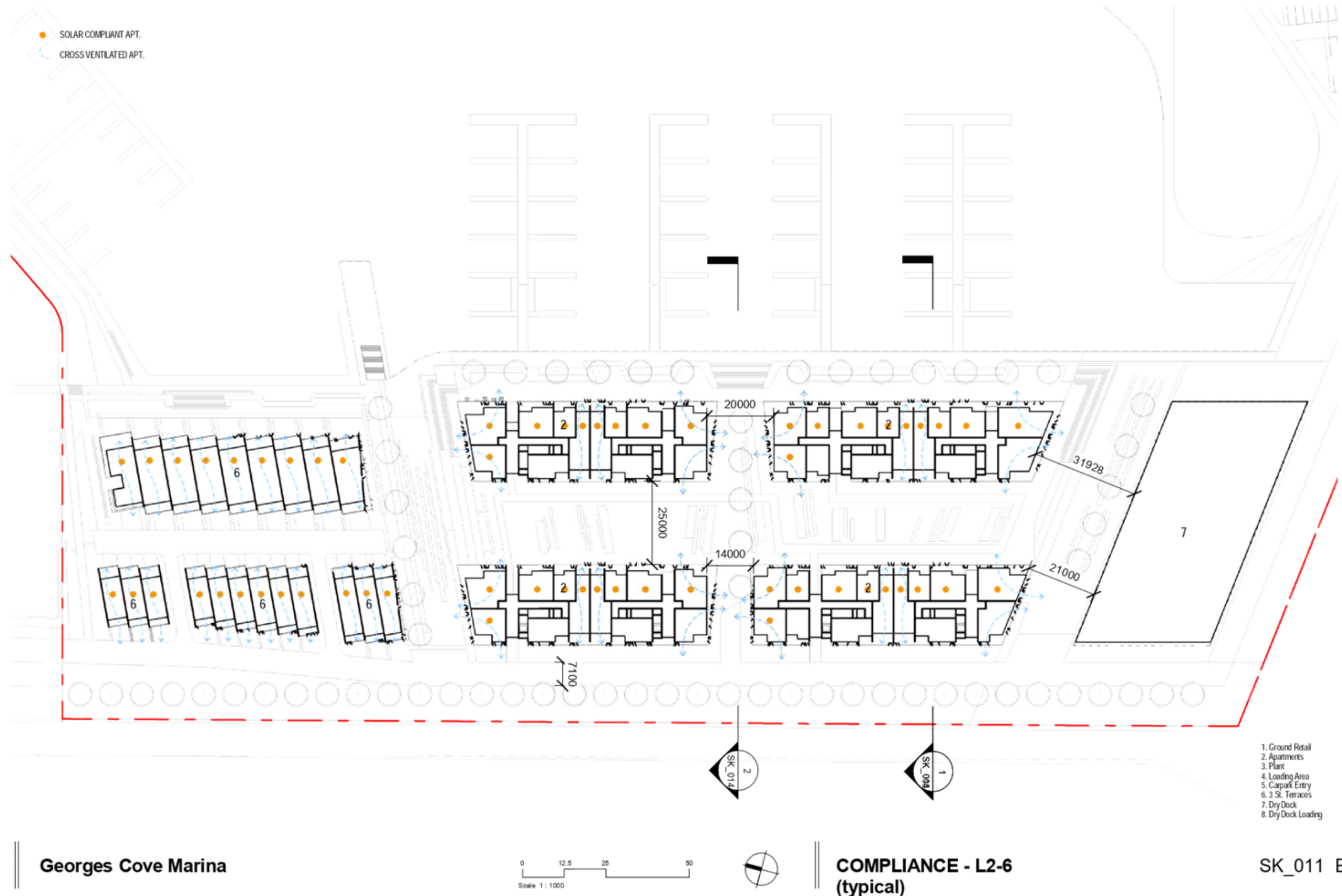
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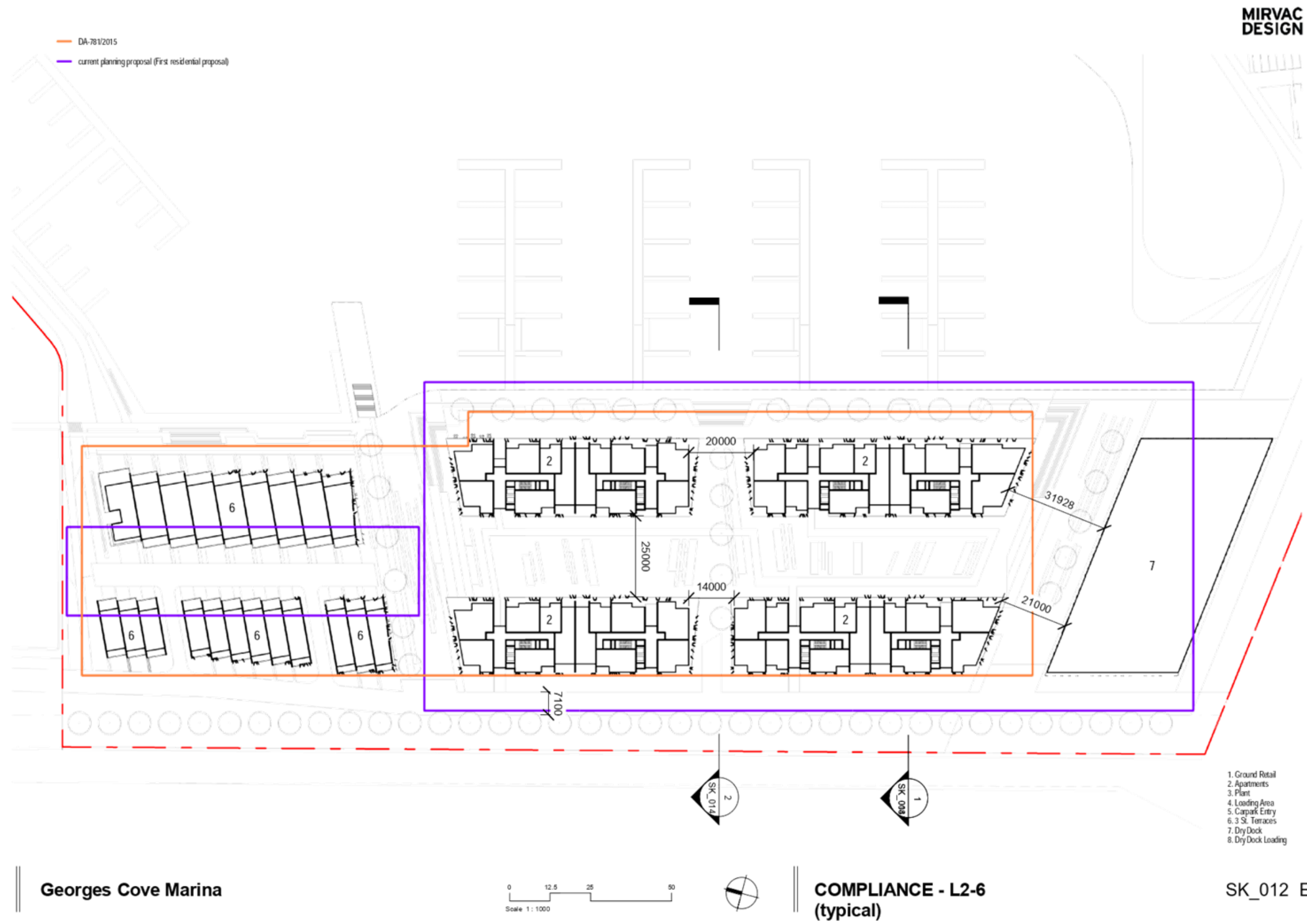


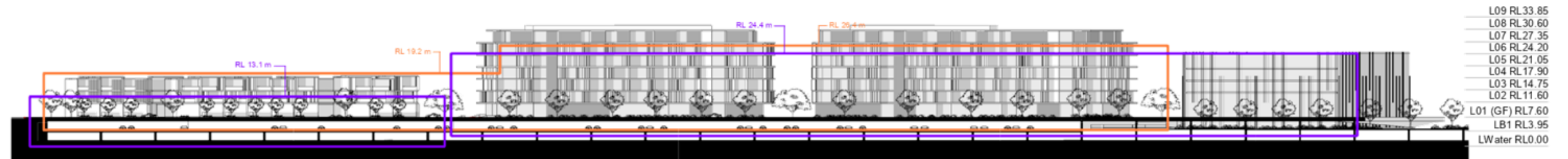
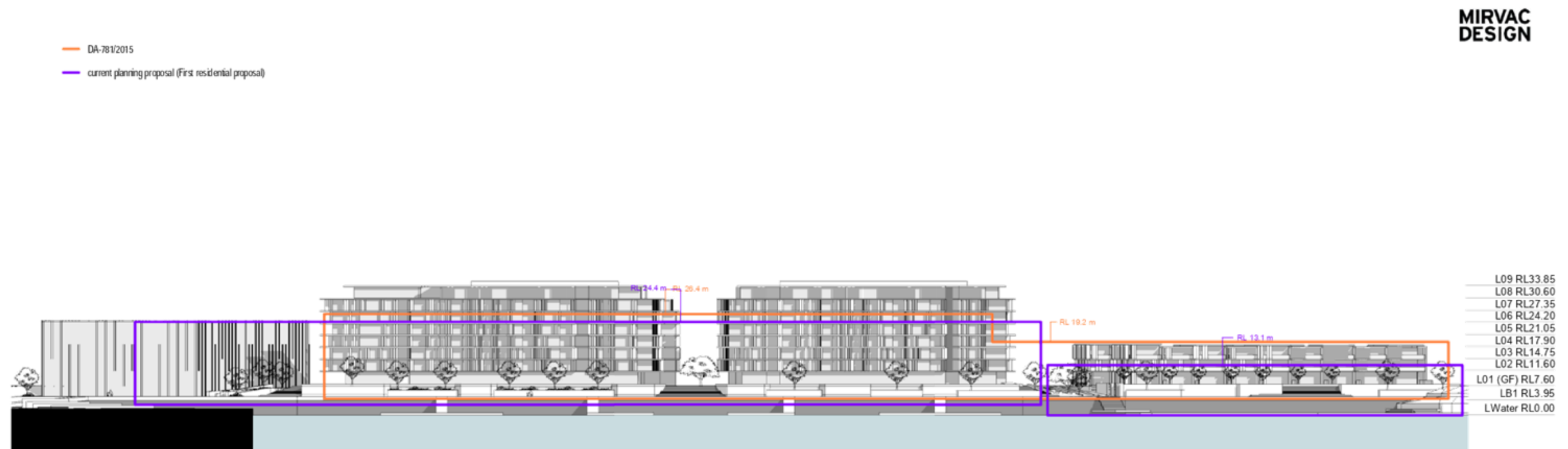
SHADOW DIAGRAMS

SK_010 E

MIRVAC
DESIGN







Georges Cove Marina

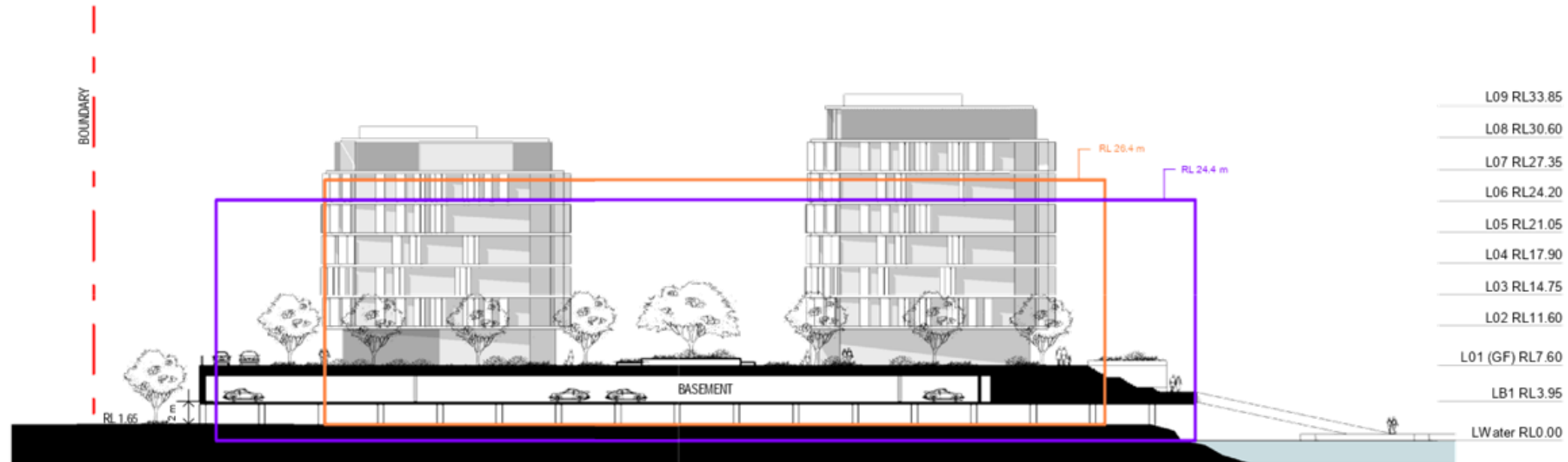
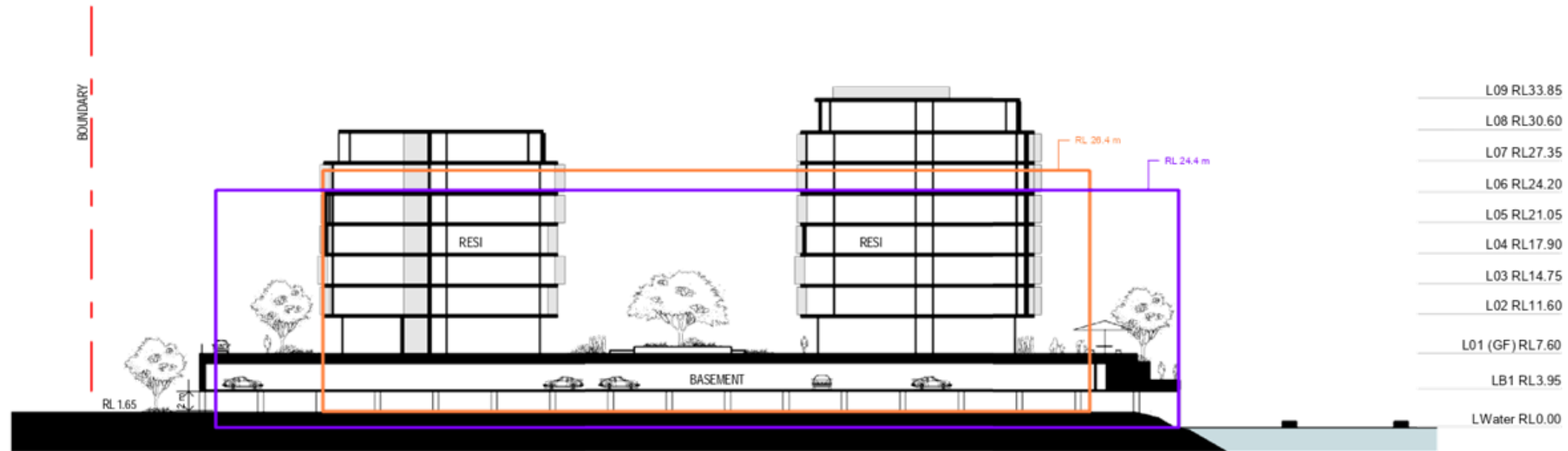


COMPLIANCE - ELEVATION

SK_013 E

DA-781/2015

current planning proposal (First residential proposal)





Georges Cove Marina

PERSPECTIVE

SK_015 E



Georges Cove Marina

PERSPECTIVE

SK_016 E



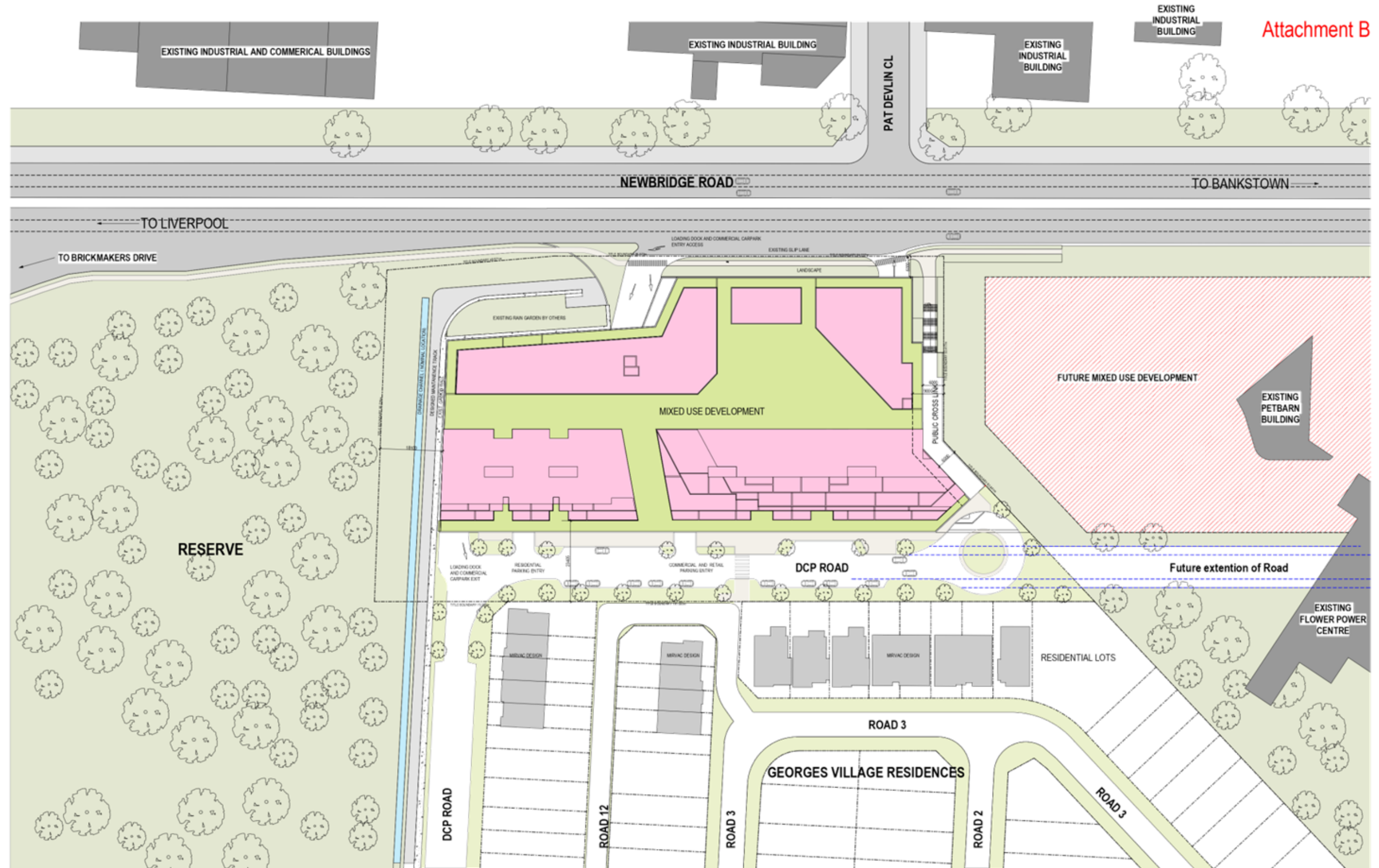
MIRVAC
DESIGN



Georges Cove Marina

PERSPECTIVE

SK_018 E



PRELIMINARY

Revisions		
P2 28.06.17	FOR INFORMATION	JM
P3 17.07.17	FOR PLANNER REVIEW	JM
P4 19.07.17	FOR PLANNER REVIEW	AK
P5 02.08.17	FOR TRAFFIC ENGINEER	AK
P6 22.08.17	FOR CONSULTANTS	JM

22/08/2017 8:14:10 PM

Project
GEORGES COVE VILLAGE
146 Newbridge Rd
MOOREBANK, NSW

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Drawing
SITE PLAN

Project No
214205

Date
11/05/2017

Author
JM

Scale
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Drawing No
SK00.003 P6

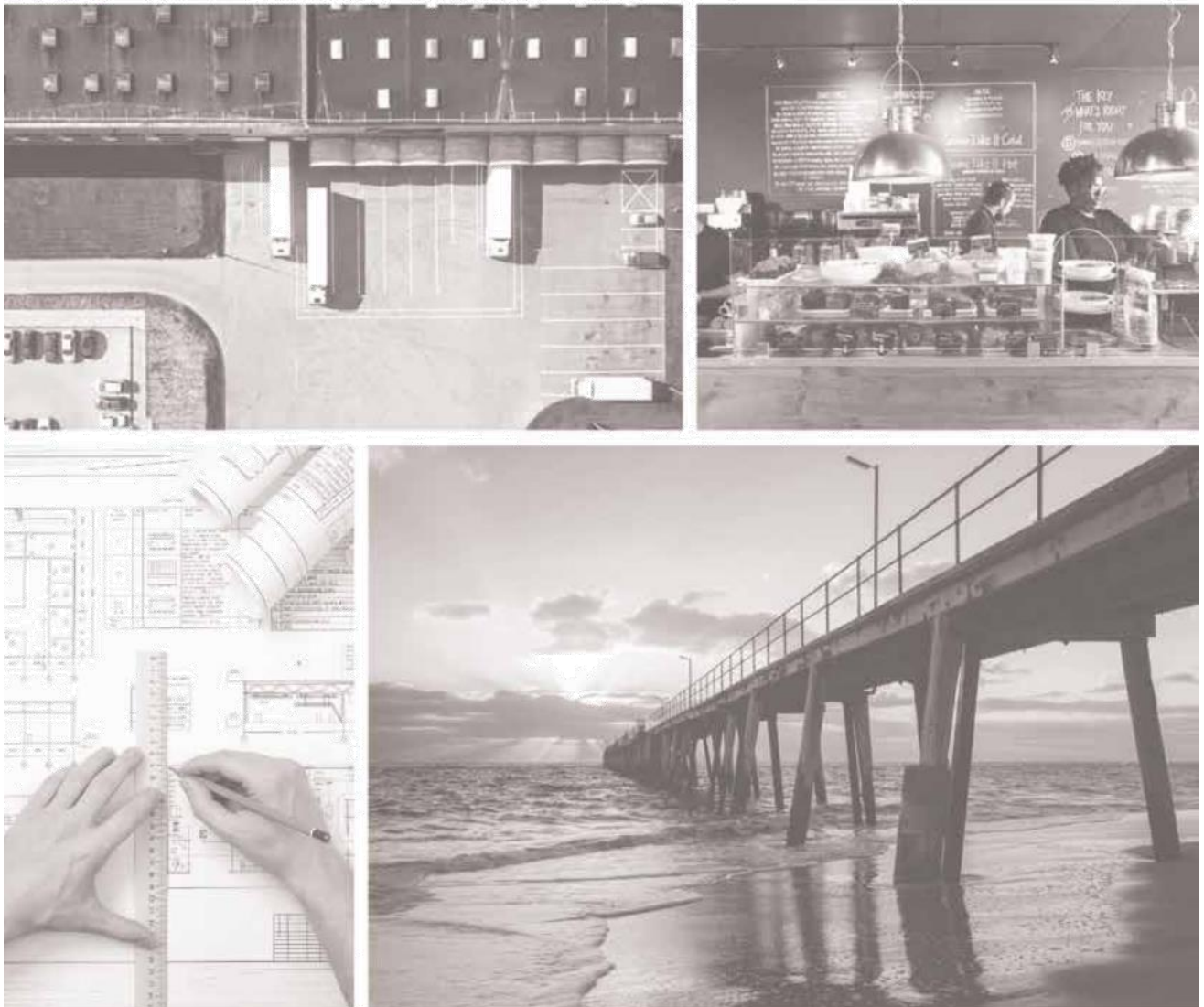
rothelowman

Brisbane, Melbourne, Sydney
www.rothelowman.com.au



Appendix F

Bushfire assessment report





Bushfire Assessment Report

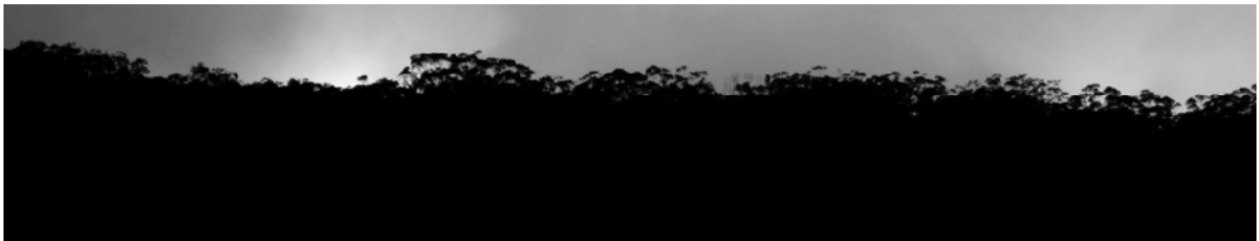
for

Georges Cove Marina Planning Proposal

Prepared

Mirvac Homes (NSW) Pty Limited


Version 1.1 10th May 2018



Document Tracking

Project Name:	Georges Cove Marina Planning Proposal
Project Number	171018
Prepared by	Lew Short
Client Details:	Mirvac Homes (NSW) PTY Limited
Project Address	Lot 7 in DP 1065574 (Lot 7) being No.146 Newbridge Road Georges
Client	Adam Perrott

BlackAsh Contact Details

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Document Control

Version	Primary Author(s)	Description	Date Completed
0.1	Lew Short	Draft for issue	20 February 2018
0.2	Lew Short	Draft incorporating AP feedback	24 March 2018
1.0	Lew Short	Final	1 May 2018



Lew Short | Principal

BlackAsh Bushfire Consulting

Fire Protection Association of Australia BPAD Level 3
 BPD-PA 16373

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Glossary of Terms

APZ	Asset protection zone
AS2419	Australian Standard – Fire hydrant installations
AS3745	Australian Standard – Planning for emergencies in facilities
AS3959	Australian Standard – Construction of buildings in bushfire-prone areas 2009
BAL	Bushfire attack level
BCA	Building Code of Australia
BSA	Bushfire safety authority
EPA Act	Environmental Planning & Assessment Act 1979
FDI	Fire danger index
ha	Hectare
m	Metres
PBP	Planning for Bush Fire Protection 2006
RF Act	Rural Fires Act 1997

1. Introduction

Mirvac Homes (NSW) PTY Limited (**Mirvac**) commissioned Blackash Bushfire Consulting (**Blackash**) to provide a Bushfire Assessment Report to support a planning proposal to allow residential development within in Lot 7 in DP 1065574 (Lot 7) being No.146 Newbridge Road Moorebank (the study area) which is known as Georges Cove Marina (see Figure 1) and is part of the former Benedict Industries sand and soil quarry and recycling facility.

The planning proposal only relates to the part of the RE2 Private Recreation zoned area within the southern portion of the development site (see figure 1) and includes the construction of the collector road on the western boundary to the site and internal road network.

This report has been prepared to support the planning proposal for the subject site to allow a residential use in two parts. The first part being a rezoning of a portion of residue land from RE2 Private Open Space to R3 Residential to join the existing zoned R3 residential area subject to development under an application with Liverpool City Council. This is referred to as the 'Approximate area to be rezoned R3' and is hatched yellow in Figure 2.

The second part is for the approval of an enabling clause for terraces and residential flat buildings over part of the existing zoned RE2 - this is referred to as 'Residential use envelope' and edged red in the Figure 2.

Access to the proposed road network will be from Brickmakers Drive, to the west via a bridge-overpass and a future connection to Newbridge Road, to the north.

The land to the north and northeast, between the R3 zoned land and Newbridge Road is zoned B6 – Enterprise Corridor. The site is zoned RE2 – Private Recreation and is proposed to contain the Georges Cove Marina. The adjoining land to the northeast is currently being rezoned to residential whilst the adjoining land to the west is SP – Drainage and E2 – Environmental Conservation.

The development is linked Integrated Development for 7//1065574 146 Newbridge Road Moorebank to the north of the site. Previous bushfire reports have been completed and the application for residential development was lodged with the RFS. On 15 December 2018, the RFS issued a Bushfire Safety Authority (**BFSA**) with conditions for this development. A copy of the BFSA is at Appendix 1. Of note, the RFS conditions recognised a temporary secondary access into the development. This application will utilise this access way to provide options for movement within and external to the site.

The proposal meets the deemed to satisfy (**DTS**) asset protection zone (**APZ**) requirements of *Planning for Bushfire Protection 2006 (PBP 2006)* and a conservative approach has been taken to provide confidence to the RFS of approving the proposal.

An inspection of the site and adjoining land occurred in late 2017. This assessment has been prepared by Lew Short, Principal Blackash Bushfire Consulting (FPAA BPAD-A Certified Practitioner No. BPD-PA-16373) who is recognised by the NSW Rural Fire Service (**RFS**) as qualified in bushfire risk assessment and have been accredited by the Fire Protection Association of Australia as a suitably qualified consultant to undertake alternative solution proposals.

Table 1 is a summary of compliance with relevant documents and approaches to mitigate bushfire attack.

2. Summary

A summary of the key assessment requirements for the RFS is provided in Table 1.

Table 1

Can this proposal comply with AS3959, 2009 + addendum to Appendix 3 of PBP?	YES
What is the recommended level of construction as per AS3959?	Various. Minimum setbacks for BAL 29 provided
Does this development comply with the requirements of PBP?	YES – Deemed to Satisfy
Does this development comply with the Aims and Objectives of PBP?	YES
Is referral to the NSW RFS required?	YES
APZ	Achieved
Access Internal Roads	YES
Access Public Roads	New and linking to existing
Services	DTS achieved
Emergency and Evacuation Planning	Can be achieved

Figure 1 Subject Site Location

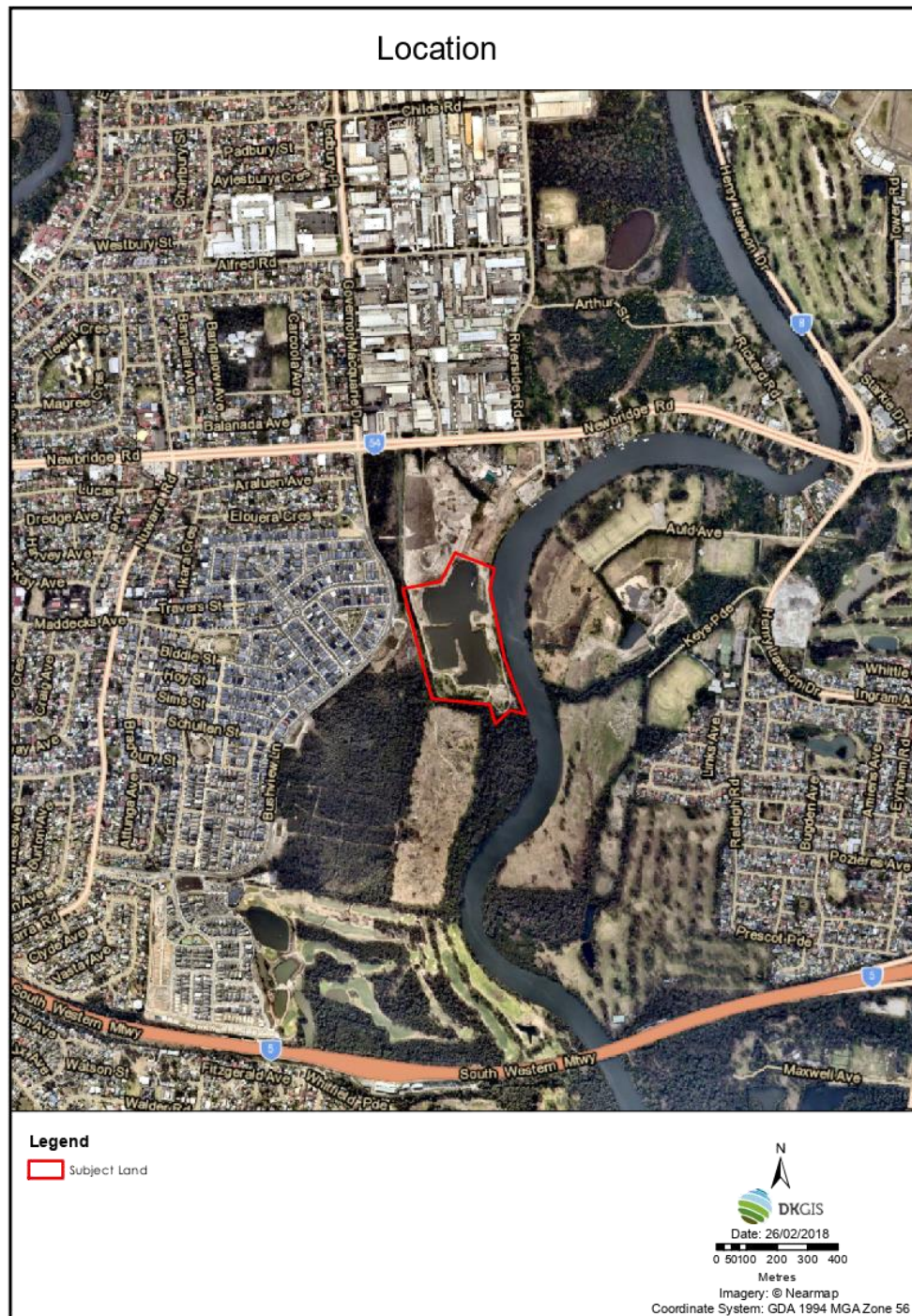
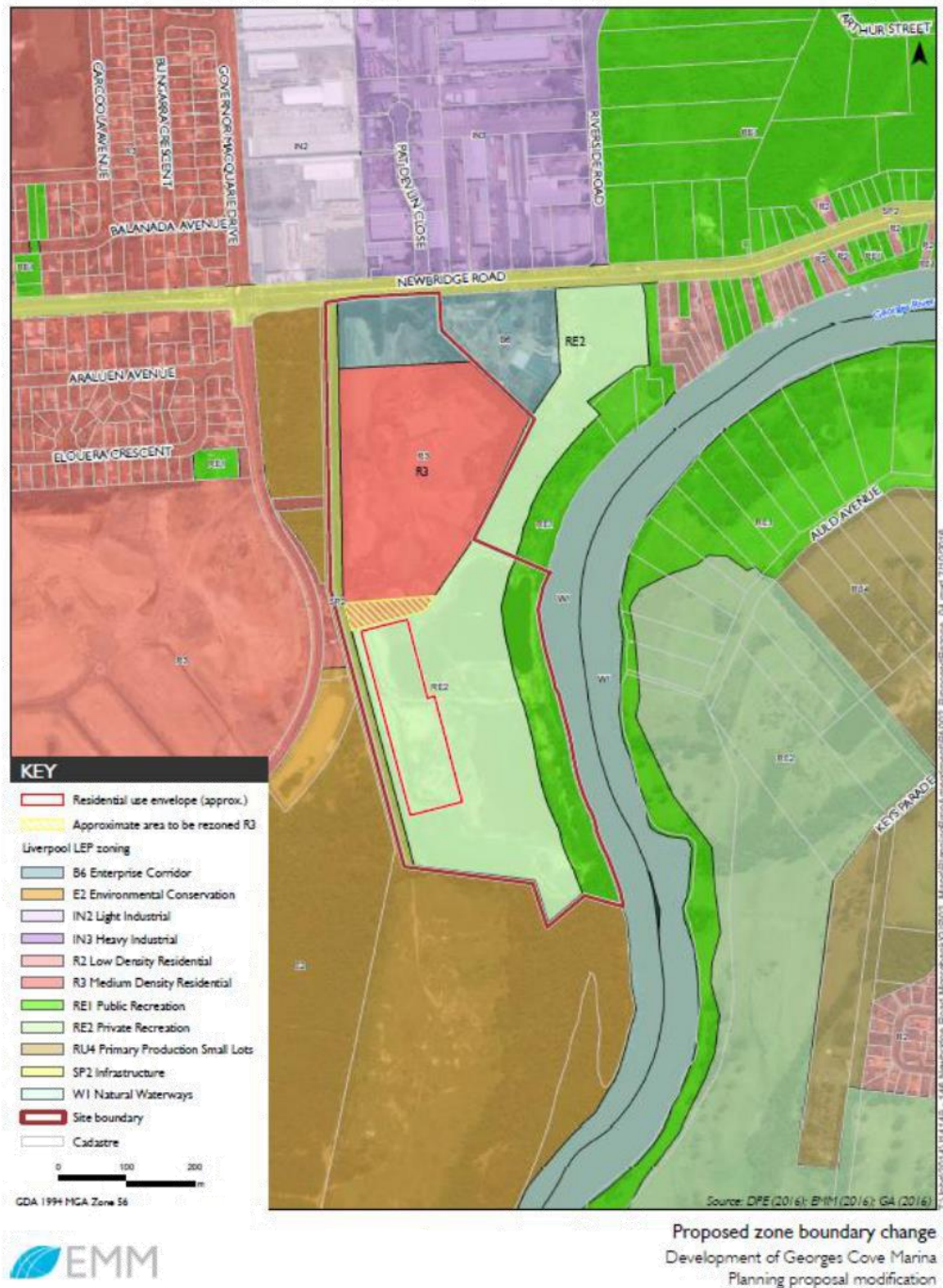


Figure 2 Proposed Zone Boundary Change (source EMM)


3. Proposed Development

The proposal seeks to include an enabling clause within the Liverpool Local Environmental Plan (**LLEP**).

This enabling clause will allow residential apartments and terraces to be constructed within an area of the existing RE2 zoning that is being rezoned as R3 Residential. The proposal seeks approximately 374 apartments and terraces within the residential use envelope (Figure 2) in a highly desirable corner of the Georges River. The site plan is shown in Figure 3.

This initiative is in keeping with the NSW Government's intent for a *Plan for Growing Sydney* to provide new housing that will be located close to jobs, public transport, community facilities and services. The Planning Proposal will also offer choices in location and size to better suit the community's lifestyles and budgets.

The planning proposal will also amend the appropriate LEP maps to allow the residential development (such as the building height map).

Upon approval and gazettal of the planning proposal, a Development Application will be lodged with the detailed designs of the residential development at which time RFS will be referred the DA under the integrated development provisions.



4. Site Description

Georges Cove Marina is legally described as Lot 7 in DP 1065574 (Lot 7) being No.146 Newbridge Road Moorebank.

Works have commenced on the Lot to the north and northeast of the site and vegetation has been removed from the site. Adjoining land to the west of the site is SP – Drainage and E2 – Environmental Conservation. A track runs parallel to the site on the western boundary which accesses the Lot to the south of the site. This access track provides a fuel free zone and a buffer from the land to the west of the site.

The land to the south of the site is extensively cleared (south western portion).

The site was previously used as a sand and soil recycling centre and was cleared of bushfire prone vegetation during the operation of this facility.

The subject site has been filled and will be further filled to be above the 1:100 year flood levels and to provide flood free access.

Land to the west of the site has been developed and is bound by Brickmakers Drive. Brickmakers Drive pinches into the site at its northern most boundary. A sewerage pump station is on the north-western boundary of the site and provides a fuel managed area.

5. Legislative Framework

This is a planning proposal to include an enabling clause for residential use within the existing zoning of the LLEP.

Strategic planning is an effective way of achieving bushfire protection objectives for new development. Planning instruments and policies can ensure bushfire management principles are given appropriate consideration at all stages of the planning and development process. A key element of strategic planning should be an assessment of the impact on existing infrastructure and the provision of adequate bushfire protection measures.

Planning for Bush Fire Protection 2006 (PBP 2006) provides guidelines for use once an area has been identified and zoned for development. Its primary purpose is to assist with the development of bushfire prone land. Instruments and policies that guide planning and land use control allow for a more strategic approach to planning and developing in bushfire prone areas and ensure future applications have considered bushfire risk.

Local Environmental Plans (LEPs) guide planning decisions at the local government area and are a useful mechanism for managing bushfire risk. The Minister for Planning, under section 117(2) of the *Environmental Planning and Assessment Act 1979 (EP&A Act)* issues directions that relevant planning authorities (such as local councils) must follow when preparing planning proposals for new LEPs. *Direction 4.4 Planning for Bushfire Protection* identifies matters for consideration for planning proposals that will affect, or are in proximity to land mapped as bush fire prone.

The RFS *Practice Note 2/12 Planning Instruments and Policies* provides the framework to consider planning proposal applications. The Practice Note provides guidance on areas that should not be rezoned where the bushfire risk is unacceptable. This could include¹:

- development is likely to be difficult to evacuate during a bush fire,
- development is likely to create control difficulties during a bush fire,
- development will adversely affect other bush fire protection strategies or place existing development at increased risk,
- development is likely to result in a substantially increased requirement for government spending on bush fire mitigation measures, infrastructure or services,
- environmental constraints to the site cannot be overcome,
- required bush fire protection measures would incur significant environmental costs.

¹ RFS *Practice Note 2/12 Planning Instruments and Policies*

The Practice Note also provides guidance on preparing a planning proposal relating to bushfire prone land, the primary objectives should be to:

- a) *protect life, property and the environment from bush fire hazards, by discouraging the establishment of incompatible land uses in bush fire prone areas, and*
- b) *encourage sound management of bush fire prone areas.*

Importantly, the planning proposal must:

- a) *not increase the risk to life from bushfire;*
- b) *not introduce controls that place inappropriate developments in areas exposed to unacceptable bushfire hazard;*
- c) *ensure that appropriate bush fire protection measures can be afforded to property at risk of bushfire;*
- d) *minimise negative impacts on the surrounding environment;*
- e) *ensure that provision is made for adequate evacuation/shelter options for the community, and;*
- f) *ensure that development is capable of complying with Planning for Bush Fire Protection 2006.*

A key principle of a merits based assessment of rezoning applications is to ensure that future development is capable of complying with PBP 2006. As such, our assessment has been completed against the subdivision requirements of PBP 2006 to ensure that future applications under s.100B of the Rural Fires Act, 1997 (**RF Act**) can be issued with a Bushfire Safety Authority (**BFSA**).

Once the rezoning application is approved, a development application will be prepared for residential subdivision. This is identified as Integrated Development in Section 91 of the EPA Act. As Integrated development, Council must seek approval from the RFS for a BFSA. The BFSA authorises development to the extent that it complies with the RFS document PBP 2006.

The BFSA authorises development to the extent that the development complies with standards regarding setbacks, provision of water supply and other matters considered by the RFS Commissioner to be necessary to protect persons, property or the environment from danger that may arise from a bush fire.

The RF Act requires that a person must obtain such a BFSA before developing bush fire prone land and that an application for a BFSA is to be made to the Commissioner of the RFS in accordance with the regulations.

This Bushfire Assessment Report has been completed in accordance with the Rural Fires Regulation to ensure that a future DA can achieve a BFSR. However, it must be stated that the Planning Proposal, while providing a degree of detail is not the final form of the proposal as this will be tightened up prior to submission of a future DA. To assist the RFS, this Bushfire Assessment Report has been completed in accordance with the RF Reg.

This report will demonstrate that an appropriate combination of bushfire protection measures and compliance with PBP 2006 can be achieved to support the planning proposal for rezoning the residue land from RE2 Private Open Space to R3 Residential to join the existing zoned R3 residential area subject to development under an application with Liverpool City Council. As such, the RFS ought to support the Planning Proposal in its current form.

6. Draft Planning for Bush Fire Protection 2017

The RFS is in the process of reviewing PBP 2006. The *Draft Planning for Bush Fire Protection 2017* was available for public exhibition from 15 May 2017 until COB 14 July 2017. The RFS has indicated that they will have the review finalised before the end of 2017 with release intended in April 2018. Legislative enactment is anticipated between November 2018 and May 2019. Transition arrangements and savings provisions from PBP 2006 to the new document are not known at this stage. However, the document that is in force at the time a DA is lodged is the document that must be used in any assessment by RFS.

The review has been flagged as significant and will seek to consolidate RFS Fast Facts and Practice Notes developed over the last ten years and to reflect the current planning considerations, such as exempt and complying development within the document. It is not expected that the review will change legislative provisions or technical requirements.

7. Bushfire Prone Land

The site is identified as 'bushfire prone land' (Figure 4) for the purposes of Section 146 of the EPA Act and the legislative requirements for building on bushfire prone lands are applicable.

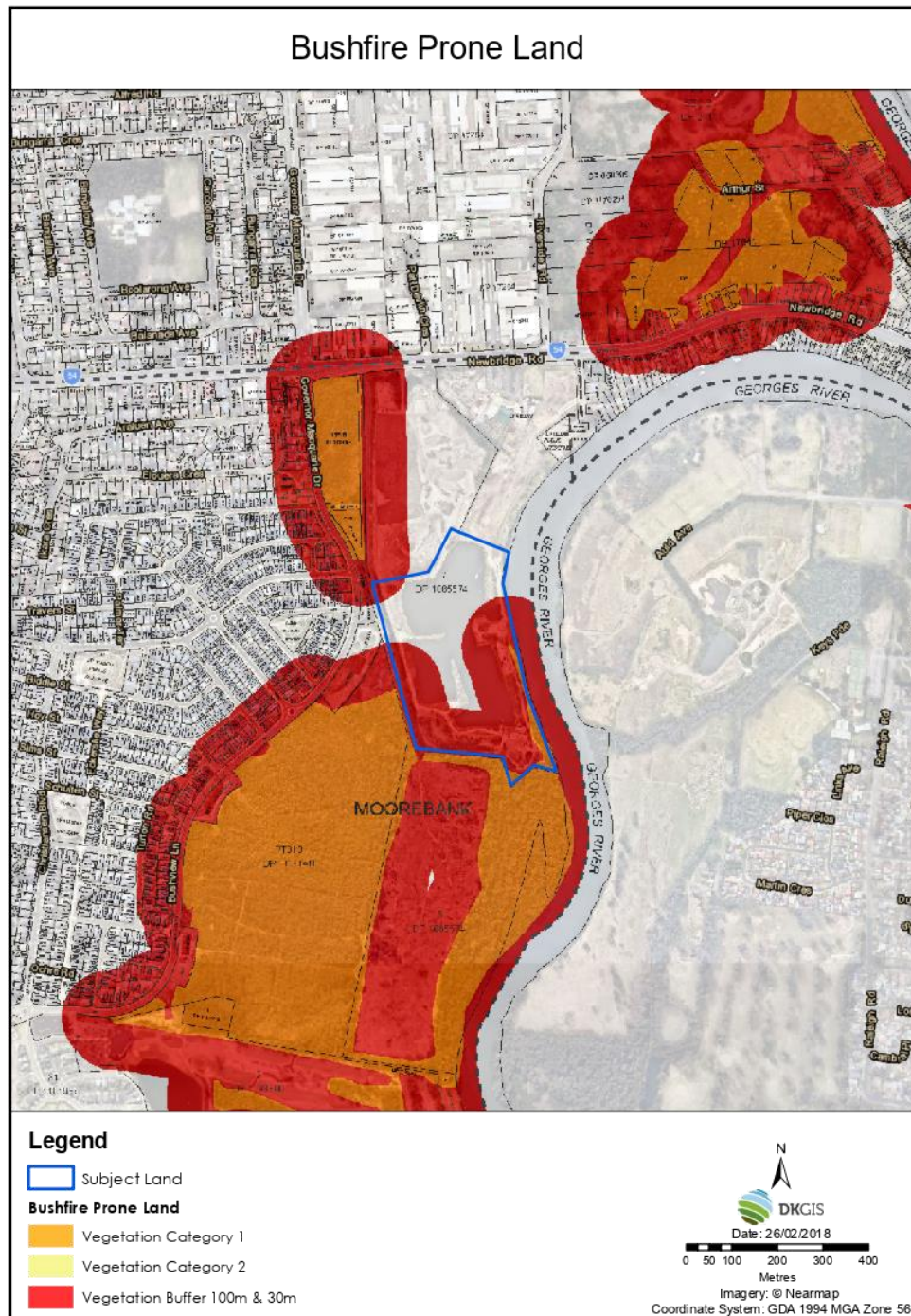
Bushfire prone land maps provide a trigger for the development assessment provisions and consideration of sites that are bushfire prone. Bushfire prone land (**BFPL**) is land that has been identified by council, which can support a bushfire or is likely to be subject to bushfire attack. Bushfire prone land maps are prepared by local council and certified by the Commissioner of the RFS.



Georges Cove Marina

The site is affected by the 100 metre vegetation buffer from the Category 1 vegetation on adjoin land to the west and south of the site and a small portion of the 100 metre buffer from Category 1 land to the north west of the site.

Figure 4 Bushfire Prone Land



8. Bushfire Threat Assessment

8.1. Methodology

PBP provides a methodology to determine the bushfire threat and commensurate size of any APZ that may be required to offset possible bushfire attack. These elements include the potential hazardous landscape that may affect the site and the effective slope within that hazardous vegetation. For new residential subdivision, APZ requirements are based on keeping radiant heat levels at new buildings below 29kW/m².

The following assessment is prepared in accordance with Section 100B of the RF Act, Clause 44 of the RF Reg and PBP. This assessment is based on the following resources:

- *Planning for Bushfire Protection* (NSW RFS, 2006);
- Council Bushfire Prone Land Map;
- Aerial mapping;
- Detailed GIS analysis;
- Site inspections undertaken in late 2017.

The methodology used in this assessment is in accordance with PBP and is outlined in the following sections.

8.2. Bushfire Hazard

An assessment of the Bushfire Prone Land is necessary to determine the application of bushfire protection measures such as APZ locations and future building construction levels. The vegetation formations (bushfire fuels) and the topography (effective slope) combine to create the bushfire threat that may affect bushfire behaviour at the site and which determine the planning and building response of PBP.

8.3. Vegetation Assessment

The RF Regulation requires a classification of the vegetation on and surrounding the property (out to a distance of 140 metres from the boundaries of the property) in accordance with the system for classification of vegetation contained in PBP.

Predominant Vegetation is classified by structure or formation using the system adopted by Keith (2004) and by the general description using PBP.

Vegetation types give rise to radiant heat and fire behaviour characteristics. The predominant vegetation is determined over a distance of at least 140 metres in all directions from the proposed site boundary or building footprint on the development site. Where a mix of vegetation types exist, the type providing the greater hazard is said to predominate and our assessment is based on the vegetation that will "most significantly affecting fire behaviour."

Figure 5 shows the vegetation adjacent to the site is categorised as forest.

8.4. Slopes Influencing Bushfire Behavior

The RF Reg requires an assessment of the slope of the land on and surrounding the property out to a distance of 100 metres from the boundaries of the property or from the proposed development footprint.

The 'effective slope' influencing fire behaviour approaching the sites has been assessed in accordance with the methodology specified within PBP. This is conducted by measuring the worst-case scenario slope where the vegetation occurs over a 100 m transect measured outwards from the development boundary or the existing/ proposed buildings. Figure 5 shows the slopes affecting the site. Table 2 shows the effective slopes relevant to the proposal.

Table 2 APZ Assessment

Direction from site	Predominant Vegetation ¹	Effective Slope ²	PBP Acceptable Solution ³	AS3959 Acceptable Solution ⁴	Provided
West and South	Forest	Flat	20m	25m	25m
North	Cleared and managed	NA			
East	NA – Georges River	NA			

¹ Predominant vegetation is identified, according to PBP and "Where a mix of vegetation types exist the type providing the greater hazard is said to be predominate"

² Slope most significantly influencing the fire behaviour of the site having regard to vegetation found on each 'fire run line'.

³ APZ identified using Table 2.6 of PBP to achieve acceptable solution

⁴ APZ identified using Table 2.4.2 of AS3959 to ensure future development can comply with AS3959

Figure 5 Vegetation and Slope



8.5. Fire Weather

The fire weather is dictated by PBP and assumes a credible worst-case scenario and an absence of any other mitigating factors relating to aspect or prevailing winds. The site has a Fire Danger Index (**FDI**) of 100 as per PBP.

8.6. Bushfire Attack Levels & APZ

PBP promotes detailed site analysis to minimise the potential for bush fire attack. An appropriate combination of Bushfire Protection Measures (**BPM**), commencing with an APZ, is to be provided to satisfy the specific objectives and the general aim and objectives of PBP.

The APZ ensures that buildings are separated from the hazard and is designed to minimize the presence of fuels, which could become involved in a fire. The APZ standards are designed to ensure that future buildings can conform to the deemed-to-satisfy arrangements under the National Construction Code (**NCC**).

The RFS will not approve the subdivision of land for a residential or rural-residential subdivision purpose when the building footprint is unable to meet the necessary setbacks to provide for future houses outside BAL 29 for an asset protection zone.

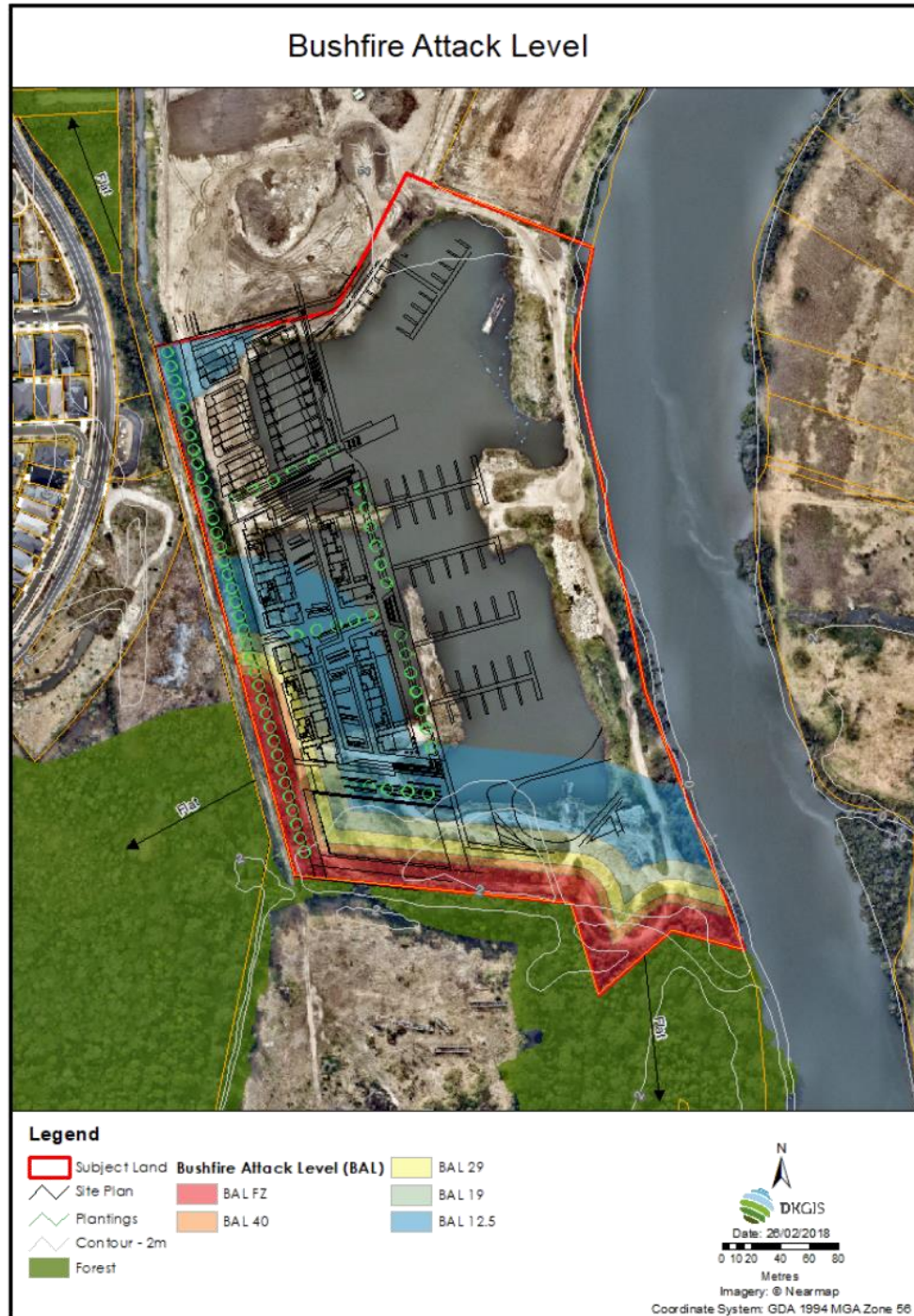
Figure 6 shows the required separation through APZs for the designated building footprints to meet BAL 29 using Table 2.6 of PBP 2006 to achieve the acceptable solution. Figure 7 shows the deemed-to-satisfy separation required to provide BAL 29 in accordance with Table 2.4.2 of AS3959 to ensure future development can comply with AS3959.

APZs can be provided to the proposed building footprints that meet the both PBP 2006 and AS3959. To provide surety, all APZs have been contained within the site. The APZs managed by the building and title management arrangements where adjoining the residential development. The foreshore area is to be dedicated to Council.

Figure 6 DTS APZ in accordance with PBP 2006



Figure 7 BAL 29 to meet AS3959 Table 2.4.2



9. Management of the Land as an APZ

An APZ is a buffer zone between a bushfire hazard and buildings, which is managed progressively to minimise fuel loads and reduce potential radiant heat levels, flame, ember and smoke attack. The appropriate APZ is based on vegetation type, slope and levels of construction. The APZ can include existing roads, other buildings and managed properties. Management of the site meets the requirements for an APZ. The site has been and continues to be extensively managed to mitigate the risk of bushfires.

10. High Rise Development

RFS Community Resilience Practice Note 2/12 provides information pertaining to high rise development in bushfire prone areas. The Practice Note identifies that:

High-rise buildings, for the purposes of PBP are defined as buildings exceeding three (3) stories in height.

The Practice Note identifies several challenges associated with High Rise Development in bushfire prone areas and articulates considerations that will need to be addressed in an application for a BFSAs. These include:

- *Location – high-rise buildings should not be located along ridges or along slopes with significant fire runs;*
- *Existing infrastructure – when high- rise developments are proposed their impact during potential bush fire emergencies needs to be considered, particularly in terms of evacuating occupants along the road network and the availability of water supplies available for high-rise fire fighting;*
- *External facades – external facades may result in increased exposure to radiant heat and also convection columns. Specialised modelling may be needed and APZs may need to be increased over and above those specified to account for this;*
- *Potential for entrapment - the risk associated with occupant egress is higher in high-rise buildings than for lower-rise structures and therefore the potential for entrapment during a bush fire emergency should be addressed.*

The proposed buildings are located to meet the deemed-to-satisfy provisions of PBP 2006 and AS3959 for separation providing acceptable levels of radiant heat.

Due to the flood prone nature of the land, the site will be built up FFL of the ground floor is RL 7.6.

Considering recent high rise fires (Melbourne, London and Dubai), the facades of the buildings will be provided in accordance with the Building Code of Australia.

The Building Code of Australia (as part of the NCC) contains provisions for external walls to be non-combustible for most multi-storey buildings. The performance requirement identifies that they avoid the spread of fire within and between buildings.

Given this and many other features of the NCC, a new building constructed in Australia, built in accordance with the NCC, provides extremely high levels of safety. Provisions in the NCC that achieve these outcomes for a typical high-rise apartment building include²:

- Smoke detection and occupant warning systems.
- Fire-isolation of exits, such as exit stairs.
- More than one exit for each storey to allow alternative means of escape should one exit become unusable.
- Exclusion of smoke from exit stairs.
- Fire sprinklers.
- Fire-resisting construction to limit the spread of fire between apartments and between storeys.
- Non-combustible external walls.
- Resistance to collapse as a result of fire.
- Features to assist fire brigade operations, such as fire hydrants.

The key features of the NCC in relation to external wall claddings and wall assemblies requires that external walls must be non-combustible if using a Deemed-to-Satisfy Solution. The NCC Deemed-to-Satisfy Provisions also require that any attachments to the external wall must not impair the fire resistance of the external wall or create an undue fire risk to the building's occupants as a result of fire spread or compromising fire exits. Permitted attachments are generally incidental in nature such as a sign, sunscreen, blind, awning, gutter or downpipe.

If not following the Deemed-to-Satisfy compliance pathway, a Performance Solution for combustibility of external walls must be able to demonstrate that it will avoid the spread of fire within and between buildings, including providing protection from the spread of fire to allow sufficient time for evacuation.

In respect of suitability of materials to be used in a building, the NCC requires that every part of a building must be constructed in an appropriate manner using materials and construction being fit for the purpose for which they are intended.

The NCC mandates the forms of evidence that must be used to demonstrate the suitability of a product, form of construction or design.

² <https://www.abcb.gov.au/Connect/Articles/Fire-safety-in-High-Rise-Buildings>

While the bushfire risk to the site is low, a detailed bushfire risk evacuation plan will be completed prior to occupation.

11. High Density Development in Bush Fire Prone Areas

RFS Community Resilience Practice Note 2/12 also provides guidance on high density development in bushfire prone areas. High density development includes *dual occupancies, multi dwelling housing and residential flat buildings*³. The considerations are the same for High Rise Development and have been addressed in section 10.

12. Water Supplies

The site land will be serviced by reticulated water. The extension of services will comply with AS2419. Future buildings will be connected to the reticulated town's water main for domestic needs. Existing water supply will be available in the adjoining Moorebank Cove development (R3) to the north feeding from Newbridge Rd and Brickmakers Dr.

13. Gas and electrical supplies

Electricity supply will comply with PBP. Any gas services are to be installed and maintained in accordance with *Australian Standard AS/NZS 1596 'The storage and handling of LP Gas'* (Standards Australia 2008). This complies with PBP.

14. Access

During a meeting with RFS on 12th October 2017, the RFS outlined their concerns about the cumulative impact of the development of the release area as a whole including the future Marina development and other adjoining sites (being the Flower Power site and the development of the B6 zoned site fronting Newbridge Road).

At the meeting Mirvac and Blackash discussed the nature of risk to the sites, the development cycle for the sites and issues pertaining to access based on risk. At the meeting, the RFS acknowledged these constraints and suggested an interim or "band aid" solution be found to ensure safe and viable access in accordance with PBP 2006 and the next version of the document.

³ RFS Community Resilience Practice Note 2/12 p. 6

The RFS have maintained their position that a secondary access would be required once the total release area is developed and until such time as the collector road through the adjoining Flower Power site is constructed. The proposed collector road finishes before the Marina access road as outlined in 'Liverpool Development Control Plan 2008, Part 2.10 Development in Moorebank East'. As such, site access road will be provided into the site that is 7.1 metres wide. The collector road is shown in Appendix 2 shows it is proposed to be 7m wide, with 2.5m wide parallel parking bays that provide access in accordance with PBP 2006.

Proposed access into the site is from will be from the existing public road network via Brickmakers Drive, to the west of the site. Access into the site is by a bridge-overpass from Brickmakers Drive and a future connection to Newbridge Road, to the north. Figure 2 shows detailed access arrangements for proposed Stage 2 works and the overall development plan. Detail is shown in Figures 8, 9 and 10. The access bridge will provide a 7.7m carriageway and a 3.5m wide pedestrian/ shared cycleway.

The subdivision will create lots which will be accessed directly off the new road network. The internal road adjacent to the bushfire hazard to the west shall have a minimum pavement width of 7.1 metres with 'No Parking' to the side of the road which accommodates the services (e.g. Water Main and Fire Hydrants). The internal roads shall have a minimum pavement width of 6.5 metres with parking provided in designated parking bays and in underground parking.

Figure 9 shows directly adjacent to Road Number 8 is additional access ways (supported by easements) that provide access into lots not associated with the DA. These additional access points will provide a fuel free area that is considered APZ.

In the event of a fire a range of options exist including sheltering in place. This presents a viable option as the narrow band of remnant bushland represents a low hazard and would burn through with low intensity in a short period of time.

Figure 8 Access to the site from Brickmakers Drive

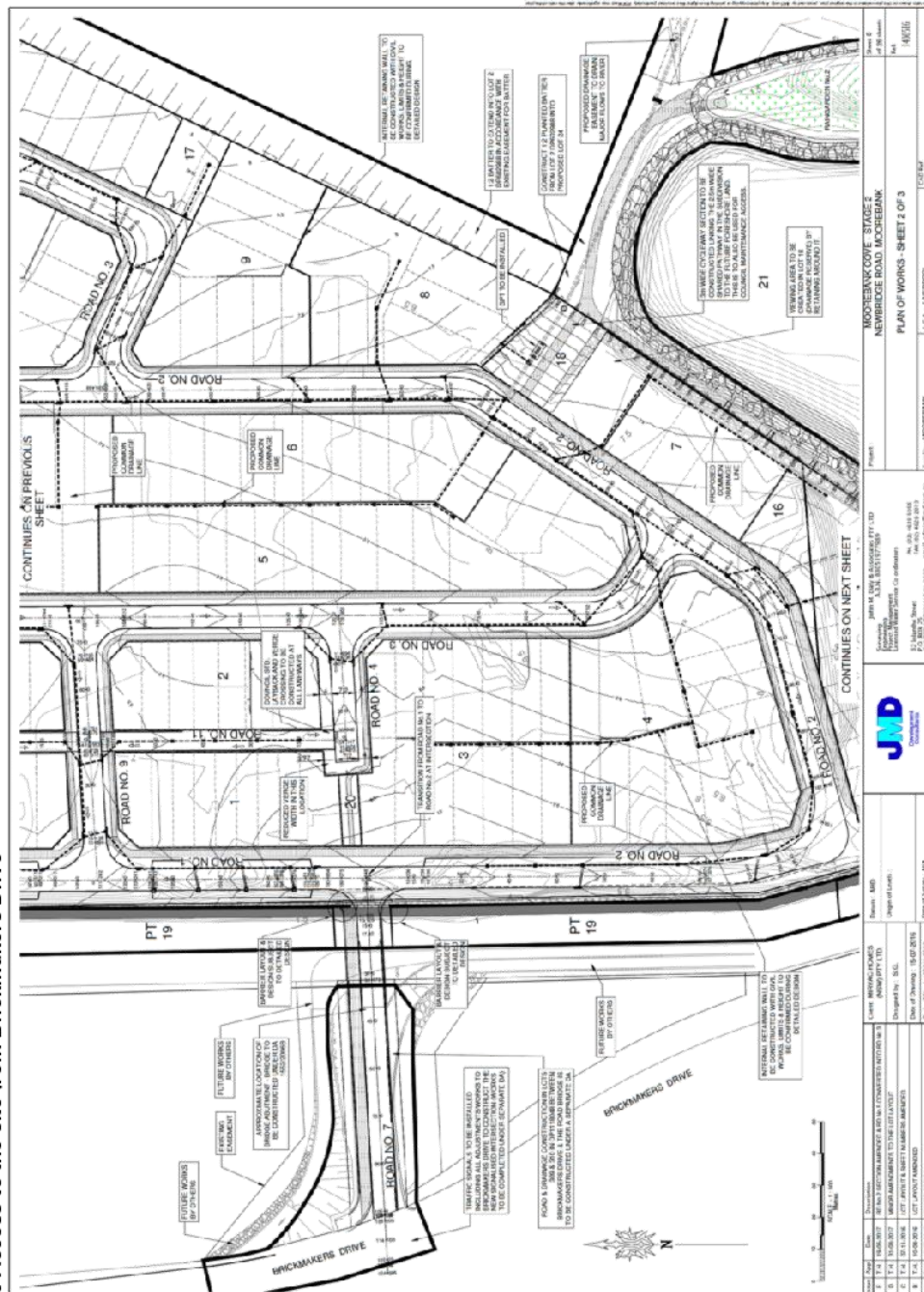


Figure 9 Longitudinal Section - Access Handle Easement

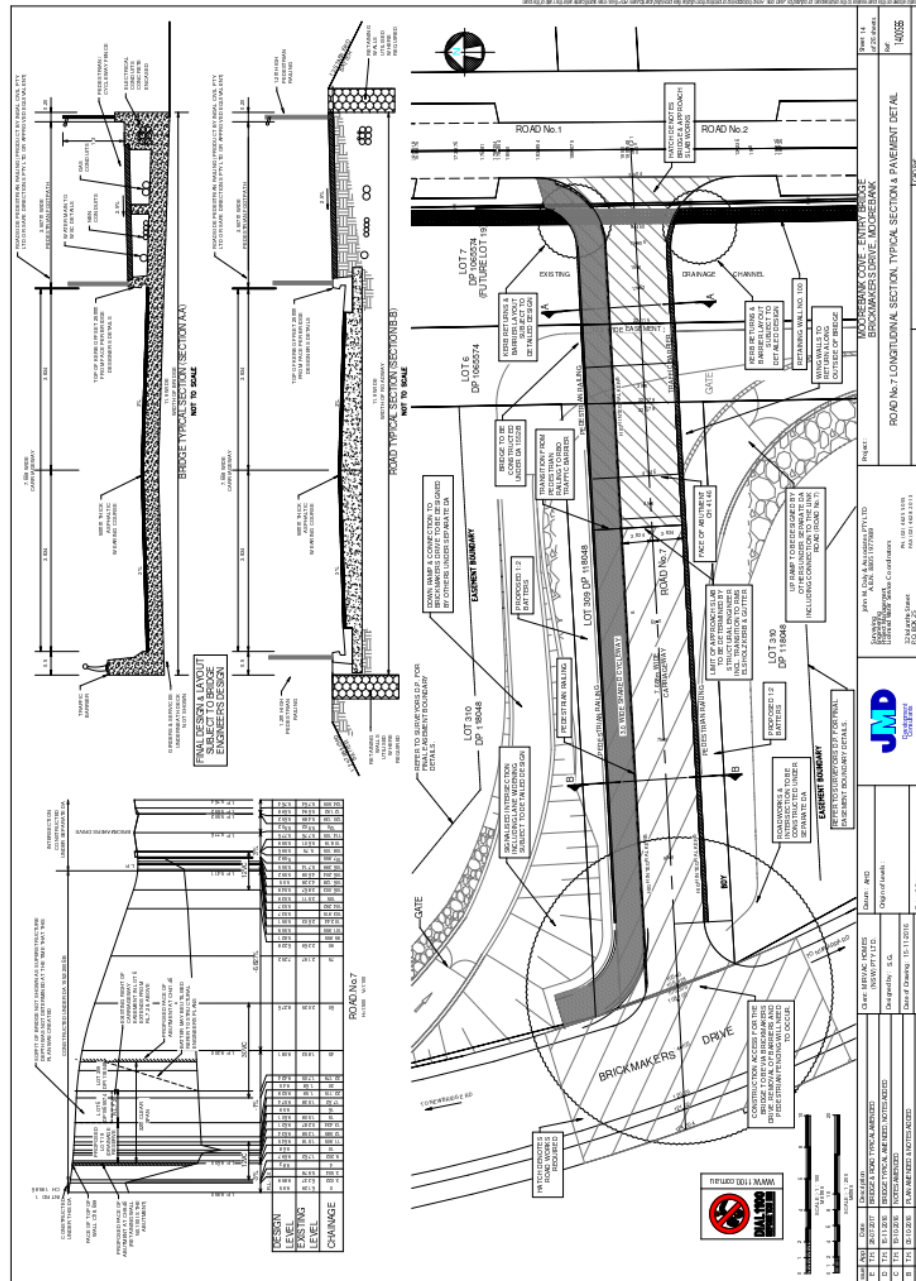
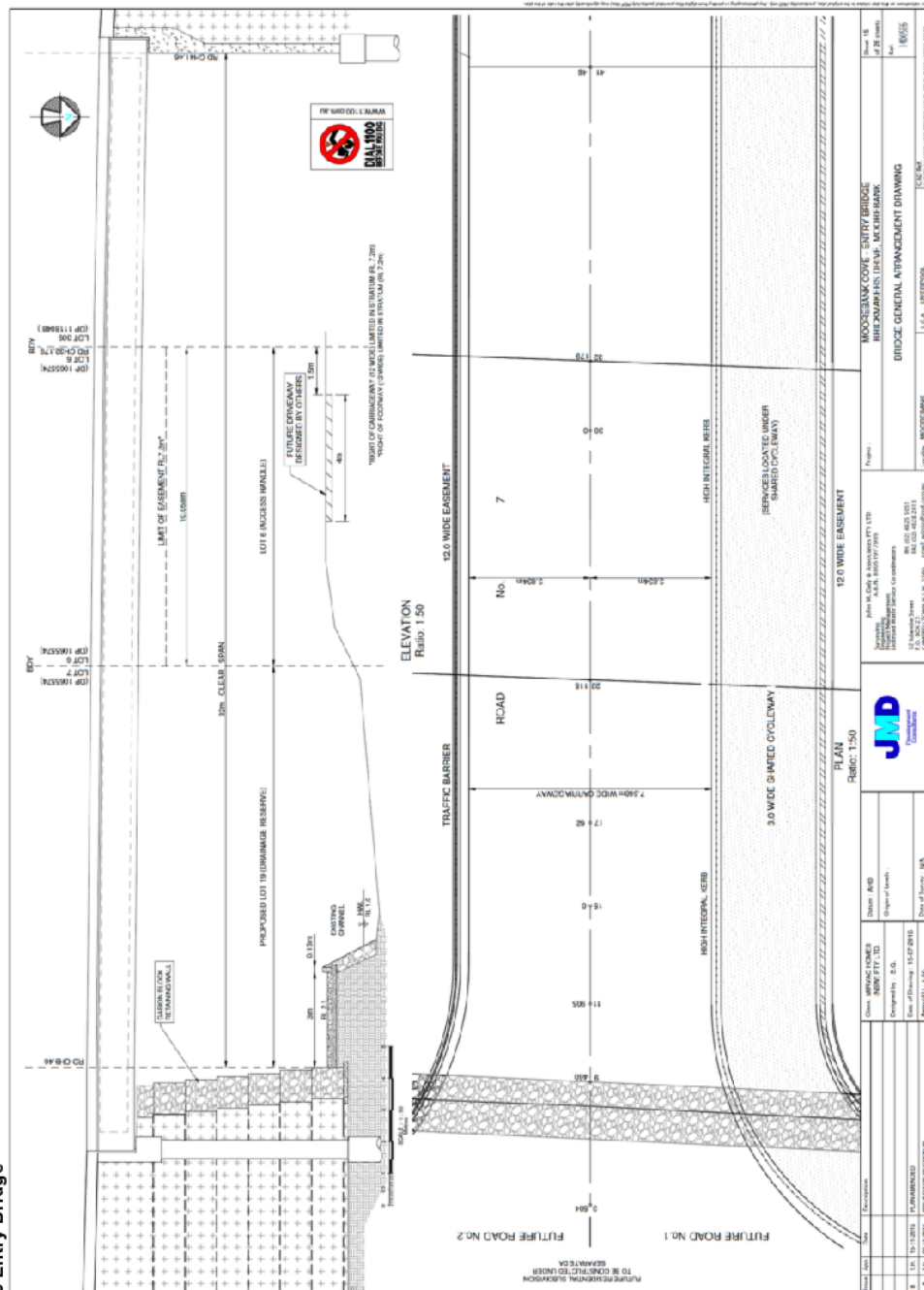


Figure 10 Entry Bridge



15. Significant Environmental Features

There are no known significant environmental features on the property.

16. Threatened Species

There are no known threatened species, population or ecological communities identified under the Threatened Species Conservation Act 1995 that is known to the applicant to exist on the property.

17. Aboriginal Objects or Places

There are no known Aboriginal objects or Aboriginal places (within the meaning of the National Parks and Wildlife Act 1974) that is known to the applicant to be situated on the property.

18. Assessment Against the Aim and Objective of PBP

The RF Reg requires an assessment of the extent to which the proposed development conforms with or deviates from the standards, specific objectives and performance criteria set out in Chapter 4 (Performance Based Controls) of PBP.

All development in Bushfire Prone Areas needs to comply with the aim and objectives of PBP. Table 4 shows the compliance with PBP.

Table 3 Compliance with Aim & Objectives of PBP

Aim	Meets Criteria	Comment
The aim of PBP is to use the NSW development assessment system to provide for the protection of human life (including fire fighters) and to minimise impacts on property from the threat of bushfire, while having due regard to development potential, onsite amenity and the protection of the environment.	Yes	Landscaping, defensible space, access and egress, emergency risk management and construction standards are in accordance with the requirements of PBP and the aims of PBP have been achieved. Bushfire Attack Level of less than BAL 29 can be achieved, meeting the deemed to satisfy requirements for the NSW RFS.
Objectives	Meets Criteria	Comment
Afford occupants of any building adequate protection from exposure to a bushfire.	Yes	The maximum exposure to a bushfire for the area where the development is proposed is BAL 29 .
Provide for defensible space to be located around buildings.	Yes	Defensible space is able to be provided on all sides of the proposed development.
Provide appropriate separation between a hazard and buildings, which, in combination with other measures, prevent	Yes	An asset protection zone commensurate with the BAL 29 can be provided at construction stage.



Georges Cove Marina

direct flame contact and material ignition.		
Ensure that safe operational access and egress for emergency service personnel and occupants is available.	Yes	The site has direct access to public roads, and access and egress for emergency vehicles and evacuation is adequate. The roads within the site may be private, but will link to existing public roads in the surrounding environment.
Provide for ongoing management and maintenance of bushfire protection measures, including fuel loads, in the asset protection zone.	Yes	Ongoing management can be provided.
Ensure that utility services are adequate to meet the needs of firefighters (and others assisting in bushfire fighting).	Yes	Utility services can be appropriate throughout the site.

19. Recommendations

The following recommendations are made for the bushfire protection measures for the site.

1. **Asset Protection Zones:** The land within the site and identified as future Asset Protection Zones, to the west and south of the development shall be maintained as an inner protection area (IPA) as outlined within section 4.1.3 and Appendix 5 of 'Planning for Bush Fire Protection 2006' and the NSW Rural Fire Service's document 'Standards for asset protection zones'.
2. The **property access roads** shall comply with section 4.1.3 (3) of 'Planning for Bush Fire Protection 2006'.
3. Any **gas** services are to be installed and maintained in accordance with AS/NZS 1596:2008 The storage and handling of LP gas (Standards Australia, 2008).
4. **Electricity** transmission lines are underground.
5. **Fire hydrant** spacing, sizing and pressure complies with AS2419.1
6. Non-combustible **cladding** shall be used on the external façade of the buildings.

20. Conclusion

This is a planning proposal to include an enabling clause for residential use within the existing zoning of the LLEP. The planning proposal only relates to the part of the RE2 Private Recreation zoned area within the southern portion of the development site.

The planning proposal seeks rezoning of a portion of residue land from RE2 Private Open Space to R3 Residential to join the existing zoned R3 residential area subject to development under an application with Liverpool City Council. In addition, the proposal with Council seeks approval of an enabling clause for terraces and residential flat buildings over part of the existing zoned RE2 land.

The planning proposal is on designated bushfire prone land buffer and the legislative requirements for development in bushfire prone areas are applicable. This assessment has been completed having regard to section 117(2) of the *Environmental Planning and Assessment Act 1979* and *Planning for Bushfire Protection 2006*.

A key principle of a merits based assessment of rezoning applications is to ensure that future development is capable of complying with PBP 2006. As such, our assessment has been completed against the subdivision requirements of PBP 2006 to ensure that future applications under s.100B of the *Rural Fires Act, 1997* can be issued with a Bushfire Safety Authority.

The proposed development can achieve the minimum setback to achieve APZs of BAL 29 in accordance with AS3959 and has been designed to meet the Bushfire Protection Requirements of *Planning for Bushfire Protection 2006*. The Planning Proposal, while providing a degree of detail is not the final form of the proposal as this will be tightened up prior to submission of a future DA. Once the rezoning application is approved, a development application will be prepared for residential subdivision.

This Report is a Bush Fire Hazard Assessment that provides the required information to assist Council and the Rural Fire Service in determining the ability of the Planning Proposal to meet *Planning for Bushfire Protection 2006*.

This report has demonstrated that an appropriate combination of bushfire protection measures and compliance with PBP 2006 can be achieved to support the planning proposal for rezoning the residue land from RE2 Private Open Space to R3 Residential to join the existing zoned R3 residential area.



Georges Cove Marina

This bushfire assessment demonstrates that the subject land is capable of accommodating future development and associated land use with appropriate bushfire protection measures. In the author's professional opinion, the planning proposal provides opportunity for future development to comply with *Planning for Bush Fire Protection 2006*. As such, the RFS ought to support the Planning Proposal in its current form.



Lew Short | Principal

BlackAsh Bushfire Consulting

B.A., Grad. Dip. (Design for Bushfires), Grad. Cert. of Management (Macq), Grad. Cert. (Applied Management)

Fire Protection Association of Australia BPAD Level 3 BPD-PA 16373

Appendix 1 RFS Bushfire Safety Authority

All communications to be addressed to:

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 Lidcombe NSW 2141

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The General Manager
 Liverpool City Council
 Locked Bag 7064
 LIVERPOOL BC NSW 1871

Your Ref: DA-24/2017
 Our Ref: D17/539
 DA17022206149 MA

ATTENTION: Marcus Jennejohn

15 December 2017

Dear Sir/Madam

Integrated Development for 7//1065574 146 Newbridge Road Moorebank NSW 2170

I refer to your letter dated 16 February 2017 seeking general terms of approval for the above Integrated Development in accordance with Section 91 of the 'Environmental Planning and Assessment Act 1979'.

This response is to be deemed a bush fire safety authority as required under section 100B of the 'Rural Fires Act 1997' and is issued subject to the following numbered conditions:

Asset Protection Zones

The intent of measures is to provide sufficient space and maintain reduced fuel loads so as to ensure radiant heat levels of buildings are below critical limits and to prevent direct flame contact with a building. To achieve this, the following conditions shall apply:

1. At the issue of subdivision certificate and in perpetuity the entire property shall be managed as an inner protection area (IPA) as outlined within section 4.1.3 and Appendix 5 of 'Planning for Bush Fire Protection 2006' and the NSW Rural Fire Service's document 'Standards for asset protection zones'.

Water and Utilities

The intent of measures is to provide adequate services of water for the protection of buildings during and after the passage of a bush fire, and to locate gas and electricity so as not to contribute to the risk of fire to a building. To achieve this, the following conditions shall apply:

2. Water, electricity and gas are to comply with section 4.1.3 of 'Planning for Bush Fire Protection 2006'.

Access

The intent of measures for public roads is to provide safe operational access to structures and water supply for emergency services, while residents are seeking to evacuate from an area. To achieve this, the following conditions shall apply:

- Public road access shall comply with the performance criteria as outlined within section 4.1.3 (1) of 'Planning for Bush Fire Protection 2006'.
- The proposed pedestrian access from the temporary turning head at the end of Road No. 1 to Newbridge Road shall be a secondary access for fire fighting resources until such time the link road connection to Davy Robinson Drive is completed.

General Advice – consent authority to note

This approval is for the subdivision of the land only. Any further development application for class 1,2 & 3 buildings as identified by the 'Building Code of Australia' may be subject to separate application under section 79BA of the EP & A Act and address the requirements of 'Planning for Bush Fire Protection 2006'.

This bush fire safety authority is issued on the basis of further information supplied to the NSW RFS in response to our correspondence dated 29/6/2017.

For any queries regarding this correspondence please contact Matthew Apps on 1300 NSW RFS.

Yours sincerely

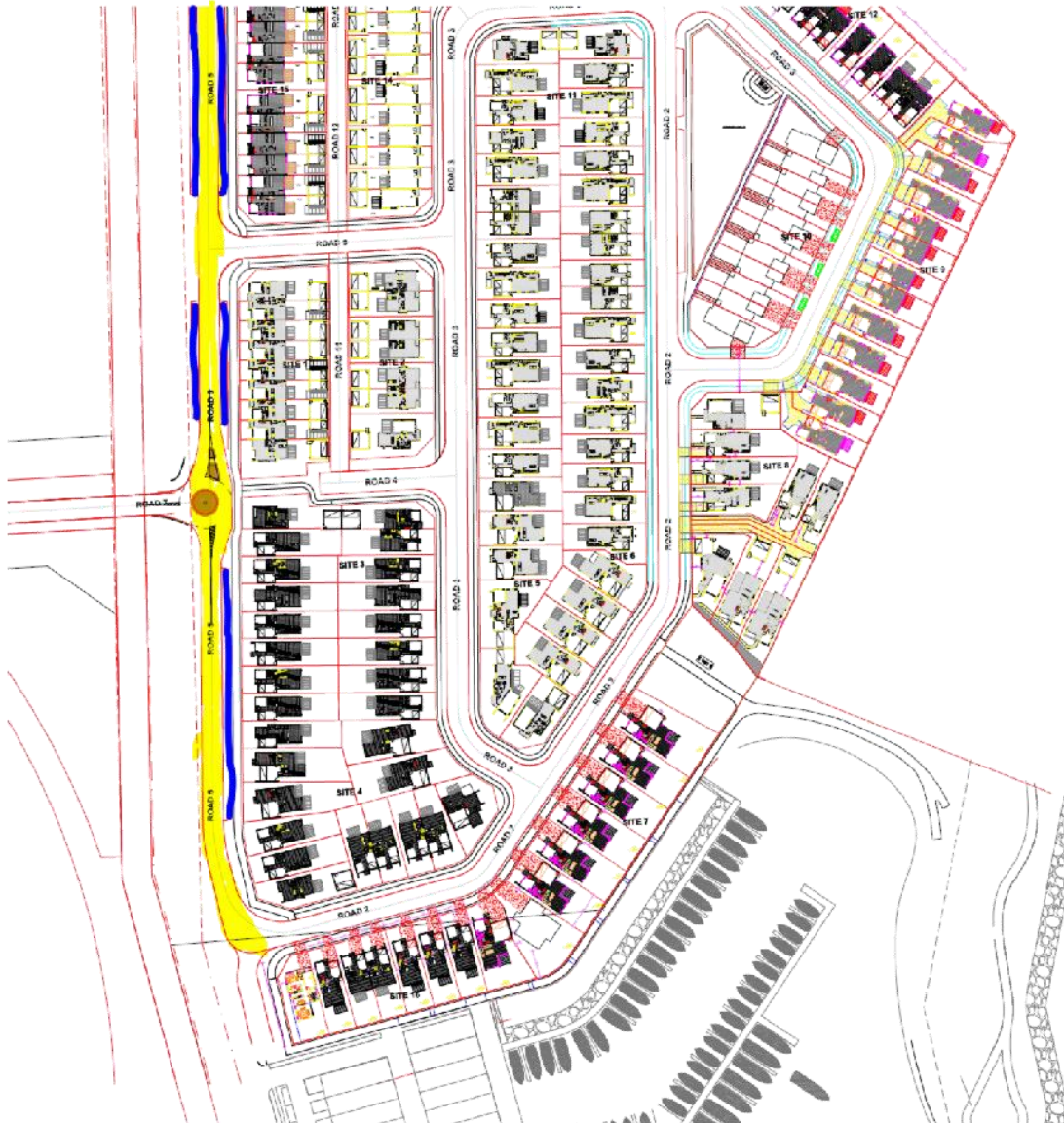


Nika Fomin
Manager, Planning and Environment Services (East)

The RFS has made getting information easier. For general information on 'Planning for Bush Fire Protection, 2006', visit the RFS web page at www.rfs.nsw.gov.au and search under 'Planning for Bush Fire Protection, 2006'.

Appendix 2

The collector road shown below highlighted yellow) itself is proposed to be 7m wide, with 2.5m wide parallel parking bays (as shown in blue below) as outlined in 'Liverpool Development Control Plan 2008, Part 2.10 Development in Moorebank East'



References

Australian Building Codes Board *Building Code of Australia Volumes 1 & 2*

Australian Standard AS/NZS 1596 'The storage and handling of LP Gas'

Councils of Standards Australia AS3959 (2009) – *Australian Standard Construction of buildings in bushfire-prone areas*

Keith, David (2004) – *Ocean Shores to Desert Dunes – The Native Vegetation of New South Wales and the ACT*. The Department of Environment and Climate Change

NSW Rural Fire Service (2015) *Guide for Bushfire Prone Land Mapping*

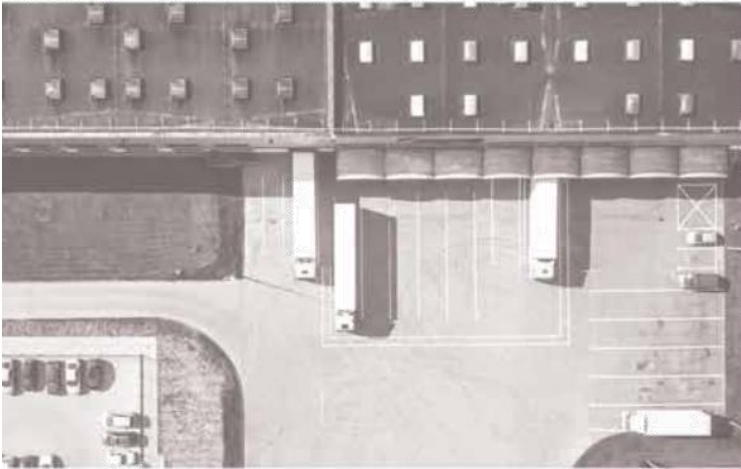
NSW Rural Fire Service (RFS). 2006. *Planning for Bushfire Protection: A Guide for Councils, Planners, Fire Authorities, Developers and Home Owners*. Australian Government Publishing Service, Canberra

NSW Government (1979) *Environmental Planning and Assessment Act 1979*. NSW Government Printer



Appendix G

Acoustic study





Georges Cove Marina Residential Planning Proposal

Acoustic study

Prepared for Mirvac Homes (NSW) Pty Ltd | 24 April 2018





Georges Cove Marina Residential Planning Proposal

Acoustic study

Prepared for Mirvac Homes (NSW) Pty Ltd | 24 April 2018

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Georges Cove Marina Residential Planning Proposal

Final

Report J17357RP1 | Prepared for Mirvac Homes (NSW) Pty Ltd | 24 April 2018

Prepared by	Teanuanua Villierme	Approved by	Najah Ishac
Position	Senior Acoustic Consultant	Position	Director
Signature		Signature	
Date	24 April 2018	Date	24 April 2018

This report has been prepared in accordance with the brief provided by the client and has relied upon the information collected at the time and under the conditions specified in the report. All findings, conclusions or recommendations contained in the report are based on the aforementioned circumstances. The report is for the use of the client and no responsibility will be taken for its use by other parties. The client may, at its discretion, use the report to inform regulators and the public.

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Document Control

Version	Date	Prepared by	Reviewed by
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1 Introduction

EMM consulting Pty Ltd (EMM) has been engaged by Mirvac Homes (NSW) Pty Ltd (Mircvac) to prepare an acoustic assessment for the planning proposal relating to residential uses at the future Georges Cove Marina development (the project) at Lot 7 DP 1065574 in the Liverpool City Council Local Government Area (LGA). The subject site is on a 22 ha lot adjoining the Georges River and has previously been used for sand extraction, dredging and recycling operations. It is noted that the subject planning proposal is for the inclusion of an enabling clause allowing residential development within the RE2 zoning, and partial rezoning from RE2 to R3. Hence this study focuses on the proposed residential development within the subject site.

The acoustic study has been prepared with reference to the following relevant guidelines, policies and standards:

- NSW Environment Protection Authority (EPA), Noise Policy for Industry (NPI) 2017;
- NSW Government, State Environmental Planning Policy (Infrastructure) 2007;
- Australian Standard AS/NZS 2107:2016 'Acoustics – Recommended design sound levels and reverberation times for building interiors'; and
- Building Code of Australia / National Construction Code (BCA/NCC) 2016, Volume One, Part F5.

This acoustic study references concept architectural drawings provided by Mirvac for the purposes of the planning proposal, which are provided in Appendix A.

Several technical terms are required for the discussion of noise. These are explained in Appendix B.

EGROW 03 Planning proposal request to rezone land from RE2 (Private Recreation) to R3 (Medium Density
Residential) at 146 Newbridge Road, Moorebank
Attachment 1 Planning Proposal Request

2 Project description

2.1 Overview

The planning proposal is seeking to amend Liverpool Council's Local Environmental Plan (LEP) to enable residential development within the development site. The proposed Georges Cove residential development includes the following main elements:

- 353 apartments (above ground floor retail facilities) and 21 terraces;
- 532 basement and 62 external carparking spaces to cater for both residential and other uses; and
- support infrastructure including power, water and sewerage services.

Refer to Appendix A for the proposed residential development concept layout.

2.2 Access and parking

Vehicular access from Brickmakers Drive to the proposed residential buildings will be provided via a road (and bridge) proposed to be constructed as part of the Moorebank Cove residential estate immediately north of the project, also proposed by Mirvac. The development will incorporate 594 car spaces, which will be provided by external parking areas and in basement car parks.

2.3 Marina

For the purposes of this assessment, the layout of the future marina development has been adopted as per the plans included in Appendix A and further detailed within the *Georges Cove Marina – Noise Impact Assessment* report prepared by EMM dated 17 June 2015 (. The main elements of the marina include wet and dry berth facilities (eg dry dock building) for small craft, ground floor retail facilities and public recreational facilities on the foreshore including bike paths and walkways.

The marina berthing and associated activities (including the use of the dry dock forklift) would operate between 7 am and 10 pm seven days a week (including on public holidays). The retail facilities would generally operate between 7 am and 12 am (midnight) seven days a week (including on public holidays).

Deliveries and on-site maintenance of watercraft (dry dock workshop) would be limited to normal daytime business hours between 7 am and 6 pm Monday to Saturday, and 8 am to 6 pm on Sunday and public holidays.

2.4 Key noise matters

The key matters addressed as part of this study include potential industrial noise impact on the proposed residential development from the (approved, but yet to be constructed) Moorebank Recycling Facility to be located immediately to the south of the subject site. The Georges Cove Marina site layout (refer to concept plans in Appendix A) includes a dry dock building (approximately 20 m high) south of the proposed residential buildings. This provides significant acoustic shielding and therefore the expected remaining issue is potential truck movement noise from the future Moorebank Recycling Facility proposed access road and its impact on the development (apartments and terraces).

Further, the potential operational noise impact from the future marina activities (boat movements, refuelling, workshop and storage) and retail are also of consideration.

3 Existing environment

3.1 Existing acoustic environment

A key element in assessing environmental noise impact is to quantify the existing ambient and background noise levels at representative assessment locations.

Existing ambient noise levels for the project area have previously been reported in the following reports:

- *Georges Cove Marina – Noise impact Assessment* prepared by EMM dated 17 June 2015;
- *Liverpool City Council v Moorebank Recyclers Pty Ltd & Ors and Benedict Industries Pty Ltd & Ors v Minister for Planning & Ors – L&EC Proceedings No 2016/159652 and 2016/157848 - Expert Evidence of Renzo Tonin – Acoustics* prepared by Renzo Tonin & Associates (Renzo Tonin) for the NSW Land and Environment Court dated 17 August 2016; and
- *Statement of Evidence: Najah Ishac – Benedict industries Pty Limited and Tanlane Pty Ltd v Minister for Planning and Moorebank Recyclers Pty Ltd – Land & Environment Court Proceedings No. 16/157848 (formerly 2015/10951)* prepared by EMM for the NSW Land and Environment Court dated 21 July 2016.

A review of the noise monitoring data presented in these reports and as agreed in the consent conditions for the Moorebank Recycling Facility (Application No: 05_0157) showed that the area surrounding the subject site is generally dominated by distant and local traffic, typical suburban or urban noise, occasional aircraft noise and natural noise sources (eg birds and wind in foliage). Background noise levels were typically controlled by traffic on Newbridge Road in areas north of the site and/or by traffic on Brickmakers Drive.

3.2 Future industrial noise

The subject site is located immediately north of land having an approval for the Moorebank Recycling Facility. The Moorebank Recycling Facility is yet to be built. Potential noise impacts from the Moorebank Recycling Facility on the proposed residential development have been assessed based on concept plans for the purpose of the planning proposal. These will be finalised during the development application stage of the proposal.

3.3 Noise-enhancing meteorological conditions

Noise propagation over distance can be significantly affected by the meteorological conditions. Of most interest are source-to-receiver winds, the presence of temperature inversions or the combination of both, as these conditions can enhance received noise levels. To account for these phenomena, the NPI specifies the following two options:

1. adopt the noise-enhancing meteorological conditions for all assessment periods for noise impact assessment purposes without an assessment of how often these conditions occur (conservative approach); and
2. determine the significance of noise-enhancing conditions.

3.3.1 Wind

Source-to-receiver wind (as being the directional component of wind) can enhance noise levels from a development at receivers.

The NPI states that where wind is identified to be a significant feature of the area then assessment of noise impacts should consider the highest wind speed up to 3 m/s, which is considered to prevail for at least 30% of the time. The NPI defines "significant" as the presence of source-to-receiver wind speed (measured at 10 m above ground level) of 3 m/s or less, occurring for 30% of the time or more in any assessment period and season.

3.3.2 Temperature inversion

The NPI states that the assessment of the impact of temperature inversion be confined to the night-time noise assessment period where temperature inversions generally occur. Sigma-theta data is required to determine the prevalence of temperature inversions, that is if they occur for 30% of the time or more during the night period.

3.3.3 Adopted meteorological conditions

The use of both 'standard' and/or 'noise-enhancing' meteorological conditions (NPI option 2) was conservatively adopted for this study. Standard and noise-enhancing conditions as presented in Table D1 of the NPI (EPA 2017) are reproduced in Table 3.1.

Table 3.1 Standard and noise-enhancing meteorological conditions

Meteorological conditions	Meteorological parameters
Standard	Day/evening/night: stability categories A-D with wind speed up to 0.5 m/s at 10 m AGL
Noise-enhancing	Day/evening: stability categories A-D with light winds (up to 3 m/s at 10 m AGL) Night: stability categories A-D with light winds (up to 3 m/s at 10 m AGL) and/or stability category F with winds up to 2 m/s at 10 m AGL

Notes: 1. m/s - metres per second; m = metres; AGL = above ground level; stability categories are based on the Pasquill-Gifford stability classification scheme.

2. Day: 7 am to 6 pm Monday to Saturday; 8 am to 6 pm Sundays and public holidays; evening: 6 pm to 10 pm; night is the remaining periods.

Industrial noise levels from the yet to be constructed Moorebank Recycling Facility have been modelled based on the meteorological parameters shown in Table 3.2.

Table 3.2 Meteorological conditions adopted for noise modelling

Assessment period	Meteorological condition	Meteorological parameter	Air temperature	Relative humidity	Wind speed	Wind direction	Stability category
Day	Standard	Calm	20°C	70%	0.5 m/s	All	D class
	Noise-enhancing	Wind	20°C	70%	3.0 m/s	All	D class

4 Project target noise levels

4.1 Industrial noise

Noise from industrial sites or processes (eg onsite traffic movements, mechanical plant, refuelling pumps etc) in NSW are regulated by the local council, the Department of Planning and Environment (DP&E) and/or the Environment Protection Authority (EPA), and usually have a licence and/or approval conditions stipulating noise limits. They are based on NPI guidelines (EPA 2017) or noise levels that can be achieved at a specific site following the application of all reasonable and feasible noise mitigation.

The objectives of assessment noise trigger levels for industry are to protect the community from excessive intrusive noise and preserve amenity for specific land uses. To ensure these objectives are met, the EPA provides two separate noise trigger levels: intrusiveness noise level and amenity noise level. The assessment of intrusiveness and amenity noise levels from the yet to be constructed Moorebank Recycling Facility were considered for the proposed residential development.

A review of the Renzo Tonin report (2016) and preliminary noise modelling indicated that the proposed dry dock building (approximately 20 m high) immediately south of the proposed apartment buildings and the noise mitigation measures (ie earth bunds) to be constructed for the Moorebank Recycling Facility (required by their approval conditions), are expected to provide a significant degree of acoustic shielding from the approved Moorebank Recycling Facility's on-site noise emissions. It is therefore anticipated that noise from the approved Moorebank Recycling Facility's road truck movements on their private access road, immediately west of the subject site boundary, will be the only material industrial noise source affecting the proposed residential buildings.

In regards to industrial noise from private access roads, the NPI (EPA 2017) states:

Where a private haul road is proposed to convey materials from one premises to another and is proposed for the express purpose of removing traffic from a public road, the private haul road should be assessed against the project amenity noise levels only.

Given the above, the noise impact from the Moorebank Recycling Facility haul road was assessed only against the amenity noise levels, relevant to the proposed residential development.

The assessment of amenity is based on trigger noise levels specific to the land use. The trigger noise levels relate only to industrial noise and exclude road or rail noise. The noise amenity category that represents the proposed residences in the fully developed subject site (including the future Marina), and should the Moorebank Recycling Facility be constructed and operated, is urban as described in Table 2.3 of the NPI (EPA 2017). The daytime ambient noise environment for the fully developed project would likely be dominated by the marina activities, industrial noise from the Moorebank Recycling Facility (from access road truck movements) and general mixed use noise sources (from retail and recreational uses). The NPI's amenity category relies on a number of factors including the typical planning zoning, and by extension the permitted land uses. Whilst the subject site is currently zoned RE1 or RE2, it is clear that, if approved, the future permitted land use would be mixed use comprising the marina, retail and medium to high density residential. On this 'future' basis, the NPI's urban category has been adopted for potential future residences of the Georges Cove development as this category applies to mixed use and high density residential developments as per Table 2.3 of the NPI reproduced in Table 4.1.

Table 4.1 Urban residential category

Receiver category	Typical planning zoning - standard instrument ¹	Typical existing background noise levels	Description
Urban residential	R1 – general residential R4 – high density residential B1 – neighbourhood centre (boarding houses and shop-top housing) B2 – local centre (boarding houses) B4 – mixed use	Daytime RBL > 45 dB(A) Evening RBL > 40 dB(A) Night RBL > 35 dB(A)	An area with an acoustical environment that: - is dominated by 'urban hum' or industrial source noise, where urban hum means the aggregate sound of many unidentifiable, mostly traffic and/or industrial related sound sources - has through-traffic with characteristically heavy and continuous traffic flows during peak periods - is near commercial districts or industrial districts - has a combination of the above

Notes: 1. As cited in Standard Instrument - Principal Local Environment Plan, New South Wales Government, Version 15 August 2014.

The amenity noise levels adopted for the future residential elements of the project are given in Table 4.2.

Table 4.2 Amenity noise levels for the project

Receiver type	Indicative area	Assessment period	Recommended amenity L _{Aeq} noise level ¹ , dB	Project amenity L _{Aeq} noise level ² , dB
Residence	Urban	Day	60	60
		Evening	50	50
		Night	45	45

Notes: 1. In accordance with Table 2.2 of the NPI (EPA 2017).

2. In accordance with Section 2.4 of the NPI (EPA 2017), project amenity noise levels are the recommended amenity noise levels as no other industries are present or likely to be introduced into the area.

4.2 Residential internal acoustic amenity

The NSW Government Infrastructure State Environmental Planning Policy (SEPP) (2007) and Australian Standard AS/NZS 2107-2016 provide guidance on design criteria for the acoustic environment within occupied building spaces. Table 4.3 provides a summary of desirable internal L_{Aeq} noise levels for residential developments relevant to the proposed development (apartments and terraces) in accordance with the SEPP (2007). These are intended for assessment of road and rail traffic noise, and provide a benchmark for internal noise expectations.

Table 4.3 Recommended internal noise levels for residential buildings

Type of occupancy	L _{Aeq} noise level, dB	Applicable time period
Sleeping areas (bedrooms)	35	10 pm to 7 am
Living areas (excluding garages, kitchens, bathrooms & hallways)	40	Any time

Source: NSW Infrastructure SEPP (2007).

These recommended internal L_{Aeq} noise levels were adopted to assess the potential impact of access road traffic noise from the Moorebank Recycling Facility on the proposed residential development.

5 Noise modelling and assessment

5.1 Modelling software

This section presents the methods and assumptions used to model access road traffic noise levels at the proposed apartments and terraces.

The noise levels were modelled using Brüel & Kjær Predictor noise modelling software. 'Predictor' calculates total noise levels at assessment locations from the concurrent operation of multiple noise sources. The model considers factors such as:

- the lateral and vertical location of noise sources;
- source-to-receiver distances;
- ground effects;
- atmospheric absorption;
- topography of the subject site and surrounding area; and
- applicable meteorological conditions.

5.2 Industrial noise impact on the proposed development

5.2.1 Moorebank Recycling Facility

As discussed earlier, the land to the south of the subject development has been approved for development (for the Moorebank Recycling Facility) but remains vacant land at this time. Hence, the following section is provided to future proof the proposed residential development occupants should industrial use occur. Furthermore, any outcomes such as identified mitigation measures as a consequence of this potential future industrial noise should only be imposed once the Moorebank Recycling Facility is constructed.

The Moorebank Recycling Facility has the potential to impact on the proposed residential development, specifically from the Moorebank Recycling Facility's access road traffic movements. The traffic noise from the Moorebank Recycling Facility was modelled and assessed based on information provided in the Moorebank Recycling Facility project approval and the Renzo Tonin report prepared for the NSW Land and Environment Court dated 17 August 2016.

Noise levels from the Moorebank Recycling Facility access road traffic were predicted at the most affected building facades (western facades) for all floor levels of the proposed apartments and terraces. No future industrial noise sources are present or likely to be introduced into the area other than the Moorebank Recycling facility and therefore noise levels from the Moorebank Recycling Facility were assessed against the relevant amenity noise levels in Table 2.2 of the NPI (EPA 2017).

The results are provided in Table 5.1. Noise levels have been predicted based on the daytime meteorological conditions provided in Table 3.2.

Table 5.1 Proposed Moorebank Recycling Facility daytime noise levels at the proposed apartments and terraces

Residential building	Receiver type	Predicted $L_{Aeq,15\text{ min}}^1$, dB	Amenity $L_{Aeq,15\text{ min}}$ noise level ² , dB	Exceedance, dB
Western apartment buildings ³	Residence ⁵	59-61	63	Nil
Western terraces ³	Residence ⁵	59-61	63	Nil
Eastern apartment buildings ⁴	Residence ⁵	39-49	63	Nil
Eastern terraces ⁴	Residence ⁵	46-52	63	Nil

Notes: 1. Range of predicted noise levels are for all floors at the most affected building facade.
 2. $L_{Aeq,15\text{ min}}$ is equal to $L_{Aeq,period} + 3\text{ dB}$ as per the NPI (EPA 2017). In accordance with Section 2.4 of the NPI (EPA 2017), cumulative industrial noise is not a necessary consideration as no other industries are present or likely to be introduced into the area.
 3. Residential buildings closer to the Moorebank Recycling Facility's private road further to the west.
 4. Residential buildings closer to the marina berths further to the east.
 5. Urban residential amenity area.

Noise levels from the Moorebank Recycling Facility are predicted to satisfy the daytime amenity noise levels on all floor levels of the apartment buildings and residential terraces during worst case meteorological conditions. The proposed residential development is therefore not expected to be impacted by industrial noise in accordance with the NPI.

5.2.2 Marina noise

The marina development as shown in Appendix A has been designed with the provision of a buffer for potential residential premises within the subject site. Notwithstanding, the proposed residential buildings design would need to consider the mitigation of potential noise from marina berthing activities (eg noise from vessels), in particular for the eastern apartments and terraces. Acoustic screening (eg louvres) on the eastern balconies of the apartments and terraces facing the marina berths would likely provide acoustic attenuation. However, it is anticipated that noise mitigation and management specific to each unit will be assessed in further detail at the development application stage.

5.2.3 Retail noise

The project design would need to consider the mitigation of potential noise from ground level retail and general foot traffic. An awning above the retail facilities and a concrete floor slab separating retail and residential spaces (eastern apartment buildings only) above would likely provide sufficient acoustic isolation.

In addition, individual retail tenancies will be required to manage their operation so as to prevent adverse noise impacts on the apartments above. It is anticipated that noise mitigation and management specific to individual tenancies will be developed at the development application stage (if required) of those tenancies when proposed uses are known.

5.3 Residential internal acoustic amenity

Noise levels from the approved Moorebank Recycling Facility's private access road truck movements were predicted for all floor levels of the proposed apartment buildings and terraces to assess internal noise levels as discussed in Section 4.2. Internal noise levels were not assessed for the night-time period (eg in bedrooms) as the Moorebank Recycling Facility is not approved to operate during the night-time period.

Internal noise levels from the approved Moorebank Recycling Facility's access road predicted at all residential facades are provided in Table 5.2. Noise levels are worst case and have been predicted based on the daytime meteorological conditions provided in Table 3.2. A typical (industry accepted standard) 10 dB reduction has been assumed for external-to-internal noise levels with windows partially open to allow for natural ventilation.

Table 5.2 Proposed Moorebank Recycling Facility daytime internal noise levels at the proposed apartments and terraces

Residential building	Predicted internal L_{Aeq} noise level ^{1,2} , dB	Internal L_{Aeq} noise criteria for living spaces	Exceedance, dB
Western apartment buildings ³	46-48	40	6-8
Western terraces ³	46-48	40	6-8
Eastern apartment buildings ⁴	26-36	40	Nil
Eastern terraces ⁴	33-39	40	Nil

Notes: 1. Range of predicted noise levels are for all floors for rooms adjacent to west facing building facade.
 2. A 10 dB reduction has been assumed for external-to-internal noise levels with windows partially open.
 3. Residential buildings closer to the Moorebank Recycling Facility's private road further to the west.
 4. Residential buildings closer to the marina berths further to the east.

The modelling results demonstrate that daytime internal noise levels for living spaces facing the approved Moorebank Recycling Facility's private access road to the west are predicted to satisfy the relevant criteria on all floor levels for the eastern apartment buildings and terraces.

For the western apartment buildings and terraces, daytime internal noise levels for living spaces facing the Moorebank Recycling Facility's private road to the west are predicted to be above the relevant criteria by up to 8 dB with partially open windows. Noise mitigation measures are therefore recommended for the proposed western apartment buildings and terraces to comply with the criteria provided within the SEPP (2007).

Industrial noise mitigation measures are discussed in Section 6.

EGROW 03 Planning proposal request to rezone land from RE2 (Private Recreation) to R3 (Medium Density
Residential) at 146 Newbridge Road, Moorebank
Attachment 1 Planning Proposal Request

6 Industrial noise mitigation measures

The assessment demonstrated that industrial noise levels from the approved Moorebank Recycling Facility's access road truck movements have the potential to impact on the proposed residential building design for western apartment buildings and terraces. Feasible and reasonable noise mitigation measures are discussed in the following sections. As noted earlier, given that the Moorebank Recycling Facility is yet to be constructed, any measures herein to mitigate that industrial noise should only be imposed once the facility is constructed. Otherwise the imposition of, a noise barrier for example, would be unreasonable to the development.

6.1 Noise barrier

A 3 m high noise barrier or earth bund (or combination of both) was modelled along the entire western site boundary and extending eastward along the northern boundary for approximately 16 m. It is noted that the relevant western and northern site boundaries are at higher elevation than the Moorebank Recycling Facility's proposed private road alignment.

The noise barrier would provide a significant reduction in industrial noise levels for most apartments and terraces, with the most significant acoustic benefits observed at the lower floor levels. Further, this would provide sufficient attenuation for industrial noise levels to satisfy the internal noise criteria for most of the apartments and terraces in accordance with the SEPP (2007). The exception would be at the higher floor levels of the western apartment buildings (including level 6, level 7 and level 8) where industrial noise levels are predicted to remain marginally (by up to 2 dB) above the relevant internal criteria.

6.2 Residential building design

Future residents of the proposed development will move in with the knowledge of the marina's activities and therefore would have an expectation consistent with such an acoustic environment. Hence the focus should be on building design treatment of units with the most potential to be affected by industrial noise from the Moorebank Recycling Facility.

Noise mitigation measures associated with the design of the residential buildings can achieve significant noise reduction. Taking into account the attenuation afforded by the construction of the noise barrier as provided in the previous section, the implementation of contemporary building design techniques for all units on floor level 6, level 7 and level 8 of the western apartment buildings would provide additional and sufficient acoustic attenuation to satisfy the internal noise criteria in accordance with the SEPP (2007). Contemporary building design techniques could include:

- partial acoustic screening (eg wintergarden with louvres) if balconies are constructed on the west facing side of the building;
- location of sleeping areas (bedrooms) on the eastern side of the buildings; and
- provision of mechanical ventilation in accordance with BCA requirements to allow occupants to keep windows/doors closed.

EGROW 03 Planning proposal request to rezone land from RE2 (Private Recreation) to R3 (Medium Density
Residential) at 146 Newbridge Road, Moorebank
Attachment 1 Planning Proposal Request

7 Conclusion

EMM has completed an acoustic assessment for the Georges Cove Marina residential development planning proposal at Moorebank, NSW.

Although the future (approved) Moorebank Recycling Facility is yet to be constructed, the potential noise impact of the facility on the proposed residential development was assessed. It was found that industrial noise levels from the Moorebank Recycling Facility, specifically from traffic movements on their proposed access road, will satisfy NPI amenity noise trigger levels.

Further, the potential impact of daytime industrial noise from the Moorebank Recycling Facility on the proposed apartments and terraces internal noise levels was assessed. The study demonstrated that daytime internal noise levels are predicted to satisfy the relevant criteria on all floor levels for the eastern apartment buildings and terraces. For the western apartment buildings and terraces, daytime internal noise levels for living spaces facing the Moorebank Recycling Facility's private road to the west require contemporary noise mitigation measures to achieve acceptable internal noise levels. This can include noise control and building design techniques provided herein for the proposed western apartment buildings and terraces.

EGROW 03 Planning proposal request to rezone land from RE2 (Private Recreation) to R3 (Medium Density
Residential) at 146 Newbridge Road, Moorebank
Attachment 1 Planning Proposal Request

Appendix A

Concept architectural drawings

MIRVAC
DESIGN

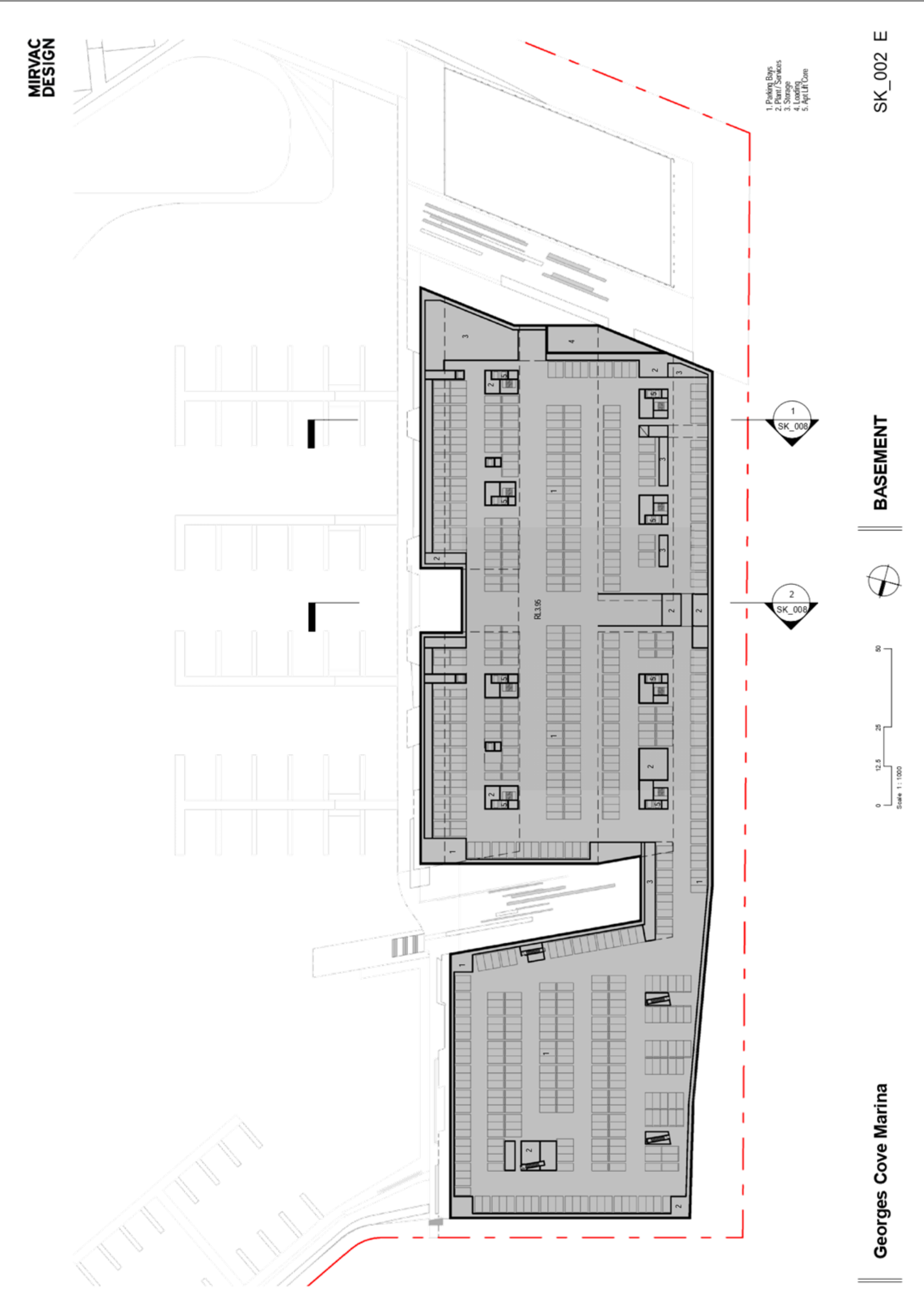


SK_001

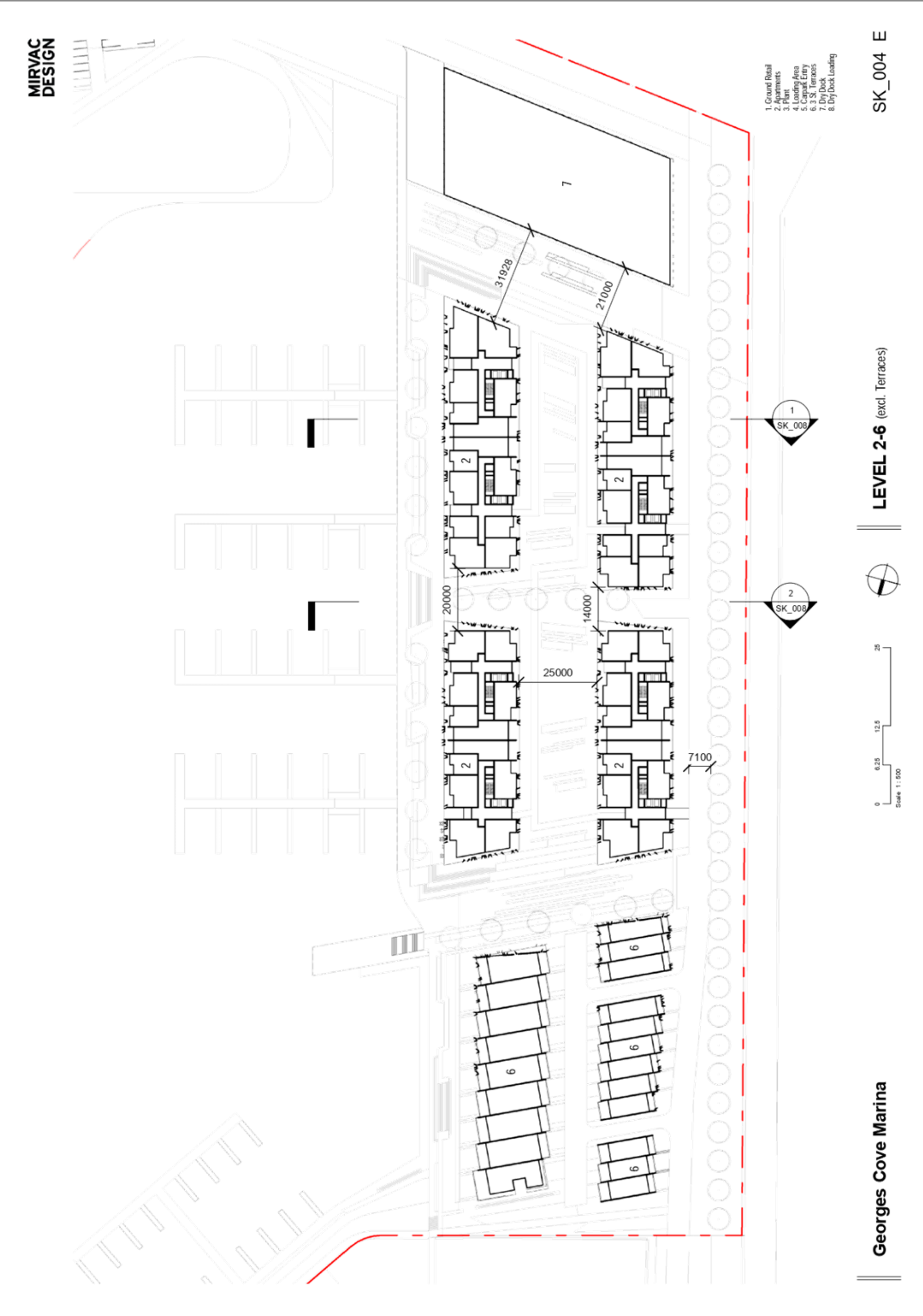
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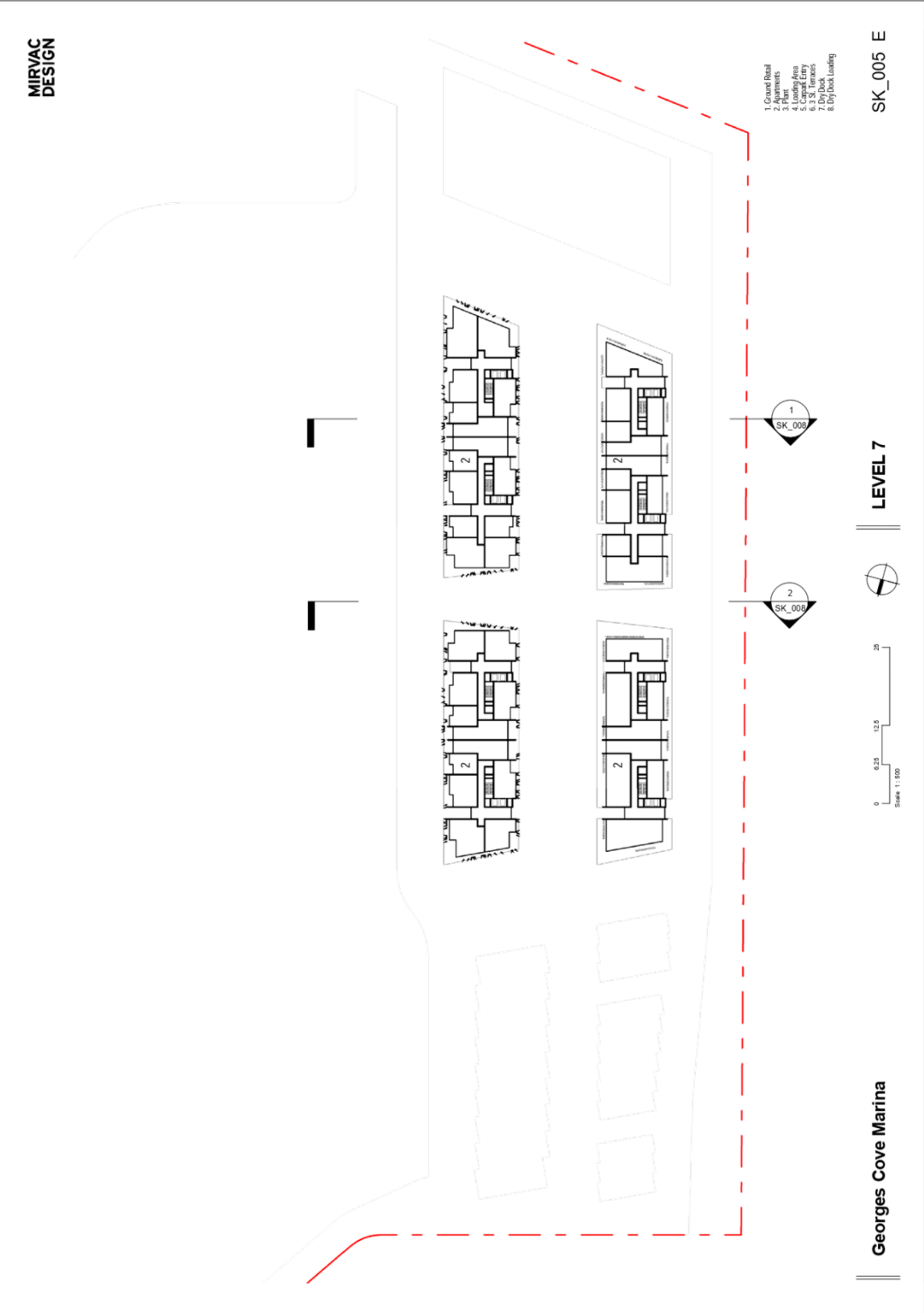


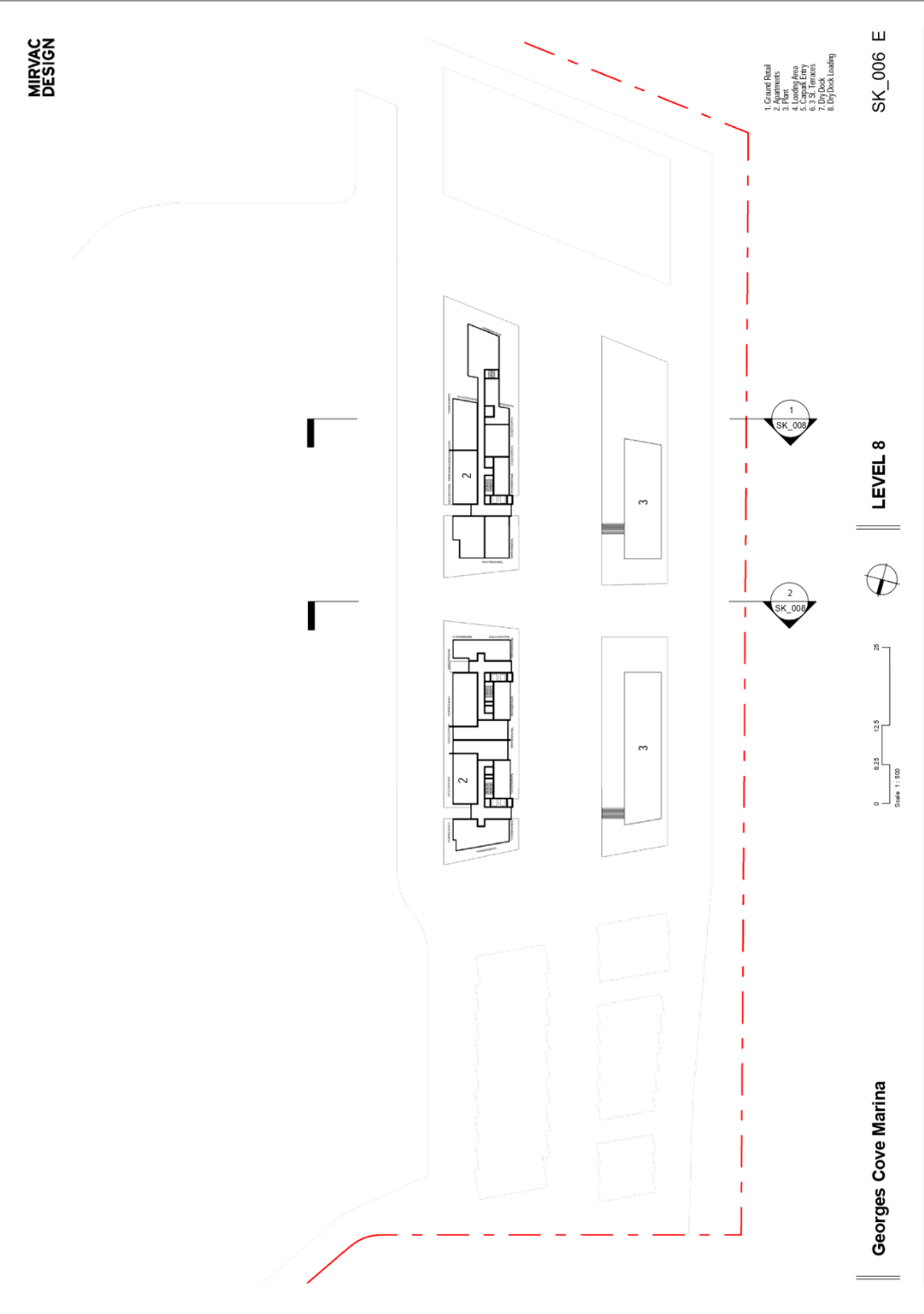
Georges Cove Marina

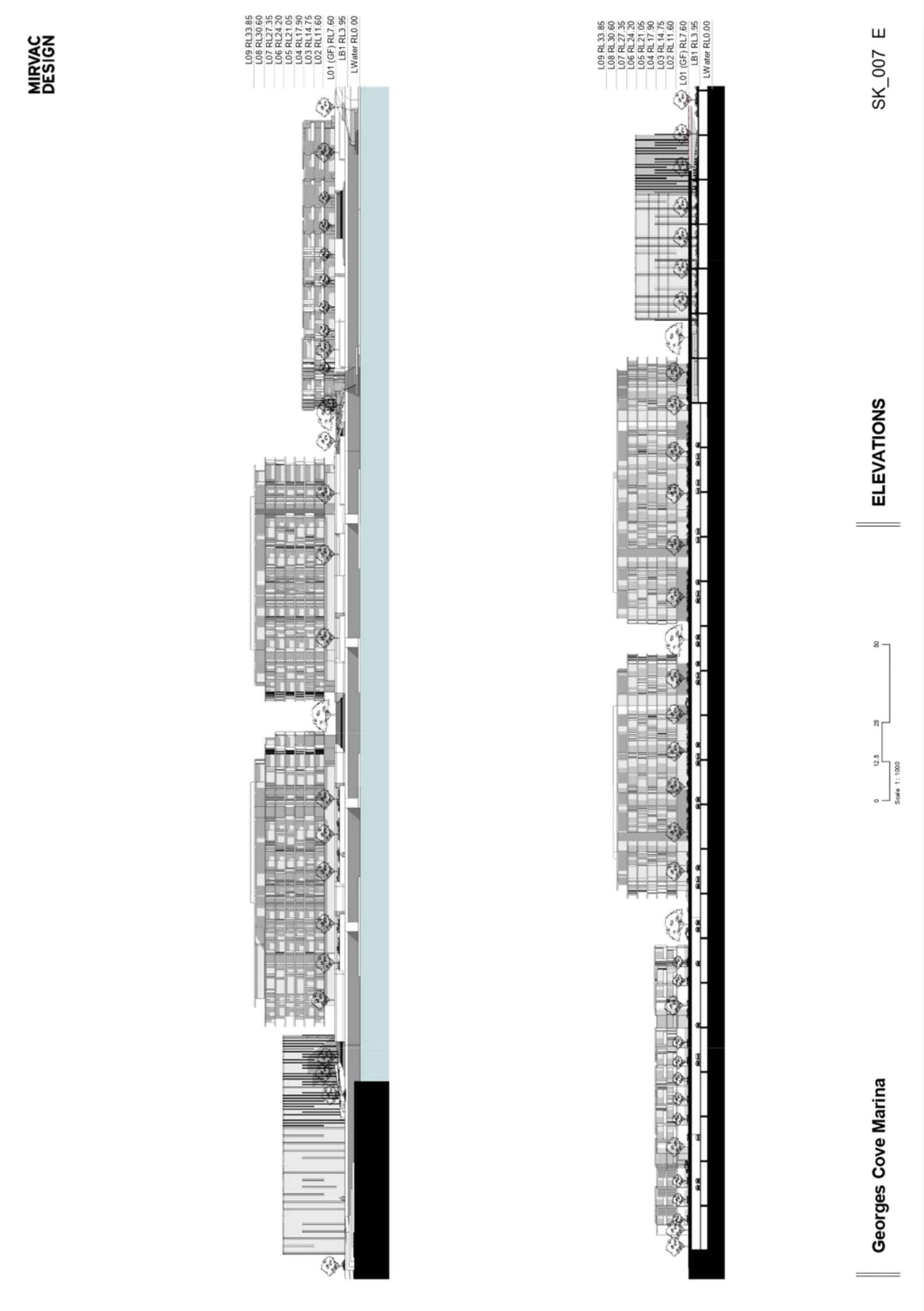




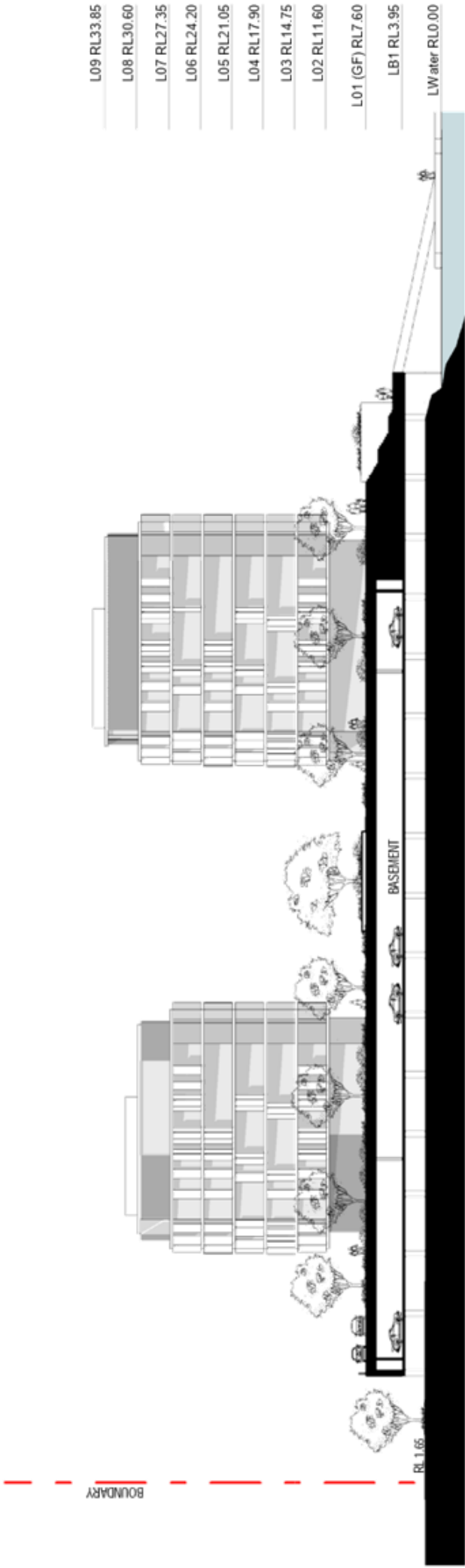
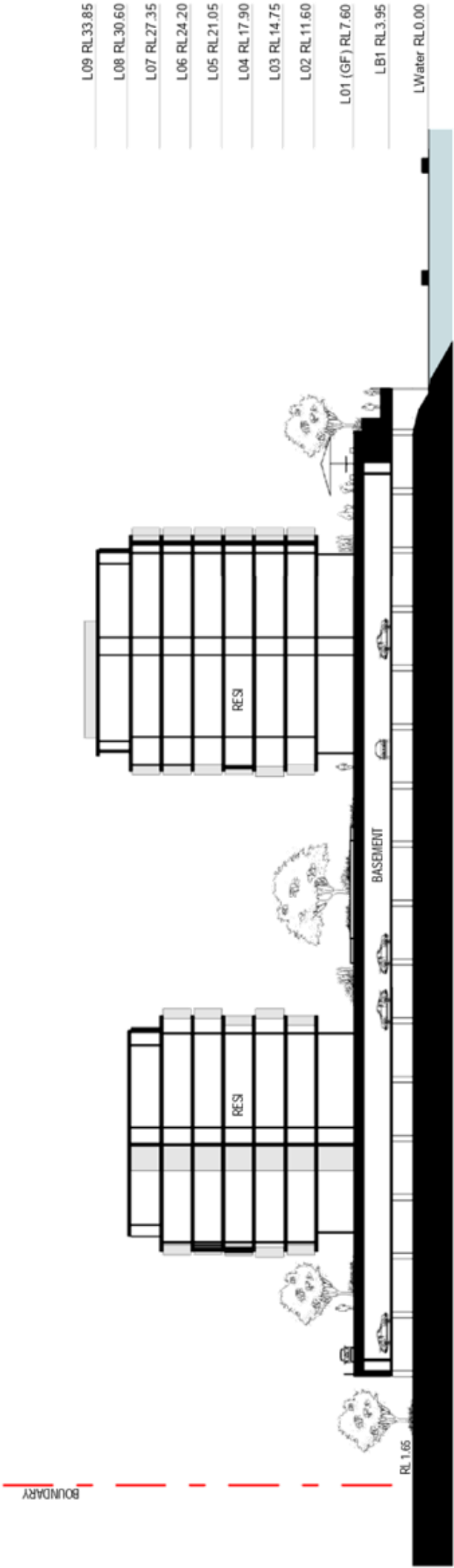








MIRVAC
DESIGN



Georges Cove Marina

SECTIONS



SK_008 E

Appendix B

Acoustic terms

A glossary of acoustic and other terms referenced in this report are provided in Table B.1.

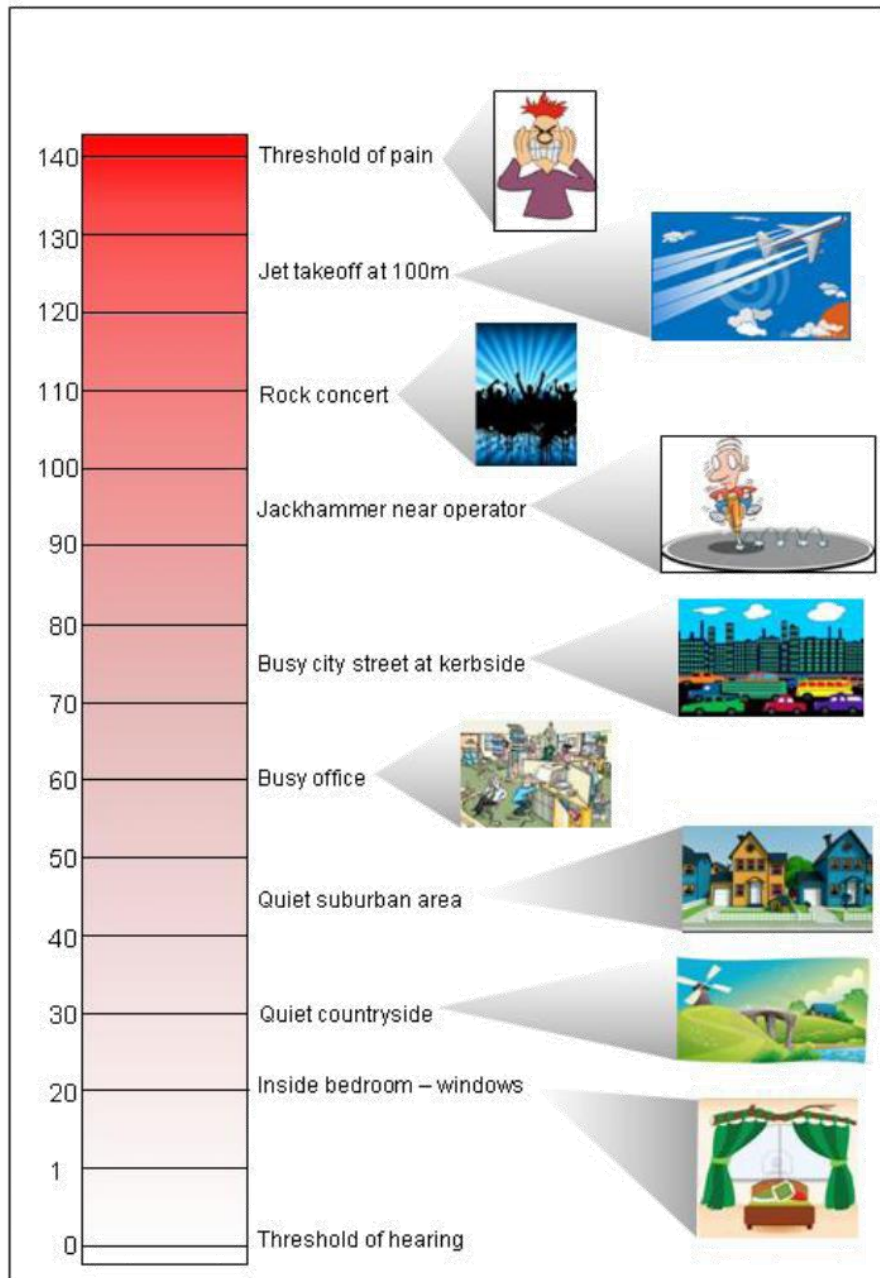
Table B.1 Glossary of terms

Abbreviation or term	Definition
ABL	The assessment background level (ABL) is defined in the NPI as a single-figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured $L_{A90,15\text{ min}}$ statistical noise levels.
Amenity noise level	The amenity noise level relate to existing industrial noise. Where industrial noise approaches base amenity noise level, then noise levels from new industries need to demonstrate that they will not be an additional contributor to existing industrial noise. See Section 3.1.2 for more detail.
Day period	Monday–Saturday: 7 am to 6 pm, on Sundays and public holidays: 8 am to 6 pm.
dB	Noise is measured in a unit called decibel (dB). There are several scales for describing noise, the most common being the ‘A-weighted’ scale which attempts to closely approximate the frequency response of the human ear.
EPA	The NSW Environment Protection Authority (formerly the Environment Protection Authority and the Department of Environment, Climate Change and Water).
Evening period	All days: 6 pm to 10 pm (including public holidays).
NPI	Noise Policy for Industry (NSW).
Intrusiveness noise level	The intrusiveness noise level refer to noise that intrudes above the background level by more than 5 dB. The intrusiveness noise level is described in detail in Section 2.3.
L_{A90}	The A-weighted sound pressure level measured that is exceeded 90% of the time. This is a measure of the background noise level.
L_{Aeq}	The energy average noise from a source. This is the equivalent continuous A-weighted sound pressure level over a given period. The $L_{Aeq,15\text{ min}}$ descriptor refers to an L_{Aeq} noise level measured over a 15-minute period.
L_{Amax}	The maximum A-weighted sound pressure level measured during a measuring interval.
Night period	Monday–Saturday: 10 pm to 7 am, on Sundays and public holidays: 10 pm to 8 am.
PNTL	The project noise trigger level (PNTL) is a target noise level for a particular noise-generating facility. The PNTL is the lower of either the intrusiveness noise level or amenity noise level.
RBL	The rating background level (RBL) is an overall single value background level representing each assessment period (day/evening/night) over the monitoring period. The RBL is used to determine the intrusiveness level for noise assessment purposes and is the median of the assessment background levels.
RNP	Road Noise Policy (NSW).
Sound power level	A measure of the total power radiated by a source. The sound power of a source is a fundamental property of the source and is independent of the surrounding environment.

Table B.2 gives an indication as to what an average person perceives about changes in noise levels. Examples of common noise levels are provided in Figure B.1.

Table B.2 Perceived change in noise

Change in sound pressure level (dB)	Perceived change in noise
3	just perceptible
5	noticeable difference
10	twice (or half) as loud
15	large change
20	four times (or quarter) as loud



Source: Noise Measurement Manual (Queensland Department of Environment and Heritage Protection 2013).

Figure B.1 Common noise levels

**SYDNEY**

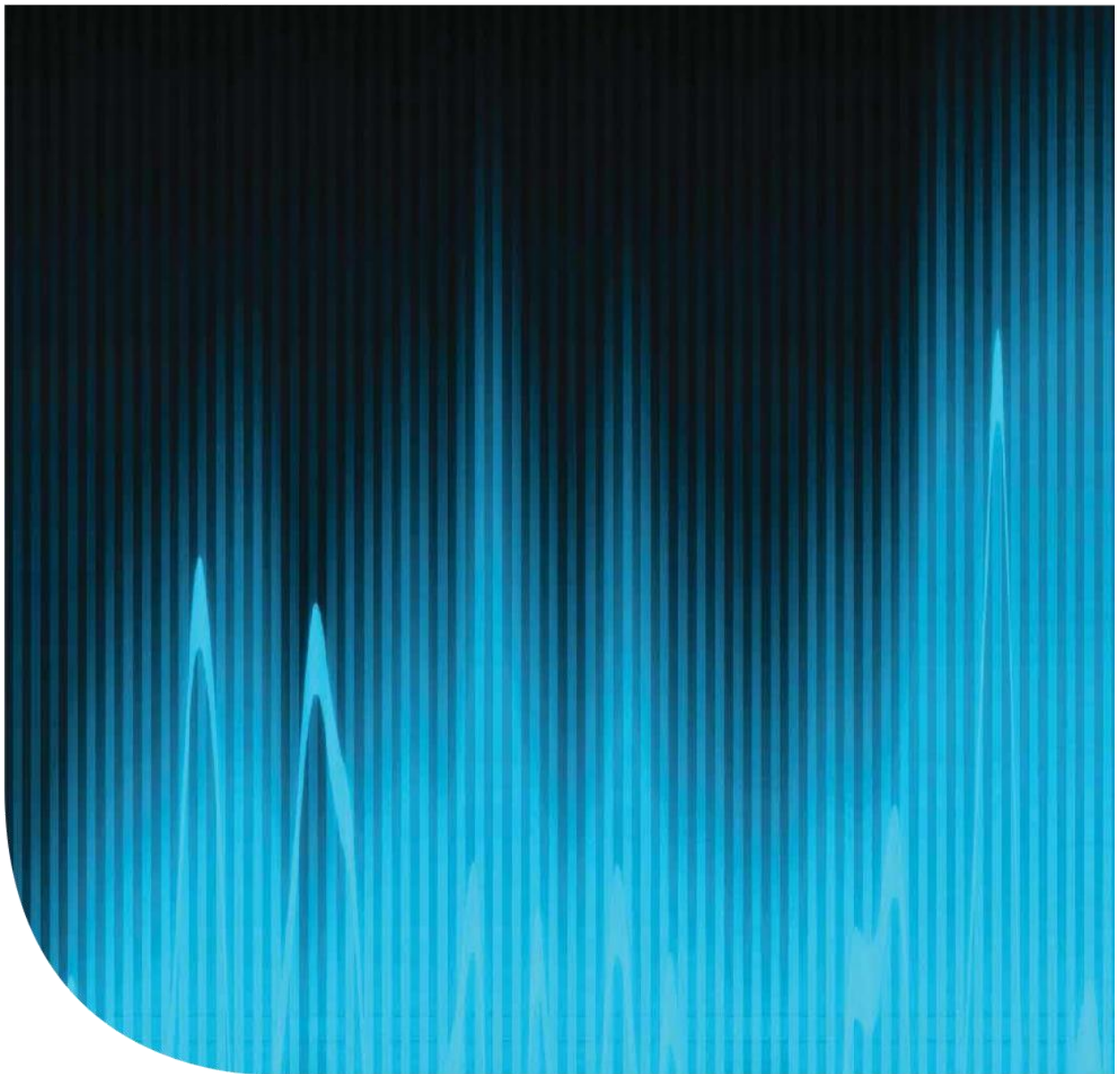
Ground floor, Suite 01, 20 Chandos Street
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NEWCASTLE

Level 1, Suite 6, 146 Hunter Street
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BRISBANE

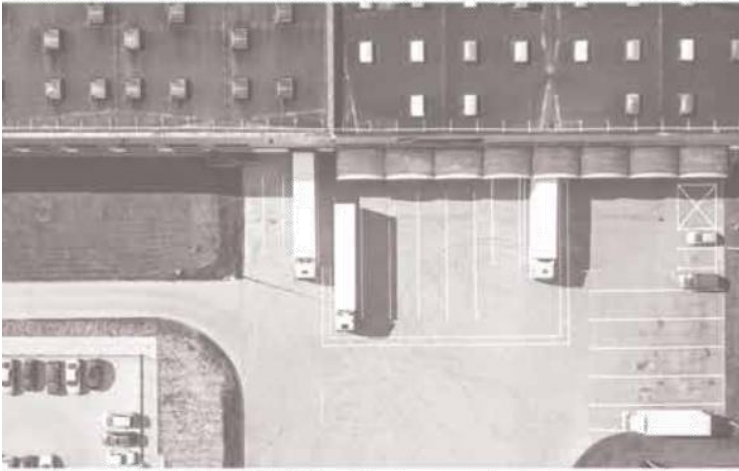
Level 4, Suite 01, 87 Wickham Terrace
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Appendix H

Aboriginal and historic due dilligence





Georges Cove Marina Due Diligence Report

Aboriginal and historical due diligence report

Prepared for Mirvac | 23 April 2018

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Georges Cove Marina Due Diligence Report

Draft

Report J17305RP1 | Prepared for Mirvac | 23 April 2018

Prepared by	Kerryn Armstrong	Approved by	Pamela Kottaras
Position	Consultant Archaeologist	Position	Heritage Services Manager
Signature		Signature	
Date	23 April 2018	Date	23 April 2018

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1 Introduction

1.1 Background

Mirvac is proposing to develop the site at 146 Newbridge Road, Moorebank, currently Lot 7 DP 1065574 (Lot 7) in the Liverpool City Council Local Government Area.

The Moorebank East residential estate will be developed on the northern section of Lot 7 within an area zoned as Medium Density Residential (R3). However, the southern-most section of the residential estate area is currently zoned Private Recreation (RE2). Mirvac will be seeking to apply an 'enabling clause' to allow the construction of residential development within the existing RE2 zoning. The residential development would be limited to a key area on the southern section of Lot 7 within the area zoned as RE2. It is also proposed to rezone part of this area to allow R3 Medium Density housing to adjoin the proposed residential estate on the northern section of Lot 7.

A planning proposal is being prepared to support these residential uses. This due diligence forms part of the planning proposal submission.

EMM Consulting (EMM) was engaged to prepare an Aboriginal and historic due diligence report on behalf of Mirvac to support development applications for the project. This report complies with the *NSW Environmental Planning and Assessment Act 1979* (EP&A Act), *Heritage Act 1977* (Heritage Act), and *National Parks and Wildlife Act 1974* (NPW Act).

1.2 Project area

The project area is 23 km west of Sydney (Figure 1.1) on the western bank of the Georges River in Moorebank (Figure 1.2). Moorebank is a growing suburb in the Liverpool local government area. It is bordered on the east side by the Western Sydney University and Bankstown airport, with Liverpool to the west and Heathcote National park to the south. The Benedict Moorebank Quarry lies directly to the north.

There are two distinct project areas for consideration, a southern project area and northern project area (Figure 1.2). The southern project area is the larger of the two at 2.2 ha stretches 280 m along the western bank of a body of water. The northern project area stretches 134 m along the northern edge of the body of water and is 0.3 ha.

1.3 Legislative context

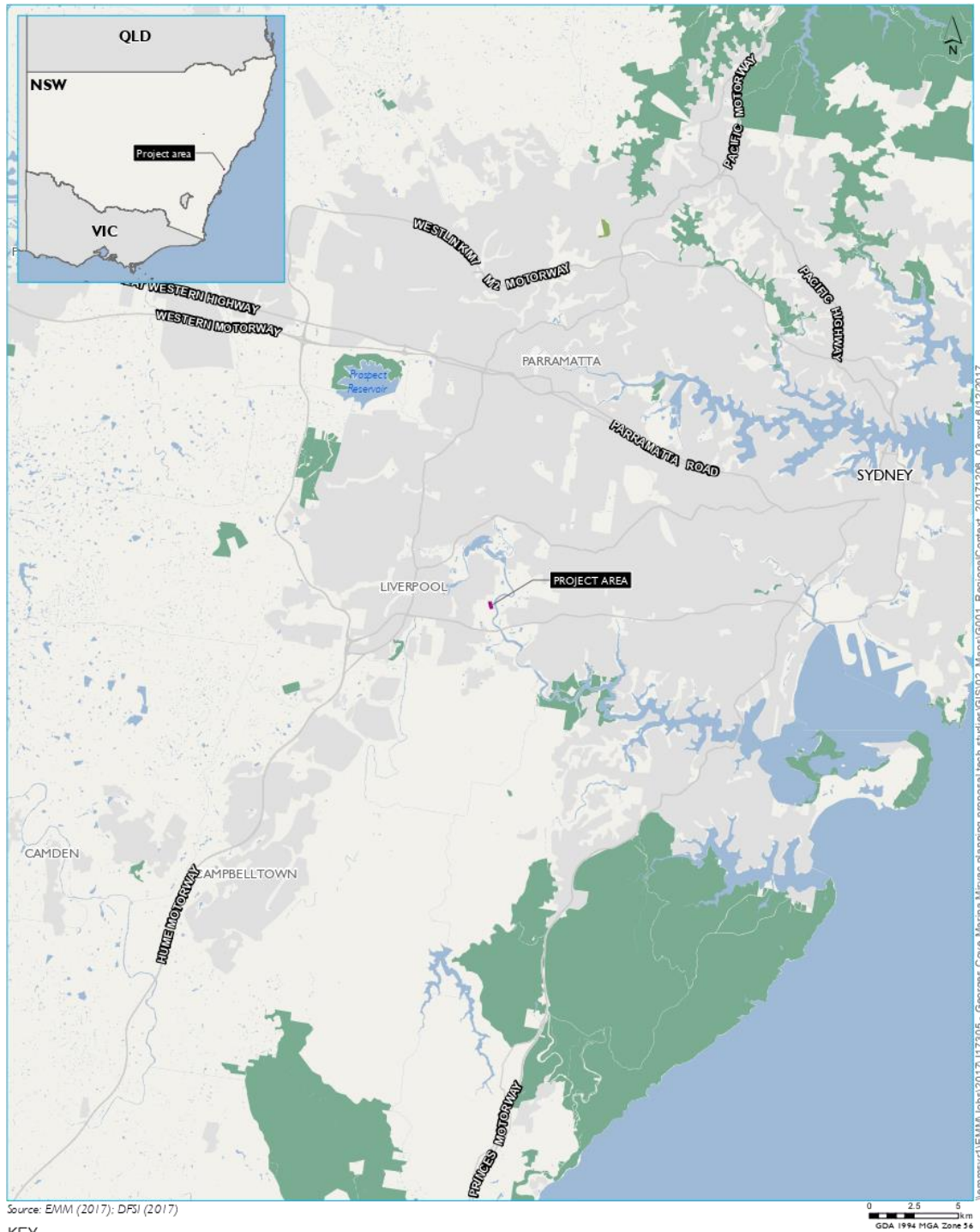
1.3.1 Aboriginal heritage

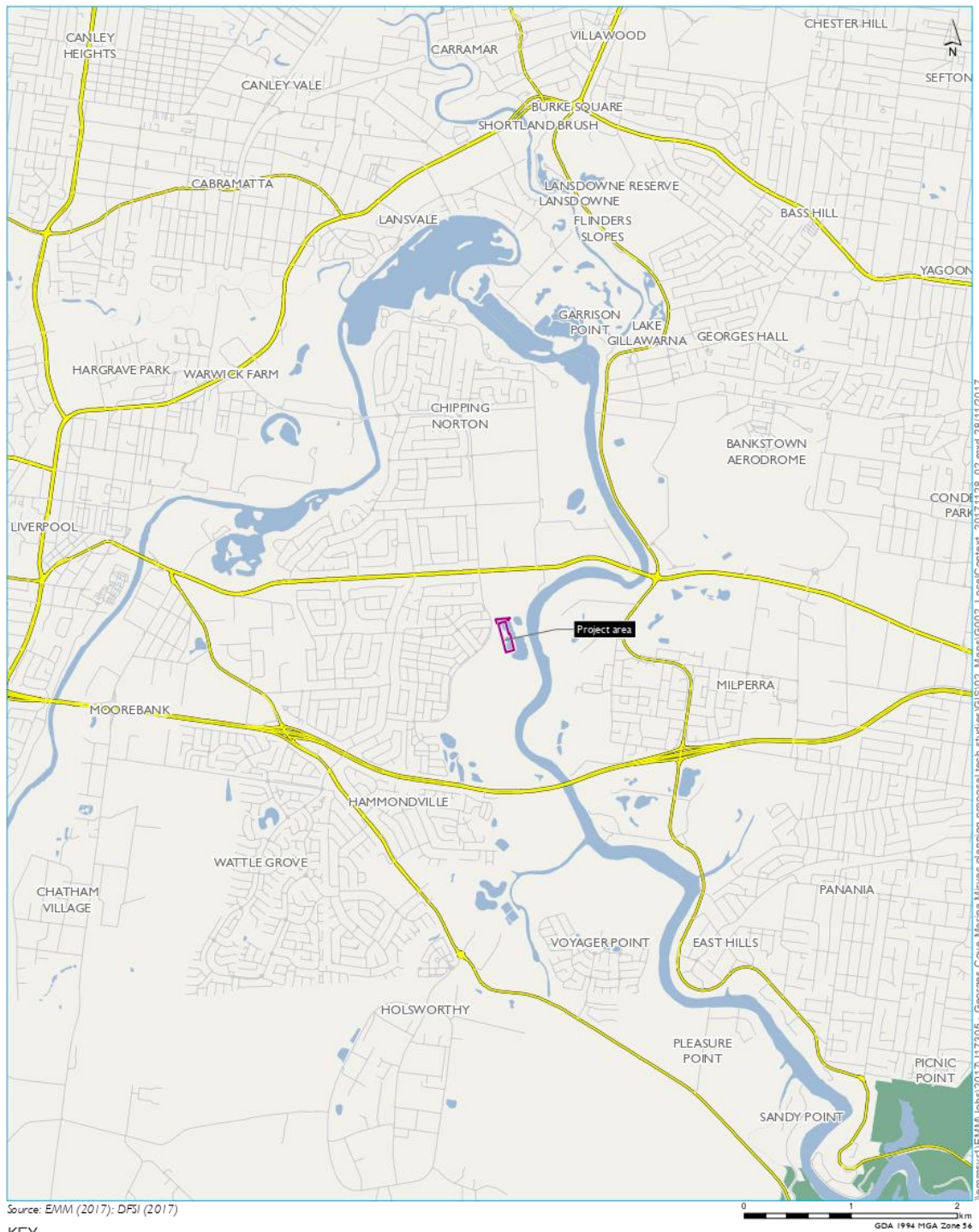
Aboriginal objects are protected in New South Wales (NSW) under the NPW Act. Section 90 of the Act requires an Aboriginal Heritage Impact Permit (AHIP) for harm to an Aboriginal object or Aboriginal place. Significant penalties are in place for harm to Aboriginal objects regardless of whether the harm was committed knowingly or not. Defences against prosecution include impacts in compliance with an AHIP, acting in accordance with specified codes of practice or the conduct of certain low impact activities. The Act defines an Aboriginal object as:

any deposit, object or material evidence (not being a handicraft made for sale) relating to the Aboriginal habitation of the area that comprises NSW, being habitation before or concurrent with (or both) the occupation of that area by persons of non-Aboriginal extraction, and includes Aboriginal remains.

Harm is defined as:

any act or omission that: (a) destroys, defaces or damages the object or place, or (b) in relation to an object—moves the object from the land on which it had been situated, or (c) is specified by the regulations, or (d) causes or permits the object or place to be harmed in a manner referred to in paragraph (a), (b) or (c), but does not include any act or omission that: (e) desecrates the object or place, or (f) is trivial or negligible, or (g) is excluded from this definition by the regulations.





This report has been prepared in accordance with *The Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW* (DECCW 2010) (the Code) to address potential Aboriginal heritage issues. Historical heritage issues are investigated by assessing historical disturbance to the site to assist with decisions about the level of archival research that is likely to be required.

The Code provides a generic checklist to assist with determining whether activities will harm an Aboriginal object and, if so, what measures can be taken to avoid that harm. The advantages of due diligence for assessing potential harm to Aboriginal objects are that it:

- provides a defence against prosecution for inadvertent impacts if the process is followed;
- assists in avoiding unintended harm to Aboriginal objects;
- provides certainty to land managers and developers about appropriate measures for them to take;
- encourages a precautionary approach; and
- results in more effective conservation outcomes for Aboriginal cultural heritage.

The steps required by the due diligence process are:

- consideration of existing archaeological investigation records of Aboriginal objects;
- consideration of landscape features on undisturbed land known to be sensitive for the presence of Aboriginal objects; and
- a visual study area inspection, where sensitive landforms occur, of proposed impact areas to identify any Aboriginal objects or potential archaeological deposits (PADs).

The conclusion of a due diligence assessment is to advise on the necessity to undertake additional investigation of the site to best manage the archaeological and cultural resource.

If the due diligence assessment determines that artefacts or areas of potential archaeological deposit are likely to be harmed, a permit is required to manage harm as defined by Part 6, Section 86 of the NPW Act.

Understanding the landscapes that lend themselves to everyday life for Aboriginal people of the past helps identify areas of higher potential. These landscape characteristics are identified in the Code and are:

- within 200 m of waters¹; or
- located within a sand dune system; or
- located on a ridge top, ridge line or headland; or
- located within 200 m below or above a cliff face; or
- within 20 m of or in a cave, rock shelter, or a cave mouth and is on land that is not disturbed land.

¹ 'Waters' means the whole or any part of: any river, stream, lake, lagoon, swamp, wetlands, natural watercourse, tidal waters (including the sea). Note: the boundary or tidal waters is defined as the high water mark. (DECCW 2010c, p.12)

In addition to these characteristics, other criteria are deep or intact soil profiles that may hold artefacts and landforms that exhibit additional desirable features for camping, such as gentle slopes or low lying hills, which are positioned to offer some protection from the elements and visibility of the surrounding area.

1.4 Report context

Table 1.1 describes the basic steps of an Aboriginal due diligence assessment as set out in Section 8 of the Code. It also provides an overview of the assessment results in accordance with these steps and lists the section(s) in the report where each of these is addressed in full.

The due diligence assessment included a search of the Aboriginal Heritage Information System (AHIMS) database on 9 November 2017. Environmental landscape information and previous archaeological investigations in the vicinity of the study area were reviewed to determine if the project would occur on any landforms that may indicate the presence and survival of Aboriginal objects.

Table 1.1 Due diligence summary

Step	Results	Section in this report
STEP 1: Check for records of Aboriginal objects and places in area of proposed activity.	AHIMS return zero results for the project area.	3.1.1
STEP 2: Is the activity a 'Low Impact Activity', as defined in the National Parks and Wildlife Regulation?	This activity is not classed as a 'Low Impact Activity' defined as in the National Parks and Wildlife Regulation.	
STEP 3: Are there any landscape features on undisturbed land that are likely to indicate the presence of Aboriginal objects?	Landforms are present that could indicate activity, however the level of disturbance is so great, any activity has likely been destroyed previously	4.1
STEP 4: Does a desktop assessment and visual inspection confirm that there are Aboriginal objects present or likely to be present?	Both the desktop survey and visual inspection confirm the level of disturbance on the site and therefore that it is improbable that Aboriginal objects are present.	4.1
STEP 5: Can the activity be relocated away from the known/likely area for Aboriginal objects?	Not applicable	
STEP 6: Commence investigation for an Aboriginal Heritage Impact Permit (AHIP).	Not applicable	

1.4.1 Historical heritage

Listing on statutory registers provides legal protection for heritage items. In NSW, the Heritage Act, and EP&A Act are the primary statutory controls protecting historical heritage and archaeology within NSW. The State Heritage Register (SHR), the Section 170 registers, and heritage schedules of Local Environmental Plans (LEPs) have varying degrees of legal obligation. Places on the National Heritage List (NHL) and the Commonwealth Heritage List (CHL) are protected under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). The Register of the National Estate (RNE) became a non-statutory register when the EPBC Act was gazetted, but is still used as a reference tool for items that have not been transferred to the NHL, the CHL or the LEP.

1.5 Authorship and acknowledgments

This report was prepared by Kerry Armstrong (EMM Consultant Archaeologist) who also conducted the site inspection. Quality assurance was provided by Pamela Kottaras (EMM Heritage Services Manager). GIS services were provided by Roshni Sharma (EMM GIS analyst).

EGROW 03 Planning proposal request to rezone land from RE2 (Private Recreation) to R3 (Medium Density
Residential) at 146 Newbridge Road, Moorebank
Attachment 1 Planning Proposal Request

2 Existing Environment

2.1 Environmental context

The environmental context is used to predict the likelihood of archaeological material being present, its spatial distribution and preservation. Landscape features were an important factor for the choice of camping, transitory and ceremonial areas used by Aboriginal people as topography and hydrology created attractive places to camp; geology was important for raw materials and soil types played a role in ecosystems and later, site preservation. Natural resources, including raw stone materials and local flora and fauna provided food, tools and material resources. Additionally, natural and cultural (anthropogenic) site formation processes influence the present location of archaeological material (eg moved through disturbance), along with its preservation and archaeological integrity.

2.1.1 Geology and soils

The Sydney basin is composed of a Triassic system of shales and rocks, called the Wianamatta group (NSW Geoscience 2017) comprising of Bringelly shale, Minchinbury sandstone and Ashfield shale. Both Ashfield and Bringelly shales are composed of a clay, quartz and siderite minerals, creating a consistent microstructure between the two. Between the two shales, lies Minchinbury sandstone which is often only obvious in road cuttings or quarries as it generally considered well covered with shale and soil. The Wianamatta group overlays the Hawkesbury sandstone which has often been documented at up to 200 m thick.

The original soil landscape for the project area is Richmond alluvial sand composed of weak composite orange and red clay loams (eSPADE 2017). This is common along the banks of both the George and Nepean rivers. The A1 Horizon is loose red-brown loamy sand with a slightly acidic pH of 5.5, which tops the A2 Horizon of brown sandy loam. The B1 Horizon is a reddish to yellow light clay, it is porous and tops a B2 horizon which is a heavy clay. This subsoil is also reddish to yellow and is dense, smooth and has a variable structure. Although this is the soil landscape for the area at, and surrounding the project area, it is notable to mention the area has been covered in fill.

2.1.2 Landscape features

The southern project area contains a large body of water in the north-east corner and is surrounded by steep banks. The geomorphology of the land described in Section 2.1.1 is not consistent with the existing landscape. The project area has been extensively disturbed by historic earthworks, which includes excavation and fill (Plate 2.1). The deep excavations have removed large volumes of soil, which has been replaced by water.

The northern project area has also been subject to a large amount of disturbance through earthworks that include substantial excavation and fill activities (Plate 2.2 and Plate 2.3). This level of disturbance has removed all the natural landforms.



Plate 2.1 Evidence of excavation in foreground, and introduced fill in background. View north



Plate 2.2 Evidence of excavation and introduced fill in the northern project area. View north.



Plate 2.3 Northern project area showing evidence of excavation and introduced fill. View east.

2.1.3 Hydrology

The project area is located 200 m west of Georges Rivers (Figure 1.2), a seventh order stream in accordance with the Strahler system. Georges River was renamed after the European contact, previously it was known as the Tucoerah River by the custodians who were the Dharawahl and Darug Aboriginal People (Campbelltown's Aboriginal History 2017). The Georges River is part of the larger Georges River catchment area which supplies roughly 1 million people with water. The river flows through Liverpool to connect up with Botany Bay, and has long been an important resource to those who have lived in the area.

A first order stream (Strahler) 60 m south of the project area was an ephemeral water source connected with Georges River, although there is no evidence of it present day.

2.1.4 Vegetation

Due to the high erodibility of the of the Richmond alluvial sands, soil fertility is generally regarded as low to very low. However, red cedar (*Toona ciliata*), paperbarks (*Melaleuca*) and coach wood (*Ceratopetalum apetulum*) were common in the past. The landscape has also known to encourage native reeds still common in the area today.

Due to the amount of degradation of native soils, transference via fill in the past and prior development of the area in large there is limited natural vegetation in the project area (Plate 2.4). There are isolated clumps of reeds and shrubs with grass coverage along the edge of the water body; no mature trees were present in the project area.



Plate 2.4 Example vegetation in the project area. View south-east

2.1.5 Land use

Moorebank and the surrounding area of Liverpool were often used as a services arm of Sydney. With a military barracks and hospital both built in the 1800s. The area developed rapidly with residential areas being built for workers in local industry, gas-works, a veterinary hospital and paper mill amongst others. Farming was mainly by returned soldiers who were allotted settlement scheme farms in the surrounding area (The Founding of Liverpool 2017).

3 Desktop Survey

3.1 Aboriginal Context

Information about the socio-cultural structure of Aboriginal society prior to European contact largely comes from ethno-historic accounts made by Europeans. These accounts and observations were made after massive social disruption due to disease and displacement. As a result, this information is often contentious, particularly in relation to language area boundaries.

However, it is generally accepted that the Dharawal and Darug Aboriginal People are the traditional custodians of the land that the project area is on. The river and surrounding vegetation provided plenty of food, in the form of possums, wallabies and lizards, birds and eggs as well as river resources such as fish and oysters; while the plant varieties included roots and berries. Shelter came in the form of sandstone overhangs and erosion as the area is rich in Hawkesbury sandstone geology (Turbet 1989, pp. 53-65).

3.1.1 Register searches

Searches were made on 9 November 2017 of the following heritage databases (Figure 3.1):

- the Aboriginal heritage information management system (AHIMS); and
- the Aboriginal places register (accessed via State Heritage Inventory); and
- the Native Title Vision website.

Table 3.1 Aboriginal register search for items within the project area

Register	Results
AHIMS and heritage database search	No sites found within a 50 m buffer of the project area
Aboriginal places register	No sites found within the project area
Native Title Claims	No claims found within the project area
Indigenous Land Use Agreements (ILUAs)	No ILUAs found within the project area

3.2 Relevant archaeological investigations

There is a lack of archaeological investigations pertaining to the project area. The reason for this could be either a low number of sites, or more likely, a low amount of investigation into the area. It can be safely posited however, that since rivers are of high economic and cultural value, the area around Georges River would also provide year round food and supplies.

3.3 Historical Context

3.3.1 Register searches

Searches were made of the following heritage databases on 9 November 2017 (Figure 3.2):

- the National Heritage List (NHL);
- the Commonwealth Heritage List (CHL);

- the State Heritage Register (SHR);
- the State heritage Inventory;
- Schedule 5 of the Liverpool Local Environmental Plan (LEP);
- Schedule 5 of the Bankstown LEP; and
- the Register of the National Estate (RNE)

Table 3.2 Historical register search for items within the project area

Register	Register listings
National Heritage List (NHL)	No items within the project area
Commonwealth Heritage List (CHL)	No items within the project area
State Heritage List (SHR)	No items within the project area
Schedule 5 of the Liverpool LEP	No items within the project area
Schedule 5 of the Bankstown LEP	No items within the project area
Register of the National Estate (RNE)	No items within the project area

Heritage items in the vicinity of the project area are listed in Table 3.3.

Table 3.3 Historical register search for items within the vicinity

Register	Register listing	Item number	Distance from project area
National Heritage List (NHL)	No items within the vicinity	Not applicable	Not applicable
Commonwealth Heritage List (CHL)	Defence national storage and distribution centre	105641	4.5 km
State Heritage List (SHR)	No items within the vicinity	Not applicable	Not applicable
Schedule 5 of the Liverpool LEP	Dwelling – Chipping Norton	20	2 km
Schedule 5 of the Liverpool LEP	Palm trees (<i>Phoenix canariensis</i>)	21	2.1 km
Schedule 5 of the Liverpool LEP	Avenue of trees	22	950 m
Schedule 5 of the Liverpool LEP	Hammondville Home for Senior Citizens	29	1.5 km
Schedule 5 of the Liverpool LEP	St Anne’s Anglican Church	30	1.6 km
Schedule 5 of the Liverpool LEP	Australian Army Engineers Group, including RAE Memorial Chapel, RAE Monument, Major General Sir Clive Steele Memorial Gates, Cust Hut	57	2.7 km
Schedule 5 of the Liverpool LEP	Warwick farm Racecourse Group	66	2.3 km
Schedule 5 of the Bankstown LEP	Bankstown Aerodrome	118	1.4 km
Schedule 5 of the	Milperra Soldier Settlement (former)	129	1.5 km

Table 3.3 Historical register search for items within the vicinity

Register	Register listing	Item number	Distance from project area
Bankstown LEP			
Register of the National Estate (RNE)	Defence national storage and distribution centre	103862	4.5 km



Source: EMM (2017); DFSI (2017); AHIMS (2017)

KEY

- AHIMS sites
- Project buffer (10km)
- Project area

AHIMS sites

Georges Cove
 Aboriginal and historic due diligence report

Figure 3.1





EGROW 03 Planning proposal request to rezone land from RE2 (Private Recreation) to R3 (Medium Density
Residential) at 146 Newbridge Road, Moorebank
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4 Results

4.1 Survey results

Desktop research predicted a low probability of sites due to both the highly disturbed nature of the project areas and that the project areas were historically subject to regular flooding. The prediction of low potential is supported by the results of the field survey.

A pedestrian survey was carried out on the 10 November 2017 in good weather (Figure 4.1). A large portion of the project area was covered in water. The site has been highly disturbed, and a large amount of previous work has been carried out, including the transference of fill and deep excavation. Ground visibility was approximately 15% and the exposure approximately 5-10%. The project area held no mature trees, and a relatively small amount of native vegetation (approximately 5%).

Although the area is known for producing suitable material for knapping and stone tools (Attenbrow 2010), there was a lack of evidence of such material in both project areas. Table 4.1 demonstrates how the project areas relate to known landscape indicators for Aboriginal sites. Although the project areas are close to a substantial river with a presence of alluvial sand, the level of disturbance is too great for sites to have survived.

Table 4.1 Landscape indicators for Aboriginal sites

Does the project area lie within 200 m of waters?	Yes, the project area is within 200 m of the Georges River
Is the project area within a sand dune system?	Yes, the soil system of the Georges River is alluvial sand
Is the project area located on a ridge top, ridge line or headland?	No
Is the project area located within 200 m below or above a cliff face?	No
Is the project area located within 20 m of a cave, or in a rock shelter or at a cave mouth and is on land that is not disturbed land?	No

The level of disturbance to the site also precludes the preservation of relics, if they ever existed.

4.2 Aboriginal sites

There are no registered or newly identified sites in the two project areas.

4.3 Historical sites

There are no listed heritage items or potential heritage items or relics in the two project areas.

4.4 Summary

There are no anticipated impacts to Aboriginal objects in the project area as it is highly unlikely that if Aboriginal objects existed in this location, they have not survived the extensive earthworks.

There are also no anticipated impacts to known or potential historical heritage items in the area.



5 Conclusion and recommendations

5.1 Conclusion

Background research and field inspection did not find evidence of either Aboriginal sites or historical sites in the two project areas. Further, the project areas have undergone a high level of disturbance through extensive excavation activities that would have removed Aboriginal sites.

The two project areas at the subject site assessed in this report have no Aboriginal cultural heritage constraints and no historical heritage constraints.

5.2 Recommendations

The following recommendations have been prepared to respond to the site conditions and current legislation and guidelines protecting Aboriginal and historical heritage. The recommendations below are informed by the background research and fieldwork undertaken for the project.

They are:

- works may proceed with caution;
- in the unlikely event that sites are discovered work should immediately cease and archaeological advice sought;
- In the event that known or suspected human skeletal remains are encountered during the activity, the following procedure will be followed:
 - all work in the immediate vicinity will cease and the find will be immediately reported to the work supervisor who will immediately advise the Environment Manager or other nominated senior staff member;
 - the Environment Manager or other nominated senior staff member will promptly notify the police and the state coroner (as required for all human remains discoveries);
 - the Environment Manager or other nominated senior staff member will contact OEH for advice on identification of the skeletal material;
 - if it is determined that the skeletal material is Aboriginal ancestral remains, the Local Aboriginal Land Council will be contacted and consultative arrangements will be made to discuss ongoing care of the remains; and
 - if it is determined that the skeletal material is not Aboriginal ancestral remains, further investigation will be conducted to determine if the remains represent a historical grave or if further involvement of the police is required.
- should the project areas be expanded, additional archaeological due diligence should be undertaken.

EGROW 03 Planning proposal request to rezone land from RE2 (Private Recreation) to R3 (Medium Density
Residential) at 146 Newbridge Road, Moorebank
Attachment 1 Planning Proposal Request

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**LIVERPOOL CITY COUNCIL
 LOCAL PLANNING PANEL REPORT**

29 June 2020

Application Number:	RZ-1/2019
Proposal:	Planning proposal request to facilitate a boundary adjustment by rezoning 4190sqm of land from RE2 (Private Recreation) to R3 (Medium Density Residential)
Property Address	146 Newbridge Road, Moorebank (Site C)
Legal Description:	Lot 7 DP1065574
Applicant:	Mirvac Homes (NSW) Pty Ltd
Land Owner:	Tanlane Pty Ltd
Recommendation:	Proceed to Gateway determination
Assessing Officer:	Kweku Aikins, Strategic Planner

1. EXECUTIVE SUMMARY

Council has received a request to prepare a planning proposal on behalf of Tanlane Pty Ltd for a portion of land within 146 Newbridge Road, Moorebank (Lot 7 DP 1065574).

The planning proposal seeks to amend the Liverpool Local Environmental Plan (LLEP) 2008 to rezone a part of the site from RE2 Private Recreation to R3 Medium Density Residential. The planning proposal seeks to amend the floor space ratio (FSR) development standard from 0.25:1 to 0.65:1 and the height of building (HOB) development standard from 21 metres to 8.5 metres. The planning proposal also seeks an amendment to the minimum subdivision lot size from 10,000sqm to 300sqm. The planning proposal would facilitate the development of approximately 9 dwellings up to 2-storeys in height.

Determination of strategic merit and site-specific merit has been assessed in accordance with *A guide to preparing planning proposals*, as updated and published by the NSW Department of Planning, Industry and Environment in 2018. The proposal has been submitted pursuant to Section 3.33 of the Environmental Planning and Assessment (EP&A) Act 1979 and the proposal is referred to the Liverpool Local Planning Panel for advice in accordance with Section 2.19 of the EP&A Act 1979.

On the basis that the planning proposal demonstrates strategic and site-specific merit, this report recommends that the planning proposal proceeds to a Gateway determination.

2. SITE DESCRIPTION AND LOCALITY

The land affected by this proposal, as outlined in the following maps, is located at 146 Newbridge Road, Moorebank and contained within Lot 7 in DP 1065574. The subject property is under the single ownership of Tanlane Pty Ltd. It is the site of a former sand mining operation by Benedict Sands, which is nearing the end of its life cycle.

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Figure 1: Aerial image of subject site (yellow) and locality

The site is adjacent to the Georges River in the east, Newbridge Road to the north and the Georges Fair residential estate to the west. Land to the east of the Georges River is located within the Bankstown Local Government Area and is characterised as recreational open space.

3. DETAILS OF THE PROPOSAL

Background

On 31 August 2016, Council resolved to support a planning proposal to amend the Liverpool Local Environmental Plan (LLEP) 2008 for land located at 146 Newbridge Road, Moorebank (Lot 7 DP 1065574). The proposal sought to enable residential uses within the RE2 Private Recreation zone (limited to a key site area) and included a zone boundary adjustment in which 4190sqm of land would be rezoned from RE2 Private Recreation to R3 Medium Density Residential.

Gateway determination was issued for the planning proposal on 9 March 2017, however Moorebank Recyclers, the previous owners of Lot 6 DP 1065574 (which is directly south of the subject site) appealed the Gateway decision in the Land and Environment Court. The legal challenge was made on the basis that the planning proposal did not adequately address Clause 6 of State Environmental Planning Policy No 55 – Remediation of Land (SEPP 55).

On 21 December 2017, the Class 4 appeal *Moorebank Recyclers Pty Ltd v Tanlane Pty Ltd* (No 2) [2017] NSWLEC 186 was dismissed. The court decision was made on the basis that there was insufficient evidence to indicate that the contamination assessment was invalid. Moorebank Recyclers subsequently lodged an appeal against this decision in the NSW Supreme Court and the Gateway determination was declared invalid by the Court of Appeal on 18 December 2018.

Given the outcome of previous legal proceedings, the proponent has since lodged a request to prepare a planning proposal which seeks to simply rezone the 4190sqm portion of land from RE2 Private Recreation to R3 Medium Density. The additional permitted (residential) uses within the

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RE2 zone will now be addressed as part of a separate planning proposal which has also been lodged with Council and is currently under assessment.

The subject proposal is one of several planning proposals lodged within the boundaries that Council defines as the Moorebank East precinct. Other proposals include the former Flower Power site to the northeast at 124 Newbridge Road (Site B), the Benedict B6 site to the north along Newbridge Road (Site A) and the Georges Cove Marina (Site D) to the immediate south. Further to the south is another planned mixed-use development known as EQ Riverside (Site E).

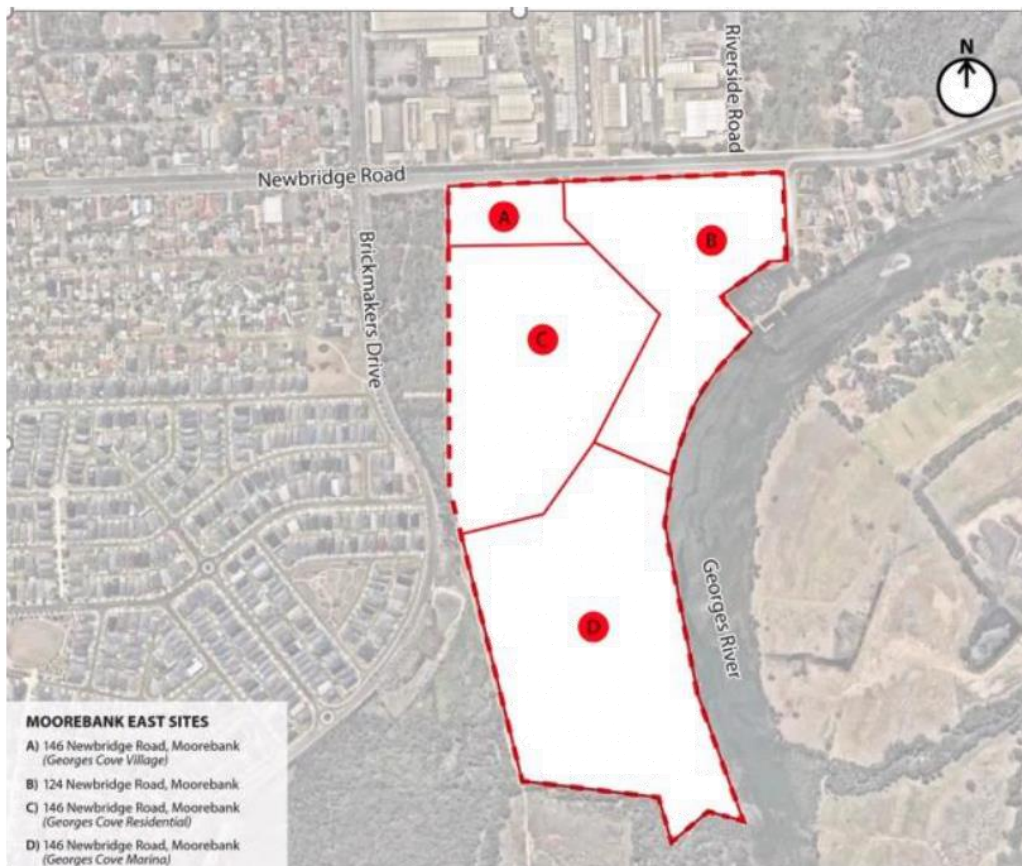


Figure 2: Moorebank East precinct, sites A-D (Tract Consultants)

Liverpool City Council has sought independent urban design and environmental advice to understand and resolve several key planning concerns to determine if the scale of development is appropriate for the precinct.

In 2018, Council engaged Tract Consultants to provide strategic and urban design advice and assist with the integration and coordination of each of the proposals at a precinct level. Tract Consultants proposed a draft structure plan for consideration which sought to balance the development interfaces between each of the sites. It was agreed that the subject site would be suitable for low density housing and would form part of Site C (subject to rezoning).

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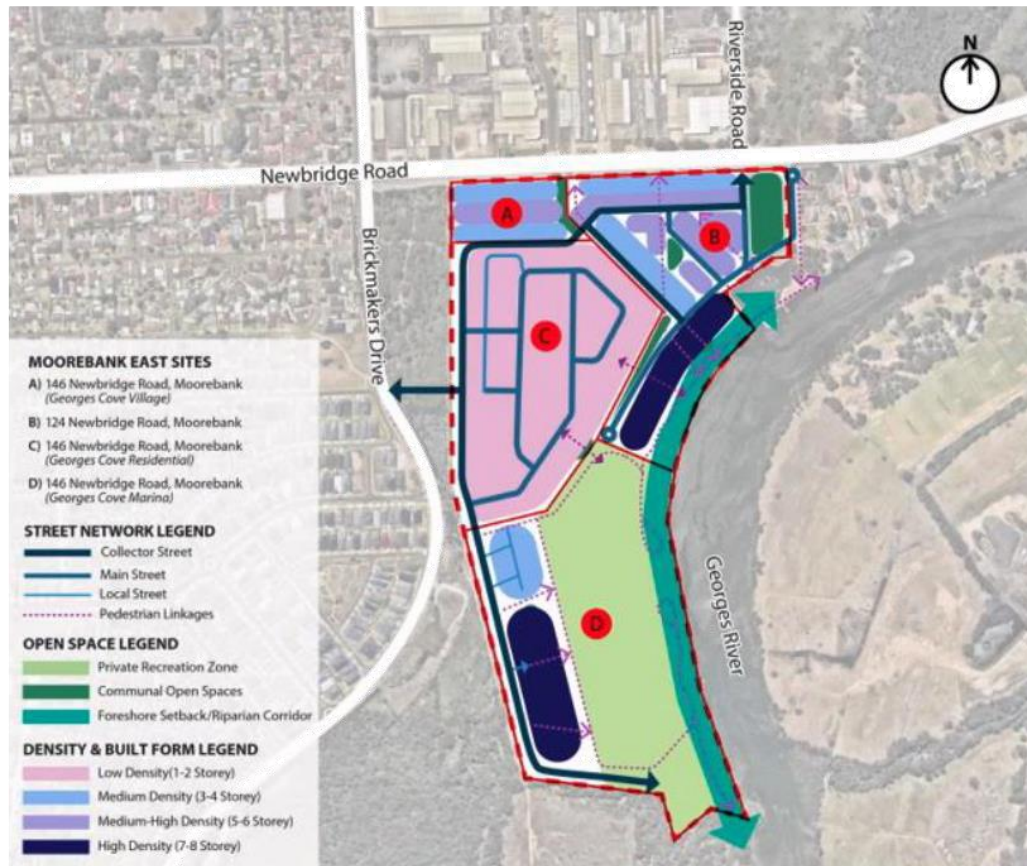


Figure 3: Moorebank East precinct Structure Plan (Tract Consultants)

Apart from the abovementioned proposals, a staged development application (DA) was lodged to subdivide 146 Newbridge Road (Lot 7 DP 1065574) into residue lots to create Sites A, C and D. A deferred commencement was issued for the DA on 26 February 2020, subject to the endorsement of detailed plans for a pedestrian evacuation bridge from 'Site C' and embellishment of Paine Park.

The Proposal

This planning proposal seeks to amend the LLEP to facilitate medium density residential development. It is envisaged that the development could support approximately 9 dwellings in addition to the 170 dwellings already being proposed directly to the north in the existing R3 zone.

The proposal is to be achieved through the following amendments to the LLEP:

- An amendment to the Land Zoning Map to rezone the site from RE2 Private Recreation to R3 Medium Density Residential (Shown in Figure 3);
- An amendment to the FSR Map from 0.2:1 to 0.65:1;
- An amendment to the HOB Map from 21 Metres to 8.5 Metres; and
- An amendment to the Lot Size Map from 10 000sqm to 300sqm.

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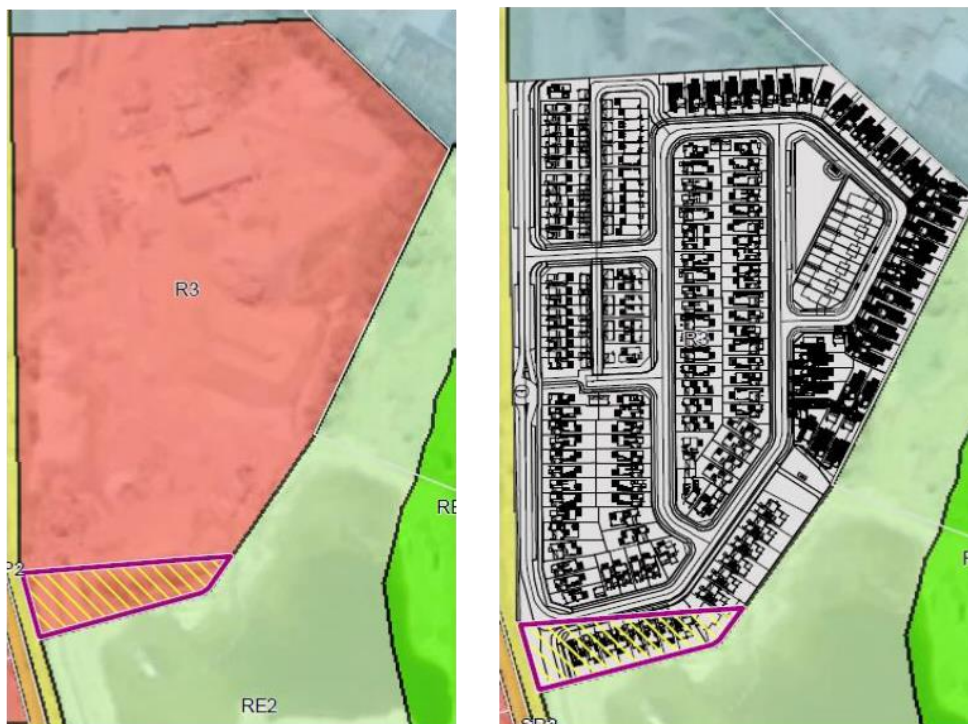


Figure 4: Proposed land zoning map and subdivision plan (site shown in yellow hatching)

4. CONSIDERATIONS FOR STRATEGIC MERIT

Section A – Need for the planning proposal

1. *Is the planning proposal a result of an endorsed strategic planning statement, strategic study or report?*

The planning proposal is not the result of any strategic study; however the Liverpool Local Strategic Planning Statement identifies the Moorebank East precinct as an urban development investigation area on the Structure Plan map (page 20).

2. *Is the planning proposal the best means of achieving the objectives or intended outcomes, or is there a better way?*

The proposed range of uses and modifications to development standards would require amendment to LLEP 2008. The planning proposal would be required to achieve these objectives.

Section B – Relationship to strategic planning framework

3. *Will the planning proposal give effect to the objectives and actions of the applicable regional, or district plan or strategy (including any exhibited draft plans or strategies)?*

Greater Sydney Regional Plan - A Metropolis of Three Cities

The *Greater Sydney Regional Plan - A Metropolis of Three Cities* (Regional Plan) was released

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in March 2018 and is the first Regional Plan prepared by the Greater Sydney Commission (GSC). The plan encompasses a global metropolis of three cities – the Western Parkland City, the Central River City and the Eastern Harbour City. Liverpool is located within the Western Parkland City and is identified as a metropolitan cluster and health and education precinct.

Table 1 Consistency with the Regional Plan

Objective	Comment
Housing the city	
<i>Objective 10 – Greater housing supply</i>	The planning proposal would lead to the provision of additional housing supply and choice within Liverpool

Western City District Plan

Section 3.8 of the EP&A Act requires that the planning proposal authority gives effect to any district strategic plan applying to the LGA to which the planning proposal relates. The Western City District Plan provides a series of priorities and actions to guide development and accommodate growth across the district.

Table 2 Consistency with the Western District Plan

Planning Priority	Comment
Housing the city	
<i>Planning Priority W5 - Providing housing supply, choice and affordability, with access to jobs, services and public transport</i>	Building on Objective 10 in the Regional Plan, the District Plan reaffirms the importance of providing a diversity of housing across the housing continuum. Accordingly, the planning proposal would provide additional housing supply and housing choice in an area identified by the LSPS as an urban development investigation area.

4. Will the planning proposal give effect to council's endorsed local strategic planning statement, or another endorsed local strategy or strategic plan?

Connected Liverpool 2040 - Local Strategic Planning Statement (LSPS)

The Local Strategic Planning Statement (LSPS) outlines Liverpool City Council's strategic planning vision for the next 20 years. It identifies the Moorebank East precinct as an urban development investigation area on the Structure Plan map (page 20). It is underpinned by four planning priorities including connectivity, productivity, liveability, and sustainability. The LSPS will inform what type of growth occurs in the local government area (LGA). It sets out actions to deliver on the four planning priorities in order to meet the community's future vision for Liverpool.

Table 3 Consistency with the LSPS

Planning Priority	Comment
Liveability	
<i>Local Planning Priority 7 - Housing choice for different needs, with density focused in the City Centre and centres well serviced by public transport</i>	The planning proposal would support additional housing choice. The planning proposal would deliver approximately 9 detached dwellings in a low density setting which would assist in meeting Liverpool City Council's five-year housing supply target.

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5. *Is the planning proposal consistent with the applicable State Environmental Planning Policies?*

The following State Environmental Planning Policies (SEPPs) are of relevance to the site.

Table 4 Consistency with the applicable SEPPs

SEPP	Consistency
SEPP No 55 – Remediation of Land	Land contamination issues for the planning proposal are addressed under the Ministerial Directions. Any future DA would be required to comply with the provisions of the SEPP
SEPP (Affordable Rental Housing) 2009	The planning proposal will not affect the application of the SEPP.
SEPP (Vegetation in Non-Rural Areas) 2017	The planning proposal will not affect the application of the SEPP.
Greater Metropolitan Regional Environmental Plan No 2—Georges River Catchment	The planning proposal will not affect the application of the SEPP.

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6. Is the planning proposal consistent with applicable Ministerial Directions (s.9.1 directions)

The Planning Proposal addresses the following Directions, pursuant to Section 9.1 of the EP&A Act 1979:

Table 5 Consistency with the relevant Ministerial Directions

Section	Comment	Compliance
2. Environment and Heritage		
<i>Direction 2.6 - Remediation of Contaminated Land</i>	<p>The objective of this direction is to reduce the risk of harm to human health and the environment by ensuring that contamination and remediation are considered by planning proposal authorities.</p> <p>The site is within Lot 7 DP 1065574 which has been identified as being contaminated by previous extractive uses that occurred on the site. The proponent has submitted a Preliminary Site Investigation (PSI). However, a deferred commencement has been issued for the subdivision of the broader site, for which a Site Audit, a draft long-term environmental management plan (LTEMP) and a revised RAP, were submitted.</p> <p>On 8 May 2020 the proponent confirmed that the documentation submitted for the DA would also be applicable to the subject planning proposal. Notwithstanding the above, any future DA for dwelling construction or subdivision would also need to comply with SEPP 55. Therefore, it is considered that this direction has been satisfied.</p>	Yes
3. Housing, Infrastructure and Urban Development		
<i>Direction 3.1 – Residential Zones</i>	<p>The objectives of this direction are:</p> <p><i>(a) to encourage a variety and choice of housing types to provide for existing and future housing needs,</i></p> <p><i>(b) to make efficient use of existing infrastructure and services and ensure that new housing has appropriate access to infrastructure and services, and</i></p> <p><i>(c) to minimise the impact of residential development on the environment and resource lands.</i></p> <p>The planning proposal facilitates the redevelopment of the site and aims to deliver new and additional housing and diversify the local housing type within Moorebank. The site is within an existing urban area with a variety of infrastructure already established within the broader area including a public primary school; a public high school; a medical centre; a shopping centre; a library; a community room and two open space areas. As the planning proposal applies to land in an urban area, it does not consume land at the urban fringe.</p>	Yes
<i>Direction 3.2 - Caravan Parks</i>	<p>The objectives of this direction are:</p> <p><i>(a) to provide for a variety of housing types, and</i></p>	Partial

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Section	Comment	Compliance
<i>and Manufactured Home Estates</i>	<p><i>(b) to provide opportunities for caravan parks and manufactured home estates.</i></p> <p>Although the proposed R3 zone will support a variety of housing types, caravan parks and manufactured home estates (MHE) will no longer be permitted under the new zoning. However, given that the site is part of a broader urban renewal precinct any caravan park or MHE would be unsuitable for the subject site as it would be relatively isolated, and out of character with surrounding development.</p>	
<i>Direction 3.3 - Home Occupations</i>	<p>The objective of this direction is to encourage the carrying out of low-impact small businesses in dwelling houses.</p> <p>The proposal will facilitate home occupations as this land use is permitted in the R3 zone without consent.</p>	Yes
<i>Direction 3.4 Integrating Land Use and Transport</i>	<p>The objective of this direction is to ensure that urban structures, building forms, land use locations, development designs, subdivision and street layouts achieve the following planning objectives:</p> <p><i>(a) improving access to housing, jobs and services by walking, cycling and public transport, and</i> <i>(b) increasing the choice of available transport and reducing dependence on cars, and</i> <i>(c) reducing travel demand including the number of trips generated by development and the distances travelled, especially by car, and</i> <i>(d) supporting the efficient and viable operation of public transport services, and</i> <i>(e) providing for the efficient movement of freight.</i></p> <p>The inherent traffic impacts would be negligible as the proposal would facilitate 9 additional dwellings only. A detailed traffic investigation will accompany any development application relating to the residential subdivision of the site.</p>	Yes
<i>Direction 3.5 - Development Near Regulated Airports and Defence Airfields</i>	<p>The objectives of this direction are:</p> <p><i>(a) to ensure the effective and safe operation of regulated airports and defence airfields;</i> <i>(b) to ensure that their operation is not compromised by development that constitutes an obstruction, hazard or potential hazard to aircraft flying in the vicinity; and</i> <i>(c) to ensure development, if situated on noise sensitive land, incorporates appropriate mitigation measures so that the development is not adversely affected by aircraft noise.</i></p> <p>The proposal will not affect the operation of any regulated airports. The proposed decrease in height sought under this Planning Proposal ensures that any development will be below the Obstacle Limitation Surface (OLS) applying to the site. The subject portion of the site is located approximately</p>	Yes

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Section	Comment	Compliance
	1.5km west of Bankstown Aerodrome and is not burdened by any ANEF restrictions.	
4. Hazard and Risk		
<i>Direction 4.1 – Acid Sulfate Soils</i>	<p>The objective of this direction is to avoid significant adverse environmental impacts from the use of land that has a probability of containing acid sulfate soils.</p> <p>The planning proposal applies to land identified as Classes 2 and 4 on Council's Acid Sulfate Soils Planning Map. Existing acid sulfate soils provisions will not be altered by the planning proposal and will apply to any future development which might intensify the use of the land.</p>	Yes
<i>Direction 4.3 – Flood Prone Land</i>	<p>The proposed development is located on the floodplain of the Georges River. The only access road to the development is via the proposed bridge from Brickmakers Drive. For flood events greater than the 1% AEP, Brickmakers Drive will be inundated by floodwaters and access will not be available. Therefore, complete evacuation of the residents is necessary before the access road becomes inaccessible.</p> <p>The R3 zone will consist of 179 two storey residences (including the proposed 9 additional dwellings) all with a minimum floor and road level greater than RL 6.1m AHD (being the 100yr ARI flood level plus 500mm freeboard) which is the Flood Planning Level. The finished road and floor levels will continually rise from RL 6.1m AHD on the south eastern edge of the development to the west reaching levels around RL 10m AHD at the proposed link road bridge which provides car access to Brickmakers Drive.</p> <p>A deferred commencement has been issued for subdivision of the broader site. Although the subdivision DA has yet to be determined, provisional conditions of consent have been included to ensure that any residential development in the R3 zone will be provided with an acceptable Flood Emergency Response Plan and an elevated pedestrian evacuation bridge.</p>	Yes
<i>Direction 4.4 – Planning for Bushfire Protection</i>	The planning proposal applies to land identified as being affected by the Vegetation Buffer zone on Council's Bushfire Map. This is the lowest risk category. Existing bushfire management provisions will not be altered by the planning proposal, and future development will be capable of complying with the Rural Fires Act 1997 and the NSW Rural Fire Service 'Planning for Bushfire Protection' guidelines 2019, subject to concurrence from the NSW Rural Fire Service.	Yes
6. Local Plan Making		
<i>Direction 6.1 – Approval and referral requirements</i>	The planning proposal does not include provisions that require development applications to be referred externally and is not related to designated development.	Yes

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Section	Comment	Compliance
<i>Direction 6.3 – Site specific provisions</i>	The planning proposal does include provisions to allow a Site-specific development to be carried out on the site.	Yes

5. CONSIDERATIONS FOR SITE SPECIFIC MERIT

Section C – Environmental, social and economic impact

7. *Is there any likelihood that critical habitat or threatened species, populations or ecological communities, or their habitats, will be adversely affected as a result of the proposal?*

The site is disturbed, and it is highly unlikely that the site would contain any critical habitat for threatened species, populations or ecological communities, or their habitats. It is not expected that any threatened species, populations or ecological communities will be adversely affected as a result of the proposal.

8. *Are there any other likely environmental effects as a result of the planning proposal and how are they proposed to be managed?*

Flooding

The site is located on the floodplain of Georges River and is wholly affected by flooding under the 1% Annual Exceedance Probability (AEP) event. The planning proposal is accompanied by a Flood Impact Assessment (FIA) by Cardno which confirms the proposal seeks to fill the majority of the site to the 1% AEP level. The FIA confirms that the impact of the proposed filling is not significant and provides alternative mitigation options to mitigate against any adverse impacts of flooding. The applicant has considered filling part of the site and providing compensatory excavation onsite.

Additionally, a deferred commencement has been issued for the staged subdivision of the broader site. Although the subdivision DA has yet to be determined, provisional conditions of consent have been included to ensure that any residential development in the R3 zone will be provided with an acceptable Flood Emergency Response Plan and an elevated pedestrian evacuation bridge.

Contamination

The site is within Lot 7 DP 1065574 and has been identified as being contaminated by the previous extractive uses that occurred on the site. The proponent has submitted a Preliminary Site Investigation (PSI). However, a deferred commencement has been issued for a staged subdivision of the broader site into residue lots, for which a Site Audit, a draft long-term environmental management plan (LTEMP) and a revised RAP, were submitted. As a result, Council's Environmental Health Unit has indicated that the submitted PSI has been superseded by the documents submitted with the subdivision DA. The proponent has since provided advice that the revised documentation will apply to the subject planning proposal and that any future DA will comply with SEPP 55 requirements.

Draft Precinct Wide Traffic Study

A draft precinct wide traffic study has been submitted to examine the cumulative traffic effects of Sites A-D within the proposed Moorebank East precinct. The assessment proposes a staged improvement works program (Stage 1 – Sites A, B, C and D / Stage 2 – Site E) to ensure that

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intersection performance remains at a satisfactory level of service. Given that the draft precinct wide traffic study and works program affects all sites, it should be finalised in consultation with Council and TfNSW at a later stage.

Bushfire

The site is affected by Category 1 Bushfire Prone Vegetation. A bushfire assessment report has been prepared by Blackash Fire Consulting and it finds that bushfire protection measures can be achieved to support the planning proposal and that further details can be addressed as part any future DA, subject to concurrence from the NSW Rural Fire Service during the post-gateway stage.

Acid Sulfate Soils

The planning proposal applies to land identified as Classes 2 and 4 on Council's Acid Sulfate Soils Planning Map. Clause 7.7 of the LLEP 2008 requires the submission of an acid sulfate soils management plan when works are below natural ground level, therefore it is possible that an acid sulfate soils management plan will be required as part of any DA.

Voluntary Planning Agreement

A Voluntary Planning Agreement (VPA) pursuant to Section 7.4 (formerly known as Section 93F) of the Environmental Planning and Assessment Act 1979 was agreed to between Liverpool City Council and Tanlane Pty Ltd, dated 11 June 2008.

The VPA applies to the subject site and contains a series of contributions/works which are summarised as follows:

- Embellishment of river foreshore land;
- Dedication of river foreshore land to Council subject to an easement for maritime vessel access as well as two easements for the drainage of water;
- Development of a Vegetation Management Plan;
- Completion of works described in the Vegetation Management Plan;
- Conduct maintenance works described in the Vegetation Management Plan;
- Construction of passive recreation facilities on the river foreshore land; Dedication of a drainage channel;
- Construction and dedication of a road bridge over drainage channel, embankment and road to Brickmakers Drive;
- Construction and dedication of pedestrian access to Newbridge Road and a pedestrian path within the public verge along the entire length of the land frontage to Newbridge Road;
- Dedication of an easement over land for access for the purpose of allowing Council to undertake maintenance to the river foreshore land.

Delivery of items in the VPA are largely dependent on the staging of development for the existing R3 zoned land, with the bridge to be completed (and dedicated) before the first subdivision certificate is issued. Accordingly, no VPA has been proposed as part of this planning proposal. However, a funding mechanism for infrastructure and traffic works (such as a precinct wide contribution plan) should be finalised at a later stage.

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9. *How has the planning proposal adequately addressed any social and economic effects?*

Social Impacts

The submitted Social Impact Assessment (SIA) indicates that additional public community facilities will not be required for the subject proposal. Accordingly, the proposal for 9 dwellings is unlikely to generate any adverse social impacts as it will be consistent with the proposed development in the immediate vicinity.

Economic Impacts

The proposal would facilitate a positive economic impact in the locality through the capital investment value of the future residential development, the creation of construction jobs, and the reinforcement of patronage to local retail businesses and services through an increase in residential population.

Section D – State and Commonwealth Interests

10. *Is there adequate public infrastructure for the planning proposal?*

Yes. There is a reasonable amount of public infrastructure to support the planning proposal, specifically in relation to social infrastructure, transport infrastructure and flooding infrastructure.

Social Infrastructure

The SIA by Cred Consulting identified a range services and social infrastructure within a kilometre of the site including a public primary school; a public high school; a medical centre; a shopping centre; a library; a community room; two open space areas (within 800m); and planned access to 2ha of foreshore open space. It also asserts that the existing VPA for 146 Newbridge Road will deliver 39,350sqm of waterfront public open space, including pedestrian and cycle ways that will enhance local access to recreational activities.

Transport Infrastructure

As discussed earlier, the draft precinct wide traffic study identifies traffic works and intersection improvements which would need to be supported by TfNSW and an appropriate funding mechanism at a later stage.

Flooding Infrastructure

As discussed earlier, Council has provided conditional support for a pedestrian bridge from 'Site C' which is expected to facilitate a 200m walk to areas above the PMF flood level. By providing this pedestrian evacuation route in the event of a flooding emergency, residents would have the option to be evacuated by either car or on foot (via the elevated pedestrian bridge) to areas above the PMF flood level.

11. *What are the views of state and Commonwealth public authorities consulted in accordance with the Gateway determination?*

The views of relevant State and Commonwealth public authorities will be obtained after the planning proposal has been considered by the Department of Planning, Industry and Environment's Gateway determination process.

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Next Steps

The usual process for planning proposal applications, following a review of the application, is for Council officers to finalise the proposal detailing the proposed changes to LLEP 2008. The planning proposal would then be reported to Council for endorsement and subsequently forwarded to the Department of Planning, Industry and Environment seeking a Gateway determination.

Should a Gateway determination be issued there would be public authority community consultation, a public exhibition period and a further report to Council prior to proceeding with the making of any amendment to LLEP 2008.

6. CONCLUSION

It is recommended that the planning proposal proceeds to a Gateway determination as the planning proposal satisfies the strategic and site-specific merit tests. A report should further be drafted detailing a decision to support the proposal for consideration by Liverpool City Council.

7. ATTACHMENTS

1. Planning Proposal
2. Preliminary Site Investigation
3. Biodiversity Assessment
4. Transport Planning Impact Assessment
5. Flood Impact Assessment
6. Bushfire Assessment Report
7. Acoustic Study
8. Heritage Report
9. Social Impact Assessment
10. Moorebank East Flood Evacuation Analysis Report
11. Flood Evacuation Response (Sites A, C, D)
12. Moorebank East Staged Traffic Assessment



**ADVICE ON PLANNING PROPOSALS
LIVERPOOL LOCAL PLANNING PANEL**

Monday 29th June 2020

Held Via Microsoft Teams

Panel: Michael Mantei (Chair)
 Marjorie Ferguson Expert
 Matthew Taylor Expert
 Daryl Hawker Community Rep

There were no conflicts of interest declared by any panel members in relation to any items on the agenda.

LIVERPOOL CITY COUNCIL

ADVICE OF LIVERPOOL LOCAL PLANNING PANEL

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29th June 2020

ITEM No:	2
APPLICATION NUMBER:	RZ-1/2019
SUBJECT:	Planning proposal request to facilitate a boundary adjustment by rezoning 4190sqm of land from RE2 (Private Recreation) to R3 (Medium Density Residential)
LOCATION:	146 Newbridge Road, Moorebank (Site C)
OWNER:	Tanlane Pty Ltd
APPLICANT:	Mirvac Homes (NSW) Pty Ltd
AUTHOR:	Kweku Aikins, Strategic Planner

ADVICE OF THE PANEL

The Panel members have familiarised themselves with the site and been provided with the Council officer's report and the documents supporting the planning proposal.

The Panel considers that the planning proposal is an appropriate rationalisation of the RE2 and R3 zone boundary given the subdivision layout recently approved by Council.

The Panel recommends that the Council officers' report to Council that progresses the planning proposal specifically addresses the requirements listed in clauses 4(a), (b), (c) and clause 5 of section 9.1 direction 2.6 (remediation of contaminated land).

The Panel otherwise considers that the planning proposal exhibits strategic and site specific merit for the reasons outlined in the Council officer's report. The Panel recommends that Council resolve to progress the planning proposal to a gateway determination.

VOTING NUMBERS:

4-Nil

EGROW 08	Proposed planning proposal - amendment to dwelling density map in the Liverpool Local Environmental Plan 2008 for certain lands in Pleasure Point
Strategic Direction	Strengthening and Protecting our Environment Exercise planning controls to create high-quality, inclusive urban environments
File Ref	302127.2019
Report By	Luke Oste - Strategic Planner
Approved By	Tim Moore - Director, City Economy and Growth / Deputy CEO

EXECUTIVE SUMMARY

This report seeks Council's support for the preparation of a planning proposal to amend the dwelling density map in the Liverpool Local Environmental Plan (LLEP) 2008 to increase the permitted number of lots on sites along Pleasure Point Road in Pleasure Point from four lots to five lots.

The LEP lot restriction in Pleasure Point was imposed primarily due to water and sewerage servicing constraints when the LEP was prepared in 2008. As Sydney Water has improved services in Pleasure Point, there is a need to review the LEP.

Council has approved a previous development application in Pleasure Point that exceeded the four-lot yield restriction through the use of Clause 4.6 of the LEP. That Clause allows development standards in the LEP to be varied if Council is satisfied that compliance with the development standard is unreasonable or unnecessary and that there are sufficient environmental planning grounds to justify the variation. Appropriate services were able to be provided to new lots in the area, and as a result, the application was approved.

In 2016, DA-724/2016 was assessed by Council with a recommendation for approval. The DA was considered by the Liverpool Local Planning Panel (LPP) who refused the application on the basis that Clause 7.12 of the LEP is not a development standard and cannot be varied under Clause 4.6 of the LEP. This opinion from the LPP differed from how Council previously interpreted the LEP. The applicant then commenced Class 1 proceedings in the Land and Environment Court to allow the development to proceed. On 15 November 2018, the Court upheld the LPP's decision and refused the application.

The applicant appealed the Land and Environment Courts decision, and through conciliation, it was agreed between the parties that Council could pursue a planning proposal to amend the dwelling density map to increase the maximum number of lots permissible in this area.

It is therefore recommended that Council supports the preparation of the planning proposal and notes that there will be a further report back to Council once the planning proposal has been drafted for Council's further consideration.

RECOMMENDATION

That Council:

1. Directs the CEO to prepare a planning proposal to amend the dwelling density map in the Liverpool Local Environmental Plan (LLEP) 2008 that increases the permitted number of lots on certain sites along Pleasure Point Road, Pleasure Point from four lots to five lots; and
2. Notes that, once drafted, the planning proposal will be reported to the Liverpool Local Planning Panel for advice and to a future Council meeting for a decision on whether to seek a Gateway determination from the Department of Planning, Industry and Environment.

REPORT

Background

Clause 7.12 of the LEP limits the development of certain lands identified as "Restricted Lot Yield" on the Dwelling Density Map. For Pleasure Point, the LEP limits the subdivision of four large sites to no more than four lots each.

Council has approved a previous development application in Pleasure Point that exceeded the four-lot yield restriction through the use of Clause 4.6 of the LEP. That Clause allows development standards in the LEP to be varied if Council is satisfied that compliance with the development standard is unreasonable or unnecessary and that there are sufficient environmental planning grounds to justify the variation. Appropriate services were able to be provided to new lots in the area, and as a result, the applications were approved.

In 2016, DA-724/2016 was assessed by Council with a recommendation for approval. The DA was considered by the Liverpool Local Planning Panel (LPP) who refused the application on the basis that Clause 7.12 of the LEP is not a development standard and cannot be varied under Clause 4.6 of the LEP. This opinion from the LPP differed from how Council previously interpreted the LEP. The applicant then commenced Class 1 proceedings in the Land and Environment Court to allow the development to proceed. On 15 November 2018, the Court upheld the LPP's decision and refused the application.

An appeal against the decision of the Commissioner of the Land and Environment Court was lodged by the applicant. Through those proceedings, a compromise was reached between the parties (Liverpool City Council and the applicant). It was agreed between the parties that Council could pursue a planning proposal to amend the dwelling density map to increase the maximum number of lots permissible in this area.

The Sites

The planning proposal would apply to the following land:

Address	Legal Description
46 Pleasure Point Road	Lot 86 within DP 1134481
48 Pleasure Point Road	Lot 85 within DP 1134481
50 Pleasure Point Road	Lot 84 within DP 1134481
52 Pleasure Point Road	Lot 83 within DP 1134481
Lot 5 Pleasure Point Road	Lot 5 within DP 239468
62 Pleasure Point Road	Lot 77 within DP 1134478
64a Pleasure Point Road	Lot 761 within DP 1217961
64b Pleasure Point Road	Lot 762 within DP 1217961
66 Pleasure Point Road	Lot 78 within DP 1134478
68 Pleasure Point Road	Lot 75 within DP 1134478
70 Pleasure Point Road	Lot 71 within DP 1134477
72 Pleasure Point Road	Lot 72 within DP 1134477
74 Pleasure Point Road	Lot 73 within DP 1134477
76 Pleasure Point Road	Lot 74 within DP 1134477

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**ORDINARY MEETING 11 DECEMBER 2019
CITY ECONOMY AND GROWTH REPORT**



Figure 1 – Location of subject site outlined in red (Nearmap 2019)



Figure 2 – Dwelling Density Map (LLEP 2008)

The land subject to the planning proposal is zoned R5 (Large Lot Residential) along the western side and E2 (Environmental Conservation) along the eastern side (see Figure 3). All land located 60m or further from Pleasure Point Road is identified as Environmentally Significant Land under the LLEP 2008. A riparian corridor is located through the centre of the land, running down the slope northwards to the Georges River. An informal unsealed fire trail is located along the rear of the individual lots that is recognised and protected under the Liverpool Development Control Plan 2008 (LDCP 2008).

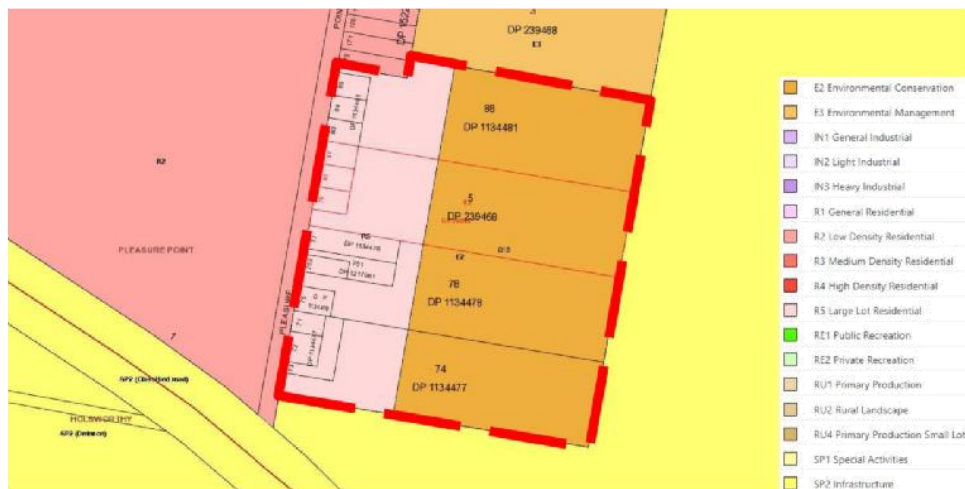


Figure 3 – Zoning Map of the Subject Site (LCC Geocortex)

Residential development is limited to the western edge fronting or connecting to Pleasure Point Road. The majority of development is in the form of single dwelling houses, with some utilising battle-axe lot configurations. A recently constructed dual occupancy is located in the south-western corner of the subject site.



Figure 4 – Looking south-east toward Lot 5 Pleasure Point Road (LCC)



Figure 5 – Looking north-east at the dual occupancy development and down Pleasure Point Road

Site History

Amendment 84 Liverpool Local Environmental Plan 1997

In February 2002, Impala Homes expressed interest in developing Lots 4, 5, 6 and 7 Pleasure Point Road, Pleasure Point for residential purposes. Due to the significance of the vegetation present and public interest, this matter was subject to a public meeting and subsequent representations from key community representatives. As a result of these meetings the proposed development was scaled down to 16 residential lots fronting Pleasure Point Road. This lot yield restriction was included, in part, in response to community consultation:

The community at the time stated that:

- *Limited development would be supported;*
- *There was support for the development principles proposed by the developer;*
- *Protection of defined environmental corridors with no development in these areas;*
- *No development should occur at the rear of the subject lots;*
- *There should be no medium density development;*
- *There should be no zero lot line development;*
- *There should be no significant traffic impacts on Pleasure Point Road; and*
- *There is some scepticism as to Council's ability to enforce proposed environmental controls.*



Figure 6 – Aerial Image of the Subject Site in May 2002 (Geocortex LCC)

The "Restricted Lot Yield" was imposed on the land on 1 April 2005 with the gazettal of Amendment 84 to the Liverpool LEP 1997. When the LLEP 2008 was prepared, this control was included.

DA-180/2015

This DA was lodged on 10 March 2015 and sought consent for the subdivision of the existing lot into two lots. This one additional lot proposed, combined with the four existing lots resulted in five lots in total, rather than the maximum of four permitted by the LEP.

A written Clause 4.6 variation request was provided by the applicant justifying the contravention of Clause 7.12 of the LLEP 2008. Council was satisfied with the variation request and the DA was recommended for approval. As the DA proposed a variation of more than 10% to a deemed development standard in the LLEP 2008, the DA was required to be considered by the then Liverpool Independent Hearing and Assessment Panel (IHAP).

On 24 August 2015, the IHAP recommended approval of the application subject to the conditions contained within the Council officer's report. Subsequently, the DA was approved by the full Council on 30 September 2015.

DA-724/2016

This DA was lodged on 4 August 2016 and sought consent for a two lot Torrens title subdivision of Lot 74 in DP 1134478, known as 76 Pleasure Point Road. This subdivision resulted in five lots, rather than the maximum of four permitted by the LEP.

On 26 March 2018 the then Independent Hearing and Assessment Panel (IHAP) deferred determination of the DA pending the submission of additional information relating to:

- i. Whether Clause 7.12 is a prohibition or a development standard capable of being varied under Clause 4.6 of LLEP 2008;
- ii. A variation request from the applicant setting out justification for the variation to Clause 7.12 having regard to the tests in Clause 4.6 of LLEP 2008 and relevant Land and Environment Court decisions; and
- iii. Further information on the existing restriction on use affecting the land relating to the conservation management plan for the land within zone E2.

A supplementary report addressing the information required by the then IHAP was provided and considered by the new Liverpool Local Planning Panel (LPP) (formerly IHAP) on 7 May 2018. The LPP refused the DA, primarily on the grounds that Clause 7.12 is a prohibition and not a development standard capable of being varied under Clause 4.6 of LLEP 2008.

The applicant then commenced Class 1 proceedings in the Land and Environment Court to allow the development to proceed. On 15 November 2018, the Court upheld the LPP's decision and refused the application. An appeal against the decision of the Commissioner of the Land and Environment Court was lodged by the applicant. Through those proceedings, a compromise was reached between the parties (Liverpool City Council and the applicant). It

was agreed between the parties that Council could pursue a planning proposal to amend the dwelling density map to increase the maximum number of lots permissible in this area.

Planning Proposal Justification

This planning proposal is considered appropriate to allow the development as sought by DA-724/2016 with minimal environmental impacts.

Council has approved a previous development application in this area that created five lots. Council planners recommended approval for DA-724/2016 based on a merit assessment of the application, including the availability of services, and the previous IHAP recommendation and decision of Council. Amending the current lot yield restriction through a planning proposal will provide legal clarity to this past Council decision and for future DA's.

The planning proposed will retain the biodiversity and scenic significance of the eastern portions of the site, while allowing for appropriate development.

Consultation

If Council endorses the preparation of a planning proposal, consultation will be undertaken with key State agencies including Sydney Water and NSW Rural Fire Service.

If Council endorses the planning proposal at a future Council meeting, the Gateway determination issued by the Department of Planning, Industry and Environment will stipulate formal consultation requirements for public exhibition.

Conclusion

It is recommended that Council supports the preparation of a planning proposal and notes that there will be a further report back to Council once the planning proposal has been drafted for Council's further consideration.

CONSIDERATIONS

Economic	Facilitate economic development.
Environment	Protect, enhance and maintain areas of endangered ecological communities and high-quality bushland as part of an attractive mix of land uses.
Social	There are no social and cultural considerations.
Civic Leadership	Act as an environmental leader in the community.
Legislative	<i>Environmental Planning and Assessment Act 1979</i>


ATTACHMENTS

1. Development Activity Summary

Pleasure Point Development History

Since the gazettal of Amendment 54, each of the four original broad lots have undergone various forms of residential development. This is summarised and depicted in **Error! Reference source not found.** below:

Table 1 - Residential Development Summary Table

Site	Development
Site 1: <ul style="list-style-type: none"> Lot 71 within DP 1134477 Lot 72 within DP 1134477 Lot 73 within DP 1134477 Lot 74 within DP 1134477 	<p>8 June 2008 – Consent was granted for DA-1914/2005 to permit the subdivision of the original broad lot to create four residential lots. Since then, the following development has occurred:</p> <ul style="list-style-type: none"> DA-805/2011 – Single storey detached dwelling (no. 70, lot 71); DA-177/2011 – Single storey detached dwelling (no. 74, lot 73); DA-88/2017 – Dual occupancy development (no. 72, lot 72); and DA-438/2019 – Pre fabricated garden shed under assessment (no. 76, Lot 74).
	
<p>Figure 1 Site 1 (LCC Geocortex)</p>	
Site 2: <ul style="list-style-type: none"> Lot 75 within DP 1134478 Lot 77 within DP 1134478 	<p>8 June 2008 – Consent was granted for DA-1915/2005 to permit the subdivision of the original broad lot to create four residential lots. Since then, the following development has occurred:</p> <ul style="list-style-type: none"> DA-1309/2013 – Double-storey dwelling (no. 68, lot 75); DA-896/2014 – Two-storey detached dwelling and a detached secondary dwelling (no. 62, lot 77);

<ul style="list-style-type: none"> Lot 78 within DP 1134478 Lot 761 within DP 1217961 Lot 762 within DP 1217961 	<ul style="list-style-type: none"> DA-180/2015 – Two lot Torrens title subdivision (no. 64, lot 76) to create no. 64a (lot 761) and no. 64b (lot 762); DA-9/2016 – Two-storey residential dwelling and pool (no. 64A, lot 761); and DA-809/2016 – Two-storey residential dwelling (no. 64B, lot 762).
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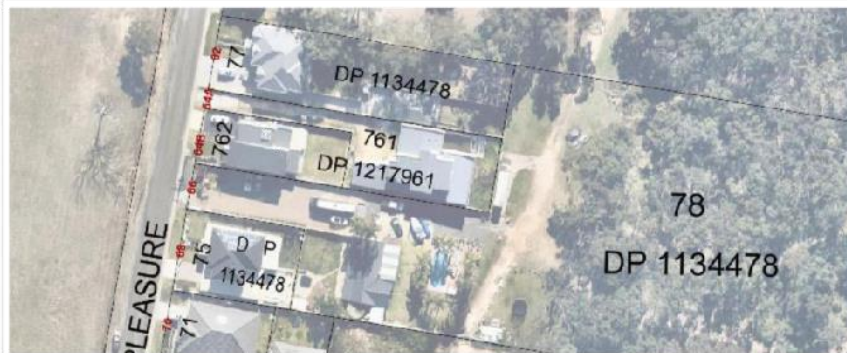


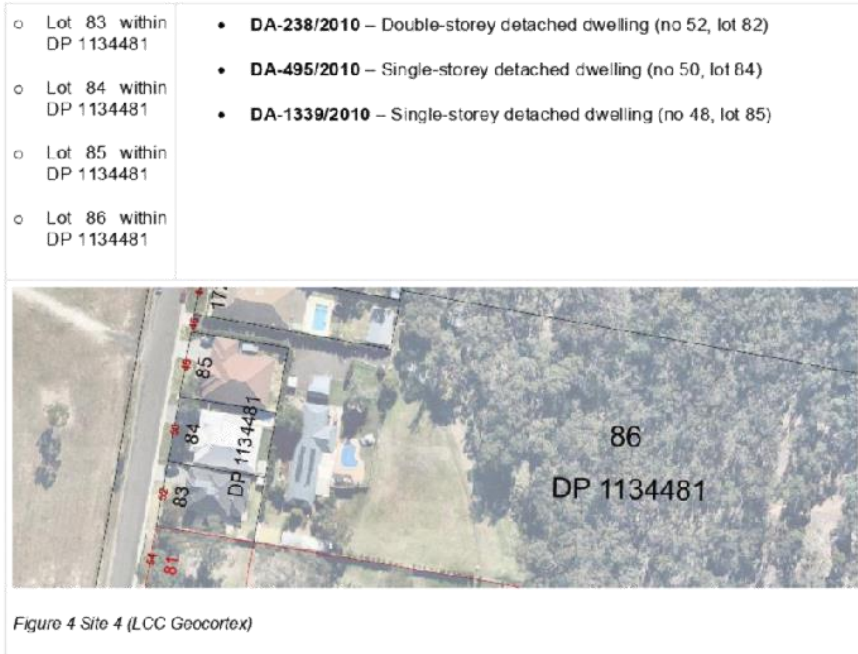
Figure 2 Site 2 (LCC Geocortex)

Site 3:	This lot has an approved development application (DA-1916/2005) and subdivision certificate (SC-63/2009) that has not yet been registered at NSW Land Registry Services. The image below shows the approved and yet to be registered subdivision lots in red.
<ul style="list-style-type: none"> Lot 5 within DP 239468 	



Figure 3 Site 3 (LCC Geocortex)

Site 4:	8 June 2008 – Consent was granted for DA-1917/2005 to permit the subdivision of the original broad lot to create four residential lots. Since then, the following development has occurred:
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Clr Hadchiti returned to the Chambers at 8:11pm.

Clr Balloot left the Chambers at 8:13pm.

ITEM NO: EGROW 08

FILE NO: 302127.2019

SUBJECT: Proposed planning proposal - amendment to dwelling density map in the Liverpool Local Environmental Plan 2008 for certain lands in Pleasure Point

RECOMMENDATION

That Council:

1. Directs the CEO to prepare a planning proposal to amend the dwelling density map in the Liverpool Local Environmental Plan (LLEP) 2008 that increases the permitted number of lots on certain sites along Pleasure Point Road, Pleasure Point from four lots to five lots; and
2. Notes that, once drafted, the planning proposal will be reported to the Liverpool Local Planning Panel for advice and to a future Council meeting for a decision on whether to seek a Gateway determination from the Department of Planning, Industry and Environment.

COUNCIL DECISION

Motion:

Moved: Clr Hadid

Seconded: Clr Harle

That the recommendation be adopted.

On being put to the meeting the motion was declared CARRIED.

Councillors voted unanimously for this motion.

Note: Clr Balloot was absent from the Council Chambers when this item was voted on.

Planning Proposal

Pleasure point Road - Amendment to Dwelling Density Map of the Liverpool Local Environmental Plan 2008

22 June 2020

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Introduction

This planning proposal applies to numerous lots along Pleasure Point Road in the southern region of Pleasure Point, referred to as the subject site throughout this report. Currently, there is a four lot yield restriction that applies to the four original larger lots that make up the subject site. This four lot yield restriction came as a result of community consultation associated with a previous proposal to amend the LEP aiming to permit a residential use and the subdivision of land. This planning proposal was Amendment 54 to the Liverpool Local Environmental Plan 1997 and was gazetted in 2005. The four original larger lots making up the subject site have been subdivided over the years and now exist in various forms.

At Council's ordinary meeting on 11 December 2019, it was resolved that Council:

1. *Directs the CEO to prepare a planning proposal to amend the dwelling density map in the Liverpool Local Environmental Plan (LEP) 2008 that increases the permitted number of lots on certain sites along Pleasure Point Road, Pleasure Point from four lots to five lots; and*
2. *Notes that, once drafted, the planning proposal will be reported to the Liverpool Local Planning Panel for advice and to a future Council meeting for a decision on whether to seek a Gateway determination from the Department of Planning, Industry and Environment.*

The planning proposal seeks to increase the existing four lot restriction stipulated within Clause 7.12 to a maximum of five lots for each of the original large lots. The impetus for the planning proposal is to increase the yield potential of these lots, and to formalise the existence of a five lot subdivision that has been approved previously.

Given the significant constraints that apply to the site in terms of water infrastructure and bushfire risk, early consultation was completed with Sydney Water and the NSW Rural Fire Service (RFS). This has helped to ensure adequate consideration is given to these constraints in the early stages of the planning proposal process. It is noted that development is severely constrained from the perspective of the RFS for Lot 4 within the subject site. However, it is deemed that the planning proposal should remain in its current form at this early stage in the process. It is likely that a Bushfire Report will need to be prepared at a post-Gateway stage that will provide more clarity as to the development potential of this site in light of the requirements of PBP 2019. Additionally, further consultation will occur with the RFS to ensure they are satisfied with the proposal.

Site description



Figure 1: Location of subject site outlined in red (Nearmap 2019)

The subject site is located in the south-eastern corner of the Liverpool local government area (LGA) within the suburb of Pleasure Point. The subject site is divided into the four original large lots within the Liverpool Local Environmental Plan 2008 (LLEP) as shown below in Figure 2. It should be noted that subsequent subdivisions have occurred since this gazettal of the LLEP map.



Figure 2 Dwelling Density Map (LLEP 2008)

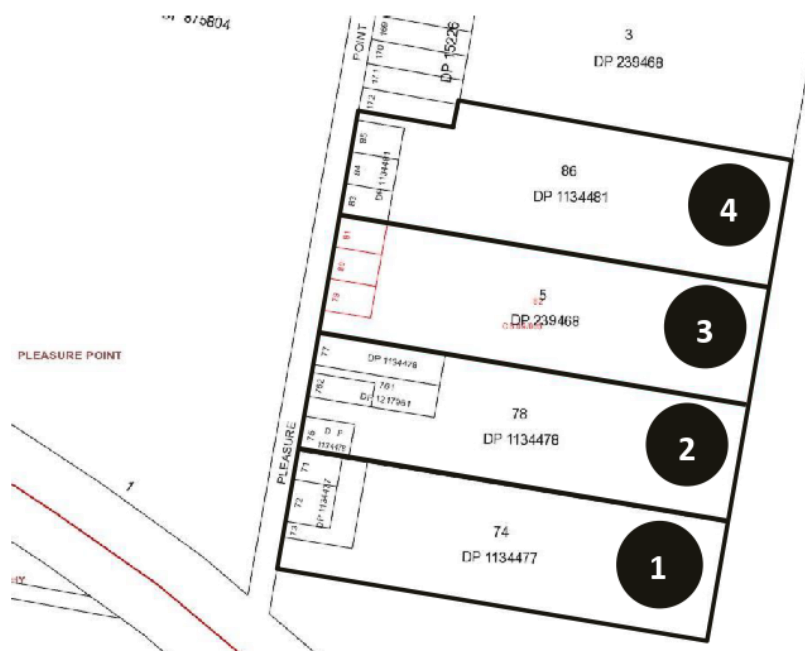


Figure 3 Subject Site - Original Larger Lots (LCC Geocortex)

The four original large lots that make up the subject site are numbered as per Figure 3 above. Currently, the four original large lots consist of the following individual formalised lots (from north to the south):

- **Site 1:**
 - Lot 71 within DP 1134477;
 - Lot 72 within DP 1134477;
 - Lot 73 within DP 1134477; and
 - Lot 74 within DP 1134477.
- **Site 2:**
 - Lot 75 within DP 1134478;
 - Lot 77 within DP 1134478;
 - Lot 78 within DP 1134478;
 - Lot 761 within DP 1217961; and
 - Lot 762 within DP 1217961.
- **Site 3:**
 - Lot 5 within DP 239468.
- **Site 4:**
 - Lot 83 within DP 1134481;
 - Lot 84 within DP 1134481;
 - Lot 85 within DP 1134481; and
 - Lot 86 within DP 1134481.

Refer to Table 1 for a summary of development approvals and construction on each individual lot within the subject site.

The subject site is zoned R5 – Large Lot Residential along the western portion, and E2 – Environmental Conservation along the eastern portion (Figure 4). All land located 60m or further from Pleasure Point Road is identified as Environmentally Significant Land under the LLEP 2008. A riparian corridor is located through the centre of the subject site, running down the slope northwards to the Georges River. An informal unsealed fire trail is located along the rear of the individual lots that is recognised and protected under the Liverpool Development Control Plan 2008 (LDCP 2008).

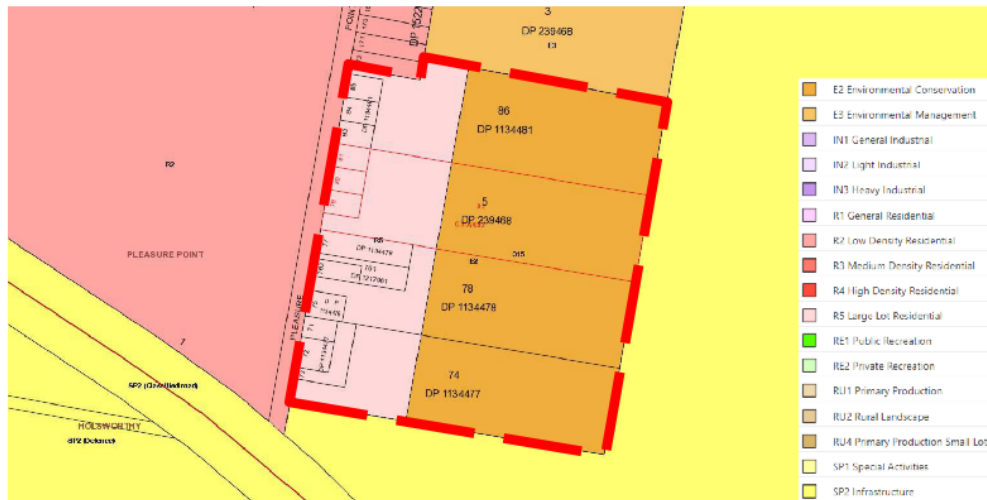


Figure 4 Zoning Map of the Subject Site (LCC Geocortex)

Residential development within the subject site is limited to the western edge fronting or connecting to Pleasure Point Road. The majority of development is in the form of single dwelling houses, with some utilising battle-axe lot configurations. A recently constructed dual occupancy is located in the south-western corner of the subject site. Site 1, 2 and 4 have all been subdivided to include battle-axe configurations, and now contain recently constructed dwellings in various forms. Site 3 remains as a single site with an older dwelling situated with a generous setback from Pleasure Point Road. A development consent exists for the subdivision of Site 3 into four lots. A subdivision certificate has also been issued, however the owner has not yet registered the subdivision with NSW Land Registry Services (LRS) and the subdivision is therefore not yet formalised.

In regard to the broader surroundings of the subject site, it is bound by Pleasure Point Road to the west, with a vast open site on the western side of the road that has yet to be developed. It is noted that this land to the west is identified as an urban release area in the LLEP 2008. To the east of the subject site is defence land (Sandy Point Military Reserve) land that contains environmentally significant bushland. This bushland is identified as Red Bloodwood – Grey Gum woodland in good condition, and has regional connectivity. To the south is Heathcote Road, and defence land (Horsworthy Military Reserve) that is densely vegetated. Finally to the north are further dwellings fronting Pleasure Point Road, and significant bushland that surrounds the creek corridor running down to the Georges River.



Figure 5 Looking north-east toward no.76 and further down Pleasure Point Road



Figure 6 Looking north-east at the no.72 dual occupancy development and further down Pleasure Point Road



Figure 7 Looking south-east toward Lot 5 Pleasure Point Road



Figure 8 Looking east down the battle-axe driveway of no. 46 Pleasure Point Road

Background

The following section details relevant past planning proposals, development applications, and legal proceedings that have occurred on the subject site.

Amendment 84

In February 2002 Impala Homes expressed interest in developing lots 4, 5, 6 and 7 Pleasure Point Road, Pleasure Point for residential purposes. Due to the significance of the vegetation and the public interest, this matter was subject to a public meeting and subsequent representations from key community representatives. As a result of these meetings the proposed development was scaled down to 16 residential lots which address Pleasure Point Road and ensure the protection of the rear of the sites. This restriction to the lot yield of the site was in response to the following outcomes of community consultation:

- *Limited development would be supported,*
- *There was support for the development principles proposed by the developer,*
- *Protection of defined environmental corridors with no development in these areas,*
- *No development should occur at the rear of the subject lots,*
- *There should be no medium density development,*
- *There should be no zero lot line development,*
- *There should be no significant traffic impacts on Pleasure Point Road,*
- *There is some scepticism as to Council's ability to enforce proposed environmental controls.*

In April 2003, Council received a formal application (Amendment 84) to rezone land at Pleasure Point to enable the development of a maximum of 16 dwellings from the subject four original large lots.

The State agency, service provider and internal Council consultations raised the suggestion of and support for a bushfire trail to enable emergency access to the rear of residential properties. It was deemed appropriate to prepare an amendment to the DCP to incorporate this requirement. The draft amendment to the DCP required that:

- A bushfire trail parallel to Pleasure Point Road is provided as part of any development of lots 4, 5, 6 and 7, DP 239468,
- The bushfire trail links to Pleasure Point Road through lots 4, 5 and 7 DP 239468,
- The bushfire trail meets the requirements of Section 4.3.3 of the NSW Government *Planning for Bushfire Protection 2001*,
- The bushfire trail is to be located as shown in the DCP map.

The draft amendment to DCP No 28 was exhibited with the LLEP 1997 draft Am No 84. Following the exhibition process, Council in November 2004 proceeded with the making of the LLEP 1997 draft Amendment 84 to rezone the land to enable the development of 16 residential lots on the subject land, and


adopt the proposed amendment to DCP No 28. The "Restricted Lot Yield" was imposed on the land on 1 April 2005 with the gazettal of Amendment No.84 to the Liverpool LEP 1997.

Amendment 54 was carried into the LLEP 2008 when this new instrument was gazetted to comply with the new standard instrument introduced by the Department. The lot yield restriction is now stipulated within Clause 7.12 and is illustrated on the Dwelling Density Map (sheet DWD-015).

Approved Residential Development

Since the gazettal of Amendment 54, each of the four original broad lots have undergone various forms of residential development. This is summarised and depicted in Table 1 below:

Table 1 Residential Development Summary Table

Site	Development
Site 1: <ul style="list-style-type: none"> Lot 71 within DP 1134477 Lot 72 within DP 1134477 Lot 73 within DP 1134477 Lot 74 within DP 1134477 	<p>8 June 2008 – Consent was granted for DA-1914/2005 to permit the subdivision of the original broad lot to create four residential lots. Since then, the following development has occurred:</p> <ul style="list-style-type: none"> DA-805/2011 – Single storey detached dwelling (no. 70, lot 71); DA-177/2011 – Single storey detached dwelling (no. 74, lot 73); DA-88/2017 – Dual occupancy development (no. 72, lot 72); and DA-438/2019 – Pre fabricated garden shed under assessment (no. 76, Lot 74).
	
<p>Figure 9 Site 1 (LCC Geocortex)</p>	
Site 2: <ul style="list-style-type: none"> Lot 75 within DP 1134478 	<p>8 June 2008 – Consent was granted for DA-1915/2005 to permit the subdivision of the original broad lot to create four residential lots. Since then, the following development has occurred:</p>

<ul style="list-style-type: none"> ○ Lot 77 within DP 1134478 ○ Lot 78 within DP 1134478 ○ Lot 761 within DP 1217961 ○ Lot 762 within DP 1217961 	<ul style="list-style-type: none"> • DA-1309/2013 – Double-storey dwelling (no. 68, lot 75); • DA-896/2014 – Two-storey detached dwelling and a detached secondary dwelling (no. 62, lot 77); • DA-180/2015 – Two lot Torrens title subdivision (no.64, lot 76) to create no. 64a (lot 761) and no. 64b (lot 762); • DA-9/2016 – Two-storey residential dwelling and pool (no. 64A, lot 761); and • DA-809/2016 – Two-storey residential dwelling (no. 64B, lot 762).
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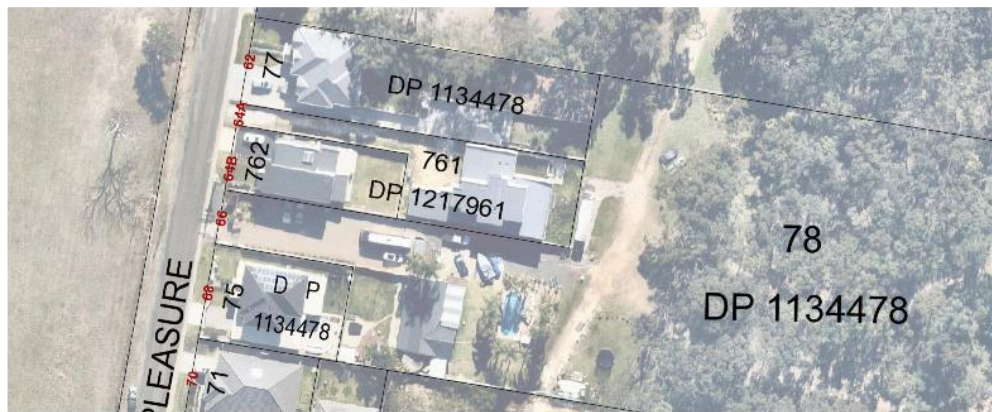


Figure 10 Site 2 (LCC Geocortex)

<p>Site 3:</p> <ul style="list-style-type: none"> ○ Lot 5 within DP 239468 	<p>This lot has an approved development application (DA-1916/2005) and subdivision certificate (SC-63/2009) that has not yet been registered at NSW Land Registry Services. The image below shows the approved and yet to be registered subdivision lots in red.</p>
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Figure 11 Site 3 (LCC Geocortex)

Site 4:

- Lot 83 within DP 1134481
- Lot 84 within DP 1134481
- Lot 85 within DP 1134481
- Lot 86 within DP 1134481

8 June 2008 – Consent was granted for **DA-1917/2005** to permit the subdivision of the original broad lot to create four residential lots. Since then, the following development has occurred:

- **DA-238/2010** – Double-storey detached dwelling (no 52, lot 82)
- **DA-495/2010** – Single-storey detached dwelling (no 50, lot 84)
- **DA-1339/2010** – Single-storey detached dwelling (no 48, lot 85)



Figure 12 Site 4 (LCC Geocortex)

DA-180/2015

This particular DA resulted in Site 2 having a total of five lots, rather than the stipulated maximum of four. The DA sought consent for the subdivision of the former Lot 76 DP 1134478, known as 64 Pleasure Point Road, Pleasure Point, to create two Torrens title lots. The proposed subdivision created one lot with a frontage to Pleasure Point Road of 15 metres (Lot 762) and another lot which will be connected to Pleasure

Point Road by a 5 metre wide access handle (Lot 761). A written Clause 4.6 variation request was provided by the applicant justifying the contravention of Clause 7.12 of the LLEP 2008 in creating five lots within Site 2. Council was satisfied with this Clause 4.6 variation request and an approval was recommended based on the assessment conducted. Given that the DA proposed a variation of more than 10% to a deemed development standard of the LLEP 2008, the DA was reported to the Independent Hearing and Assessment Panel (IHAP).

On Monday 24 August 2015, the IHAP recommended approval of the application subject to the conditions contained within the Council officer's report. Subsequently, the DA was approved by Council on 30 September 2015.

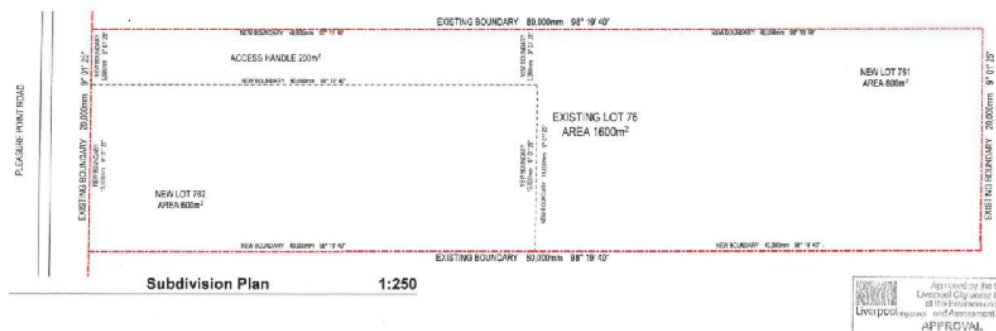


Figure 13 Approved Subdivision Plan DA-180/2015 (LCC E-Planning Portal)

DA-724/2016

The subject DA was lodged on 4 August 2016 that sought consent for the two lot Torrens title subdivision of Lot 74 in DP 1134478, known as 76 Pleasure Point Road, Pleasure Point. This subdivision would result in a total of five lots within the original broad lot (Site 1).

On the 26 March 2018 the Independent Hearing and Assessment Panel (IHAP) deferred the determination of DA-724/2016. The DA was deferred pending the submission of additional information addressing the issues raised by IHAP, which relate to:

- i. Whether Clause 7.12 is a prohibition or a development standard capable of being varied under clause 4.6 of LLEP 2008;
- ii. A variation request from the applicant setting out justification for the variation to Clause 7.12 having regard to the tests in Clause 4.6 of LLEP 2008 and relevant Land and Environment Court decisions; and
- iii. Further information on the existing restriction on use affecting the land relating to the conservation management plan for the land within zone E2.

The panel was provided with the supplementary report containing the information required. The DA was again considered by the Liverpool Local Planning Panel (formerly IHAP) on 7 May 2018 and ultimately refused.

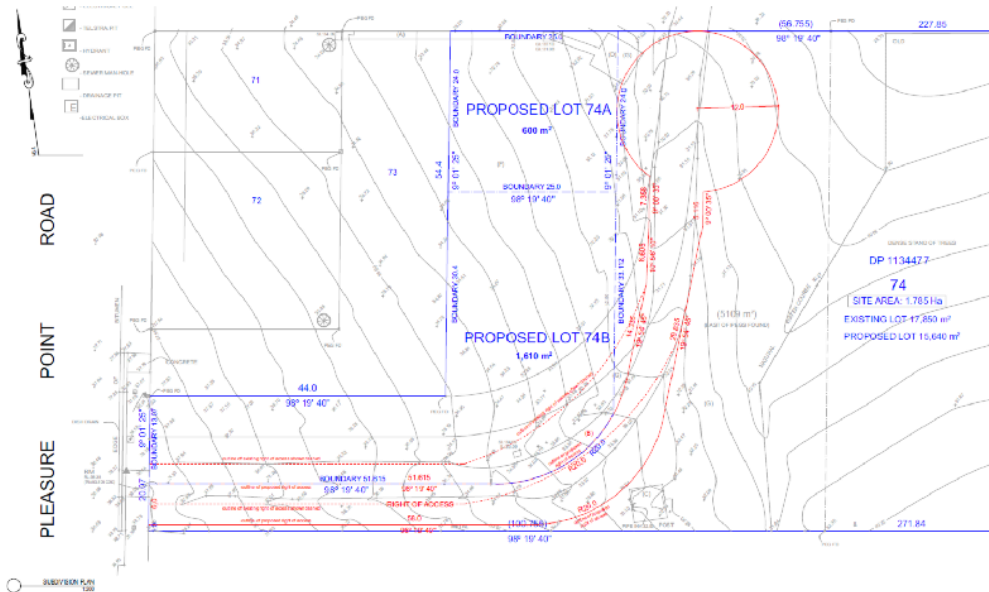


Figure 14 Proposed Subdivision Plan DA-724/2016 (LCC E-Planning Portal)

The applicant initiated a Class 1 appeal, however this appeal was dismissed in the Land and Environment Court by Commissioner Gray. This court decision was in the process of being reviewed by a Judge, when a compromise was reached between Liverpool City Council and the applicant. It was agreed that a planning proposal would be prepared to remove this four lot restriction within the LLEP 2008 to rectify the existing five lot development (Site 2) and facilitate the further development of the other sites.

Initial State Agency Referrals

Given the significant constraints that apply to the site in terms of water infrastructure and bushfire risk, early consultation was completed with Sydney Water and the NSW Rural Fire Service (RFS). It is noted that further consultation as part of the state agency consultation process will be undertaken should the planning proposal receive a Gateway Determination.

RFS Referral

The RFS referral firstly emphasised that *Planning for Bush Fire Protection 2019* (PBP 2019) was adopted on 1 March 2020, which means the Planning Proposal and any future development applications will need to comply with these new guidelines.

The RFS referral raised the issue of the fire trail that exists behind the existing dwellings within the subject site. Any future lots that rely on this existing fire trail for access will be required to upgrade this access to a perimeter road. This perimeter road would need to be constructed in accordance with PBP 2019 and have a minimum carriageway width of 8m (excluding any on-street parking). It is noted that this requirement will be a sizeable cost for any subdivision proposal to create an additional lot.

Asset protection zone (APZ) requirements were also identified in relation to the proposal. An APZ is a buffer zone between a bush fire hazard and buildings. The APZ is managed to minimise fuel loads and reduce potential radiant heat levels, flame, localised smoke and ember attack. It was identified that the APZ requirements applying to the subject planning proposal would potentially preclude the creation of a sizeable dwelling on a fifth lot to the west of 46 Pleasure Point Road. This is demonstrated in Figure 4 below, demonstrating a high-level estimation of the APZ required and the resulting hypothetical dwelling location.



Figure 15 Approximate APZ Constraint Map at 46 Pleasure Point Road (Nearmap)

Various requirements have been established through this early consultation with the RFS which will impact on the nature and feasibility of future development within the subject site. The following implications have been identified at this early stage for each of the four original large lots:

- **Lot 1** – The further subdivision and development of this lot has been refined already as part of the assessment process for DA-724/2016. The requirement for the construction of a perimeter road with an 8m carriageway width remains, as do the APZ requirements under PBP 2019.
- **Lot 2** – This lot has already been subdivided into five lots, and this will become formalised as part of this planning proposal. It is noted that the existing firetail at the rear of the site is to remain, be maintained and be accessible to the RFS.
- **Lot 3** – This lot has yet to be subdivided and developed. Any access to the rear of the site utilising the fire trail along its southern boundary must be constructed as a perimeter road in accordance with PBP 2019. Additionally, an APZ must also be established to the rear of development in accordance with PBP 2019.
- **Lot 4** – It was recommended by the RFS that this lot be excluded from the planning proposal. This is because of the limited space available for an additional lot as a result of the APZ required. Additionally, access would need to be upgraded to a perimeter road with an 8m carriageway. This requirement cannot not be satisfied given the existing lot orientation within Site 4 that includes a narrow driveway access to the existing dwelling at 46 Pleasure Point Rd.

It is noted that development is severely constrained from the perspective of the RFS for Lot 4 within the subject site. However, development could be possible in the future should significant redevelopment occur on Lot 4. Furthermore, access could be provided from Lot 3 should an agreement be made.

It is deemed that the planning proposal should remain in its current form at this early stage in the process, noting the significant constraints applying to Lot 4 within the subject site. It is likely that a Bushfire Report will need to be prepared at a post-Gateway stage that will provide more clarity as to the development potential of this site in light of the requirements of PBP 2019. Additionally, further consultation will occur with the RFS to ensure they are satisfied with the proposal.

Sydney Water Referral

The Sydney Water referral advised that additional lot development would be serviceable through the existing water infrastructure present. However, it was noted that any development above 35m AHD could not be serviceable by Sydney Water through the existing infrastructure present. It was added that no planned infrastructure upgrades were anticipated.

This will not preclude additional development along Pleasure Point Road given that the additional developable land is situated at a height below 35m AHD. A high-level indication of the height where servicing can no longer be provided is demonstrated in Figure 16.

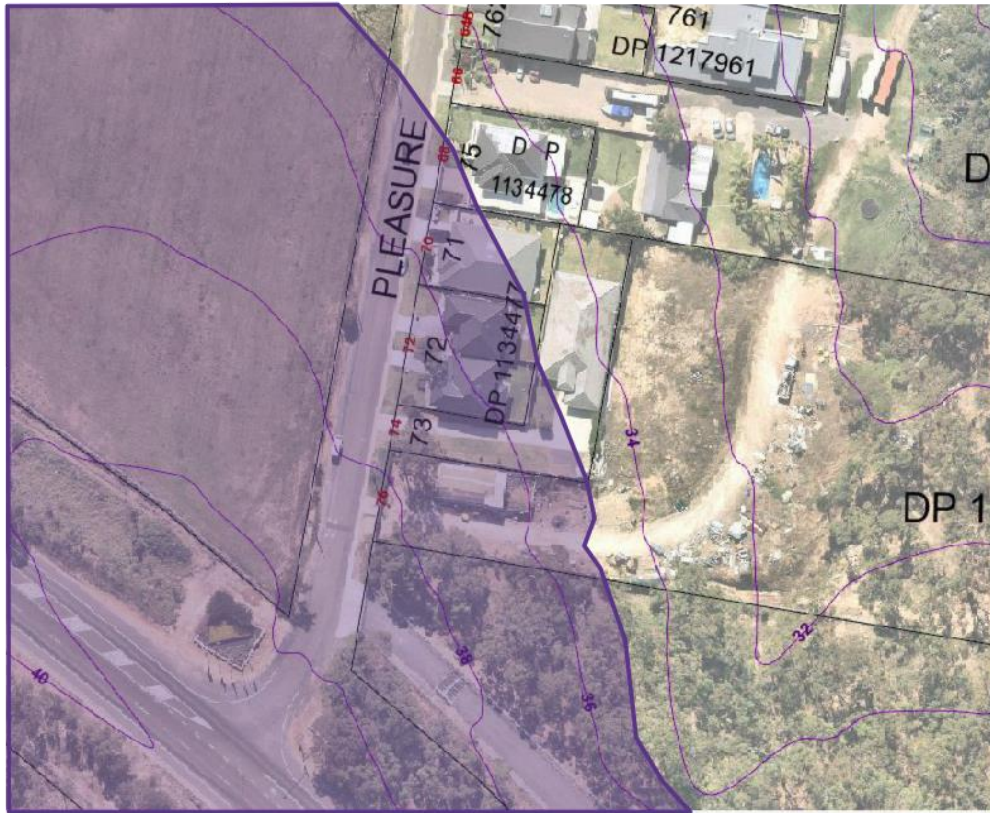


Figure 16 Approximate indication of Sydney Water servicing constraints above 35mAHD (LCC Geocortex)

Part 1 – Objectives

The objective of this planning proposal is to amend the LLEP 2008 to increase the restricted lot yield of the four original broad sites along Pleasure Point Road. This objective applies to the subject site only.

Part 2 – Explanation of provisions

The objective of the planning proposal will be achieved through an amendment to the Dwelling Density Map DWD-0015 (4900_COM_DWD_015_020_20091013) of the LLEP 2008 to stipulate a restricted lot yield of five. This would apply to the subject site only, which is legally defined as follows:

- **Site 1:**
 - Lot 71 within DP 1134477;
 - Lot 72 within DP 1134477;
 - Lot 73 within DP 1134477; and
 - Lot 74 within DP 1134477.
- **Site 2:**
 - Lot 75 within DP 1134478;
 - Lot 77 within DP 1134478;
 - Lot 78 within DP 1134478;
 - Lot 761 within DP 1217961; and
 - Lot 762 within DP 1217961.
- **Site 3:**
 - Lot 5 within DP 239468.
- **Site 4:**
 - Lot 83 within DP 1134481;
 - Lot 84 within DP 1134481;
 - Lot 85 within DP 1134481; and
 - Lot 86 within DP 1134481.

Part 3 – Justification

Section A – Need for the planning proposal

3.1 Is the planning proposal a result of an endorsed local strategic planning statement, strategic study or report?

No, the planning proposal is not the result of an endorsed local strategic planning statement, strategic study or report.

3.2 Is the planning proposal the best means of achieving the objectives or intended outcomes, or is there a better way?

Yes, amending the current lot yield restriction to a five lot maximum is the best means of achieving the intended outcome. The complete removal of the restricted lot yield for the subject site is an alternative. However, this is deemed to be inappropriate given the sensitive nature of the eastern portions of the subject site, and other constraints present such as bushfire risk.

Increasing the lot yield restriction from four to five lots will legitimise the subdivision of Site 2 and facilitate the development of the other sites while ensuring the impacts of over development are mitigated.

Section B – Relationship to strategic planning framework.

3.3 Will the planning proposal give effect to the objectives and actions of the applicable regional, or district plan or strategy (including any exhibited draft plans or strategies)?

A Metropolis of Three Cities

The planning proposal will give effect to the following objectives of the Greater Sydney Region Plan 2018, *A Metropolis of Three Cities*:

- **Objective 10:** Greater housing supply
- **Objective 11:** Housing is more diverse and affordable

The proposed amendment will facilitate the provision of additional housing on the subject site through lifting the current lot yield restriction from four to five for each of the original broad lots. Given the R5 Large Lot Residential zoning of the site, the form of housing will be a relative rarity within the context of Liverpool, and the wider developed areas of metropolitan Sydney. This housing then will help to the diversity of residential development within the local government area of Liverpool.

- **Objective 27:** Biodiversity is protected, urban bushland and remnant vegetation is enhanced
 - **Strategy 27.1:** Protect and enhance biodiversity by:
 - Supporting landscape-scale biodiversity conservation and the restoration of bushland corridors
 - Managing urban bushland and remnant vegetation as green infrastructure
 - Managing urban development and urban bushland to reduce edge-effect impacts.
- **Objective 28:** Scenic and cultural landscapes are protected

The proposed amendment to the lot yield restriction will not impact on the existing zoning provisions, and environmentally significant land classification of the subject site. The proposed change is aimed at

improving the efficiency of the large lot residential land along the western portion of the site only, while retaining the biodiversity and scenic significance of the eastern portions of the site.

Western City District Plan

The planning proposal also gives effect to the following priority and action of the Western City District Plan:

- **Planning Priority W5:** Providing housing supply, choice and affordability, with access to jobs, services and public transport
 - **Objective 10:** Greater housing supply
 - **Objective 11:** Housing is more diverse and affordable

By extension of Objective 10 and 11 of the Region Plan, the planning proposal will give effect to the Planning Priority W5 of the District Plan. The proposed amendment will provide additional housing in a unique form on the subject site with proximity to local jobs and services within the centres of Liverpool, as well as public transport in the form of the 902x bus that provides access to the nearby Holsworthy train station.

- **Planning Priority W14:** Protecting and enhancing bushland and biodiversity
 - **Objective 27:** Biodiversity is protected urban bushland and remnant vegetation is enhanced.

The proposed amendment to the lot yield restriction will not impact on the existing zoning provisions, and environmentally significant land classification of the subject site. The proposed change is aimed at improving the efficiency of the large lot residential land along the western portion of the site only, while retaining the biodiversity and scenic significance of the eastern portions of the site.

Assessment Criteria

Assessment Criteria have been established to assist proponents or a PPA justify a planning proposal. Refer to Table 2 below for an assessment of the planning proposal against this prescribed criteria.

Table 2 Assessment of strategic and site-specific merit

Consideration	Merit	Justification
Does the proposal have strategic merit? Will it:		
Give effect to the relevant regional plan outside of the Greater Sydney Region, the relevant district plan within the Greater Sydney Region, or corridor/precinct plans applying to the site, including any draft regional, district or corridor/precinct plans released for public comment; or	Yes	The proposal has demonstrated that it will give effect to these strategic plans and documents, as outlined in section 3.3 of this report.
Give effect to a relevant local strategic planning statement or strategy that has been endorsed by the Department or required as part of a regional or district plan or local strategic planning statement; or	Yes	An assessment against the Connected Liverpool 2040 Liverpool Local Strategic Planning Statement (LSPS) has been provided in Section 3.4 of this report.

Consideration	Merit	Justification
Responding to a change in circumstances, such as the investment in new infrastructure or changing demographic trends that have not been recognised by existing strategic plans.	Yes	The proposed amendment responds to the sufficient provision of infrastructure, and changing demographic trends of the Pleasure Point locality. The proposal will ensure the efficient development of this existing urban land in providing an appropriate increase in residential lots while ensuring environmental impacts continue to be managed appropriately.
<i>Does the proposal have site-specific merit, having regard to the following?</i>		
The natural environment (including known significant environmental values, resources or hazards) and	Yes	The proposed amendment will not change any existing controls that currently mitigate against impacts to the natural environment. This proposal will simply permit the development of previously cleared land within the existing residential portions of the subject site. All future Development Applications will be required to confirm that the natural environment will not be adversely impacted and hazards are appropriately managed.
The existing uses, approved uses, and likely future uses of land in the vicinity of the proposal and	Yes	The existing uses present on the subject site will remain, and simply permit the development of additional lots on Site 1, 3 and 4. Any proposed uses will be required to adhere to the objectives and controls of the R5 Large Lot Residential zone. Future development will be compatible with existing uses within the locality of Pleasure Point.
The services and infrastructure that are or will be available to meet the demands arising from the proposal and any proposed financial arrangements for infrastructure provision.	Yes	It is not anticipated that the proposed amendments will create servicing and infrastructure deficiencies for the existing and future development on the subject site. State agency consultation will be undertaken subject to a Gateway determination to ensure that all infrastructure and servicing considerations are addressed.

3.4 Will the planning proposal give effect to a council's endorsed local strategic planning statement, or another endorsed local strategy or strategic plan?

Liverpool Community Strategic Plan – Our Home, Liverpool 2027

The proposal to amend the lot yield restriction on the subject site gives effect to the Liverpool's Community Strategic Plan (CSP) – Our Home, Liverpool 2027, which states:

- Direction 2: Strengthening and Protecting our Environment
 - Council will: Exercise planning controls to create high-quality, inclusive, urban environments.

The proposed amendment will not rezone the site, nor is there any amendments proposed to the existing environmentally significant land classification. The proposed amendment will facilitate the efficient development of the subject sites in a manner that retains the environmental protection restriction mechanisms within the LLEP 2008 and the LDCP 2008. This will improve the urban environment while ensuring mitigation against environmental impacts remains.

- Direction 3: Generating Opportunity
 - Council will: Meet the challenges of Liverpool's growing population.

The increase to the lot yield restriction proposed will help to ensure the efficient development of this existing urban land. Efficient development of the site will be facilitated to meet the population growth occurring within Liverpool and the wider Metropolitan Sydney area.

Connected Liverpool 2040 – Liverpool's Local Strategic Planning Statement (LSPS)

The planning proposal gives effect to the LSPS as follows:

- *Planning Priority 8 – Community-focused low-scale suburbs where our unique local character and heritage are respected*

The proposed amendment to the lot yield control will allow the subject site to reach its development potential within the unique area that it is located. It is noted that the existing R5 – Large Lot Residential zoning is to remain which will help to retain the low-scale and high amenity character of the area.

- *Planning Priority 14 – Bushland and waterways are celebrated, connected, protected and enhanced*

The planning proposal will allow for the remaining developable area within the subject site to be utilised, while retaining the existing E2 – Environmental Conservation land to the east. The proposed amendment will simply allow for a small amount of additional development within areas mostly cleared for such purposes.

- *Planning Priority 15 – A green, sustainable, resilient and water-sensitive city*

The proposed amendment has already been referred to the RFS for initial consultation, and further consultation will occur should a Gateway determination be given. The proposal will not impact on the requirements of the PBP 2019 to be satisfied as part of any future development.

Liverpool Local Environmental Plan 2008

The planning proposal gives effect to some of the aims of the LLEP 2008, being:

- (a) to encourage a range of housing, employment, recreation and services to meet the needs of existing and future residents of Liverpool,*
- (b) to foster economic, environmental and social well-being so that Liverpool continues to develop as a sustainable and prosperous place to live, work and visit,*
- (h) to protect and enhance the natural environment in Liverpool, incorporating ecologically sustainable development,*
- (i) to minimise risk to the community in areas subject to environmental hazards, particularly flooding and bush fires,*

The proposed amendment will help to improve the range of housing available for residents within Liverpool, ensuring that the unique typology of larger lot residential dwellings is provided. Furthermore, the efficient provision of housing in this locality will provide benefits to residents in facilitating the considered development of this high amenity area. Any future development as facilitated by the amendment will be required to adhere to the R5 Large Lot Residential zone objectives, encouraging low impact, high amenity and environmentally sensitive development. Finally, all future proposal will be required to confirm that all potential hazards have been adequately addressed, and mitigation measures employed to avoid impacts to the site and its surrounds.

The zoning is to remain as existing for the subject site. This zoning is R5 Large Lot Residential for the western portion and E2 Environmental Conservation for the remaining eastern portion of the subject site.

The objectives of the R5 Large Lot Residential zone are as follows:

- *To provide residential housing in a rural setting while preserving, and minimising impacts on, environmentally sensitive locations and scenic quality.*
- *To ensure that large residential lots do not hinder the proper and orderly development of urban areas in the future.*
- *To ensure that development in the area does not unreasonably increase the demand for public services or public facilities.*
- *To minimise conflict between land uses within this zone and land uses within adjoining zones.*
- *To ensure that a high level of residential amenity is achieved and maintained.*
- *To provide for complementary uses that are of low impact and do not unreasonably increase the demand for public services or public facilities.*

The proposed amendment will facilitate the development of the western portion of the site within the R5 zone. The minor amendment to increase the lot yield restriction from four to five will not change the requirement for future development to satisfy these objectives. The proposed amendment will ensure that efficient development of the existing urban land within the subject site can be developed in alignment with the objectives of the R5 zone.

The objectives of the E2 Environmental Conservation zone are as follows:

- To protect, manage and restore areas of high ecological, scientific, cultural or aesthetic values.
- To prevent development that could destroy, damage or otherwise have an adverse effect on those values.
- To enable the recreational enjoyment, cultural interpretation or scientific study of the natural environment.

This zoning will remain, and continue to safeguard the eastern portion of the site from clearing and development.

It should be noted that the current minimum subdivision lot size control applying to the subject site is 600m², and this requirement will remain. The existence of this control will contribute to the protection of the large lot character of the subject site, and avoid any inappropriate overdevelopment.

Liverpool Development Control Plan 2008 (DCP)

The DCP has two parts that are of particular relevance to the proposed amendment.

Part 2.13 Land Subdivision in Pleasure Point

The proposed amendment will not alter this existing part of the DCP, ensuring that development remains aligned with these objectives and controls. It is noted that the DCP requires a fire trail that runs behind the existing development and parallel with Pleasure Point Road (Figure 17).

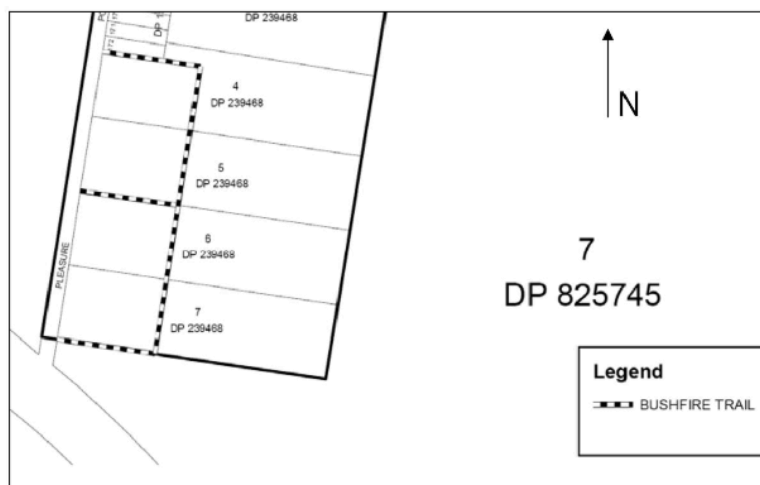


Figure 17 Bushfire Trail DCP Requirement

Any future additional lots facilitated by the proposed amendment will still be required to include this bushfire trail and ensure that it is accessible to the RFS.

Part 3.1 Dwelling Houses in the R5 zone

It is noted that control 3 within section 1. Preliminary of Part 3.1 states that “requirements for Setbacks and Landscaped Area and Private Open Space must be assessed on their merits” for the lots within the subject site. Therefore, future development as part of this proposed amendment will be assessed on a merit basis.

3.5 Is the planning proposal consistent with applicable State Environmental Planning Policies?

Table 3 SEPP Consistency

State Environmental Planning Policy	Consistency
State Environmental Planning Policy No 19—Bushland in Urban Areas	Yes – No immediate impacts are anticipated as a result of the proposed amendment. The proposal will facilitate the development of existing R5 land that has been predominately cleared previously.
State Environmental Planning Policy No 44 – Koala Habitat Protection	Yes – No immediate impacts are anticipated as a result of the proposed amendment. No known Koala habitation exists within the R5 portion of the subject site given the limited vegetation present and the developed nature of this portion. Nonetheless, any future development application will be required to provide evidence that there are no Koala habitats are present, and that this SEPP has been addressed.
State Environmental Planning Policy No 55—Remediation of Land	Yes – No immediate impacts are anticipated as a result of the proposed amendment. Given that the subject site is currently developed and has historically been vacant, no contamination impacts are anticipated.
State Environmental Planning Policy (Affordable Rental Housing) 2009	Yes – Secondary dwelling development is permissible under this SEPP within the subject site. Any future development applications for secondary development will be required to comply with the objectives and controls of this SEPP.
State Environmental Planning Policy (Building Sustainability Index: BASIX) 2004	Yes – Any future dwelling construction will be required to adhere with the requirements of BASIX, as stipulated within the SEPP.
State Environmental Planning Policy (Vegetation in Non-Rural Areas) 2017	Yes – No immediate impacts are anticipated as a result of the proposed amendment. The proposed amendment does not facilitate the clearing of vegetation without a permit. Any future development applications that include vegetation clearing will be required to adhere with the SEPP.
Greater Metropolitan Regional Environmental Plan No 2—Georges River Catchment	Yes – No immediate impacts are anticipated as a result of the proposed amendment. Any future development applications will be required to indicate consistency with the principles of the SEPP.

3.6 Is the planning proposal consistent with applicable Ministerial Directions (Section 9.1 directions)?

Table 4 Section 9.1 Directions Consistency

Section 9.1 Direction	Complies	Justification
Environment and Heritage		
2.1 Environment Protection Zones	Yes	The planning proposal does not reduce the environmental protection standards that apply to the land. The proposed

Section 9.1 Direction	Complies	Justification
		amendment will not facilitate development within the E2 portions of the subject site.
Housing, Infrastructure and Urban Development		
3.1 Residential Zones	Yes	<p>The planning proposal will help to broaden the choice of building types and locations in the Liverpool housing market. Furthermore, it will allow for the efficient development of the existing urban land located in the western portion of the site.</p> <p>In regard to servicing, the planning proposal process will include consultation with State Agencies to guarantee that servicing and infrastructure is adequate for the subject site and future development as facilitated by the proposed amendment.</p>
Hazard and Risk		
4.1 Acid Sulfate Soils	Yes	The subject site is identified as containing class 5 acid sulfate soils. Given the current and potential future development on the subject site, adverse impacts are not anticipated regarding acid sulfate soils. Any future development applications will be required to address this constraint in accordance with the acid sulfate soils provisions of the LLEP 2008 (cl. 7.7).
4.4 Planning for Bushfire Protection	Yes	The planning proposal will undergo State Agency consultation pending a Gateway Determination. This process will include consultation with the NSW Rural Fire Service (RFS). This process will ensure that bushfire protection is sufficiently considered, and any mitigation measures are employed as part of the proposed amendment.
Regional Planning		
5.10 Implementation of Regional Plans	Yes	Consistency with <i>A Metropolis of Three Cities</i> is outlined in Section B above.
Local Plan Making		
6.1 Approval and Referral Requirements	Yes	Referral is proposed to the RFS as part of state agency consultation, as well as any other consultation prescribed by the Department as part of a Gateway Determination.
Metropolitan Planning		
7.1 Implementation of A Plan for Growing Sydney	Yes	The proposal is consistent with <i>Direction 2.1: Accelerate housing supply across Sydney</i> , <i>Direction 2.3: Improve housing choice to suit different needs and lifestyles</i> , and <i>Direction 4.3: Manage the impacts of development on the environment</i> .

Section C – Environmental, social, and economic impact

3.7 *Is there any likelihood that critical habitat or threatened species, populations or ecological communities, or their habitats, will be adversely affected as a result of the proposal?*

The proposed amendment applies to the subject site, however it will facilitate development within the western portion of the site only where development and vegetation clearing has occurred previously. It is noted that the environmentally significant land classification of the subject site will remain. This classification will ensure that any future development applications are required to address the significant nature of the site, and mitigate against potential adverse impacts.

3.8 *Are there any other likely environmental effects as a result of the planning proposal and how are they proposed to be managed?*

The subject site is identified as bushfire prone land. The western portion of the site is specifically identified as 'vegetation buffer'. As mentioned previously within this report, further consultation will be undertaken with the RFS pending a Gateway Determination.

No other likely environmental effects are identified. Where environmental impacts do exist, are deemed to be of minor significance.

3.9 *Has the planning proposal adequately addressed any social and economic effects?*

It is not anticipated that the proposed amendment will have any adverse social or economic impacts on the subject site, or surrounding locality. The proposed amendment will simply facilitate the efficient development of this existing urban land. A community consultation process will be undertaken pending a Gateway Determination that will ensure all social or economic concerns are considered and sufficiently addressed.

Section D – State and Commonwealth interests

3.10 *Is there adequate public infrastructure for the planning proposal?*

The planning proposal will have a modest impact on public infrastructure, with potential future development resulting in a small increase in dwelling numbers along Pleasure Point Road. It is not anticipated that public infrastructure deficiencies are present. Nonetheless, the state agency consultation process will ensure that any such issues are identified, and addressed as required.

3.11 *What are the views of state and Commonwealth public authorities consulted in accordance with the Gateway determination?*

The views of state and Commonwealth public authorities will be considered following Gateway determination. The following government agencies should be considered:

- Roads and Maritime Services;
- Sydney Water;
- Department of Planning, Industry and Environment – Environment, Energy and Science Group (Formerly OE&H);
- Department of Lands and Industry;
- Rural Fire Service and
- State Emergency Services.

Part 4 – Mapping



Figure 18: Proposed Dwelling Density Map



Figure 19 Proposed Dwelling Density Map Excerpt

Part 5 – Community Consultation

Community consultation will be undertaken in accordance with the Gateway determination. It is anticipated that the proposal will be exhibited for 14 days through:

- Notification on Liverpool City Council's planning portal and Liverpool Council website; and
- Letters to the affected and adjoining landowners.

Part 6 – Project Timeline

An anticipated project timeline is shown in Table 5.

Table 5: Anticipated project timeline

Timeframe	Action
June 2020	Presented at the Local Planning Panel meeting
July 2020	Presented to Liverpool City Council
August 2020	Submission of Planning Proposal to DPIE
December 2020	Gateway Determination issued
January 2021 – March 2021	State agency consultation
January 2021 – February 2021	Community consultation
March 2021 – May 2021	Consideration of submissions and proposal post-exhibition
June 2021	Post-exhibition report to Council
July 2021 – August 2021	Legal drafting and making of the plan

LIVERPOOL CITY COUNCIL LOCAL PLANNING PANEL REPORT

29 June 2020

Application Number:	RZ-6/2019
Proposal:	Planning proposal to amend the Dwelling Density Map 1 of the Liverpool Local Environmental Plan 2008 to allow four additional lots in Pleasure Point.
Property Address	46, 48, 50, 52, Lot 5, 62, 64a, 64b, 66, 68, 70, 72, 74, and 76 Pleasure Point Road, Pleasure Point
Legal Description:	Lot 71 within DP 1134477; Lot 72 within DP 1134477; Lot 73 within DP 1134477; Lot 74 within DP 1134477; Lot 75 within DP 1134478; Lot 77 within DP 1134478; Lot 78 within DP 1134478; Lot 761 within DP 1217961; Lot 762 within DP 1217961; Lot 5 within DP 239468; Lot 83 within DP 1134481; Lot 84 within DP 1134481; Lot 85 within DP 1134481; and Lot 86 within DP 1134481.
Recommendation:	Proceed to gateway review
Assessing Officer:	Luke Oste, Executive Planner

1. INTRODUCTION

The planning proposal seeks to increase the existing four lot restriction that applies to numerous lots along Pleasure Point Road in Pleasure Point. The impetus for the planning proposal is to increase the yield potential of these lots to five and to formalise the existence of a five lot subdivision that has been approved previously.

It is noted that this is a Council initiated planning proposal. Consequently, this assessment report functions as a summary for the planning proposal justification report.

2. SITE DESCRIPTION AND LOCALITY

The Site

The subject site is located in the south-eastern corner of the Liverpool local government area (LGA) within the suburb of Pleasure Point. The subject site is divided into the four original large lots within the Liverpool Local Environmental Plan 2008 (LLEP) as shown below in **Error! Reference source not found.** It should be noted that subsequent subdivisions have occurred since the gazettal of the LLEP map.

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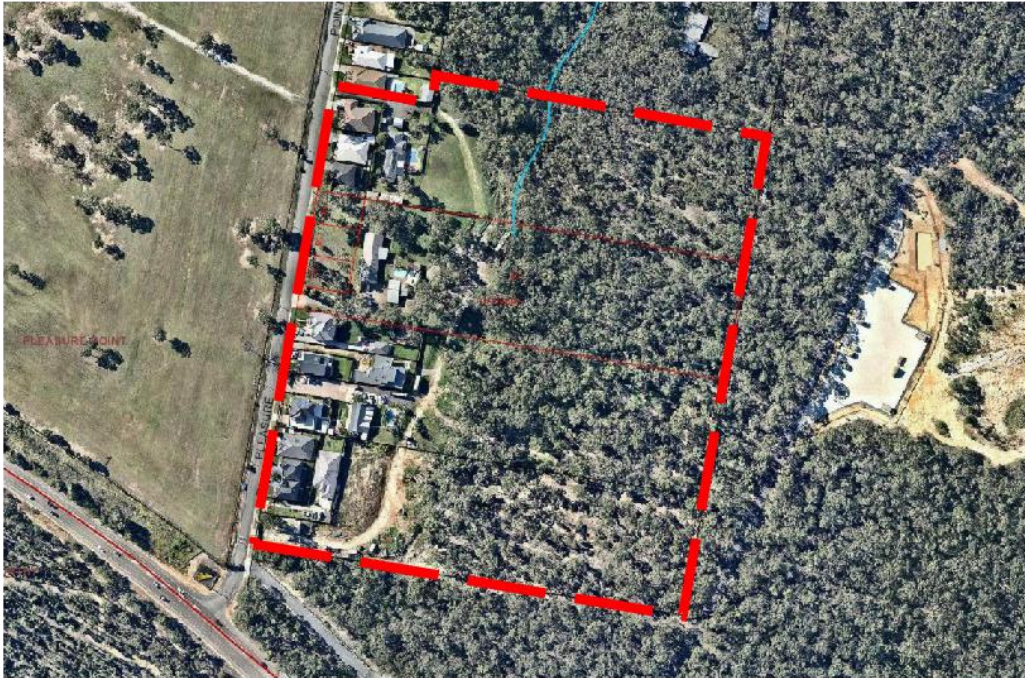


Figure 1 Location of subject site outlined in red (Nearmap 2019)



Figure 2 Dwelling Density Map (LLEP 2008)

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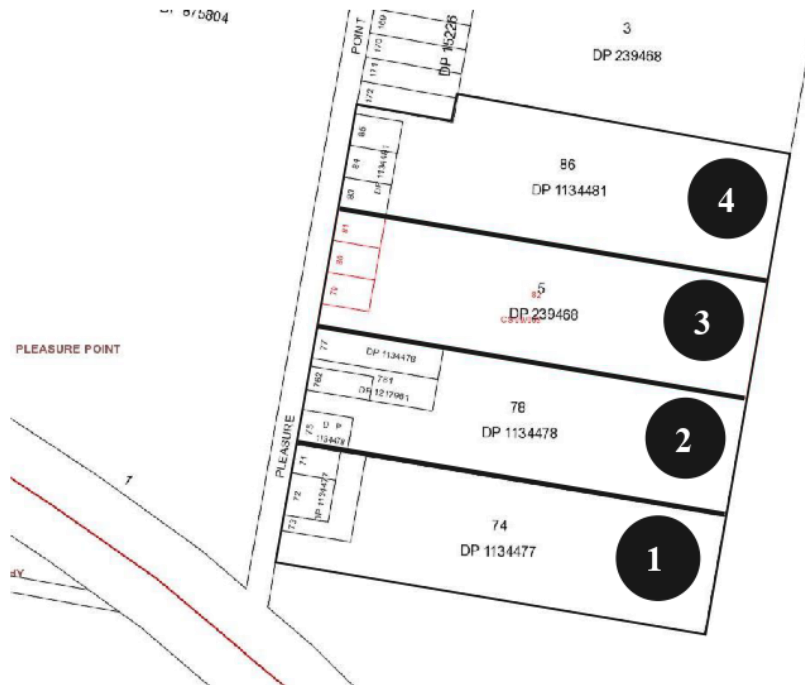


Figure 3 Subject Site - Original Larger Lots (LCC Geocortex)

The four original large lots that make up the subject site are numbered as per **Error! Reference source not found.** above. Currently, the four original large lots consist of the following individual formalised lots (from north to the south):

- **Site 1:**
 - Lot 71 within DP 1134477;
 - Lot 72 within DP 1134477;
 - Lot 73 within DP 1134477; and
 - Lot 74 within DP 1134477.
- **Site 2:**
 - Lot 75 within DP 1134478;
 - Lot 77 within DP 1134478;
 - Lot 78 within DP 1134478;
 - Lot 761 within DP 1217961; and
 - Lot 762 within DP 1217961.

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- **Site 3:**
 - Lot 5 within DP 239468.
- **Site 4:**
 - Lot 83 within DP 1134481;
 - Lot 84 within DP 1134481;
 - Lot 85 within DP 1134481; and
 - Lot 86 within DP 1134481.

The subject site is zoned R5 – Large Lot Residential along the western portion and E2 – Environmental Conservation along the eastern portion (**Error! Reference source not found.**). All land located 60m or further from Pleasure Point Road is identified as Environmentally Significant Land under the LLEP 2008. A riparian corridor is located through the centre of the subject site, running down the slope northwards to the Georges River. An informal unsealed fire trail is located along the rear of the individual lots that is recognised and protected under the Liverpool Development Control Plan 2008 (LDCP 2008).

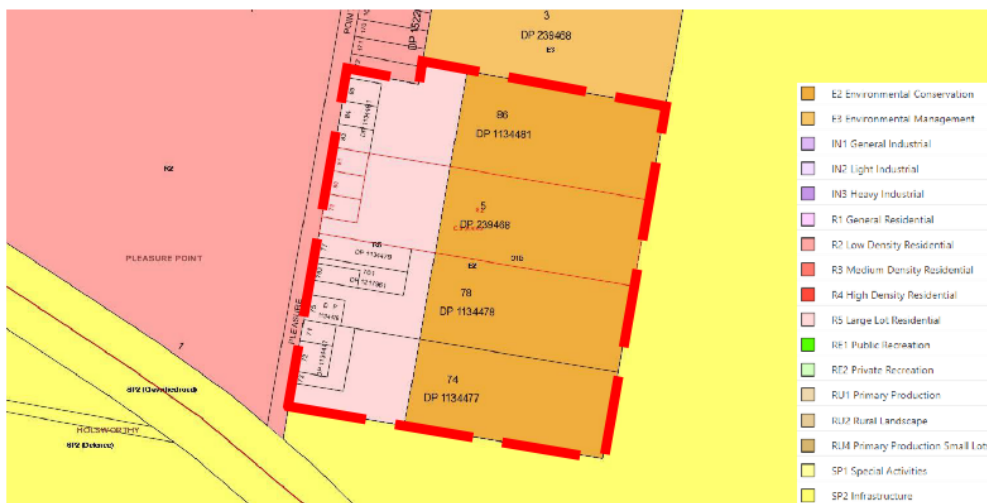


Figure 4 Zoning Map of the Subject Site (LCC Geocortex)

Residential development within the subject site is limited to the western edge fronting or connecting to Pleasure Point Road. The majority of development is in the form of single dwelling houses, with some utilising battle-axe lot configurations. A recently constructed dual occupancy is located in the south-western corner of the subject site. Site 1, 2 and 4 have all been subdivided to include battle-axe configurations, and now contain recently constructed dwellings in various forms. Site 3 remains as a single site with an older dwelling situated with a generous setback from Pleasure Point Road. A development consent exists for the subdivision of site 3 into four lots. A subdivision certificate has also been issued, however the owner has not yet registered the subdivision with NSW Land Registry Services (LRS) and the subdivision is therefore not yet formalised.

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The Locality

The subject site is bound by Pleasure Point Road to the west, with a vast open site on the western side of the road that has yet to be developed. It is noted that this land to the west is identified as an urban release area in the LLEP 2008. To the east of the subject site is defence land (Sandy Point Military Reserve) land that contains environmentally significant bushland. This bushland is identified as Red Bloodwood – Grey Gum woodland in good condition, and has regional connectivity. To the south is Heathcote Road, and defence land (Holsworthy Military Reserve) that is densely vegetated. Finally to the north are further dwellings fronting Pleasure Point Road, and significant bushland that surrounds the creek corridor running down to the Georges River.

3. DETAILS OF THE PROPOSAL

At Council's ordinary meeting on 11 December 2019, it was resolved that Council:

1. *Directs the CEO to prepare a planning proposal to amend the dwelling density map in the Liverpool Local Environmental Plan (LLEP) 2008 that increases the permitted number of lots on certain sites along Pleasure Point Road, Pleasure Point from four lots to five lots; and*
2. *Notes that, once drafted, the planning proposal will be reported to the Liverpool Local Planning Panel for advice and to a future Council meeting for a decision on whether to seek a Gateway determination from the Department of Planning, Industry and Environment.*

The planning proposal has been drafted as required by the above Council resolution (see **Attachment 1**).

The Proposal

The planning proposal seeks to increase the existing four lot restriction stipulated within Clause 7.12 LLEP 2008 to a maximum of five lots for each of the original large lots. The amendment involves a change to the Dwelling Density Map applying to the subject site. The impetus for the planning proposal is to increase the yield potential of these lots, and to formalise the existence of a five lot subdivision that has been approved previously.

4. CONSIDERATIONS FOR STRATEGIC MERIT

In summary, the proposed amendment is deemed to have strategic merit as outlined within the planning proposal justification report (Attachment 1). The proposal gives effect to the Metropolitan and District Plan, as well as the Liverpool Local Strategic Planning Statement (LSPS). The proposed amendment has also been assessed against the current zoning objectives of the site, and considered the DCP controls applying to the locality. Finally, consideration has been given to the relevant 9.1 Ministerial Directions and State Environmental Planning Policies to confirm consistency.

5. CONSIDERATIONS FOR SITE SPECIFIC MERIT

In summary, the proposed amendment is deemed to have site specific merit as outlined within the planning proposal justification report (Attachment 1). It is noted that the site is constrained in regard to water servicing, bushfire threat and because of the existence of significant bushland. Early consultation has been undertaken with Sydney Water and the Rural Fire Service (RFS) to

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ensure sufficient site-specific consideration is completed at this early stage in the planning proposal process.

6. CONCLUSION

It is recommended that the planning proposal proceeds to a gateway determination as the proposal has demonstrated strategic and site specific merit and is consistent with the resolution of Council.

7. ATTACHMENTS

1. Planning Proposal
2. Council Resolution
3. Sydney Water Initial Referral
4. RFS Initial Referral

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ITEM No:	4
APPLICATION NUMBER:	RZ-6/2019
SUBJECT:	Planning proposal to amend the Dwelling Density Map 1 of the Liverpool Local Environmental Plan 2008 to allow four additional lots in Pleasure Point.
LOCATION:	Lots 46, 48, 50, 52, Lot 5, 62, 64a, 64b, 66, 68, 70, 72, 74, and 76 Pleasure Point Road, Pleasure Point
APPLICANT:	Liverpool Council
AUTHOR:	Luke Oste

ADVICE OF THE PANEL

The Panel members have familiarised themselves with the site and been provided with the Council officer's report and the documents supporting the planning proposal.

The Panel acknowledges that this planning proposal has been instigated by Council and aims to formalise a limited increase in the density of dwellings in this precinct that had previously been the subject of an number of development applications seeking variation of what was considered to be a development standard.

The Panel notes the Rural Fire Service concern about resubdivision of Lot 86 DP 1134481, but agrees with Council officers that this Lot should be included in the planning proposal at this stage in the process.

The Panel otherwise considers that the planning proposal exhibits strategic and site specific merit for the reasons outlined in the Council officer's report. The Panel recommends that Council resolve to progress the planning proposal to a gateway determination.

VOTING NUMBERS:

4-Nil



GRANTS, DONATIONS, AND CORPORATE SPONSORSHIP POLICY

Adopted: 29 May 2019

TRIM: 2016/2682, 091748.2019



GRANTS, DONATIONS, AND CORPORATE SPONSORSHIP POLICY**1. LEGISLATIVE REQUIREMENTS**

Local Government Act 1993, Section 356

2. OBJECTIVE

Council is committed to building strong and resilient communities within the Liverpool Local Government Area (LGA) and to increase social wellbeing for all residents. One way of achieving these goals is to provide financial assistance in the form of grants, donations, and sponsorships to individuals and groups to develop leadership skills, increase participation in community life and address identified social issues. Council seeks to support programs that can build or enhance the reputation and brand of Liverpool City in accordance with Council's Community Strategic Plan.

3. DEFINITIONS

Acquittal	Reporting on the activities of a project as set out in the funding agreement. This could take the form of providing financial reports, written reports, evidence of activity performance and where funding was spent
Auspice	An agreement where an incorporated organisation agrees to apply for funding or resources on behalf of an applicant that is not incorporated. If the application is successful, the auspicing organisation then administers the resources on behalf of the applicant, and is legally responsible for ensuring that the terms of the agreement are met
Charity	Listed on the Australian Charities and Not-for-profit Commission (ACNC) website as a registered charity
Community Capacity Building	Involves the provision of community activities that contribute to people developing their own capacity and resilience to maintain and build on their own resources and to manage future challenges
Incorporated Association	A legal entity (organisation) that provides legal protection to its members in legal transactions

4. GRANT PRIORITIES

- 4.1** Council seeks to enhance the use of public funds through effective and efficient grant processes. Clear grant program objectives are linked to the organisation's strategic goals, outlined in Council's Community Strategic Plan. Council's grants and sponsorship programs provide a coordinated and integrated approach to growing Liverpool socially, culturally, economically and environmentally.

Council grants, donations and sponsorships may be provided to individuals who reside in the LGA, or to community-based groups, organisations and services that operate within the Liverpool LGA and/or for the benefit of Liverpool residents. Council facilitates nine programs for the allocation of grants, donations, and sponsorship:

1. Kick-Starter Grants
2. Small Grants
3. Liverpool Young Achievers Awards
4. Community Grants
5. Sustainable Environment Grants
6. Matching Grants
7. Corporate Sponsorship
8. Sporting Grants
9. Sporting Donations

GRANTS, DONATIONS, AND CORPORATE SPONSORSHIP POLICY**4.2 GRANT MAKING PRINCIPLES**

The key principles that inform grant making by Council are:

- Council's Community Strategic Plan. All grants align with Council's Community Strategic Plan, and other social, economic and environmental policies and plans;
- Partnerships and collaboration. Develop and maintain partnerships between Council and the community to achieve Council's strategic directions based on mutual respect and transparency;
- Capacity building. Support community groups and organisations to function positively, develop skills and increase community participation;
- Social inclusion. Liverpool is a diverse community and our grant making process encourages directing resources to specific needs of disadvantaged groups;
- Leveraging value. Council seeks to leverage community expertise, capacity, networks and resources to provide the best suite of grant programs to meet the needs of and maximise positive outcomes for the community and business. Council supports projects that represent good value for the level of cash or in-kind support requested. Through effective and efficient grant management processes, Council seeks to ensure costs for administration by the Council and grant applicants are minimised;
- Good governance. Council is committed to demonstrating integrity, professionalism and transparency in our decision making and have strong governance structures in place to support this. Council will ensure that grant processes are transparent and fair. Applications are assessed objectively against the assessment criteria. All conflicts of interests are addressed and declared as part of this process; and
- Reflection and learning. As part of Council's commitment to continuous improvement, Council will ensure there are evaluation mechanisms in place and opportunities for feedback on grant processes.

5. GENERAL ELIGIBILITY AND EXCLUSIONS**5.1 GENERAL ELIGIBILITY**

To be eligible for funding an applicant must:

- a) Acquit previous Council grants, donations or sponsorship and have no outstanding debts to Council;
- b) Be a resident of the LGA, or an organisation located in the LGA and/or principally providing services to the residents of Liverpool; and
- c) Include all required supporting documentation with their application.

5.2 APPLICATIONS THAT ARE INELIGIBLE FOR FUNDING INCLUDE:

- a) Projects that duplicate existing Council services or programs.
- b) Projects that directly contravene existing Council policy.
- c) Projects that do not meet the identified priority needs of Liverpool as set out in Council's Community Strategic Plan.
- d) Applications from government departments, political parties, or commercial/profit-making/private organisations (excluding Corporate Sponsorship which accepts applications from private organisations).
- e) Applications from charities for general donations.
- f) Applications for general fundraising activities, general operational expenditure (e.g. administration, insurance, office equipment, car parking, IT costs/equipment), shortfalls in funding by government departments, or completed/retrospective projects.
- g) For employee salaries/wages or any direct employment costs.
- h) Projects that will rely on recurrent funding from Council.

GRANTS, DONATIONS, AND CORPORATE SPONSORSHIP POLICY

- i) Identical projects that have previously been funded by Council (excluding Corporate Sponsorship).
- j) Projects or programs that charge people for participation, including charges to participants through an individual's NDIS funding plan.

5.3 FURTHER CONDITIONS**5.3.1 Council will not:**

- a) Provide in-house design, printing and distribution services (organisations may apply for funding to undertake these activities themselves).
- b) Provide cleansing and waste services for events (organisations may apply for cash funding to undertake these activities themselves).
- c) Support political activities or activities that could be perceived as benefiting a political party or political campaign.
- d) Support religious activities that could be perceived as divisive within the community.
- e) Support activities that deliberately exclude any individuals or groups from participating or attending.
- f) Provide in-kind support of any nature (eg: the provision of chairs or portable toilets for events).

5.3.2 For specific eligibility requirements and exclusions for each program, refer to Section 7 of this policy.**5.4 ETHICS FRAMEWORK**

Council will not support any activities or entities that:

- a) Pollute land, air or water, or destroy or waste non-recurring resources.
- b) Market or promote products/services in a misleading or deceitful manner.
- c) Produce, promote or distribute products/services likely to be harmful to the community.
- d) Acquire land or commodities primarily for speculative gain.
- e) Create or encourage militarism or engage in the manufacture of armaments.
- f) Entice people into financial over-commitment
- g) Exploit people through the payment of below award wages or poor working conditions.
- h) Discriminate by way of race, religion, or sex in employment, marketing or advertising.
- i) Contribute to the inhibition of human rights generally.

5.5 CONFLICTS OF INTEREST**5.5.1 Council staff assessing and determining applications should identify and manage any potential conflicts of interest in accordance with Council's Code of Conduct and Ethical Governance: Conflicts of Interest Policy.****5.5.2 Members of Council staff and Councillors must ensure that any affiliation between them and the applicant is appropriately managed when assessing and determining applications for grants and donations.****6. GRANTS MANAGEMENT PROCESS****6.1 APPLICATIONS**

All applicants must register with Council's online grants management system before applying. Applications must be submitted using the approved online application form on Council's online grants management system. Council will not accept any hard copy or emailed submissions, or any submissions after any applicable closing date or time.

GRANTS, DONATIONS, AND CORPORATE SPONSORSHIP POLICY**6.2 ASSESSMENT AND RECOMMENDATIONS**

- 6.2.1 All applications received by Council will be assessed by relevant Council staff members. Sporting Grants and Donations will be sent to the Sports Committee for review. Recommendations for funding of \$1,000 or less may be approved by the CEO or their delegate, provided the funding is in accordance with sections 356(3), 377(1A), and 378 of the Local Government Act 1993. Council will be notified of funded projects by Council report as soon as appropriately possible. Recommendations for funding over \$1,000 will be made to Council for endorsement in accordance with Section 356 of the Local Government Act 1993.
- 6.2.2 For grant programs that are open for applications all year, recommendations will be made to the next available Council Meeting. For grant programs with specific funding rounds, recommendations will be made within three months of the closing date.
- 6.2.3 Unsuccessful applicants are encouraged to seek feedback from relevant Council staff on their application. Programs are highly competitive and even though an application may meet the program criteria it may not be competitive against other applications.
- 6.2.4 Council uses the Australian Business Register (ABN) as its sole source of truth to confirm an applicant's operating status as an incorporated not-for-profit or charitable organisation <http://www.abr.business.gov.au/>.
- 6.2.5 Council values and recognises the importance of applicant financial and in-kind contributions. Applicants that demonstrate a commitment to the project through either financial or volunteer support are considered favourably.

6.3 APPROVAL

- 6.3.1 The elected Council has authority to approve grants, donations, and sponsorship. In some circumstances, specific delegation for this purpose is given to the CEO.
- 6.3.2 Approval of a grant, donation or sponsorship does not imply that Council has given any other consent. Applicants should note that events or any capital works require approvals and consents from Council, NSW Police and other state government agencies.

6.4 FUNDING AGREEMENTS

All successful applicants are required to enter into a funding agreement before funds are released and before a project can commence.

Council's support must be acknowledged on all promotional material. The Council logo should be used with the text "proudly supported by Liverpool City Council". All promotional material must be approved by Council prior to publication. Council also reserves the right to receive the following: joint media release opportunities, opportunity for Mayor to speak at the event or occasion, space at the event (table or marquee stall), and tickets to attend the event or occasion.

6.5 REPORTING

All grant recipients are required to acquit their project as detailed in their funding agreement. Reports are to be submitted using the approved online grants management system. Reports provide feedback on the success of the project in terms of the agreed outputs and outcomes, relevant data, and any lessons learnt. Funding recipients are required to submit detailed financial reports and may be requested to provide further documentation and evidence of expenditure. Council may audit recipients at any time. Previously funded applicants must receive an acknowledgement of a successful acquittal

GRANTS, DONATIONS, AND CORPORATE SPONSORSHIP POLICY

prior to applying for further funding. No further funding will be granted to any organisation who has failed to submit an acquittal report for previous funding from Council.

6.6 MINOR CHANGES TO THIS POLICY

Council authorises the CEO to make minor changes to this policy to reflect changes in legislation, expiry of or changes to grant programs, and changes in Council structure.

GRANTS, DONATIONS, AND CORPORATE SPONSORSHIP POLICY**7. FUNDING PROGRAMS****7.1 KICK-STARTER GRANTS | UP TO \$500 | OPEN ALL YEAR**

This program supports individuals or unincorporated community groups to establish a social enterprise aimed at addressing priorities in Council's Community Strategic Plan or a project which promotes social inclusion and increased community participation. Applications can be made for funding of up to \$500 per financial year. Repeated applications of the same project in subsequent years will not be accepted. Applications for events are not eligible under this program.

Project outcomes must meet at least one of the below priorities:

- a) Improve connections and social networks within the community.
- b) Increase participation in community activities, including by those experiencing social disadvantage.
- c) Facilitate access to education, training, or employment opportunities.
- d) Improve collaboration and coordination of community support and services.
- e) Improve social and physical wellbeing through prevention and early intervention approaches.

7.1.1 Program timeframe

Applications can be made all year. Grants must be spent within 12 months of receiving them.

7.1.2 Eligibility

To be eligible for funding applicants must:

- a) Be an individual resident or unincorporated community group based within the Liverpool LGA.
- b) Be 100% volunteer run or operate as a not-for-profit.
- c) Must update Council's Community Development Worker (Funding and Support) during the delivery of the project or initiative.

For more information on eligibility and exclusions refer to Section 5: General Eligibility and Exclusions.

Assessment criteria

To be considered for a grant, applicants should clearly describe the proposed project and how it will meet the following criteria:

Evidence provided to support the need for the project, including addressing at least one of the strategic directions in Council's Community Strategic Plan
The anticipated number of individuals that will benefit from the proposed project
Timeframe and budget are realistic and align with project objectives
Evidence of collaboration and partnership to maximise the use of existing community resources and to avoid duplication
Evidence that project strategies are innovative or practical to meeting the project need
Appropriate project evaluation method
Sustainability of project post funding

GRANTS, DONATIONS, AND CORPORATE SPONSORSHIP POLICY

7.2 SMALL GRANTS | UP TO \$1,000 | OPEN ALL YEAR

This program supports a range of small-scale community initiatives and is for community groups who may not have experience with grants programs. It aims to provide more intensive support and build the capacity of less established groups to familiarise themselves with grants programs and Council processes.

7.2.1 Expected program outcomes

Initiatives and projects can contribute to one or more of the following outcomes:

- Develop trial community capacity building programs or facilitate small-scale community awareness events.
- Increase engagement of individuals in academic, cultural, and environmental fields.
- Improve relative equality, resilience and adaptive capacity of Liverpool's diverse communities.
- Enhance positive social, cultural, or sustainability outcomes for local communities related to Council's strategic priorities.

7.2.2 Available funding

Applications can be made for funding of up to \$1,000 per project. Repeated applications of the same project or initiative in subsequent years will not be accepted.

7.2.3 Program timeframe

Grants must be spent within 12 months of receiving them.

7.2.4 Eligibility

To be eligible for funding applicants must:

- Be incorporated or auspiced by an incorporated organisation;
- A non-profit community service organisation or group providing programs/services to the residents of Liverpool; and
- Supply a copy of their most recent annual report and/or financial statements.

For more information on eligibility and exclusions refer to Section 5: General Eligibility and Exclusions.

7.2.5 Assessment criteria

To be considered for a grant, applicants should clearly describe the proposed project and how it will meet the following criteria:

Evidence that the organisation has capacity to deliver the project
Evidence provided to support the need for the project, including addressing at least one of the strategic directions in Council's Community Strategic Plan
The anticipated number of individuals that will participate in and benefit from the proposed project
Timeframe and budget are realistic and align with project objectives
Evidence of collaboration and partnership to maximise the use of existing community resources and to avoid duplication
Evidence that project strategies are innovative or practical to meeting the project need
Appropriate project evaluation method
Sustainability of project after funding ceases

GRANTS, DONATIONS, AND CORPORATE SPONSORSHIP POLICY**7.3 LIVERPOOL YOUNG ACHIEVERS AWARDS | OPEN ALL YEAR**

The Liverpool Young Achiever Awards are given as a prize to a student who has excelled in citizenship, academic studies, artistic endeavors, or sporting proficiency.

7.3.1 Available funding

Under each applicable category there will be two prizes as follows:

<u>Citizenship:</u>	<u>Artistic Endeavours:</u>
1x \$1,000 for a high school student	1x \$1,000 for a high school student
1x \$500 for a primary school student	1x \$500 for a primary school student
<u>Academic Studies:</u>	<u>Sporting Proficiency:</u>
1x \$1,000 for a high school student	1x \$1,000 for a high school student
1x \$500 for a primary school student	1x \$500 for a primary school student

Highly Commended:

All eligible nominees who are not selected for the major prize will be awarded a \$200 student donation.

Each high school and primary school are only eligible to submit one student nomination per year.

7.3.2 Program timeframe

Applications will be accepted from the beginning of school Term 1 until the end of Term 3. A presentation ceremony will be held during Term 4.

7.3.3 Eligibility

To be eligible for this award applicants must:

- Be a high school or primary school based in the Liverpool Local Government Area (LGA);
- Be nominating a student attending either a high school or primary school based in the Liverpool LGA; and
- Supply a letter of support from the principal of the applying school for the nominated student.

For more information on eligibility and exclusions refer to Section 5: General Eligibility and Exclusions.

GRANTS, DONATIONS, AND CORPORATE SPONSORSHIP POLICY**7.4 COMMUNITY GRANTS | UP TO \$5,000 | TWO ROUNDS PER YEAR**

This program provides financial assistance to community groups, organisations and services for projects that foster partnerships and collaboration, build capacity, promote social inclusion and increase community participation. The program assists in developing pilot or trialling innovative services or programs that address the needs of residents, workers and visitors. The program will support projects that:

- a) Improve connections and build social networks within the community.
- b) Increase participation of people in community activities and programs, including members of the community who are experiencing social disadvantage.
- c) Facilitate access to education, training and employment opportunities.
- d) Improve opportunities for people to build confidence and develop their skills.
- e) Facilitate inclusion and access to facilities, services, open spaces and activities.
- f) Improve collaboration and coordination of community support and services.
- g) Improve social or physical wellbeing through prevention and early intervention.
- h) Strengthen governance and accountability in community organisations.

7.4.1 Expected program outcomes

Initiatives and projects can contribute to one or more of the following outcomes:

- a) Increased involvement and engagement by communities in social activities.
- b) Increased number of people feeling a strong sense of social wellbeing.
- c) Strengthened maintenance, management or improvement of physical and mental health and wellbeing.
- d) Improved access to information and development of new skills.
- e) Increased numbers of people undertaking educational courses and gaining sustainable employment.
- f) Reduced financial hardship and social disadvantage, including food insecurity and homelessness.

7.4.2 Available funding

Applications can be made for funding of up to \$5,000 per year.

7.4.3 Program timeframe

This grant program has two rounds per year. Round dates will be advised on Council's website. Grants must be spent within 12 months of receiving them.

7.4.4 Program eligibility and exclusions

To be eligible for funding through the Community Grants Program applicants must:

- a) Be incorporated or auspiced by an incorporated organisation.
- b) A non-profit community service organisation or group providing programs/services to the residents of Liverpool.
- c) Have public liability insurance of at least \$10 million (must be active during the period of funding).
- d) Supply a copy of their most recent annual report and/or financial statements.

For more information on eligibility and exclusions refer to Section 5: General Eligibility and Conditions.

7.4.5 Assessment criteria

To be considered for a grant, applicants should clearly describe the proposed project and how it will meet the following criteria:

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Evidence that the organisation has capacity to deliver the project
Evidence provided to support the need for the project, including addressing at least one of the strategic directions in Council's Community Strategic Plan
Anticipated number of individuals participating in and benefiting from the proposed project
Timeframe and budget are realistic and align with project objectives
Evidence of collaboration and partnership to maximise the use of existing community resources and to avoid duplication
Evidence that project strategies are innovative or practical to meeting the project need
Appropriate project evaluation method
Sustainability of project after funding ceases

GRANTS, DONATIONS, AND CORPORATE SPONSORSHIP POLICY

7.5 SUSTAINABLE ENVIRONMENT GRANTS | UP TO \$5,000 | TWO ROUNDS PER YEAR

The Sustainable Environment Grants program provides financial assistance to support schools and community groups to play an active role in reducing their impact on the environment and implementing environmentally sustainable actions. The program seeks projects focused on environmental improvement, sustainability education, awareness-raising and the promotion of sustainable living as a way of life that provide benefit to the natural environment and local community. Projects can include:

- **Waste Minimisation** – including reuse, recycling, litter reduction, composting and worm farming, waste education projects.
- **Sustainable Water Use** – including water efficiency, stormwater harvesting and water reuse, rain gardens and water quality improvements, and sustainable water use education programs.
- **Environmental Improvement** – including protection and enhancement of natural areas, habitat creation for native fauna, and natural environment education programs.
- **Sustainable Living** – including establishment of vegetable or native display gardens, bush tucker or community gardens, and the keeping of chickens or native bees.

7.5.1 Expected program outcomes

Grants from this program can contribute to one or more of the following outcomes:

- a) Build the capacity of schools and community groups to promote efficient resource use and improve the quality of the local environment.
- b) Encourage community members to become involved and take initiative in improving their behaviours for a more sustainable future.
- c) Encourage schools and community groups to identify and implement innovative approaches and positive solutions that protect and enhance Liverpool's unique natural environment.
- d) Improve the health of vegetation, water quality and healthy ecosystems contributing to cleaner waterways, air and healthier native vegetation.
- e) Raise awareness and promote sustainable living as a way of life, including actively participating in Council's environmental programs and activities.
- f) Generate positive community engagement (e.g. involvement of local businesses, environmental education centres or botanic gardens).

7.5.2 Available funding

Applications can be made for funding of up to \$5,000 per year by a school or an incorporated community group.

7.5.3 Program timeframe

This grants program has two rounds per year. Round dates will be advised on Council's website. Grants must be spent within 12 months of receiving them.

7.5.4 Program eligibility and exclusions

To be eligible for the Sustainable Environment Grants program applicants must have not received funding under this or another program for the same project (separate and additional stages of a previous project are eligible), and:

- a) Be a registered NSW school, not-for profit pre-school or child care centre; or
- b) An incorporated, non-profit, community service, welfare or charitable organisation or group providing programs or services to the residents of Liverpool; or
- c) Community group auspiced by an incorporated organisation.

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Applications will not be accepted for:

- a) For profit organisations
- b) Overall project coordination
- c) Capital works for major infrastructure or construction of buildings
- d) Work being completed on land not owned by the applicant without evidence of approval from the landowner.

For more information on eligibility and exclusions refer to Section 5: General Eligibility and Conditions.

7.5.5 Assessment criteria

To be considered for a grant, applicants should clearly describe the proposed project and how it will meet the following criteria:

Demonstrate the capacity to deliver the project or activity and subsequent sustainability of the project beyond initial funding
Evidence provided to support the need for the project, including addressing at least one of the strategic directions in Council's Community Strategic Plan
Demonstrate tangible and measurable environmental outcomes
The anticipated number of individuals that will participate in and benefit from the project
Demonstrate measurable student learning and/or increase teacher capacity to deliver environmental education
Value for money

GRANTS, DONATIONS, AND CORPORATE SPONSORSHIP POLICY

7.6 MATCHING GRANTS | UP TO \$20,000 | TWO ROUNDS PER YEAR

This program is designed to provide financial support to projects and activities that build or strengthen communities within Liverpool. These projects will focus on supporting the development and implementation of community capacity building activities and providing opportunities for a broader cross section of the community to be involved in community and recreational activities. Funding will support projects that address one of the following categories:

Arts	Contribute community art to a neighbourhood or work to increase the participation of residents within art-based programs/projects.
Community capacity building	Bring residents together and enhance participation in the community, including those who are experiencing social disadvantage, or provide benefits to address an identified community need. This could be a community event or community-based capacity building project.
Youth engagement	Focus on increasing the ability of young people to obtain skills and qualifications or increase their active participation within the community.
Accessibility	Enhance and improve access options for the community, either through education, transport, disability access or connectivity.
Environmental	Address environmental issues and concerns or contribute to environmental education and awareness.
Community safety/public space activation	Address community safety and security issues such as activities that activate or diversify the night time economy including pop up entertainment and night time performances in public spaces. These projects can also include addressing perceptions of community safety.
Sports development	Contribute to the development of sporting groups or enhance participation in sporting and recreational activities.

7.6.1 Expected program outcomes

Grants from this program can contribute to one or more of the following outcomes:

- Develop social connections and partnerships within communities, or reinforcement of those that already exist.
- Increased participation in community activities and organisations by improving collaboration and coordination of community support and services.
- Strengthened opportunities for community members and others to build personal creativity and self-expression.
- Increased opportunities for community members to acquire or develop new skills and/or employment.
- Create, renew or revitalise places and spaces within the community.
- Strengthened community members' feelings of safety and sense of belonging within public spaces.

7.6.2 Available funding

The matching grants program recognises community contribution towards a project and can offer up to \$20,000 support to match this contribution. The program supports projects that involve genuine community participation. By 'matching' what the community contributes, Council is building a sense of community and strengthening partnerships as people work together on the project. Contributions from the community or Council can be made in cash or value-in-kind. Recognised in-kind community contributions include:

- Design services, professional services, trade services (such as plumbing), provision of trucks and plant, concreting and painting, donated supplies, materials or venues.
- Volunteer time such as labour, set up and pack down, and meeting time to identify, plan and implement projects. The rate of volunteer time is calculated as \$20 per hour. For professional or contracted services, the rate is \$75 per hour.
- Direct cash input to the project through donations or income generated.

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The value of in-kind contributions should be verified by an independent quote, and where the value is in question, Council's assessment of the value of in-kind contributions will take precedence in the assessment of the matching grant given. The costs of Council and other approvals required by government agencies/authorities must also be considered when applying under this grants program.

7.6.3 Program timeframe

This program accepts applications twice per year. Grants must be spent within 12 months of receiving them.

7.6.4 Program eligibility and conditions

To be eligible for the Matching Grants program applicants must:

- a) Be incorporated or auspiced by an incorporated organisation.
- b) A non-profit community service organisation or group providing programs/services to the residents of Liverpool.
- c) Have public liability insurance of at least \$20 million (must be active during the period of funding).
- d) Supply a copy of their most recent annual report and/or financial statements.

Organisations are only eligible to receive funding through this program once each financial year. Council reserves the right to defer consideration of a Matching Grant application where planning, leasing or ownership, statutory approvals, or appropriate development issues are raised by a project.

For more information on eligibility and exclusions refer to Section 5: General Eligibility and Exclusions.

7.6.5 Assessment criteria

Matched contribution (financial or in-kind)
Consulted with Council staff prior to submitting application
Project is considered an appropriate development on the proposed site
Project meets Council's construction and safety standards
Evidence that the organisation has capacity to deliver the project
Evidence provided to support the need for the project, including the degree to which the project addresses at least one of the strategic directions in Council's Community Strategic Plan
The anticipated number of individuals that will participate in and benefit from the proposed project
Timeframe and budget are realistic and align with project objectives
Evidence of collaboration and partnership to maximise the use of existing community resources and to avoid duplication
Proposed project evaluation method including sustainability of project

GRANTS, DONATIONS, AND CORPORATE SPONSORSHIP POLICY**7.7 CORPORATE SPONSORSHIP | UP TO \$10,000 | OPEN ALL YEAR**

Council may provide financial contributions of up to \$10,000 through its Corporate Sponsorship Program to organisations, groups, or individuals for programs that can build or enhance Council's reputation. These include but are not limited to providing appropriate branding benefits and opportunities for Council, and/or providing cross-promotional opportunities for Council's services or facilities.

Applications to Council for sponsorship must address at least one of the following:

1. Economic benefit

- a) Delivers significant economic benefit to the Liverpool LGA.
- b) Delivers benefit to tourism, hospitality and retail sectors through the attendance of regional, national, or international delegates at events.
- c) Provides a platform for research, trade, and/or investment opportunities.
- d) Attracts national or international attention to Liverpool as a place to reside, visit, work and/or invest.
- e) Creates employment opportunities within the Liverpool LGA.

2. Community, cultural, and social benefit

- a) Provides an innovative opportunity to meet community needs and promote Liverpool's cultural diversity and celebrate our City's uniqueness.
- b) Enhances Liverpool's profile and reputation as an outward looking, creative and connected city.
- c) Creates opportunities for education and information exchange between Council, the community and the sector.
- d) To support the organisation and activation of a charity event with the Liverpool LGA. Sponsorship funds are not to be used for direct fundraising, including but not limited to the purchase of tickets or tables at a fundraising event.
- e) Attracts a major program to Liverpool that has South West-Sydney region, state or national significance.

3. Environmental benefit

- a) Enhances Liverpool's reputation as a sustainable city through leadership in waste and environment management.

7.7.1 Expected program outcomes

Projects must contribute to one or more of the following outcomes:

- a) Provide an opportunity for measurable economic, social, environmental and/or cultural benefits to Council and the Liverpool LGA.
- b) Provide opportunities for the community to participate and contribute in activities/events in the Liverpool LGA.
- c) Create a valuable strategic alliance for Council.
- d) Provide extensive coverage and promotional/publicity opportunities across a range of media outlets.
- e) Promote Liverpool's reputation as a great place to live, visit, work, and invest.

7.7.2 Program timeframe

- This program accepts applications all year.
- Applications must be submitted at least three months prior to an event taking place. Applications submitted with less than three months lead time will be deemed ineligible.

GRANTS, DONATIONS, AND CORPORATE SPONSORSHIP POLICY

- Activities should take place within 12 months of successful sponsorship funding being received.

7.7.3 Program eligibility and conditions:

To be eligible for the Corporate Sponsorship program applicants must:

- a) Be incorporated or auspiced by an incorporated organisation and hold a current ABN.
- b) A non-profit community service organisation or group providing programs/services to the residents of Liverpool.
- c) Have public liability insurance of at least \$10 million (must be current during the period of funding).
- d) Supply a copy of their most recent annual report and/or financial statements.
- e) Must apply for sponsorship towards an event or activity in the Liverpool LGA that attracts a significantly high level of attendance from the community and provides direct benefits for Liverpool based organisations and/ or Liverpool residents.
- f) Must ensure that attendance and participation is free where sponsorship is sought for a community event.
- g) Must be registered with the Australian Charities and Not-for-profits Commission if an application is for a local charity event.

7.7.4 Funding will not be provided to:

- a) Projects that do not address the identified directions of the Liverpool LGA as set out in Council's Community Strategic Plan.
- b) Charities for general donations including the purchase of tickets or fundraising tables at an event.
- c) Projects that will rely on recurrent funding from Council.
- d) More than one event within the Liverpool area in a two-month period that celebrates or marks a specific occasion or activity.
- e) Organisations whose activities are not aligned with the City's ethical framework.
- f) Previous recipients who have not fulfilled the conditions of a sponsorship.
- g) Organisations that are not registered in Australia.
- h) Activities or events that do not benefit the Liverpool LGA or its residents.
- i) Underwrite events, programs or projects.

For more information on eligibility and exclusions refer to Section 5: General Eligibility and Exclusions.

7.7.5 Council's current standing sponsorship resolution:

Sponsorship Activity	Amount	Council Resolution
Police Officer of the Year	\$1,000	27/06/2011

- 7.7.6 Approval of sponsorship does not imply that Council has given any other consent. Applicants should note that many festivals and events require approvals and consents from Council, NSW Police and other NSW Government agencies. For guidelines on applying to host an event in Liverpool, visit www.liverpool.nsw.gov.au/whats-on/events/event-organisers-information-kit-guidelines

GRANTS, DONATIONS, AND CORPORATE SPONSORSHIP POLICY**7.8 SPORTING GRANTS | UP TO \$5,000 | ONE ROUND PER YEAR**

This program offers funding to sporting clubs and junior disability sporting clubs to assist with the development of young people and encourage participation of the broader community in local sporting and recreational activities. Grants can also be used towards the purchase or maintenance of sporting equipment.

Funding will support applications by recreation and sporting organisations/clubs under one of six categories:

- a) **Sports development** – Coaching clinics, sports camps, or training/development
- b) **Ground development** – Minor capital improvements
- c) **Maintenance Equipment** – Line marking equipment or ground maintenance equipment (to be eligible, equipment must remain the property of the club)
- d) **Sporting Equipment** – Kits, bags, first aid supplies, safety equipment (to be eligible, equipment must remain the property of the club)
- e) **Education** – First aid training, coaching programs or safe play
- f) **Club diversity** – Introduction of additional sports or expansion of club to encourage greater community involvement

7.8.1 Expected program outcomes

Projects must contribute to one or more of the following outcomes:

- a) Increased opportunities for participation of the broader community in sporting and recreational activities.
- b) Improved condition and functionality of sporting equipment.
- c) Enhanced awareness of emerging trends in sports development and demonstrated best practice.
- d) Strengthened maintenance, management or improvement of physical and mental health and wellbeing by improving opportunities for physical activity.

7.8.2 Available funding

Grants of up to \$5,000 per sporting club are available. Clubs may submit applications for more than one project. Within the funding pool, \$5,000 is reserved to fund applications that support participants with a disability. Where eligible applications that support participants with a disability are less than \$5,000 the remaining funds are returned to the main pool of funding for distribution.

7.8.3 Program timeframe

This program accepts applications once per year. Grants must be spent within 12 months of receiving them.

7.8.4 Program eligibility and exclusions

To be eligible for the Sporting Grants Program applicants must:

- a) Be incorporated or auspiced, a non-profit recreation or sporting organisation/club, providing programs/services to the residents of Liverpool.
- b) Have public liability insurance of up to \$10 million.
- c) Supply a copy of most recent annual report and/or financial statements.
- d) Have not received funds from the Sporting Grants program in the previous year.

For more information on eligibility and exclusions refer to Section 5: General Eligibility and Exclusions.

GRANTS, DONATIONS, AND CORPORATE SPONSORSHIP POLICY

7.8.5 Assessment criteria

An independent panel consisting of members from the Liverpool Sports Committee will assess applications based on set criteria. To be considered for a grant, applicants should clearly describe the proposed project and how it will meet the following criteria:

Application received prior to the closing date
Proof of costs provided
Grant able to be spent within 12 months
Applications signed by Club Office bearers
Project meets Council's construction and safety standards
Demonstrate improvements to the delivery of junior sport in Liverpool
Demonstrate meeting an identified community need including access opportunities for specific special needs groups or individuals
Timeframe and budget are realistic and align with project objectives
Contribution from club (financial or in-kind)
Demonstrate benefit to the broader community
Proposed project evaluation method including sustainability of project

7.9 SPORTING DONATIONS | UP TO \$500 | OPEN ALL YEAR

This program enables Council to provide small amounts of funding to assist community members in their efforts to achieve excellence in sport at a regional, state or national representative level. Individuals and teams based in the Liverpool LGA are eligible to apply for donations towards the cost of participating in representative sporting events for which they have qualified. Donations are based on the level of representation achieved and where events will be held. Participation at school sport events is also eligible for consideration.

7.9.1 Expected program outcomes

Donations from this program can contribute to one or more of the following outcomes:

- Increased participation of individuals/teams in representative sporting events.
- Improved accessibility to participation in representative sporting events.
- Improved confidence and capacity of local individuals and teams by acknowledging and supporting participation at a representative level.
- Enhanced positive social outcomes and opportunities for local communities.

7.9.2 Available funding

Donations are available for the following amounts:

- \$100 for regional representation (competitor only), or for coach/referee/umpire/official representation at a regional, state or national event more than 100km from Liverpool.
- \$200 for state representation (competitor only).
- \$300 for Australian national representation at an event within New South Wales, Australian Capital Territory, Queensland and Victoria (competitor only).
- \$400 for Australian national representation at an event within Tasmania, South Australia, Northern Territory and Western Australia (competitor only).
- \$500 for Australian national representation at an overseas event (competitor only).
- \$500 for team representation.

7.9.3 Program timeframe

This program accepts applications all year and applicants are required to submit their application prior to the event taking place. Activities must take place within 12 months from when the application was submitted. Information must be provided on the costs associated with participating in the representative events.

GRANTS, DONATIONS, AND CORPORATE SPONSORSHIP POLICY

7.9.4 Program eligibility and exclusions

To be eligible for funding through the Sporting Donations Program the following criteria applies:

- a) Individual applicants must be a resident of the Liverpool LGA.
- b) Applicants must provide proof of selection for the event.
- c) Applications from students at state, private or independent schools or for participation at school sport events, are eligible for consideration.
- d) Team applications – must have a minimum of 75% of the team residing in the Liverpool LGA, club must be based in the Liverpool LGA, and a maximum of three teams per club can be funded in a financial year.

For more information on eligibility and exclusions refer to Section 5: General Eligibility and Exclusions.

7.9.5 Assessment criteria

To be considered for a grant, applicants should meet the following criteria:

Evidence the individual/team qualified for a representative sporting event
Information provided on costs associated with participating in the representative event
Evidence that the individual or 75% of the team resides in the Liverpool LGA

AUTHORISED BY

Council Resolution

EFFECTIVE FROM

XXXX 2019

DEPARTMENT RESPONSIBLE

City Community and Culture (Community Development and Planning)

REVIEW DATE

The policy will be reviewed every two years.

VERSION	AMENDED BY	DATE	TRIM NUMBER
1	Council Resolution	18 October 2010	158320.2014
2	Council Resolution	29 May 2013	097264.2013
3	Council Resolution	31 July 2013	150967.2014
4	Council Resolution	25 February 2014	026269.2014
5	Council Resolution	28 May 2014	126057.2014
6	Council Resolution	30 September 2015	227843.2015
7	Minor changes approved by CEO	12 July 2016	185151.2016
8	Council Resolution	26 April 2017	026648.2017
9	Council Resolution	26 April 2019	

THIS POLICY WAS DEVELOPED AFTER CONSULTATION WITH

City Community and Culture, Corporate Services (Governance, Legal and Procurement), Infrastructure and Environment.

REFERENCES

Australian Institute of Grants Management: Grant making Manifesto (2011)
 Liverpool City Council: Council's Community Strategic Plan
 Liverpool City Council: Code of Conduct Procedures
 Liverpool City Council: Social Justice Policy and Ethical Governance, Conflicts of Interest Policy
 Services: Community Builders Program Guideline (2012)

CONCEPT REPORT

CARNES HILL MASTERPLAN STAGE 2

CARNES HILL, NSW

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CO-OP | Carnes Hill Masterplan Stage 2

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CO-OP Studio prepared this report with the assistance of Warren Green Consulting, Clouston Associates and Turner & Townsend from information available to the team. Preparation and completion of this report is an iterative process and this report will evolve during the course of the project.

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Concept Design Presentation | 2

INTRODUCTION

Brief & Context

Stage 1 of the Carnes Hill Recreation Precinct is clearly a valued part of Liverpool's community fabric, particularly important for those residents of the surrounding suburbs of Hoxton Park, West Hoxton and Horningsea Park. The facility has been successfully delivering leisure services to the Liverpool community since it opened in 2016.

Sport and recreation plays a significant role in Australian communities. An analysis of the Carnes Hill community, a young cohort with extraordinary diversity, indicates a population in need of health and wellness facilities. The municipality has a comparatively young population, particularly in the 0-9 and 20-45 age brackets and a significantly lower proportion of aged (+65 years) residents. The community boasts a higher than average proportion of migrants, and a higher than average proportion of people in long term, stable relationships. Significantly, demographic analysis indicates locals are well educated and have a high level of income than the state and national average. There is a significant proportion of families with children where both parents work, which probably explains the extraordinary proportion of the population that reside in a four bedroom detached dwelling. Projections indicate that this trend in demographic profile will continue as the population grows.

Trends towards healthier living, particularly given a family demographic, would encourage development of indoor aquatic facilities. Experience tells us that program and leisure pools, incorporating interactive water play, are among the most popular and heavily programmed spaces in contemporary community aquatic facilities.

Emerging trends in community recreation provision would indicate that the following facilities will go a considerable way to satisfying longer term demand in the local community:

- 50m pool designed to deliver multiple programs;
- Learn-to-swim and programmable water space;
- Interactive leisure water;
- Gymnastics and multi-purpose dry spaces;
- Support spaces;
- External informal recreation space, including play areas;
- External fields of play.

Achieving accessibility to and within the site is critical, as is the connection to the Michael Clarke Centre in Stage 1 of the Carnes Hill Recreation Precinct. With this in mind, it is noted that this masterplan does not include a detailed traffic engineering analysis. The masterplan explores opportunities for vehicular, pedestrian and bicycle connections to the surrounding network, however, does not define a definitive recommendation. It is recommended that a more detailed traffic analysis be included in the next design phase to better understand parking demand and capacity analysis, including overflow requirements for Stage 1.



MASTERPLAN DISCUSSION

Current Aquatic and Leisure / Facility Provision

The City of Liverpool currently has four aquatic and / or leisure facilities as summarised below:

- Holsworthy Aquatic Centre which includes: a 25m pool and a program pool. This Centre is leased to a private learn to swim operator and in 2018/19 had 105K annual visits.
- Michael Clarke Recreation Centre which is a "dry" facility and includes: multi-purpose indoor sports courts, tennis courts and a health club. In 2018/19 the Centre had 134K visits with income of \$1.37M and expenditure of \$1.35M (excluding major maintenance and utility costs).
- Michael Wenden Aquatic Leisure Centre which includes an outdoor seasonal 50m pool and splash park, indoor hydrotherapy pool, health club, multi-purpose rooms and sports courts. In 2018/19 the Centre had 68K visits with income of \$1.32M and expenditure of \$1.27M (excluding major maintenance and utility costs).
- Whitlam Leisure Centre which includes: a seasonal outdoor 50m pool, indoor 25m pool, leisure pool and toddlers pool, spa, and sauna, health club, indoor sports courts and gymnastics centre. In 2018/19 the Centre had 574K visits with income of \$4.43M and expenditure of \$3.57M (excluding major maintenance and utility costs).

In summary, the Council's aquatic and leisure facilities had 880K annual visits in 2018/19 with the Whitlam Leisure Centre accounting for 65% of total visits. Note: inclusive of utility and maintenance costs, in 2018/19 the Michael Wenden Aquatic Leisure Centre had an operational deficit of \$551K and a subsidy of \$7.42 per visit while the Whitlam Leisure Centre had an operational deficit of \$905K and a subsidy of \$1.60 per visit.

- 📍 Carnes Hill Stage 2 (Michael Clarke Rec Centre)
- 📍 Michael Wenden Aquatic Leisure Centre
- 📍 Whitlam Leisure Centre
- 📍 Holsworthy Aquatic Centre
- 📍 New Aquatic & Leisure Greenfield Development



Aquatic and Leisure Centres

In addition to these aquatic and leisure facilities, Council also has splash parks at Bigge Park and Carnes Hill Stage 1 (very small) and a water play at Macquarie Mall.

MASTERPLAN DISCUSSION

Future Facility Plans

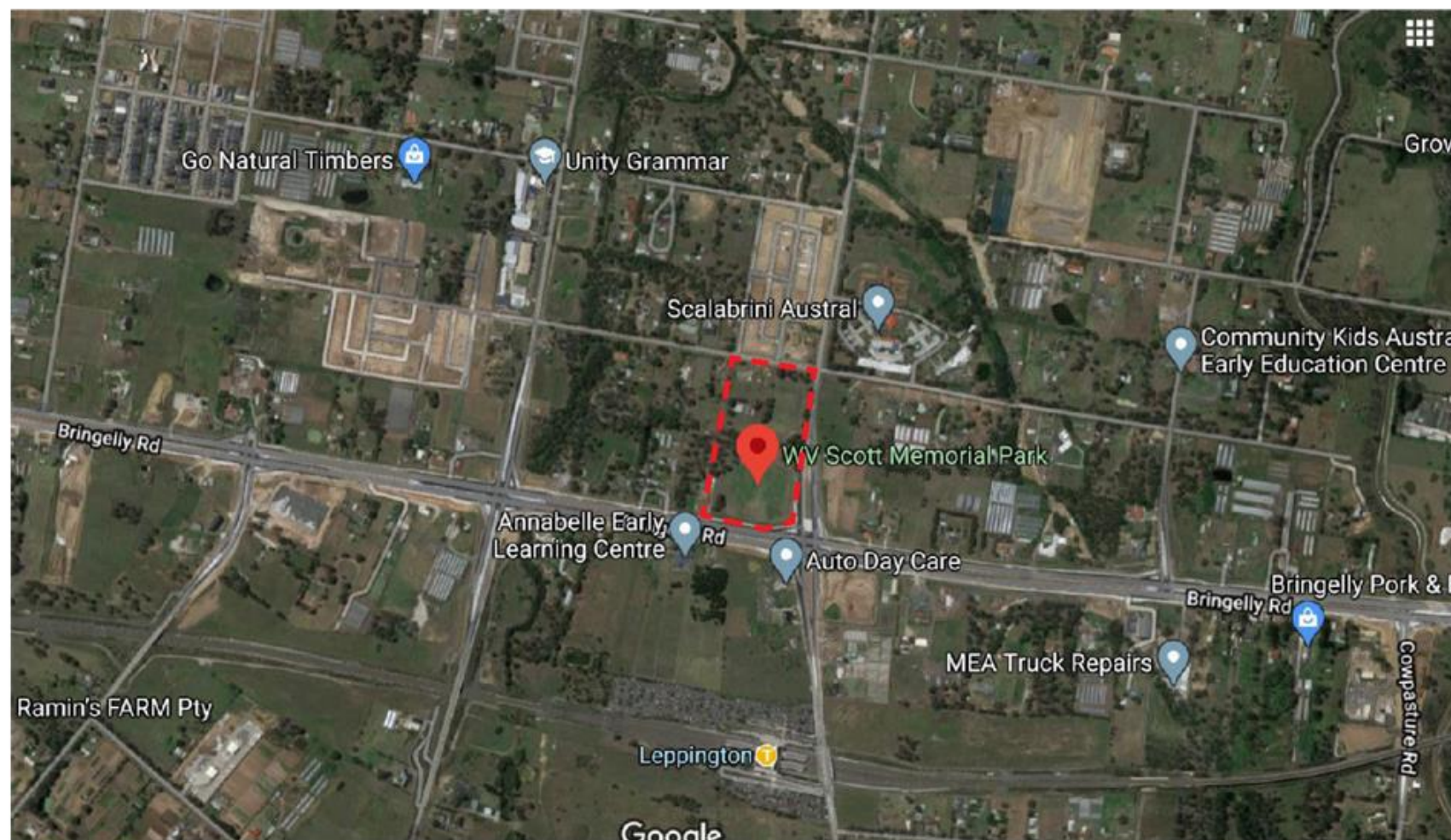
Based on a review of relevant documents and internal consultation, the following information provides an overview of the proposed future aquatic facility provision changes in the LGA.

1. A new aquatic facility at Carnes Hill is proposed with facility components to be determined.
2. A redevelopment and reconfiguration of the Whitlam Leisure Centre with facility components potentially including: indoor 50m indoor with grandstand seating, two program / warm water pools, large indoor and outdoor leisure pools, large health club and four indoor sports courts (reference the Aquatic and Leisure Centres Strategy 2019 and Woodward Place Planning).
3. A "greenfield" development for a new facility in Austral with facility components potentially including: indoor 50m pool, training pool, leisure spaces, learn to swim pool, diving pool, spa / sauna / steam, health club, four indoor sports courts and allied health services (as informed by the Liverpool Contributions Plan – Austral and Leppington North Precincts 2014). The proposed location of the facility is on the corner of Bringelly Road and Edmondson Avenue, Austral.
4. Any future changes to the Michael Wenden Aquatic Leisure Centre will be recommended as part of the Miller Masterplan process.
5. The potential for closure of the Holsworthy Aquatic Centre with a new facility that includes 25m pool and warm water pool at a new location.

In summary it is identified that in the future the City will have a suite of five stand-alone aquatic facilities potentially with new or redeveloped facilities for: Austral, Carnes Hill (Stage 2), Holsworthy Aquatic Centre, Michael Wenden Aquatic Leisure Centre and Whitlam Leisure Centre. Excluding the Carnes Hill aquatic facility, the City will potentially have two indoor 50m pools and one outdoor 50m pool in the future.

In addition to the aquatic centres, Council has endorsed a masterplan for Lighthorse Park, which includes a community centre, informal sporting oval, children's play area and water play. A water play is also proposed at Stante Reserve, Middleton Grange which is approximately 3 km from Carnes Hill.

A summary of the proximity of existing and future aquatic and leisure centres to Carnes Hill is outlined below.



01: Location of New "Greenfield" Development

Distances	Austral Aquatic Centre (Future)	Holsworthy Aquatic Centre	Michael Wenden ALC	Whitlam Leisure Centre
Distance to Carnes Hill Site	5.1km	12.0km	4.8km	8.5km

02: Summary of the proximity of existing and future aquatic centres to Carnes Hill

It is highlighted that the Austral Aquatic Centre, which is a major regional facility, will become the western most aquatic facility in the LGA. This Centre will be approximately 5.1km from the proposed Carnes Hill development site.

MASTERPLAN DISCUSSION

Key Background Planning Documents

Relevant findings from the key background documents associated with Carnes Hill planning are as follows. The Aquatic and Leisure Centres Strategy (2019) outlines that:

- Residents in Liverpool are likely to have a lower propensity to swim and participate in sport and fitness based on a number of demographic indicators (except age) such as income, employment, education, place of birth and religious affiliation. Given the main cultural backgrounds of residents there may be low levels of competency in aquatic sports.
- Liverpool City Council has a higher proportion of people under 15 years of age (22.7%) than for New South Wales (18.5%) and a smaller percentage of people over 65 years (10.4%) compared to NSW's (16.3%). Liverpool has a higher proportion of young children (under 9 years) than NSW, for whom there will be high demand for water familiarisation, safety programs, lessons and water play.
- The makeup of the local community would suggest a lower acceptance and participation in swimming and other sport and leisure activities when compared to Australia generally. This is predominately as a result of only 51.7% of the residents being born in Australia.
- The Strategy recommends the development of a splash park and dry play space with a learn to swim / program pool, two additional indoor netball/basketball sports courts and additional car parking at Carnes Hill.
- The key requirements for aquatic and leisure centres in Liverpool to address the issues associated with policy, planning, facility and demand issues and the directions related to the development of the centres in the next decade are identified as: social relevance, accessibility and inclusion, responsiveness to climate, responsiveness to safety, design responses, management model and financial sustainability.
- The Strategy identifies approximately 70% users of the Michael Clarke Recreation Centre live within a three kilometre radius and approximately 94% within a six kilometre radius. The primary and secondary catchment of Carnes Hill extends to the suburbs of Cecil Hills to the north, Casula to the east, Denham Court and Bardia (Campbelltown LGA) to the south and Austral to the west.
- The Strategy also highlights the level of unmet demand in Carnes Hill and this is discussed as part of the Demand Assessment in Section 5 (following).

The Community Facilities Strategy outlines the following key points:

- Population growth in Liverpool is expected to reach almost 300,000 by 2031 which necessitates the need for a longer-term vision for Community Facilities. Council appreciates that while the current stock of facilities has served the community well, most of the facilities which were designed and constructed 20-50 years ago will not meet the needs of current and future residents.
- The key challenges and associated actions are: delivering a world class network of facilities, having a customer focused delivery approach, introducing a new governance model and implementing best practice facility asset management.

The Recreation, Open Space and Sports Strategy 2018-2028 outlines the following key points:

- The overall vision is to create best practice recreation, open space and sports facilities for the community that connect residents and foster a healthy community.
- The key Guiding Principles associated with future provision are: creating a sense of place, ensuring equity and access, developing multi-purposes spaces, maximising connections, promoting social capital, providing green infrastructure, ensuring safety and security, delivering commercial developments and maximising partnerships.
- The Strategy notes that the Carnes Hill precinct will be Liverpool City Council's premier flagship development with the precinct delivering a new library, multi-purpose recreation centre and community centre, café and outdoor spaces that cater for all ages and accessibility needs.

The Recreation, Open Space and Sports Strategy (2018), outlines the following key points:

- The planning and delivery of district and local sporting venues in new release areas, along with the planning for multi-use sporting venues integrated with community facility infrastructure is identified as a key action in the ROSS Strategy's action plan.
- Developing a sporting and recreation precinct at Carnes Hill.
- Support health, wellbeing, biodiversity and ecosystem services by providing tree canopy, increased amenity, whilst protecting and enhancing our natural areas.

- Increasing the number of water structures and Council's desire to increase public access to water play facilities in hot weather.

In February 2019, a report on Access to Facilities in Hot Weather and a Measures to Cool the City was presented to Council. The report was an outcome of the demand for facilities on hot weather days due to the extremely high temperatures in Liverpool over summer. At the time Council resolved the following:

- Work with Belgrave Leisure to look at strategies to support access to leisure centres. (Note this is somewhat limited due to existing hot day capacity constraints).
- Look at strategies which could include providing additional water parks in the LGA and consider new locations, including new growth areas, for the water parks. The following matters are to be considered: pricing, ample parking, seating, shade and other options.
- Develop a strategy to inform the community as to where savings can be made on services for families.
- A subsequent Council resolution (August 2019), endorsed Carnes Hill Stage 2 (together with three other sites namely Lighthorse Park, Stante Reserve and Carnes Hill Stage 2) for the inclusion of water play facility, subject to further investigation and feasibility through the detailed design phase and master planning process.



MASTERPLAN DISCUSSION

Consultation

A range of consultation relating to the Carnes Hill planning and aquatic and leisure provision generally and the following information provides a summary of the relevant findings. A recent consultation process for the Carnes Hill Stage 2 planning identified that:

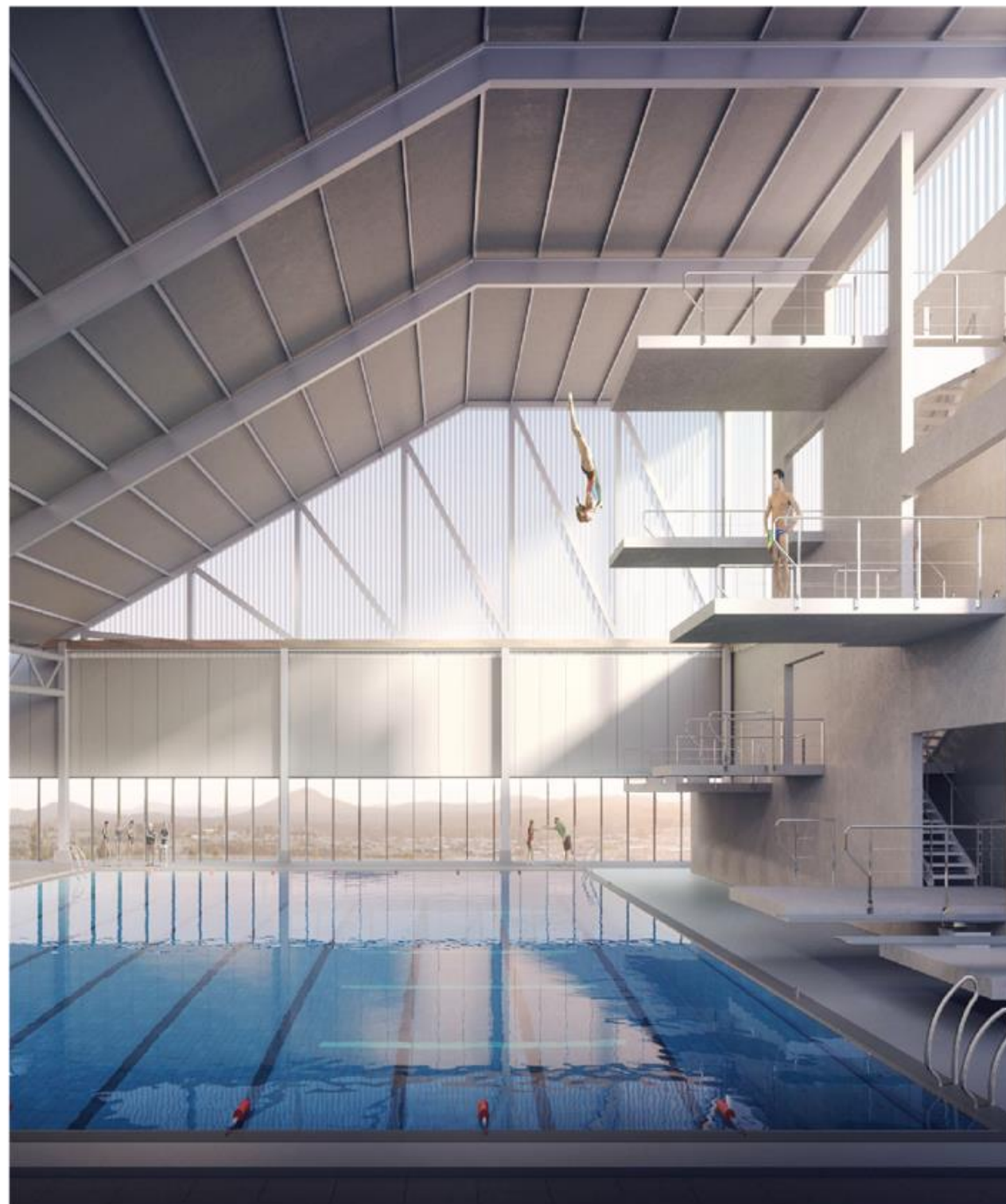
- While a relatively small sample, the highest preferred facility component was a swimming pool or aquatic facility (37 responses) followed by the provision of water play (15 responses).
- In relation to general precinct amenities and facilities, the highest identified priority was car parking (30 responses).

Key consultation findings identified as part of the Aquatic and Leisure Centres Strategy (2019) includes:

- The public consultation was clear about the need for more informal leisure water to meet resident needs in hot weather. A 'beach in the west' with a large number of shallow water play options would be enormously popular. Residents are currently travelling out of Liverpool in search of places to cool off on hot days, with these venues turning people away due to high demand.
- Management feedback regarding the Michael Clarke Recreation Centre indicated that the Centre is still in a growth phase and not yet at capacity and that a major issue is the inadequacy of car parking.
- Feedback regarding the Holsworthy Aquatic was that the pool is never available due to swim classes, there is very little or any space available for non-swim class activities and that the public only get one lane for recreational use.
- Feedback about the Michael Wenden Aquatic Leisure Centre was that the Centre lacks the ability to operate all year round squads, that there is insufficient space for swimming at peak times and that the program pool is too small.
- Feedback about the Whitlam Leisure Centre was that the indoor pool is only 25-metre pool with no room for leisure and limited opportunity for lap swimming and it becomes over crowded in the evenings.

The original consultation undertaken for the Carnes Hill Recreation and Community Precinct (2012) identified that:

- The addition of an indoor swimming pool and swim school/lessons was also noted by approximately one quarter of respondents (61 responses).



MASTERPLAN DISCUSSION

Demand Assessment

A range of different information is noted in assessing the demand for aquatic facilities at Carnes Hill and this is summarised below.

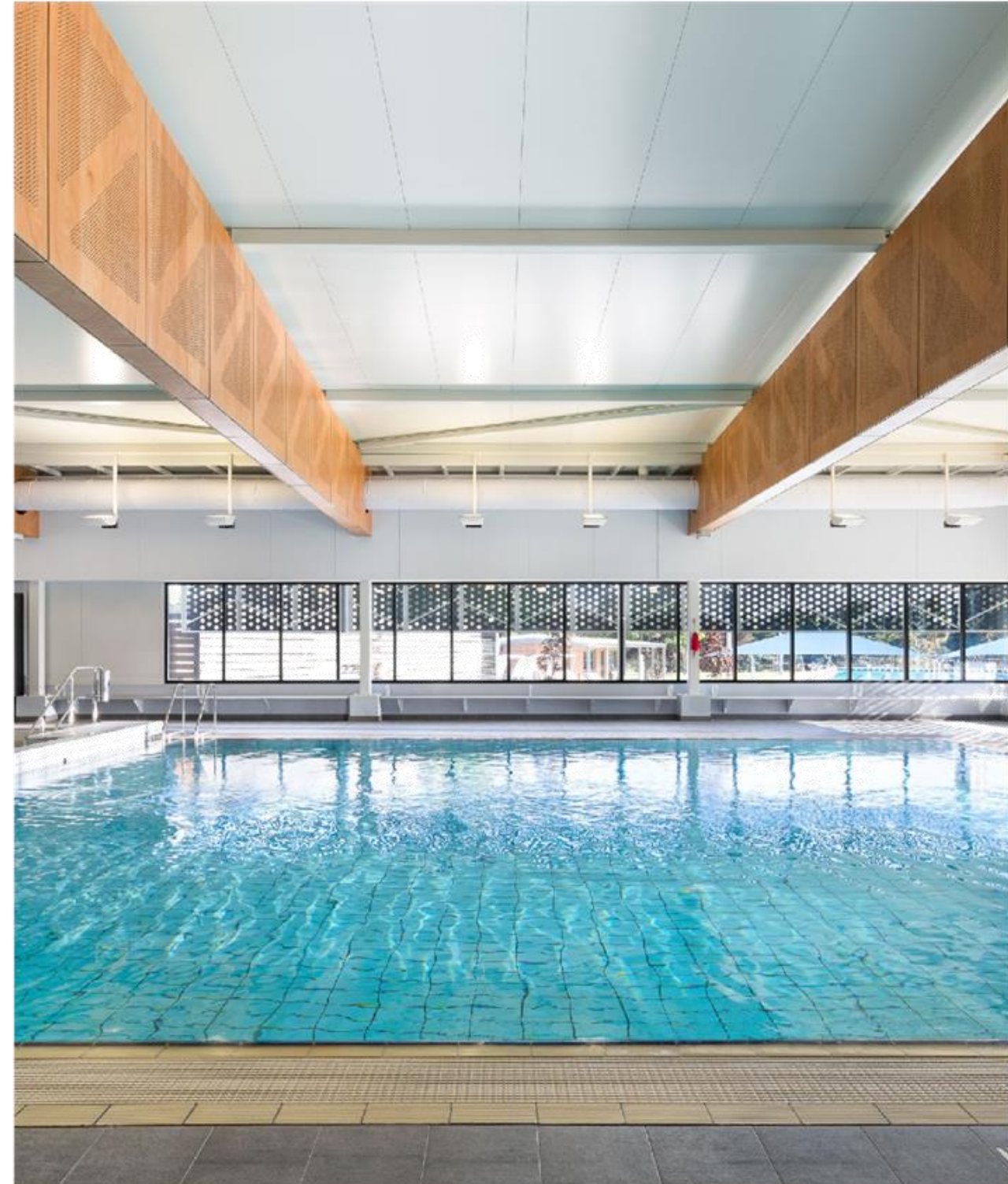
The Aquatic and Leisure Centres Strategy (2019) outlines that the population in the Michael Clarke Recreation Centre catchment (3km) is expected to increase from 32,982 to 34,433 by 2026. Modelling for the Clarke catchment shows that there is currently potential unmet demand for 447,000 annual gym workouts decreasing to 364,600 by 2026 with at least 2 proposed facilities opening in the short term. Unmet demand for swimming shows potential of 371,000 annual visits increasing to some 380,000 in 2026. (Note: This equates to 11 aquatic annual visits per head of 3km catchment).

This level of aquatic visits (excludes dry visits) would appear to be optimistic when compared to current Liverpool facility visitations which indicate that:

- Holsworthy Aquatic Centre: 3.4 annual visits per head of 3km catchment.
- Michael Wenden Aquatic Leisure Centre: 0.8 annual visits per head of 3km catchment.
- Whitlam Leisure Centre: 4.7 annual visits per head of 3km catchment.

Liverpool facilities overall have an average of 2.9 annual aquatic visits per head of 3km catchment. A separate analysis undertaken by ActiveXchange (with Belgravia Leisure) for Carnes Hill projected aquatic visits in 2029 of 95K per annum for an indoor 25m pool and leisure area and 49K per annum for a program pool for a total of 144K annual visitations. This analysis also highlighted the unique demographics of the Carnes Hill area which is projected to have very high numbers of different ethnicities with the highest demographic cohort of 20K being extended families with diverse backgrounds.

Based on industry benchmarking and independent analysis, it is projected that under a realistic scenario that an aquatic facility in Carnes Hill with a 25m pool, leisure water and a program pool would have demand of around four to five visits per head of 3km population (estimated at 50K) or approximately 200K to 250K visitations per annum. It is also noted that the projected demographics of the catchment area consists of high levels of different ethnic groups and also young children with both these groups more suited to shallower water for non-swimmers and learning to swim.



MASTERPLAN DISCUSSION

General Research

The following information provides an overview of general industry research undertaken by the consulting team.

- Council is aware of a Development Application that has been lodged for a potential private sport facility in Prestons, which proposes a 25m heated lap swimming pool, learn to swim program, gymnasium, and indoor sports facilities. The developer has further advised Council Officers that this will not proceed in the near future.
- The optimal level of car parking provision equates to around one car park per 2,000 to 2,500 annual visitations. As an example, if an aquatic facility at Carnes Hill was to have 250K annual visits it would require approximately 125 dedicated car parks.
- The Waves Fitness and Aquatic Centre is currently being developed by The Hills Shire Council. This facility consists of an indoor 25m pool, leisure pool, warm water pool, gymnasium and group program rooms and also an outdoor 50m pool and water play. This project is currently out for construction tender and the estimated cost is \$57M. Given the larger scale of both the Whitlam Leisure Centre redevelopment and the new Austral facility it is identified that they will both cost significantly more than the Waves Fitness and Aquatic Centre.
- As the usage of a pool is determined by water temperature, depth and size, it is important to note that a 25m pool and 50m pools service different needs. As the water temperature of a 25m pool water is generally warmer than a 50m pool, a 25m pool is more suited to all year round usage, aquatic programs such as aquarobics, older adult programs, higher level learn to swim, school activities and young family usage. By comparison a 50m pool is generally preferred for lap swimming, squads and summer recreational usage.
- A high level review of an indoor 50m versus an indoor 25m pool indicates overall capital cost of a 50m pool would be approximately \$6M more, the operational cost would be \$400K per annum more, the site footprint requirements would be approximately 1,500sqm more and the environmental impact would be greater.
- Industry benchmarking of major Sydney aquatic and leisure facilities indicates that total visitation numbers (i.e. wet and dry) equate to approximately 8 visits per head of the 3km catchment. Facilities such as Des Redford Leisure Centre (980K visitations per annum), Hurstville Aquatic and Leisure Centre (1M visits), Lane Cove Aquatic and Leisure Centre (780K visits), Ryde Aquatic Leisure Centre (740K visits) and SOPAC (1.1M) all have over 700K visitations per annum. Liverpool facilities by comparison have lower visitation numbers per catchment (with Whitlam Leisure Centre the highest with 7.1 visits per head of 3km catchment) potentially due to the limited diversity at each facility and the age and condition.

- When compared to surrounding LGAs' (excluding Blue Mountains City Council and Wollondilly Shire Council) the Liverpool LGA has a lower level of aquatic facility provision with one aquatic facility per 75K residents compared to an average of one aquatic facility to 65K residents. Camden Council has the highest aquatic facility provision ratio with one facility to 50K residents and Canterbury Bankstown has the highest total number of facilities with six. Only the City of Penrith, which has one aquatic facility to 106K residents, has a lower level of aquatic facility provision per head than the City of Liverpool.

- A key driver for facility provision of aquatic facilities in the Liverpool LGA is the weather. The review of Bureau of Meteorology reports indicates that over the long term December to February averages 25 days over 30°C. January averages a maximum of 28.5°C and this year had days of 43°C and 44°C.

The following information provides an overview of general industry research undertaken by the consulting team.

- One of Australia's most successful Olympians, Shane Gould, recently completed a PhD on swimming in Australia. This research involved travelling extensively around Australia from coast to coast and speaking to average Australians about their own swimming experiences. In discussing the key findings from this research, she noted the following key points: "If communities are thinking they need to build an Olympic 50m pool, I say no you don't you would be better off with a 5 lane 25m pool. The notion of our culture being tied to swimming is wishful thinking, and a disconnect from the realities of swimming skills. People in Australia don't swim as well as we believe the population can. Only 30 per cent of Aussies are competent swimmers while only one in five children can swim 50m at the end of primary school. The dominant model of swimming in Australia is to get people to the Olympics but there are only 40 people at most that go to the Olympics each year. There are hundreds of swimming pools in the country that are not being used as much as they could be. If these were conceived as a public meeting place or an adventure playground, there would be more creative play at pools and improved water safety and swimming skills".
- Over the past five years, there has been significant development and renewal of aquatic leisure centres nationally. These developments are in direct response to: ageing assets, the changing needs of users and the provision of health and leisure activities for individuals, groups and families. Key trends include the provision of: dedicated learn to swim pools, large water play areas, warm water pools, excellent universal design and a diverse range of changerooms. Examples of design trends are provided below.



NOTE: A review of gymnastics at Five Dock Leisure Centre (City of Canada Bay) indicates that the gymnastics program is at practical capacity within the allocated space of 760sqm. The program derives income of over \$2,000 per sqm which is a very high level of revenue. Due to the demand, the City is currently considering the expansion of the space for this program.

MASTERPLAN DISCUSSION

Key Drivers for Carnes Hill Aquatic Centre

Based on the research and analysis undertaken, the key drivers associated with the development of an aquatic facility at Carnes Hill are as follows:

- 1. Future Facility Provision and Cost** – The Council is proposing new aquatic and leisure facility developments at Carnes Hill, Austral and potentially for Holsworthy and also a redevelopment / reconfiguration of the Whitlam Leisure Centre. It is planned that both the Austral Aquatic Centre and Whitlam Leisure Centre will be major regional facilities including indoor 50m pools and a range of other aquatic and dry facilities and may indicatively cost in excess of \$70M each. This will bring the Council's aquatic provision to five facilities in the future (excluding the Michael Clarke Recreation Centre) with the new Austral Aquatic Centre only 5.1km from the Carnes Hill site.
- 2. Social and Demographic Factors** – Residents in Liverpool are likely to have a lower propensity to swim and participate in sport and fitness based on a number of indicators (except age) such as income, employment, education, place of birth and religious affiliation. Given the cultural backgrounds of residents there may be low levels of competency in aquatic sports. Liverpool also has a high proportion of people under 15 years old indicating high demand for water familiarisation, safety programs, lessons and water play. Also, noting Liverpool LGA's high cultural and ethnic diversity, it is important to provide facilities to familiarise the community with swimming and related water activities. It also about providing recreation and aquatic facilities that responds to the different demographic traits of the community.
- 3. Environmental Factors** – A key driver for aquatic facility provision in the LGA is the weather. Over the long term, December to February averages 25 days over 30°C. January averages a maximum of 28.5°C and this year had days of 43°C and 44°C. As a result of this, a Council resolution (August 2019), endorsed Carnes Hill Stage 2 for the inclusion of water play facility, subject to further investigation in the design and master plan phases.
- 4. Community and Operator Feedback** – Previous consultation was clear about the need for more informal leisure water to meet resident needs in hot weather. A 'beach in the west' with a large number of shallow water play options would be enormously popular. Feedback has also been provided about the lack of indoor space for swimming and leisure activities at Council's existing aquatic and leisure




facilities while management at the Michael Clarke Recreation Centre highlighted the lack of car parking in the precinct.

- 5. Carnes Hill Aquatic Facility Demand** – Based on industry benchmarking and independent analysis, it is projected that under a realistic scenario that an aquatic facility in Carnes Hill with a 25m pool, leisure water and a program pool would have demand of around four to five visits per head of 3km population (estimated at 50K) or approximately 200K to 250K visitations per annum. It is also noted that the projected demographics of the catchment area consists of high levels of different ethnic groups and also young children with both these groups more suited to shallower water for non-swimmers and learning to swim.
- 6. Function and Cost** – when comparing a 25m and 50m pool it is noted that a 25m pool is generally warmer with no "deep" water. The results in a 25m pool being more suitable for year round usage, aquatic programs such as aquarobics, older adult programs, learn to swim, school activities and young family usage while a 50m pool is generally more suited to lap swimming and summer recreational use. When compared to an indoor 25m, an indoor 50m pool would indicatively cost \$6M more, cost \$400K per annum more to operate, require approximately 1,500sqm more space and have a greater environmental impact. Based on the demand and future provision, a 50m pool at Carnes Hill would arguably result in an oversupply of water space at the conventional lap swimming temperature of 27°C.
- 7. Cultural Factors** – Research undertaken by one of Australia's most successful Olympians, Shane Gould, concluded that due to low levels of overall swimming competency that Australia needs more 25m pools and leisure type areas and not more 50m pools. This approach would result in increased creative play, water familiarisation and improved water safety and swimming skills.



AQUATIC AND LEISURE FACILITIES

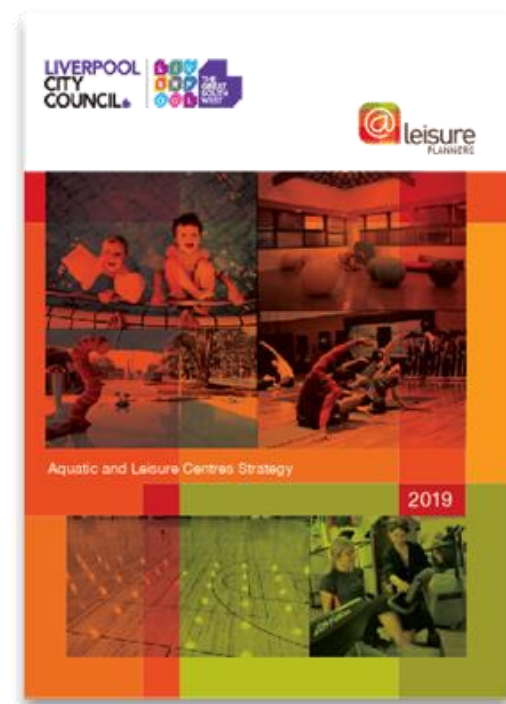


-  Carnes Hill Stage 2 (Michael Clarke Rec Centre)
-  Michael Wenden Aquatic Leisure Centre
-  Whitlam Leisure Centre
-  Holsworthy Aquatic Centre
-  New Aquatic & Leisure Greenfield Development in Austral

INTRODUCTION

Liverpool City Council

An overview of the current leisure and aquatic assets of Liverpool City Council



Aquatic and Leisure Centres Strategy
Liverpool City Council / Leisure Planners
November 2019



- Health Club - weights/cardio
- Group fitness
- PT/HITT
- Multi-purpose courts



Michael Clarke Recreation Centre Carnes Hill, NSW



- 50m seasonal pool
- Splash park
- Hydrotherapy pool
- Learn to swim programs
- Health club
- Multi-purpose courts



Michael Wenden Aquatic Centre Miller, NSW



- Outdoor 50m pool
- Indoor leisure pool
- Splash pool
- Spa/sauna
- Learn to swim
- Health club
- Recreational gymnastics



Whitlam Leisure Centre Liverpool, NSW

PROJECT BACKGROUND



Introduction

Liverpool is known and enjoyed for its multi-cultural and outdoor lifestyle, but with the forecasts of significant growth in Liverpool council population over the next ten years there is an urgent need to ensure that open space, recreation and community facilities provided by the public and private sector reflect current needs and can respond to that growth in an innovative and adaptive manner.

Project background

The site identified in the functional brief of 2010, offers over 15 hectares of open space divided into a northern and a southern parcel by Beard Creek. Stage One of the precinct on the southern parcel was delivered in 2016, and includes a library, multi-purpose community centre, indoor recreation centre, skate park, café, outdoor play area and a public plaza.

Previous studies

Council conducted community consultation, reviewed relevant planning and recreation strategic documents, conducted a site analysis and reviewed existing recreation infrastructure around Carnes Hill.

Analysis of Relevant Strategies

a. Recreation, Open Space and Sports Strategy (ROSS Strategy):

Adopted in 2018, the ROSS Strategy is a principal document directing and guiding the planning and development of Public Recreation (RE1) land. This includes planning for the current and future needs of recreation, open space and sporting needs in Liverpool Local Government Area (LGA).

b. Draft Aquatic and Leisure Centres Strategy:

The draft Aquatic and Leisure Centres Strategy informs planning and provision of aquatic and leisure facilities within the Liverpool Local Government Area (LGA) over the next 10 years. The Strategy identifies approximately 70% users of the Michael Clarke Recreation Centre live within a three kilometre radius and approximately 94% within a six kilometre radius. The primary and secondary catchment of Carnes Hill extends to the suburbs of Cecil Hills to the north, Casula to the east, Denham Court and Bardia (Campbelltown LGA) to the south and Austral to the west.

c. Council Report on access to water play facilities in hot weather:

At 27 February 2019 Council meeting, a report was presented to Council with initial investigations on the provision of water parks and water play features across the LGA. This report outlined the benefits and constraints of "zero water depth" design, accessibility and social interaction; construction and ongoing cost; and a snapshot of the maintenance and operation model. The report outlined the existing deficit and demand for provision of water play and cooling facilities across the LGA.

The provision of aquatic facilities and/or water play feature at Carnes Hill Precinct Stage Two will respond to the ROSS Strategy's direction towards increasing the number of water structures and Council's desire to increase public access to water play facilities in hot weather.

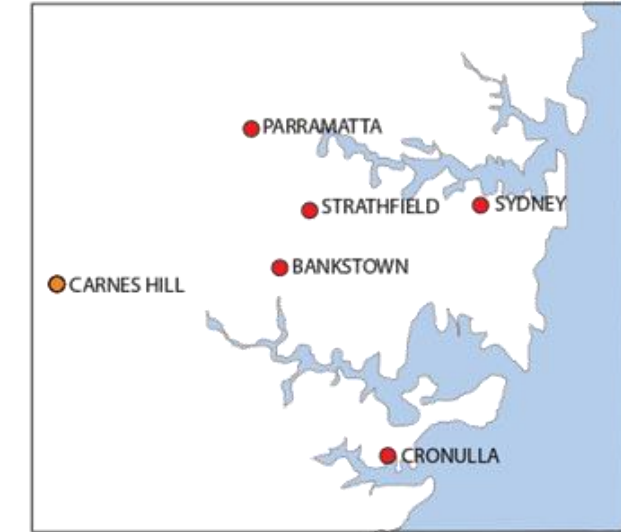
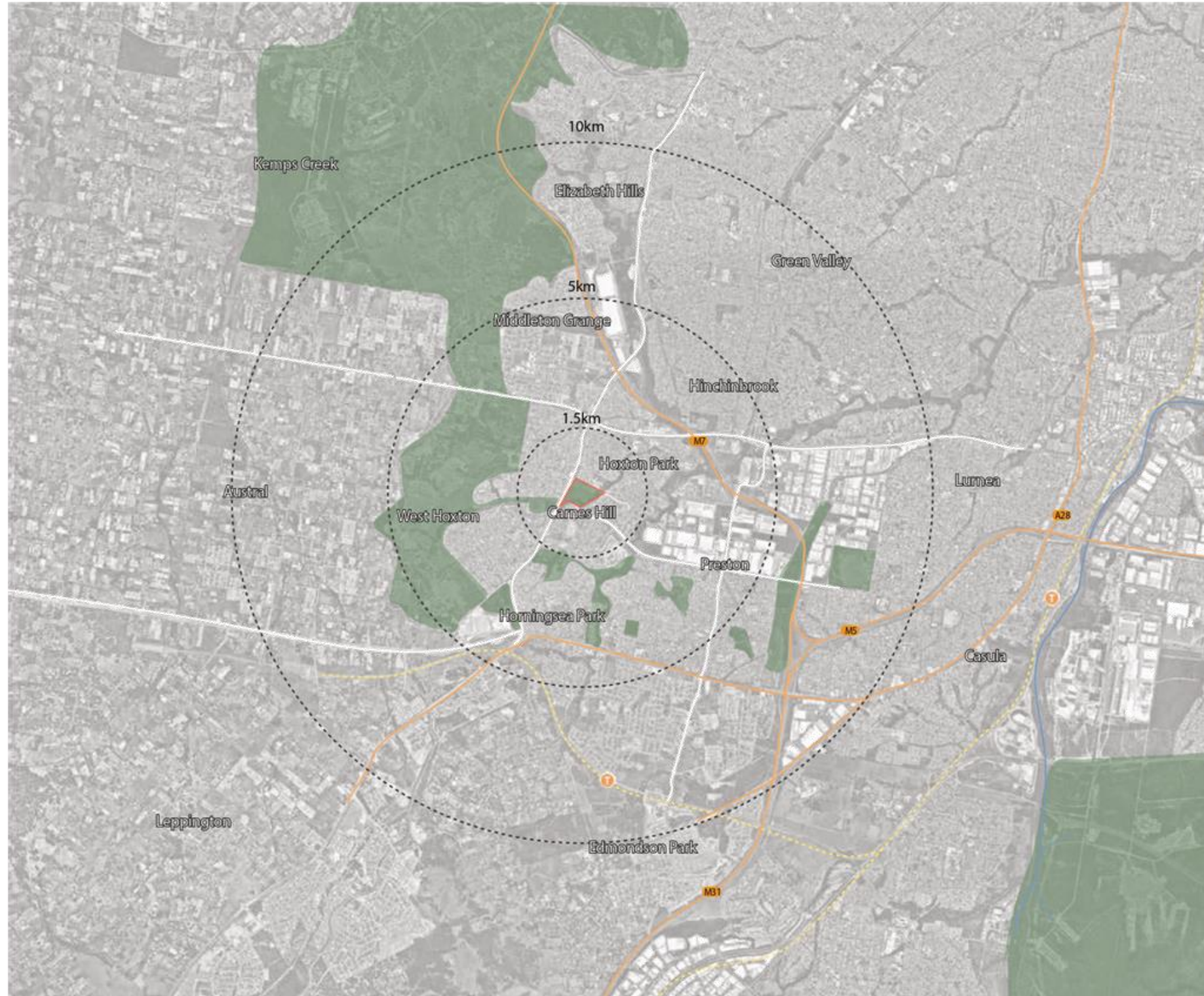
d. Carnes Hill Recreation and Community Precinct Functional Brief:

The Recreation and Community Precinct Functional Brief for Carnes Hill developed in November 2010 describes the key elements and design principles for the proposed precinct. This document identifies a Recreation and Community Precinct Model for Carnes Hill (Stage One and Two), inclusive of the following facilities:

- District library;
- Multi-purpose community centre;
- Indoor recreation centre;
- Skate park;
- Key suburb park;
- District sportsground; and
- Natural area.



SUB-REGIONAL CONTEXT PLAN



Sub - Regional Context

On a sub-regional scale Carnes Hill Stage 2 is situated within 5km from Preston and Middleton Grange. The site is also located between the M7 Highway and the A28 that connects to Casula and Elizabeth Hills respectively.

The current recreation and sporting facilities around Carnes Hill include:

- Greenway Park: 2 x AFL ovals with turf cricket pitches, Greenway Park Community Centre and a small shaded children's play area; and
- Brownes Farm Reserve: 1 x shared cricket oval/football field, 1 x soccer field, amenity block, exercise equipment and 2 x small children's play area.

- Train Line
- Highway
- Site Boundary
- Distance from site
- Green Open Space

LOCAL CONTEXT PLAN



Different modes of arrival into the site currently exist, for example:

- There are a few bus stops on Kurrajong Rd. that sits on the southern side of Phase 1;
- 90% of visitors arrive at the site by vehicle.

The sporting fields at Greenway Park serve the immediate 400m catchment and the suburb of West Hoxton. Cowpasture Rd is a major access barrier for Carnes Hill and neighbouring suburbs. On the other hand, Brownes Farm Reserve sporting fields on its own cannot address the demand for active recreation in the current setting. Provision of multi-use sporting fields at Carnes Hill will address the recognised demand for soccer and other active recreation in Carnes Hill, Homingsea Park, Hoxton Park and Prestons, along with the reinforcement of the green grid network.

The provision of recreational facilities will benefit the surrounding schools which are:

- Hoxton Park Public School (within 400m catchment);
- Holy Spirit Catholic Primary School (within 800m catchment);
- Greenway Park Public School (within 1200m catchment); and
- Malek Fahd Islamic School (within 1200m catchment).

SITE PHOTOS



1 View under powerline easment



2 Corner of Pacific Palms Cct



3 Level site topography at north-east corner



4 Flat underneath existing powerlines



5 Steep embankment on North-west corner of site



6 Existing buildings on site



7 Existing driveway to building from Cowpasture Rd.

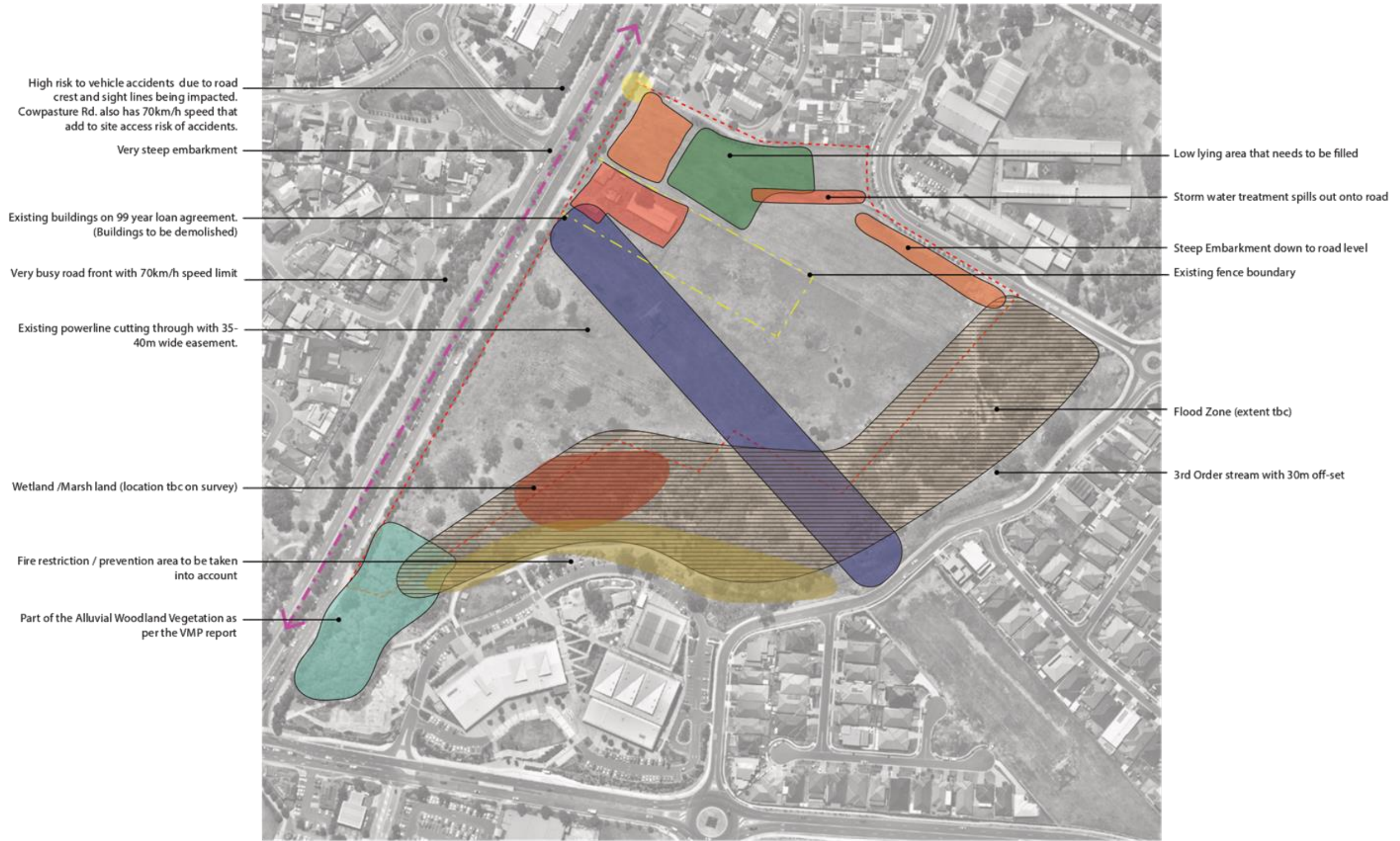


8 Cycle and walking pathway on Cowpasture Rd.

SITE PHOTOS



SUB-REGIONAL CONTEXT PLAN



VEGETATION COMMUNITIES (BIOSIS 2014)



Legend

Vegetation Communities

- Alluvial Woodland (RFEFCF)
 Native Grassland (RFEFCF)
 Exotic Grassland

SITE ANALYSIS - OPPORTUNITIES PLAN



MASTERPLAN PRINCIPLES



Access, Circulation and Wayfinding

- Creating a clear and well defined entry point to the park
- Visual and physical connections to Phase 1
- Universal access
- Creating clear pedestrian paths between facilities and open spaces
- Well defined vehicular parking areas and maximising available car parking spaces
- Incorporating cycle routes into the park
- Maintenance entry point
- Emergency entry point
- Transport mode connections

User Facilities

- Consolidating into a central building(s)
- Incorporating passive recreational activities into the aquatic facility

Environmental

- Incorporating the ecological valuable bush-land areas into the design
- Designing around and incorporating the flood zone and fire restriction zones

Image and Character

- Providing meaningful and memorable experiences
- Creating clear visual connecting sight lines between phase 1 and phase 2
- Carnes Hill Recreational Precinct Phase 2 being seen as a District level facility.
- Providing clarity of uses and spaces



LANDSCAPE MASTERPLAN



LANDSCAPE MASTERPLAN - SOUTH



LEGEND

- ① New Aquatic facilities building as per CO-OP drawings
- ② New access road from Cowpasture Rd into site (left turn in and left out) under power line easement with new round about
- ③ Additional 90 degree street parking for overflow parking from phase 1. Clear pedestrian linkages from car parking area back to phase 1 and to the new aquatic facilities.
- ④A Outdoor Water Play Area.
- ④B Children play ground with multiple age group allocations.
- ⑤ Existing natural vegetation left undisturbed as it forms part of the Alluvial Woodland as documented by BIOSIS (2014) in the VMP report that needs to be protected. All existing trees remain.
- ⑥ Boardwalk connections from phase 1 to phase 2. The longer boardwalk through the riparian zone on the eastern side can become a interpretive experience.
- ⑦ New walkway and cycle way that connects to Cowpasture Rd. all the way through the site to Pacific Palms Circuit. Also delineates the natural vegetation from the new proposed laws. This walkway and cycle way has a visual design connection as it replicates the ripple effect from phase 1.
- ⑧ Arrival and orientation zone.
- ⑨ Secondary vehicular entrance / exit into the site from Cowpasture Rd. Possible left turn entry for busses and service vehicles to allow drop-off area to work in front of Aquatics facility.
- ⑩ Possible drop-off area for busses.
- ⑪ Possible shelter with seating and look out area over riparian corridor. Close to children play ground and overflow parking.
- ⑫ Open lawn areas for pick nick and bird watching.
- ⑬ Pedestrian walkway linking the new aquatics facility to the boardwalk connection back to phase 1 and also to the sporting fields to the north.
- ⑭ Existing trees on site to remain.
- ⑮ Aquatic facility car parking area
- ⑯ Power line tower
- ⑰ Power line tower easement off-set with elements of 4.3m maximum height allowed underneath.
- ⑱ Power line easement off-set with elements of 4.3m maximum height allowed underneath.



LANDSCAPE MASTERPLAN - NORTH



LEGEND

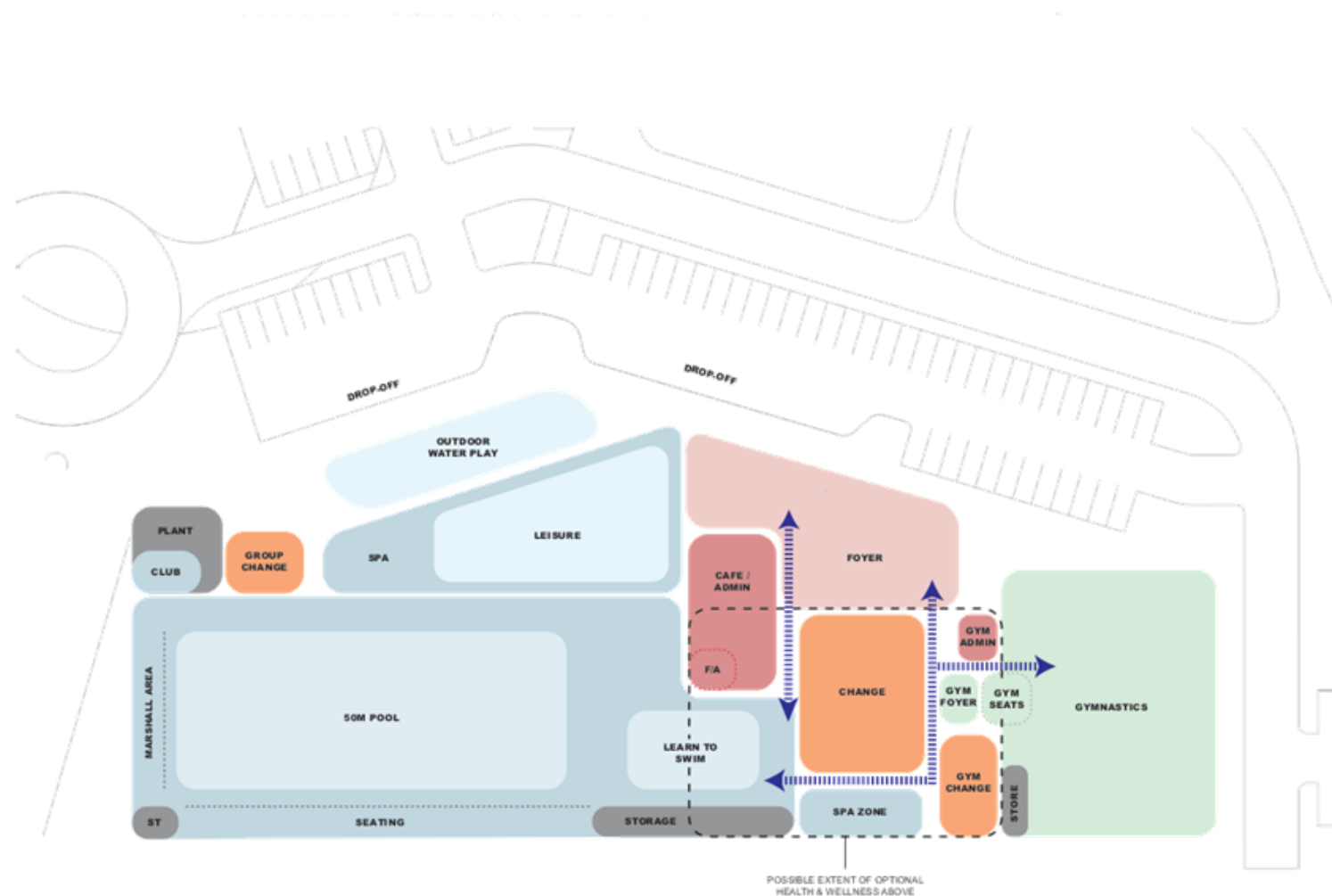
- ①9 WSUD system. Storm water on the site will be collected in the WSUD system situated under the power line easement. This natural filtration system will help purify the water to be reused for field irrigation.
- ②0 Irrigation pump house for field irrigation system that reuses the storm water run off from the WSUD system for irrigation.
- ②1 Amenities building for sporting recreational elements. Changerooms, bathrooms, kiosk, meeting rooms, etc.
- ②2 Spectator seating for sporting fields basketball courts.
- ②3 Basketball courts with the potential to act as multi- purpose courts.
- ②4 Parking for recreational activity users.
- ②5 Arrival space and outdoor gathering area with potential shelter. Feature trees to be used to create a sense of arrival.
- ②6 Boulevard of feature trees on median at new proposed vehicular entrance road. Low planting shrubs to be used on median in line CPTED principles and to allow for pedestrian crossing sight lines.
- ②7 Universal access area from Cowpasture Rd. with a series of ramps to incorporate the steep slope in this area
- ②8 Mounded berms with shade trees for spectators.
- ②9 Arrival and orientation zone. Possible pedestrian entry point and cycle connection to Pacific Palms Circuit.
- ③0 New walkway and cycle way that connects to Pacific Palms Circuit all the way through the site to Cowpasture Rd. Also takes the protected vegetation areas into consideration as documented by BIOSIS (2014) in the VMP report.
- ③1 New round about vehicular entrance areas to the site. This will ease traffic movement from Cowpasture Rd. and have clear and easy access from the residential side and from phase 1. Positioned away from the main entrance of Hoxton Park Public School.
- ③2 New sporting fields with sizing adequate for rugby union, soccer and rugby league. Field size and run-off zones reduced to minimum requirements to be able to fit outside 30m off-set zone from top of bank 3rd order Beard creek.
- ③3 30m off-set zone from top of bank Beard Creek.
- ③4 Overflow permeable car parking that is part of the WSUD system.



SPATIAL ARRANGEMENT PLAN

Preferred Option

This proposed layout reflects the facility componentry as agreed by the elected members of Council. The facility includes an indoor 50m competition pool, indoor learn-to-swim pool, indoor leisure pool and an indoor spa / steam / sauna area. An external water play space is provided for operation when climatic conditions are suitable. Associated aquatic support spaces include change rooms, including family and group / competition change areas, storage and plant spaces.



Legend

- Community / Administration
- Aquatic
- Gymnastics
- Change / Amenities
- Storage / Services



SPATIAL ARRANGEMENT PLAN

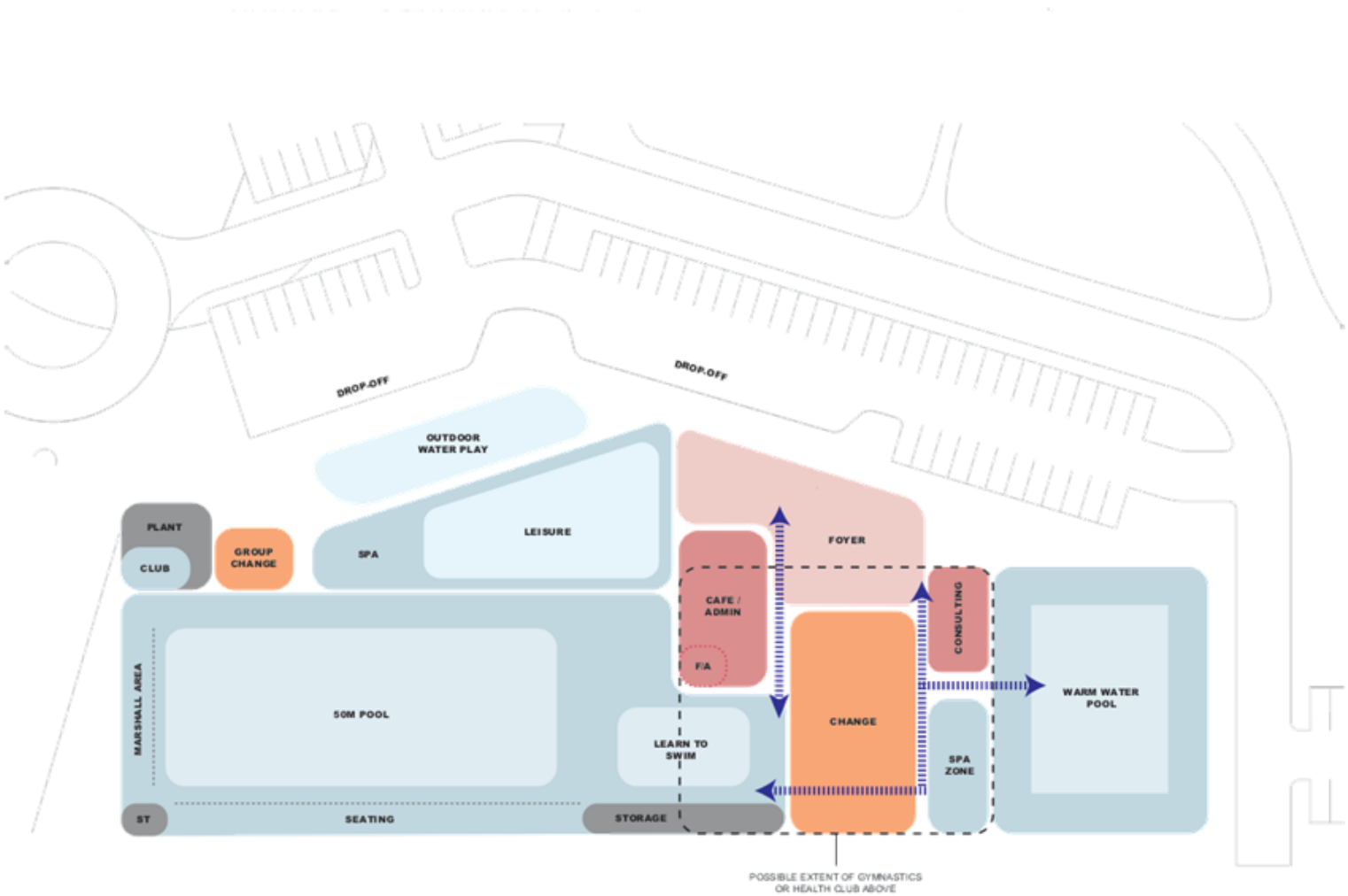
Alternative 01

It is imperative to explore other opportunities for the precinct to maximise social benefit and return on Council's investment. In order to ensure longer term sustainability, the proposed facility may benefit from the inclusion of a broader range of facilities, both wet and dry.

Warm water pools are popular for warm water exercise, recovery, rehabilitation and often attract a culturally diverse patronage. There is a strong trend in facility design towards having the ability to separate the warm water pool from the main pool hall in order to achieve a more comfortable, discrete environment for users. Separation has the benefit of being able to better control space temperature and humidity, provide better privacy for groups who may have a physical impairment, injury or to address cultural sensitivities, and helps to better control acoustics, which are a significant challenge in sports and aquatic facilities.

Legend

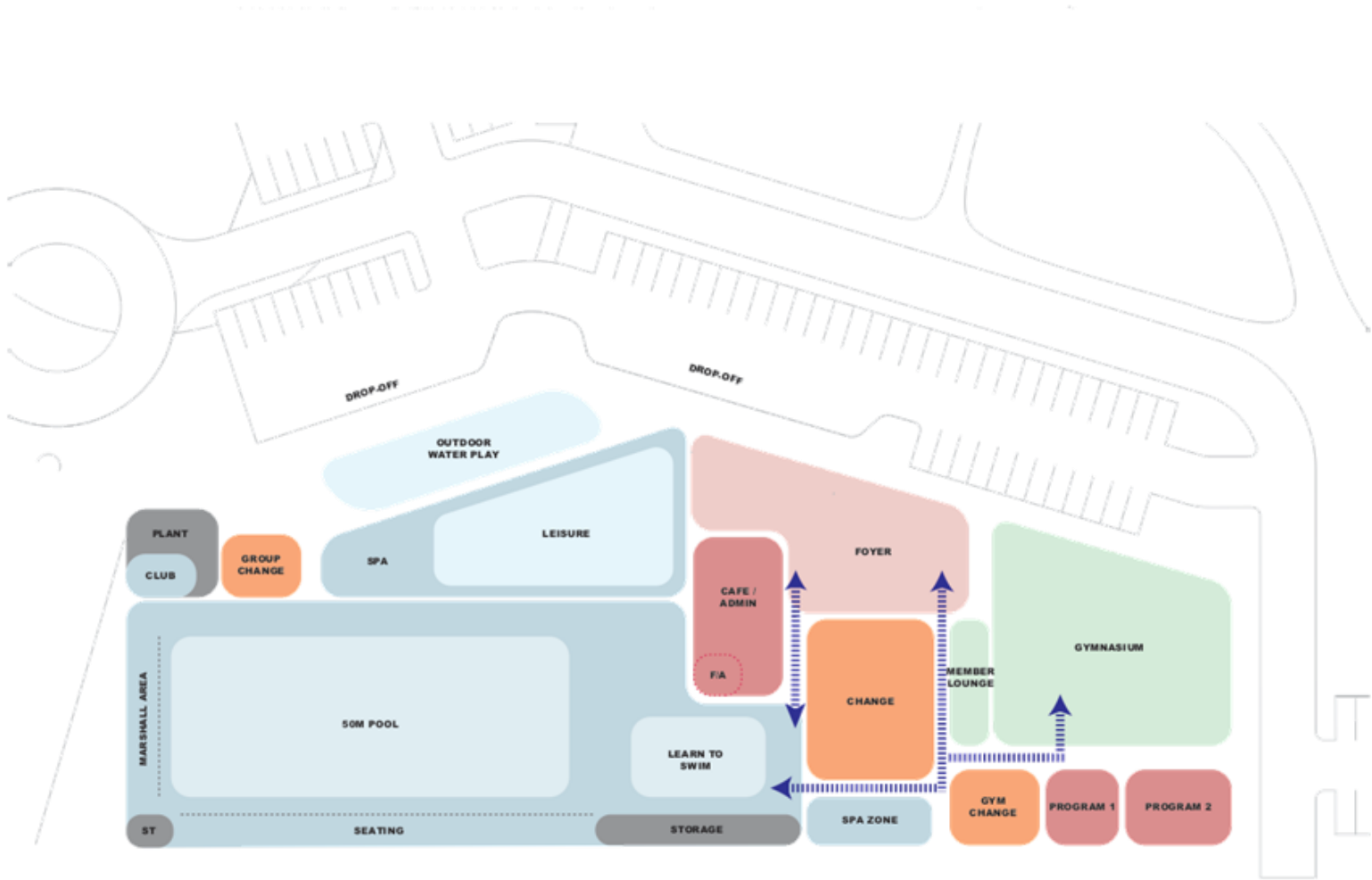
- Community / Administration
- Aquatic
- Gymnastics
- Change / Amenities
- Storage / Services



SPATIAL ARRANGEMENT PLAN

Alternative 02

Gymnasiums and multi-purpose program rooms can encourage a significant participation rate and therefore provide a healthy revenue stream for integrated leisure facilities. The inclusion of a more diverse service model should be explored during feasibility analysis to ensure Council has the information it requires to make sound strategic decisions.



- Legend
- Community / Administration
 - Aquatic
 - Gymnastics
 - Change / Amenities
 - Storage / Services



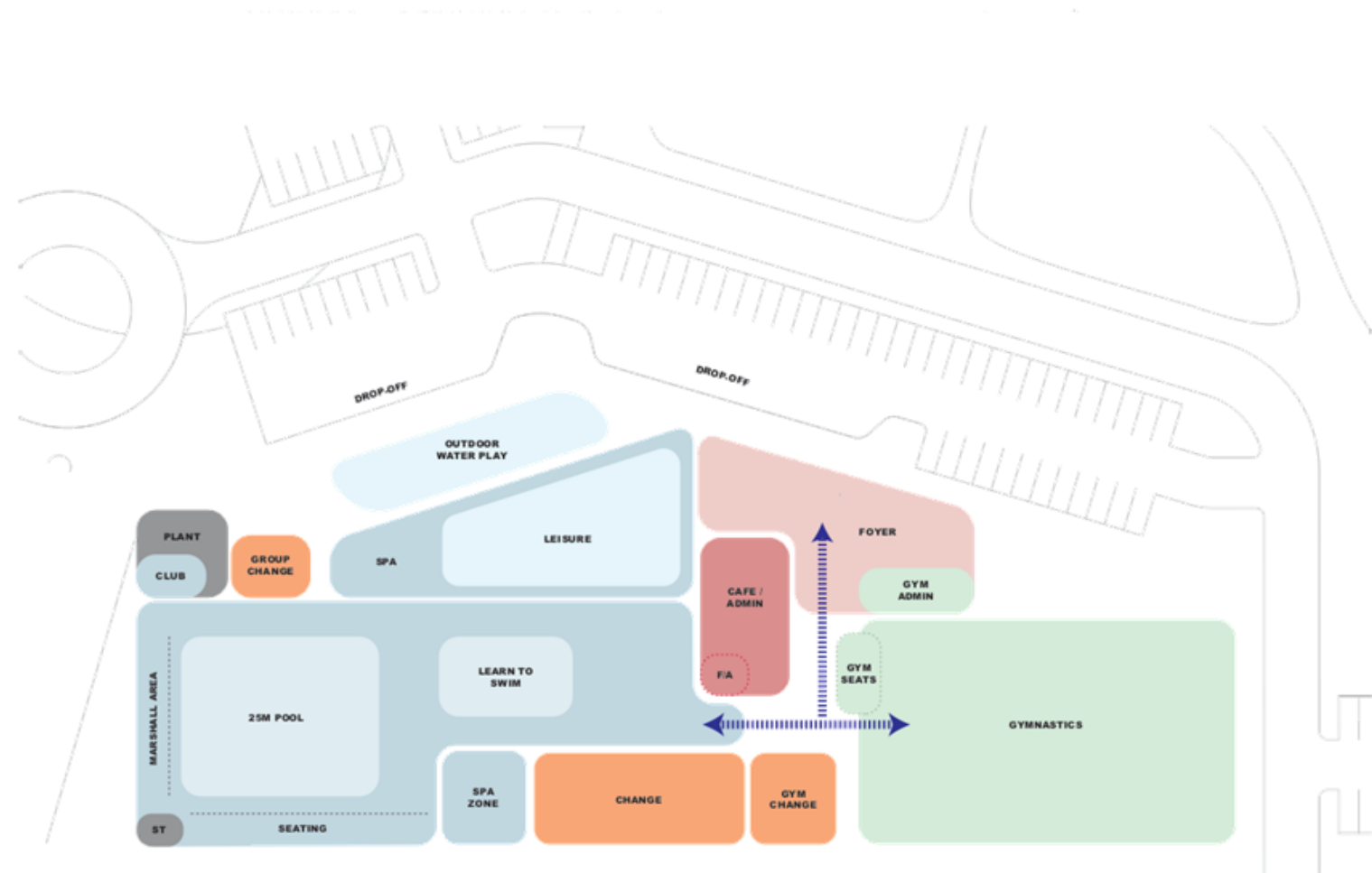
SPATIAL ARRANGEMENT PLAN

Alternative 03

The alternative development options shown include:

- Proposed facility layout with possible provision of a health club facility (gymnasium and group fitness / program rooms) on an upper level;
- Provision of a warm water pool in lieu of the gymnastics component, with possible provision of a health club facility (gymnasium and group fitness / program rooms) on an upper level;
- Provision of a health club facility (gymnasium and group fitness / program rooms) in lieu of the gymnastics component;
- Reduction to a 25m indoor pool to enable provision of a larger gymnastics component.

These alternative component mixes should be tested during further feasibility analysis to determine the most sustainable facility mix within the Carnes Hill context.



Legend

- Community / Administration
- Aquatic
- Gymnastics
- Change / Amenities
- Storage / Services



SUSTAINABLE DEVELOPMENT

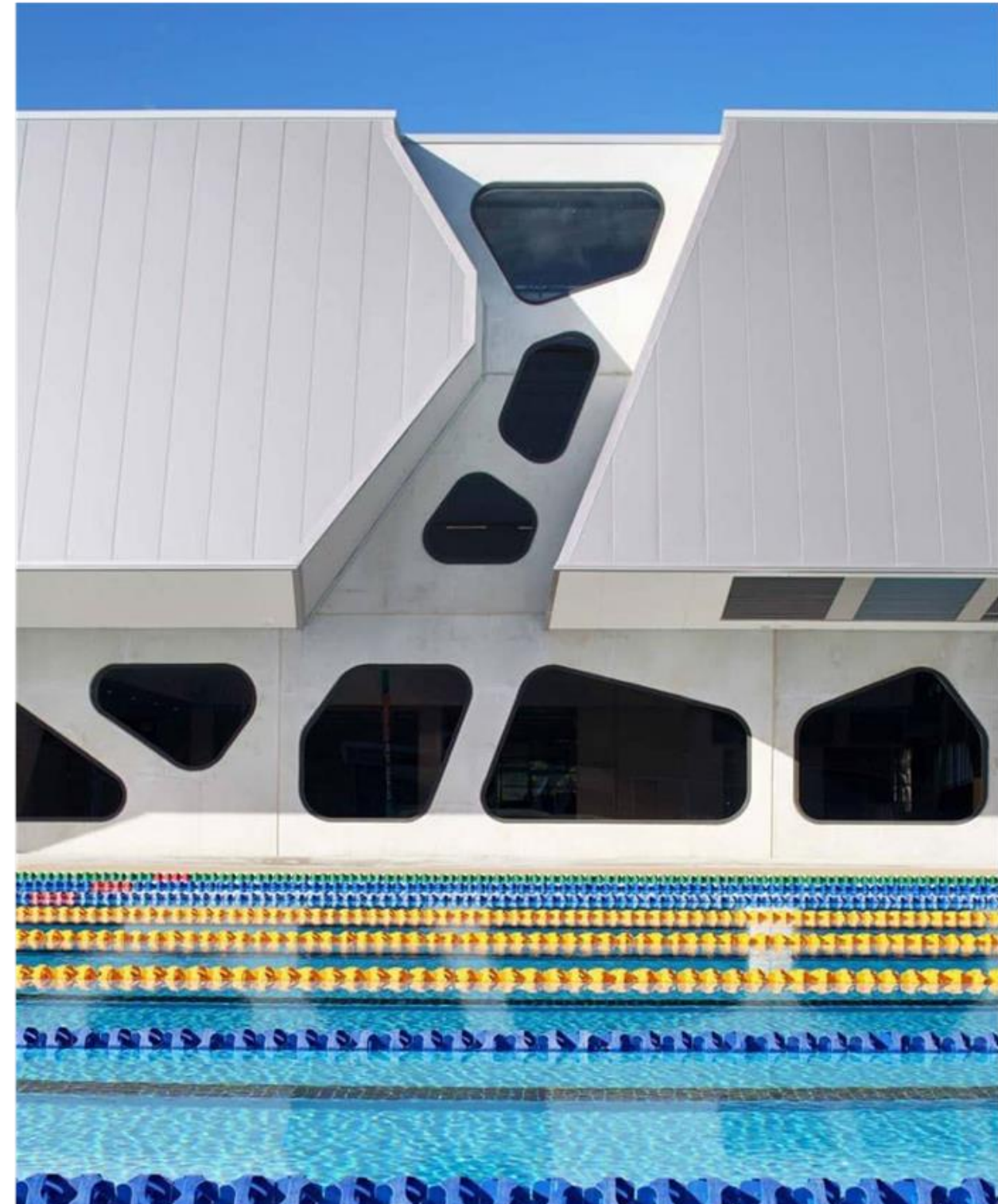
Indoor aquatic facilities are big consumers of energy and water. Therefore, careful consideration must be given to determine which sustainability initiatives are most appropriate and which will realise tangible operational benefits. We would typically prioritise achieving operational efficiencies and benefits within the decision process of formal accreditation frameworks.

Provision of universal access to broaden community participation in health and leisure activities is clearly an important objective. Spatial and operational requirements and implications of access provision for all areas of the facility will need to be tested with stakeholders and the broader design team.

Sport and leisure facilities are popular destinations for engaging in recreational activities and for meeting with friends and family. They provide opportunities to introduce community groups to each other, developing an inclusive community that transcends age groups and cultural barriers, building and nourishing social capital, facilitating social healing and encouraging social cohesion.

In order to achieve these overarching objectives at Carnes Hill, the facility must be:

- Universally accessible so that no patron is hindered in their desire to participate in leisure activities;
- Socially sustainable and therefore an enjoyable facility to visit, requiring that the proposed renewal works improve the quality of the patron's experience, and encourage them to visit more often;
- Environmentally and therefore economically sustainable, whereby Council's ongoing operating costs are reduced.



COST ANALYSIS

An indicative order of cost has been prepared as part of the development of an implementation strategy. The cost plan reflects the current masterplan, including the layout and areas indicated in the preferred aquatic facility model. Costs are provided for some of the alternative facility components for general reference / information.

The cost plan allows for escalation for a period of 12 months, assuming that construction of all components of the masterplan commences in July 2021. We note that any components of the masterplan that are delivered beyond this date will be subject to further escalation costs.

In broad terms, the works proposed in the masterplan (excluding alternative / additional components) equate to approximately \$76.3 million, with indicative component costs as follows:

- Indoor aquatic and gymnastics facility: \$54-56 million
- Sports pavilion, playing fields and multi-purpose courts: \$5-6 million
- Circulation roads and car parks: \$5-6 million

Costs for provision of alternative / additional components are as follows:

- Warm water pool (in lieu of gymnastics): additional \$1.5-2.5 million
- Health club or gymnastics (on upper level): additional \$4-5 million



Liverpool City Council
Carnes Hill Masterplan - Stage 2

Indicative Cost Plan

QS REF: me
Date: 6/07/2020

Function	Rate \$/m2	Preferred Option	
		Area m2	Total \$
Building Works - Ground Floor			
Entrance foyer	\$ 2,400	350	\$ 840,000
Reception	\$ 3,000	30	\$ 90,000
- Extra for reception joinery		Allow	\$ 40,000
- Extra for turnstiles		Allow	\$ 100,000
Retail / Merchandise	\$ 2,500	20	\$ 50,000
Admin - office / open plan / store / print	\$ 2,500	72	\$ 180,000
Admin - staff kitchen / amenities	\$ 3,300	15	\$ 49,500
Café / Kiosk kitchen / servery	\$ 3,200	60	\$ 192,000
Extra for cafe equipment	\$ 2,200	Allow	\$ 200,000
Café / Kiosk seating	\$ 2,200	75	\$ 165,000
Party Room	\$ 2,500	20	\$ 50,000
Community / child minding - MP space	\$ 2,900	120	\$ 348,000
Community / child minding - Office	\$ 2,500	12	\$ 30,000
Community / child minding - Amenities	\$ 3,600	12	\$ 43,200
Community / child minding - Kitchenette / Store	\$ 3,300	15	\$ 49,500
Pool Hall [incl spectator seating]	\$ 2,900	3250	\$ 9,425,000
Extra for spectator bench seating		Allow	\$ 200,000
Spa / Sauna / Steam - shell	\$ 2,200	80	\$ 176,000
Swim club / competition room	\$ 2,700	50	\$ 135,000
First Aid	\$ 2,700	15	\$ 40,500
Pool storage	\$ 2,500	120	\$ 300,000
Wet Change - M&F / family	\$ 3,300	210	\$ 693,000
Wet Change - Accessible	\$ 3,600	16	\$ 57,600
Wet Change - Changing Places	\$ 4,000	15	\$ 60,000
Wet Change - Outdoor Family	\$ 3,300	20	\$ 66,000
Wet Change - Group Change	\$ 3,300	80	\$ 264,000
Pool Plant room	\$ 2,500	400	\$ 1,000,000
- Extra for access to pool plant		Allow	\$ 100,000
Plant rooms - mech / elec	\$ 2,500	568	\$ 1,420,000
- Extra for access to pool plant		Allow	\$ 100,000
Cleaners Store	\$ 2,900	20	\$ 58,000
Waste Store	\$ 2,200	40	\$ 88,000
Gymnastics			
Training / Competition / Program Space	\$ 2,800	800	\$ 2,240,000
Spectator viewing space	\$ 3,000	60	\$ 180,000
Entry / Reception	\$ 3,000	20	\$ 60,000
Office / Administration	\$ 2,500	30	\$ 75,000
Amenities and Change	\$ 3,300	100	\$ 330,000
Storage	\$ 2,200	50	\$ 110,000
Circulation / plant allowance	\$ 2,200	674.5	\$ 1,483,900
Allowance for grossing		Allow	\$ 1,854,875
Allowance for roof plant platform		Allow	\$ 300,000
Allowance for piled foundations		Allow	\$ 1,959,000
Allowance for fire sprinklers		Allow	\$ 376,000
Allow for AV infrastructure		Allow	\$ 357,000
Building signage		Allow	\$ 400,000
Entrance Canopy		Allow	\$ 375,000
ESD Initiatives [Best Practice]	3%	Allow	\$ 802,000
- Solar Panels		Allow	\$ 350,000
- Rainwater harvesting tanks & treatment for pool use		Allow	\$ 219,000
Total Building Works Option		7,419.50	\$ 28,082,075
Aquatic Works - Internal			
50m x 8 lane pool incl ramp access		Allow	\$ 4,000,000
Boom		Allow	\$ 450,000
25m x 8 lane pool incl ramp access		Allow	\$ 830,000
Learn-to-Swim Pool - 17m x 10m - incl ramp access		Allow	\$ 1,500,000
Leisure pool with beach entry / splashpad		Allow	\$ 400,000
- Extra for water features		Allow	\$ 500,000
Balance / Backwash tanks		Allow	\$ 200,000
Pool equipment		Allow	\$ 150,000
Builders works [excavation, etc - piling included in building above]		Allow	\$ 1,000,000
Preliminaries on aquatic works		Allow	\$ 1,000,000
Total Aquatic Works			\$ 9,636,000
External Works & Services			
Demolition of existing buildings		PROV SUM	\$ 100,000

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Liverpool City Council
Carnes Hill Masterplan - Stage 2

Indicative Cost Plan

QS REF: me
Date: 6/07/2020

Function	Rate \$/m2	Preferred Option	
		Area m2	Total \$
Site Preparation / sundry demolition		Allow	\$ 118,400
- Earthworks		Allow	\$ 298,150
Waste yard		Allow	\$ 30,000
Pool plant access / bund		Allow	\$ 30,000
Entry forecourt		Allow	\$ 182,160
Outdoor forecourt		Allow	\$ 178,080
New carpark - Aquatic		Allow	\$ 429,680
Crossovers		Allow	\$ 20,000
Allowance for fencing		Allow	\$ 31,500
Allowance for soft landscaping [around aquatic centre]		Allow	\$ 371,025
Allowance for External Services		Allow	\$ 1,225,000
Total External Works & Services			\$ 3,012,035
Carnes Hill Masterplan	\$ 4,000	400	\$ 1,600,000
Sports pavilion to sports fields		Allow	\$ 305,000
Spectator seating for sporting fields		Allow	\$ 592,560
- Forecourt to pavilion / seating		2 No	\$ 150,000
Outdoor multi-purpose courts		Allow	\$ 50,000
- allow for lighting		Allow	\$ 50,000
- allow for bench seating, scoreboards, etc		2 No	\$ 450,000
Turf soccer pitches		Allow	\$ 150,000
- allow for lighting		Allow	\$ 100,000
- allow for interchange benches, officials box, scoreboards, etc		Allow	\$ 370,400
Entry boulevard from Cowpasture Rd		Allow	\$ 385,200
New access road		Allow	\$ 200,000
- Extra for roundabout		Allow	\$ 1,094,400
Boulevard incl feature trees and median		Allow	\$ 300,000
New roundabout		Allow	\$ 171,000
Carparks - south site		Allow	\$ 876,600
Carparks - north site		Allow	\$ 445,800
Childrens Playground		Allow	\$ 200,000
- Extra for play equipment		Allow	\$ 215,400
Boardwalk connection		Allow	\$ 224,000
New walkway and cycle way [south site]		Allow	\$ 234,400
New walkway and cycle way [north site]		2 No	\$ 60,000
Shelter with seating		Allow	\$ 46,400
Pedestrian walkway linking aquatic centre to pavilion		Allow	\$ 1,107,700
New Soft Landscaping		Allow	\$ 50,000
Allowance for protection of existing landscaping		Allow	\$ 535,800
WSUD system		Allow	\$ 167,500
Irrigation pump house		Allow	\$ 20,000
- allow for irrigation plant		Allow	\$ 101,250
Additional fill to 'low lying area'		Allow	\$ 480,000
Allowance for retaining walls to steep embankments [north boundary]		Allow	\$ 300,000
Universal access from Cowpasture Rd - series of ramps on steep slope		Allow	\$ 116,780
Spectator mound		Allow	\$ 33,648
Site Preparation / sundry demolition		Allow	\$ 1,008,425
- Earthworks		Allow	\$ 1,094,545
Allowance for External Services			
Total External Works & Services			\$ 14,181,788
Sub Total		7,401	\$ 54,911,898
Design Contingency	10%		\$ 5,492,000
Cost Escalation to tender [1 year]		based on 3% pa	\$ 1,813,000
Construction Cost	10%		\$ 62,216,898
Construction Contingency	8%		\$ 6,222,000
Professional Fee Allowance		Allow	\$ 5,476,000
Authority Fees & Charges		Allow	\$ 687,000
- Contribution to substation		Allow	\$ 200,000
Fixtures, Fittings and Equipment		Allow	\$ 623,000
Audio Visual/ Active IT Equipment Allowance/ Members systems		Allow	\$ 350,000
Public Art allowance		Allow	\$ 200,000
Council internal costs		Allow	\$ 150,000
Legal, permits, marketing, other professional Fees		Allow	\$ 150,000
Sub Total			\$ 14,058,000
Project Total (excluding GST)			\$ 76,274,898

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IMPLEMENTATION PLAN

The following information provides a summary of relevant background and key considerations associated with the funding for the implementation of the Carnes Hill Recreational Precinct Masterplan.

Overview

The development of aquatic and leisure facilities and sporting infrastructure is generally funded through a combination of different sources including:

- Council funding.
- State government grants.
- Federal government funding.
- Public private partnerships.
- Commercial investment.
- Community fundraising.

In a general sense, the broad funding options associated with funding of Council infrastructure includes:

- Section 7.11 contributions – collected from new development in the relevant areas.
- Proceeds from the sale of assets – following on from a review and rationalising community assets where assets are either under-utilised, are surplus or may no longer meet the service expectations of our community.
- Debt / loan borrowings – where appropriate, Council utilises debt to fund capital expenditure, subject to it fulfilling agreed economic, social or environmental benefits and not affect existing recurrent operations and / or cash flows.
- Forward borrowing from reserves – any cash surpluses of a general fund nature will be restricted and held for strategic priorities.
- Other general income sources – Council's look to investigate and generate other alternate sources of revenue.
- Grants and contributions (operational and capital) – actively pursuing grant funding and other contributions to assist in the delivery of services and facilities.
- Delivery partnerships – where Council and key partners (such as schools or private developers) collaborate to deliver a new facility.

A survey of Council projects identified the following investment mix for aquatic and leisure facilities and sporting infrastructure developments:

- Council capital funding: 80% plus.
- Other government funding: up to 20%.
- Community Trusts / Institutions: up to 2%.
- Commercial fundraising: up to 10%.
- Community fundraising: up to 5%.
- Asset sales: up to 5%.
- Management company contributions: up to 2%

Industry Consultation and Research

The following information provides a summary of the research and consultation undertaken in relation to funding for the Carnes Hill Recreational Precinct Masterplan.

i) The NSW state government provides access to a range of funding grants and programs which vary over time. Examples of some current and previous relevant grants programs include: sport development program, community building partnership program, community development grants program and stronger communities' program. In addition to these grants, funding associated with COVID-19 sport recovery and capital stimulus programs are evolving.

ii) The federal government has ongoing funding programs and these also vary and evolve over time, including COVID-19 related programs. One example is the City Deals program which is aimed at projects that create genuine partnerships between the three levels of government and the community to work towards a shared vision for productive and liveable cities. City Deals work to align the planning, investment and governance necessary to accelerate growth and job creation, stimulate urban renewal and drive economic reforms.

iii) Important to the success of any funding application is the development of a feasibility study and / or business case that outlines the benefits, operational model and financial performance. In relation to benefits, this may relate to general participation, alignment with health and wellbeing outcomes or support for females, marginalised or disconnected communities.

iv) Beyond traditional government and private sector funding, there is an emerging opportunity to leverage philanthropic and corporate sectors looking to invest in health and wellbeing intervention at a community level. There are investment brokers who access social impact investment funding to incubate and deliver population health innovation under 'Wellbeing Communities' platforms, through social enterprise design, delivery and scale. Such impact investment for community health and wellbeing has been pioneered in some European countries and this type of approach to funding may be accessible in Australia soon.

v) The opportunity for investment from a consortia including Council, superannuation provider / health insurance provider, state government and a management group may be a possible funding mechanism, providing there was ongoing impact measurement and evaluation was undertaken to demonstrate a return on investment.

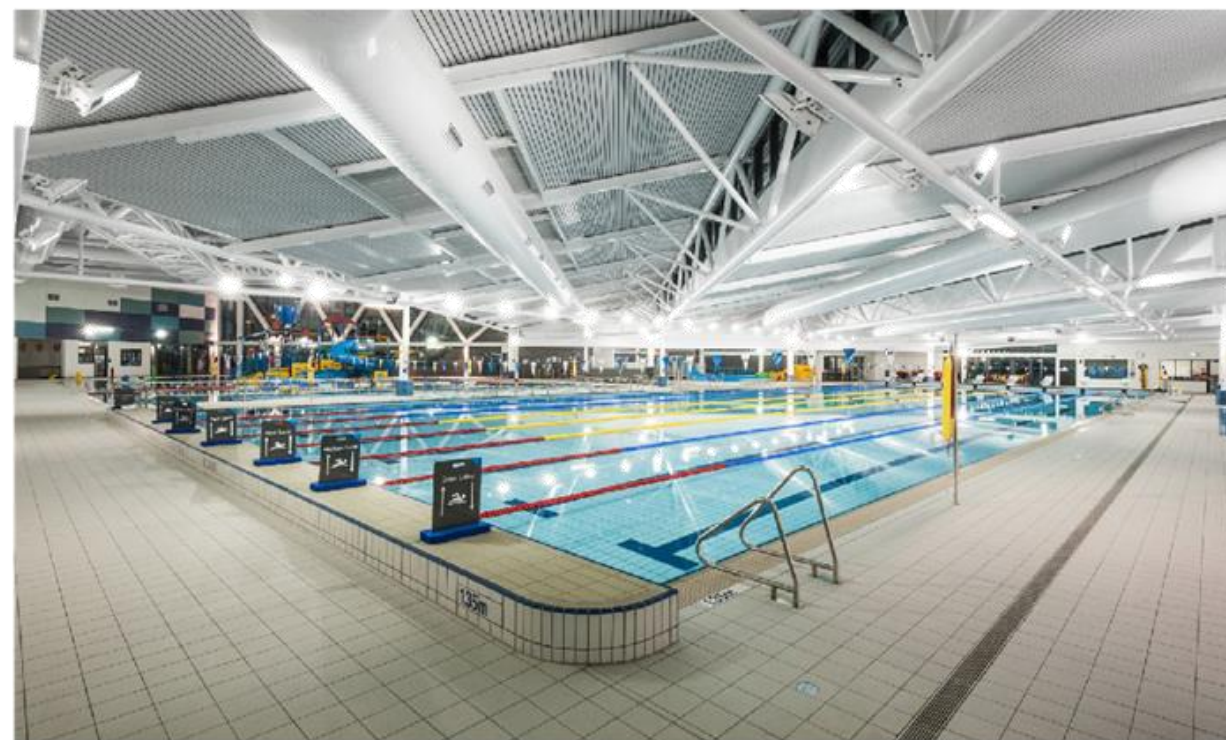


IMPLEMENTATION PLAN

Key Success Factors and Major Considerations

Central to the success of funding procurement are the following critical factors. It is recommended that Council considers these factors prior to the development of a detailed funding strategy for the Carnes Hill Recreational Precinct Masterplan.

Key Success Factors	Council Consideration
1. The determination of Council's financial contribution to the project. This funding generally equates to 80% or more of the total project costs.	What will Council's financial contribution to the Masterplan implementation be?
2. The completion of a detailed feasibility study and / or business case that outlines: alignment with Council plans and strategies, the project costs, design, financial performance, community need, consultation with potential funding organisations, an overview of the operational model, a detailed analysis of benefits and outcomes and the development of a clear strategic vision for the project.	Will Council be completing a feasibility study and / or business case for the Masterplan?
3. A major focus area for any funding is an alignment with the funder's objectives, strategies and plans. Hence it is important to understand the funder's priorities and then evolve projects to maximise the associated benefits.	What are the major project benefits and how do they align with potential funder objectives?
4. The procurement of funding generally requires broad based advocacy and support for the project from community groups, local organisations, schools and / or other key stakeholders. Hence it is important to actively engage with these groups and ensure that they can support any funding procurement process.	What advocacy support can Council receive for the project?
5. It may be necessary to stage works to ensure that funding streams are consistent with the capacity of Council to make a contribution to each phase of a project and therefore demonstrate a strong commitment throughout the development.	The chart below outlines the steps associated with a traditional approach to maximising funding opportunities.



CO-OP

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Local Government Remuneration Tribunal

Annual Report and Determination

*Annual report and determination under sections 239 and
241 of the Local Government Act 1993*

**10 June
2020**

Local Government Remuneration Tribunal

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Executive Summary

The *Local Government Act 1993* (the LG Act) requires the Local Government Remuneration Tribunal (the Tribunal) to report to the Minister for Local Government by 1 May each year as to its determination of categories of councils and the maximum and minimum amounts of fees to be paid to mayors, councillors, and chairpersons and members of county councils.

In response to the COVID-19 pandemic the Minister for Local Government, the Hon Shelley Hancock MP, made the *Local Government (General) Amendment (COVID-19) Regulation 2020* which extends the time for the making of this determination to no later than 1 July 2020.

Categories

Section 239 of the LG Act requires the Tribunal to determine the categories of councils and mayoral offices at least once every 3 years. The Tribunal last undertook a significant review of the categories and the allocation of councils into each of those categories in 2017. In accordance with the LG Act the Tribunal undertook a review of the categories and allocation of councils into each of those categories as part of the 2020 review.

In reviewing the categories, the Tribunal examined a range of statistical and demographic data and considered the submissions of councils and Local Government NSW (LGNSW). Having regard to that information, the Tribunal has determined to retain a categorisation model which differentiates councils primarily on the basis of their geographic location, and the other factors including population, the sphere of the council's economic influence and the degree of regional servicing.

For the Metropolitan group the Tribunal has determined to retain the existing categories and has amended the population criteria applicable to Metropolitan Large and Metropolitan Medium. For the Non-Metropolitan group, the Tribunal has determined to: create two new categories - Major Strategic Area and Regional Centre; rename one category - Regional City to Major Regional City; and revise the criteria for some of the existing categories to account for the new categories.

In accordance with section 239 of the LG Act the categories of general purpose councils are determined as follows:

Metropolitan

- Principal CBD
- Major CBD
- Metropolitan Large
- Metropolitan Medium
- Metropolitan Small

Non-metropolitan

- Major Regional City
- Major Strategic Area
- Regional Strategic Area
- Regional Centre
- Regional Rural
- Rural

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Fees

The Tribunal has determined that there will be no increase in the minimum and maximum fees applicable to each existing category. For the new categories, the Tribunal has determined fees having regard to relevant relativities.

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Section 1 Introduction

1. Section 239 of the LG Act provides for the Tribunal to determine the categories of councils and mayoral offices and to place each council and mayoral office into one of those categories. The categories are to be determined at least once every 3 years.
2. Section 241 of the LG Act provides for the Tribunal to determine, not later than 1 May in each year, for each of the categories determined under section 239, the maximum and minimum amount of fees to be paid to mayors and councillors of councils, as well as chairpersons and members of county councils.
3. In response to the COVID-19 pandemic the Minister for Local Government, the Hon Shelley Hancock MP, made the *Local Government (General) Amendment (COVID-19) Regulation 2020* which extends the time for the making of this determination to no later than 1 July 2020.
4. In determining the maximum and minimum fees payable in each of the categories, the Tribunal is required, pursuant to section 242A (1) of the LG Act, to give effect to the same policies on increases in remuneration as those of the Industrial Relations Commission. The current policy on wages is that public sector wages cannot increase by more than 2.5 per cent, and this includes the maximum and minimum fees payable to councillors and mayors and chairpersons and members of county councils.
5. The Tribunal is however able to determine that a council can be placed in another existing or a new category with a higher range of fees without breaching the Government's wage policy pursuant to section 242A (3) of the LG Act.
6. The Tribunal's determinations take effect from 1 July in each year.

Section 2 2019 Determination

7. The Tribunal considered ten requests for re-categorisation. At the time of making the determination the Tribunal had available to it the 30 June 2018 population data. In reviewing the submissions received the Tribunal applied a multi variable approach assessing each council against all the criteria (not only population) for the requested category and the

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relativities within the categories.

8. The Tribunal found that the allocation of councils into the current categories was appropriate but again noted that some of those councils seeking to be moved were likely to meet the criteria for re-categorisation in future determinations.
9. The Tribunal's 2019 Determination was made on 15 April 2019 and provided a general increase of 2.5 per cent which was consistent with the Government's policy on wages.
10. The Tribunal's findings for North Sydney was not addressed in the 2019 Determination and is dealt with in Section 3 below.

Section 3 Review of categories

Scope of review

11. Section 239 of the LG Act requires the Tribunal to determine the categories of councils and mayoral offices at least once every 3 years. The Tribunal last reviewed the categories during the 2017 annual review.
12. In determining categories, the Tribunal is required to have regard to the following matters that are prescribed in section 240 of the LG Act:

"240 (1)

- *the size of areas*
- *the physical terrain of areas*
- *the population of areas and the distribution of the population*
- *the nature and volume of business dealt with by each Council*
- *the nature and extent of the development of areas*
- *the diversity of communities served*
- *the regional, national and international significance of the Council*
- *such matters as the Remuneration Tribunal considers relevant to the provision of efficient and effective local government*
- *such other matters as may be prescribed by the regulations."*

13. The Tribunal foreshadowed in the 2019 Determination of its intention to undertake a review of the categories in accordance with the LG Act:

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“12. A few submissions have suggested alternative categorisation models. The Tribunal will consider this in detail in the 2020 review. The Tribunal intends to commence the 2020 annual review earlier than usual to ensure there is time to review the existing model and to examine alternatives. The Tribunal is of the preliminary view that a case may exist to revise the number of categories, and their applicable criteria, particularly for regional and rural councils.”

14. The Tribunal wrote to all mayors in October 2019 advising of the commencement of the 2020 review and invited submissions from councils on the following matters:

1. *Proposed classification model and criteria*
2. *Allocation in the proposed classification model*
3. *Range of fees payable in the proposed classification model*
4. *Other matters*

15. The Tribunal also wrote to the President of Local Government NSW (LGNSW) in similar terms, and subsequently met with the President and Chief Executive of LGNSW. The Tribunal thanks the President and Chief Executive for making the time to meet with the Tribunal.

16. The Tribunal also met with the Mayors and General Managers of Central Coast and Maitland Councils and the Tribunal thanks them for making the time to meet with the Tribunal.

Submissions received - categorisation

17. The Tribunal received 38 submissions from individual councils, a submission from LGNSW and a submission from Regional Cities NSW. Most of the submissions addressed the Tribunal’s proposed categorisation model, the allocation of councils into those categories and fees. A summary of the matters raised, and the Tribunal’s consideration of those matters is outlined below.

Proposed classification model and criteria

18. Submissions from 20 councils and LGNSW supported the Tribunal’s proposal to create a new category of Regional Centre for the Non-Metropolitan group and were of the view

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that the range of fees would be somewhere between Regional Strategic Area and Regional Rural.

19. Several submissions from Non-Metropolitan councils proposed alternative changes to the model such as, the merging of the Regional Rural and Rural categories, the creation of a new 'Regional' category and the renaming of Regional City to 'Gateway City' or 'Nationally Significant Regional City'.
20. Four submissions from Metropolitan councils sought the creation of a new Metropolitan category with the title of 'Metropolitan Large – Growth Area' or 'Metropolitan Major'.

Allocation in the proposed classification model

21. The Tribunal proposed to allocate 24 councils in the proposed new category of Regional Centre. Of these 24 councils, 14 provided a submission - 11 councils noted or supported their allocation as Regional Centre and 3 councils sought re-categorisation as Regional Strategic Area.
22. In addition to the 3 councils, another 17 councils sought re-categorisation into one of the categories included in the Tribunal's proposed model or into requested alternative new categories. The 20 re-categorisation requests are addressed in Section 3 – Allocation of councils into categories.

Findings - categorisation

23. The Tribunal acknowledges the significant number of submissions received this year and is grateful for the positive response and effort made in those submissions to comment on the proposed categorisation model and suggest alternatives for consideration.
24. There has been broad support to the Tribunal's proposal to create a new Non-Metropolitan category of Regional Centre and rename Regional City to Major Regional City. On that basis the Tribunal will determine the new category of Regional Centre and rename Regional City to Major Regional City. There have been some new criteria added to the category of Major Regional City to acknowledge the broader national and state focus of these cities which impact upon the operations of the council.
25. After considering the views in submissions the Tribunal re-examined the Non-Metropolitan category of Regional Strategic Area in terms of its criteria and the

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characteristics of the councils allocated into it. The Tribunal concluded that the characteristics of the two councils allocated to this category – Central Coast and Lake Macquarie – were sufficiently different to warrant further differentiation. Central Coast has a population greater than 340,000 making it the third largest council by population in NSW and the sixth largest council by population in Australia. It also has the second largest revenue base of all councils in NSW. Central Coast is a significant contributor to the regional economy associated with proximity to and connections with Sydney and the Hunter Region. A new category has been created for Central Coast Council and is to be titled Major Strategic Area. The criteria for this category include local government areas with a minimum population of 300,000, and larger scale and scope to those categorised as Regional Strategic Area. There is no change to the population threshold for the category of Regional Strategic Area, however the other criteria have been amended to account for other changes in the Non-Metropolitan group.

26. The Tribunal's preliminary thinking was that no changes to the categories and criteria for Metropolitan and County Councils were warranted. In respect to the categories, the Tribunal continues to hold that view. In respect to the criteria, after considering submissions the Tribunal re-examined the population criteria for both the Metropolitan Medium and Metropolitan Large categories.
27. North Sydney and Willoughby councils again put forward cases for non-resident workers to be included in the population for Metropolitan Medium. To examine this claim more broadly the Tribunal reviewed non-resident working populations across all metropolitan councils. After careful consideration the Tribunal concluded there was a strong case to recognise the impact on councils of serving significant numbers of non-resident workers. The criteria now provide for councils with a non-resident working population of 50,000 or above to move to another category if their combined resident and non-resident working population exceeds the minimum population threshold. The criteria for Metropolitan Medium and Metropolitan Large have been amended as follows:

Metropolitan Large

Councils may also be categorised as Metropolitan Large if their residential population combined with their non-resident working population exceeds 200,000. To satisfy this criteria the non-resident working population must exceed 50,000.

Metropolitan Medium

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Councils may also be categorised as Metropolitan Medium if their residential population combined with their non-resident working population exceeds 100,000. To satisfy this criteria the non-resident working population must exceed 50,000.

28. In making this determination the Tribunal reviewed the criteria for other Metropolitan categories and found that the current population thresholds are appropriate.

29. The revised model which will form the basis of this determination is as follows:

Metropolitan	Non-Metropolitan
<ul style="list-style-type: none"> • Principal CBD • Major CBD • Metropolitan Large • Metropolitan Medium • Metropolitan Small 	<ul style="list-style-type: none"> • Major Regional City • Major Strategic Area • Regional Strategic Area • Regional Centre • Regional Rural • Rural

30. The criteria for each of the categories are outlined at Appendix 1. Minor changes have been made to the criteria for some of the existing categories to account for the new categories. As with the previous categorisation model the predominant factor to guide categorisation is population. Other common features of councils within those categories are also broadly described. These criteria have relevance when population alone does adequately reflect the status of one council compared to others with similar characteristics. In some instances, the additional criteria will be significant enough to warrant the categorisation of a council into a group with a higher population threshold.

31. There is no change to the categorisation of county councils.

Allocation of councils into categories

32. In accordance with section 239 of the LG Act the Tribunal is required to allocate each of the councils into one of the categories. The allocation of councils is outlined in Determination No. 1 of Section 6.

33. Twenty (20) submissions received from councils requested re-categorisation and were considered having regard to the case put forward and the criteria for each category.

34. At the time of making the determination the Tribunal had available to it the 30 June 2019 population data released by the Australian Bureau of Statistics (ABS) on 25 March 2020.

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35. A summary of the Tribunal's findings for each of the applications for re-categorisation is outlined in the following paragraphs.

Metropolitan Large Councils

36. Canterbury-Bankstown, Penrith and Blacktown have requested the creation of new categories into which they be re-categorised. Canterbury-Bankstown has requested a new category named 'Metropolitan Major'. Penrith and Blacktown have requested a new category named 'Metropolitan Large – Growth Centre'.
37. The Tribunal considers that Canterbury-Bankstown, Penrith and Blacktown are appropriately categorised as Metropolitan Large.

Metropolitan Medium Councils

38. Inner West has again sought to be re-categorised as Metropolitan Large. The Tribunal outlined in the 2019 determination that Inner West's June 2018 population of 198,024 was below the indicative population of other Metropolitan Large councils, but based on growth predictions it was likely Inner West would meet the minimum population threshold for inclusion in Metropolitan Large in 2020.
39. Inner West's June 2019 population is 200,811 and the council now meets the criteria to be categorised as Metropolitan Large.
40. Ryde has sought to be re-categorised as Metropolitan Large on the basis of the large non-resident working population in the Macquarie Park Business Park (MPBP) precinct, the economic output of the precinct and its array of significant regional services.
41. The Hills has requested the creation of a new category named 'Metropolitan Growth' and that it be categorised into it. Recognition is sought for councils experiencing significant growth. The submission also notes that while Ryde does not meet the residential population criteria for Metropolitan Large it meets the other relevant criteria.
42. As previously discussed, the Tribunal has reviewed the impact of large numbers of non-residents visitors and workers and revised the criteria for Metropolitan Large Councils. Ryde and The Hills have been assessed against the new revised criteria being - *Councils may also be categorised as Metropolitan Large if their residential population combined*

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with their non-resident working population exceeds 200,000. To satisfy this criteria the non-resident working population must exceed 50,000.

43. Both Ryde and The Hills have a non-resident working population of more than 50,000 and combined with their resident populations they meet the revised criteria for inclusion in the group of Metropolitan Large councils. Both councils also provide a sphere of economic influence and provide regional services considered akin to those of other metropolitan large councils.

Metropolitan Small Councils

44. Camden, Willoughby and North Sydney have sought to be re-categorised as Metropolitan Medium.
45. The Tribunal outlined in the 2019 determination that Camden's June 2018 population of 94,159 was below the indicative population of other Metropolitan Medium councils, but based on growth predictions it was likely Camden would meet the minimum population threshold for inclusion in Metropolitan Medium in 2020.
46. Camden's June 2019 population is 101,437 and the council now meets the criteria to be categorised as Metropolitan Medium.
47. The Tribunal has previously considered requests from Willoughby and North Sydney Councils to be re-categorised as Metropolitan Medium in 2018 and 2019. Both Councils have populations within the indicative population range for Metropolitan Small councils but well below that of Metropolitan Medium. Both Councils have argued that their scale of operations, degree of regional servicing and high number of non-resident visitors and workers more closely align with the characteristics of Metropolitan Medium Councils.
48. As previously discussed, the Tribunal has reviewed the impact of large numbers of non-resident workers and revised the criteria for Metropolitan Medium Councils. Willoughby and North Sydney have been assessed against the new revised criteria being - *Councils may also be categorised as Metropolitan Medium if their residential population combined with their non-resident working population exceeds 100,000. To satisfy this criteria the non-resident working population must exceed 50,000.*
49. Both Willoughby and North Sydney have a non-resident working population of more than 50,000 and combined with their resident populations they meet the revised criteria for inclusion in the group of Metropolitan Medium councils. Both councils also meet the

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other criteria having: a significant regional role as the third and fourth biggest CBDs in Sydney after Sydney City and Parramatta; strategic significance as either transport hubs, business, cultural or employment centres.

50. Both North Sydney and Willoughby meet the criteria for re-categorisation as Metropolitan Medium.

Regional City Councils

51. Newcastle and Wollongong have proposed new categories into which they have sought to be re-categorised. Newcastle has proposed a new category named 'Gateway City' and Wollongong a new category named 'Nationally Significant Regional City'.
52. The Tribunal's revised categorisation model re-named the existing category of Regional City to Major Regional City and found no case to adopt the new categories proposed by Newcastle and Wollongong. The Tribunal considers that both councils are appropriately categorised as Major Regional City.

Regional Strategic Area Councils

53. Central Coast has again sought to be re-categorised as Regional City. The council submits that its characteristics are more like Newcastle and Wollongong (Regional City) and substantially different to Lake Macquarie (Regional Strategic Area).
54. Central Coast does not meet the broader criteria applicable to other councils in the category of Major Regional City - being Newcastle and Wollongong. As previously discussed a new category - Major Strategic Area - has been created to recognise the scale and unique position of Central Coast Council to both the Sydney and Hunter regions.

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Regional Rural Councils

55. Bathurst, Maitland, and Shoalhaven noted that under the Tribunal's proposed allocation of councils they would be allocated to the new Regional Centre category, however the three councils sought to be re-categorised as Regional Strategic Area.
56. Bathurst's June 2019 population of 43,618, Maitland's June 2019 population of 85,166 and Shoalhaven's June 2019 population of 105,648 are below the indicative population of Regional Strategic Area councils. The Tribunal considers that Bathurst, Maitland and Shoalhaven are all appropriately categorised as Regional Centre.
57. Bega, Byron and Eurobodalla have sought to be re-categorised to the new Regional Centre category. Bega's June 2019 population of 34,476, Byron's June 2019 population of 35,081 and Eurobodalla's June 2019 population of 38,473 are significantly below the indicative population of Regional Centre councils. These councils have not demonstrated the additional criteria to warrant inclusion in the Regional Centre group.

Rural Councils

58. Muswellbrook and Federation have again sought to be re-categorised as Regional Rural. Muswellbrook's June 2019 population of 16,377 and Federation's June 2019 population of 12,437 are well below the indicative population of Regional Rural councils. Both councils have not demonstrated the additional criteria to warrant inclusion in the Regional Rural group.

Section 4 Fees

59. In determining the maximum and minimum fees payable in each of the categories, the Tribunal is required, pursuant to section 242A of the LG Act, to give effect to the same policies on increases in remuneration as those that the Industrial Relations Commission is required to give effect to under section 146C of the *Industrial Relations Act 1996* (IR Act), when making or varying awards or orders relating to the conditions of employment of public sector employees.
60. The current policy on wages pursuant to section 146C(1)(a) of the IR Act is articulated in the *Industrial Relations (Public Sector Conditions of Employment) Regulation 2014* (IR Regulation 2014). When the Tribunal undertook the annual review the effect of the IR Regulation 2014

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was that public sector wages could not increase by more than 2.5 per cent, and this includes the maximum and minimum fees payable to councillors and mayors and chairpersons and members of county councils.

61. The Tribunal received submissions for consideration during the annual review in late 2019. Those submissions were made prior to the pandemic and overwhelmingly supported a 2.5 per cent increase in the ranges of fees which was consistent with the Government's wages policy at the time. A summary of those submissions is outlined in the paragraphs 62 and 63.
62. The LGNSW submission requested that the Tribunal increase fees by the allowable maximum of 2.5 per cent. The submission also reiterated the long-held view that fees for mayors and councillors are well behind, the current fee structure fails to recognise the work of elected representatives and is inadequate to attract and retain individuals with the necessary skills and experience. Comparative information was again presented in respect to board fees, fees paid to mayors and councillors of councils in Queensland, and salaries for members of Parliament. The LGNSW submission also noted the Tribunal's previous observations that it does not have jurisdiction on the matter of non-payment of superannuation but again invited the Tribunal to make a recommendation to the NSW State Government for councillor remuneration to include a payment for superannuation equivalent to the Superannuation Guarantee.
63. Several submissions sought an increase to the allowable maximum of 2.5 per cent acknowledging the restrictions on the Tribunal from the Government's wages policy. Several submissions sought an increase greater than 2.5 per cent by requesting that fees be aligned to councillor fees in Victoria and Queensland or to NSW members of Parliament.
64. Since receiving and considering those submissions there have been a number of factors which have influenced the Tribunal's views in regard to the annual increase. These include the impact of the bushfires and the current COVID-19 pandemic on the state and federal economies and the wellbeing of our communities.
65. To ensure the Tribunal had sufficient time to consider the COVID-19 pandemic the Minister for Local Government, the Hon Shelley Hancock MP, made the *Local Government*

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(General) Amendment (COVID-19) Regulation 2020 which extends the time for the making of this determination to no later than 1 July 2020.

66. On 29 May 2020 the Premier, the Hon Gladys Berejiklian MP, made the *Industrial Relations (Public Sector Conditions of Employment) Amendment (Temporary Wages Policy) Regulation 2020*. That regulation amended the IR Regulation 2014 to implement a temporary wages policy, being a 12-month pause on wage increases for public sector employees covered by the IR Act.
67. On 2 June 2020 the amending regulation was disallowed by the Legislative Council. The effect of that disallowance is that the Government's wages policy which provides for increases of up to 2.5 per cent continues to apply.
68. While the Tribunal is required to give effect to the Government's wages policy in the making of this determination, it is open to the Tribunal to determine an increase of up to 2.5 per cent or no increase at all. Given the current economic and social circumstances, the Tribunal has determined that there be no increase in the minimum and maximum fees applicable to each existing category.
69. The minimum and maximum fees for the two new categories of Major Strategic Area and Regional Centre have been set having regard to relevant relativities. The new category of Major Strategic Area has equivalent annual fees to Major Regional City. The new category of Regional Centre has annual fees between those applicable to Regional Strategic Area and Regional Rural. In accordance with the LG Act councils can be placed in a new category with a higher range of fees without breaching the Government's wages policy.

Section 5 Other matters

70. The Tribunal addressed the matter of non-payment of superannuation in the 2019 Determination:

"40. The submission from LGNSW and several councils have again raised the matter of the non-payment of superannuation. The Tribunal addressed this matter in the 2018 determination as outline below and will make no further comment:

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“54. The matter of the non-payment of superannuation has been previously raised in submissions to the Tribunal and is not a matter for the Tribunal to determine. Section 251 of the LG Act confirms that councillors are not employees of the council and the fee paid does not constitute a salary under the Act. The Tribunal notes that the Australian Tax Office has made a definitive ruling (ATO ID 2007/205) that allows councillors to redirect their annual fees into superannuation on a pre-tax basis and is a matter for councils (Ref: Councillor Handbook, Oct 2017, Office of Local Government p.69).”

71. By way of clarification, the amount redirected under this ruling is funded from the annual fees as determined by Tribunal – it is not an additional amount funded by the council.
72. The Tribunal notes that the Hon Shelly Hancock MP, Minister for Local Government released the *Councillor superannuation discussion paper* in March 2020, to seek the views of councils and their communities on whether councillors should receive superannuation payments. The deadline for submissions was Friday 8 May 2020.

Conclusion

73. The Tribunal’s determinations have been made with the assistance of the two Assessors - Mr Brian Bell and Mr Tim Hurst. The allocation of councils into each of the categories, pursuant to section 239 of the LG Act, is outlined in Determination No. 1. The maximum and minimum fees paid to councillors and mayors and members and chairpersons of county councils, pursuant to section 241 of the LG Act, are outlined in Determination No. 2.

The Local Government Remuneration Tribunal

Signed

Dr Robert Lang

Dated: 10 June 2020

Local Government Remuneration Tribunal

Section 6 Determinations

Determination No. 1- Determination Pursuant to Section 239 of Categories of Councils and County Councils Effective From 1 July 2020

Table 1: General Purpose Councils - Metropolitan

Principal CBD (1)	Major CBD (1)
Sydney	Parramatta
Metropolitan Large (11)	Metropolitan Medium (9)
Blacktown	Bayside
Canterbury-Bankstown	Campbelltown
Cumberland	Camden
Fairfield	Georges River
Inner West	Hornsby
Liverpool	Ku-ring-gai
Northern Beaches	North Sydney
Penrith	Randwick
Ryde	Willoughby
Sutherland	
The Hills	
Metropolitan Small (8)	
Burwood	
Canada Bay	
Hunters Hill	
Lane Cove	
Mosman	
Strathfield	
Waverley	
Woollahra	

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Table 2: General Purpose Councils – Non-Metropolitan

Major Regional City (2)	Major Strategic Area (1)	Regional Strategic Area (1)
Newcastle	Central Coast	Lake Macquarie
Wollongong		

Regional Centre (24)		Regional Rural (13)	
Albury	Mid-Coast	Bega	
Armidale	Orange	Broken Hill	
Ballina	Port Macquarie-Hastings	Byron	
Bathurst	Port Stephens	Eurobodalla	
Blue Mountains	Queanbeyan-Palerang	Goulburn Mulwaree	
Cessnock	Shellharbour	Griffith	
Clarence Valley	Shoalhaven	Kempsey	
Coffs Harbour	Tamworth	Kiama	
Dubbo	Tweed	Lithgow	
Hawkesbury	Wagga Wagga	Mid-Western	
Lismore	Wingecarribee	Richmond Valley Council	
Maitland	Wollondilly	Singleton	
		Snowy Monaro	

Rural (57)			
Balranald	Cootamundra-Gundagai	Junee	Oberon
Bellingen	Cowra	Kyogle	Parkes
Berrigan	Dungog	Lachlan	Snowy Valleys
Bland	Edward River	Leeton	Temora
Blayney	Federation	Liverpool Plains	Tenterfield
Bogan	Forbes	Lockhart	Upper Hunter
Bourke	Gilgandra	Moree Plains	Upper Lachlan
Brewarrina	Glen Innes Severn	Murray River	Uralla
Cabonne	Greater Hume	Murrumbidgee	Walcha
Carrathool	Gunnedah	Muswellbrook	Walgett
Central Darling	Gwydir	Nambucca	Warren
Cobar	Hay	Narrabri	Warrumbungle
Coolamon	Hilltops	Narrandera	Weddin
Coonamble	Inverell	Narromine	Wentworth
			Yass

Table 3: County Councils

Water (4)	Other (6)
Central Tablelands	Castlereagh-Macquarie
Goldenfields Water	Central Murray
Riverina Water	Hawkesbury River
Rous	New England Tablelands
	Upper Hunter
	Upper Macquarie

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Determination No. 2- Determination Pursuant to Section 241 of Fees for Councillors and Mayors

Pursuant to s.241 of the *Local Government Act 1993*, the annual fees to be paid in each of the categories to Councillors, Mayors, Members and Chairpersons of County Councils effective on and from 1 July 2020 are determined as follows:

Table 4: Fees for General Purpose and County Councils

Category		Councillor/Member Annual Fee		Mayor/Chairperson Additional Fee*	
		Minimum	Maximum	Minimum	Maximum
General Purpose Councils - Metropolitan	Principal CBD	27,640	40,530	169,100	222,510
	Major CBD	18,430	34,140	39,160	110,310
	Metropolitan Large	18,430	30,410	39,160	88,600
	Metropolitan Medium	13,820	25,790	29,360	68,530
	Metropolitan Small	9,190	20,280	19,580	44,230
General Purpose Councils - Non-metropolitan	Major Regional City	18,430	32,040	39,160	99,800
	Major Strategic Area	18,430	32,040	39,160	99,800
	Regional Strategic Area	18,430	30,410	39,160	88,600
	Regional Centre	13,820	24,320	28,750	60,080
	Regional Rural	9,190	20,280	19,580	44,250
	Rural	9,190	12,160	9,780	26,530
County Councils	Water	1,820	10,140	3,920	16,660
	Other	1,820	6,060	3,920	11,060

*This fee must be paid in addition to the fee paid to the Mayor/Chairperson as a Councillor/Member (s.249(2)).

The Local Government Remuneration Tribunal

Signed

Dr Robert Lang

Dated: 10 June 2020

Local Government Remuneration Tribunal

Appendices

Appendix 1 Criteria that apply to categories

Principal CBD

The Council of the City of Sydney (the City of Sydney) is the principal central business district (CBD) in the Sydney Metropolitan area. The City of Sydney is home to Sydney's primary commercial office district with the largest concentration of businesses and retailers in Sydney. The City of Sydney's sphere of economic influence is the greatest of any local government area in Australia.

The CBD is also host to some of the city's most significant transport infrastructure including Central Station, Circular Quay and International Overseas Passenger Terminal. Sydney is recognised globally with its iconic harbour setting and the City of Sydney is host to the city's historical, cultural and ceremonial precincts. The City of Sydney attracts significant visitor numbers and is home to 60 per cent of metropolitan Sydney's hotels.

The role of Lord Mayor of the City of Sydney has significant prominence reflecting the CBD's importance as home to the country's major business centres and public facilities of state and national importance. The Lord Mayor's responsibilities in developing and maintaining relationships with stakeholders, including other councils, state and federal governments, community and business groups, and the media are considered greater than other mayoral roles in NSW.

Major CBD

The Council of the City of Parramatta (City of Parramatta) is the economic capital of Greater Western Sydney and the geographic and demographic centre of Greater Sydney. Parramatta is the second largest economy in NSW (after Sydney CBD) and the sixth largest in Australia.

As a secondary CBD to metropolitan Sydney the Parramatta local government area is a major provider of business and government services with a significant number of organisations relocating their head offices to Parramatta. Public administration and safety have been a growth sector for Parramatta as the State Government has promoted a policy of moving government agencies westward to support economic development beyond the Sydney CBD.

The City of Parramatta provides a broad range of regional services across the Sydney Metropolitan area with a significant transport hub and hospital and educational facilities. The City of Parramatta is home to the Westmead Health and Medical Research precinct which represents the largest concentration of hospital and health services in Australia, servicing Western Sydney and providing other specialised services for the rest of NSW.

The City of Parramatta is also home to a significant number of cultural and sporting facilities (including Sydney Olympic Park) which draw significant domestic and international visitors to the region.

Local Government Remuneration Tribunal

Metropolitan Large

Councils categorised as Metropolitan Large will typically have a minimum residential population of 200,000.

Councils may also be categorised as Metropolitan Large if their residential population combined with their non-resident working population exceeds 200,000. To satisfy this criteria the non-resident working population must exceed 50,000.

Other features may include:

- total operating revenue exceeding \$200M per annum
- the provision of significant regional services to greater Sydney including, but not limited to, major education, health, retail, sports, other recreation and cultural facilities
- significant industrial, commercial and residential centres and development corridors
- high population growth.

Councils categorised as Metropolitan Large will have a sphere of economic influence and provide regional services considered to be greater than those of other metropolitan councils.

Metropolitan Medium

Councils categorised as Metropolitan Medium will typically have a minimum residential population of 100,000

Councils may also be categorised as Metropolitan Medium if their residential population combined with their non-resident working population exceeds 100,000. To satisfy this criteria the non-resident working population must exceed 50,000

Other features may include:

- total operating revenue exceeding \$100M per annum
- services to greater Sydney including, but not limited to, major education, health, retail, sports, other recreation and cultural facilities
- industrial, commercial and residential centres and development corridors
- high population growth.

The sphere of economic influence, the scale of council operations and the extent of regional servicing would be below that of Metropolitan Large councils.

Metropolitan Small

Councils categorised as Metropolitan Small will typically have a residential population less than 100,000.

Other features which distinguish them from other metropolitan councils include:

- total operating revenue less than \$150M per annum.

While these councils may include some of the facilities and characteristics of both Metropolitan Large and Metropolitan Medium councils the overall sphere of economic influence, the scale of council operations and the extent of regional servicing would be below that of Metropolitan Medium councils.

Local Government Remuneration Tribunal

Major Regional City

Newcastle City Council and Wollongong City Councils are categorised as Major Regional City. These councils:

- are metropolitan in nature with major residential, commercial and industrial areas
- typically host government departments, major tertiary education and health facilities and incorporate high density commercial and residential development
- provide a full range of higher order services and activities along with arts, culture, recreation, sporting and entertainment facilities to service the wider community and broader region
- have significant transport and freight infrastructure servicing international markets, the capital city and regional areas
- have significant natural and man-made assets to support diverse economic activity, trade and future investment
- typically contain ventures which have a broader State and national focus which impact upon the operations of the council.

Major Strategic Area

Councils categorised as Major Strategic Area will have a minimum population of 300,000.

Other features may include:

- health services, tertiary education services and major regional airports which service the surrounding and wider regional community
- a full range of high-order services including business, office and retail uses with arts, culture, recreation and entertainment centres
- total operating revenue exceeding \$250M per annum
- significant visitor numbers to established tourism ventures and major events that attract state and national attention
- a proximity to Sydney which generates economic opportunities.

Currently, only Central Coast Council meets the criteria to be categorised as a Major Strategic Area. Its population, predicted population growth, and scale of the Council's operations warrant that it be differentiated from other non-metropolitan councils. Central Coast Council is also a significant contributor to the regional economy associated with proximity to and connections with Sydney and the Hunter Region.

Regional Strategic Area

Councils categorised as Regional Strategic Area are differentiated from councils in the Regional Centre category on the basis of their significant population and will typically have a residential population above 200,000.

Other features may include:

- health services, tertiary education services and major regional airports which service the surrounding and wider regional community
- a full range of high-order services including business, office and retail uses with arts, culture, recreation and entertainment centres
- total operating revenue exceeding \$250M per annum
- significant visitor numbers to established tourism ventures and major events that attract state and national attention
- a proximity to Sydney which generates economic opportunities.

Currently, only Lake Macquarie Council meets the criteria to be categorised as a Regional Strategic Area. Its population and overall scale of council operations will be greater than Regional Centre councils.

Local Government Remuneration Tribunal

Regional Centre

Councils categorised as Regional Centre will typically have a minimum residential population of 40,000. Other features may include:

- a large city or town providing a significant proportion of the region's housing and employment
- health services, tertiary education services and major regional airports which service the surrounding and wider regional community
- a full range of high-order services including business, office and retail uses with arts, culture, recreation and entertainment centres
- total operating revenue exceeding \$100M per annum
- the highest rates of population growth in regional NSW
- significant visitor numbers to established tourism ventures and major events that attract state and national attention
- a proximity to Sydney which generates economic opportunities.

Councils in the category of Regional Centre are often considered the geographic centre of the region providing services to their immediate and wider catchment communities.

Regional Rural

Councils categorised as Regional Rural will typically have a minimum residential population of 20,000. Other features may include:

- a large urban population existing alongside a traditional farming sector, and are surrounded by smaller towns and villages
- health services, tertiary education services and regional airports which service a regional community
- a broad range of industries including agricultural, educational, health, professional, government and retail services
- large visitor numbers to established tourism ventures and events.
- Councils in the category of Regional Rural provide a degree of regional servicing below that of a Regional Centre.

Rural

Councils categorised as Rural will typically have a residential population less than 20,000.

Other features may include:

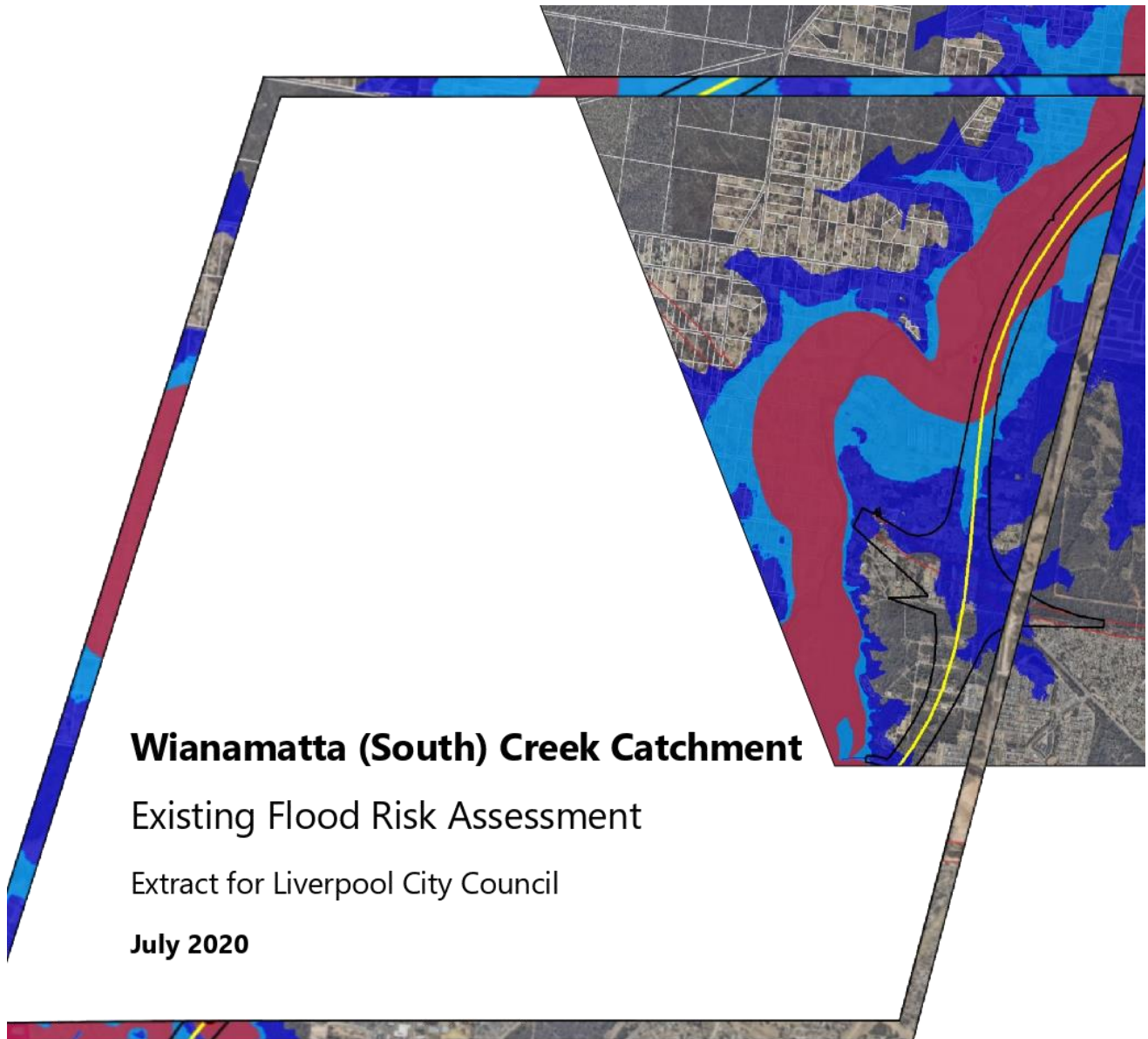
- one or two significant townships combined with a considerable dispersed population spread over a large area and a long distance from a major regional centre
- a limited range of services, facilities and employment opportunities compared to Regional Rural councils
- local economies based on agricultural/resource industries.

County Councils - Water

County councils that provide water and/or sewerage functions with a joint approach in planning and installing large water reticulation and sewerage systems.

County Councils - Other

County councils that administer, control and eradicate declared noxious weeds as a specified Local Control Authority under the *Biosecurity Act 2015*.



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Revision E

Advisian
Worley Group

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**Wianamatta (South) Creek Catchment
Existing Flood Risk Assessment**

Extract for Liverpool City Council

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Project: Wianamatta (South) Creek Catchment Existing Flood Risk Assessment

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B	Final Draft Report (Issued for Client Review)	Roy Golaszewski	Chris Thomas		21/04/2020
C	Final Report	Roy Golaszewski	Chris Thomas	Chris Thomas	22/04/2020
D	Updated Draft Report (Incorporating Modelling of Austral Tributaries)	Roy Golaszewski	Chris Thomas	Chris Thomas	13/07/2020
E	Final Draft (Incorporating Review Comments)	Roy Golaszewski	Chris Thomas	Chris Thomas	20/07/2020



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1 Introduction

This draft report is extracted from broader work on the Wianamatta (South) Creek catchment being undertaken by government. It supports Liverpool City Council by providing more up to date information about the extent of flooding in the areas of LGA covered by the report. Further reporting on this project will be available as part of the broader project in future.

South Creek is a tributary of the Hawkesbury-Nepean River that drains a 640 km² catchment in Western Sydney. The catchment extends from its headwaters near Narellan in the south, to its confluence with the Hawkesbury River near Windsor. Approximately 65% (414 km²) of the catchment falls upstream of Richmond Road forming the study area.

Floodwaters from South Creek have the potential to inundate properties across six Local Government Areas (LGA) including the LGAs of Penrith, Blacktown, Liverpool, Fairfield, Camden and Hawkesbury City Councils.

The South Creek catchment is also projected to be a major employment hub as the population of western Sydney grows. The Second Sydney Airport at Badgerys Creek also falls partly within the catchment and is scheduled for completion in 2026. The need for improved transport to and from the airport and surrounding aerotropolis will also require new road and rail lines to be constructed. As a result, development pressure has and will continue to increase within the catchment and along the creek corridors.

The project involves hydrologic and hydraulic modelling to assess the current flood regime and test a range of development and floodplain modification scenarios in South Creek, including consideration of climate change. The modelling builds on the existing XP-RAFTS and RMA-2 models developed for the 'Updated South Creek Flood Study' (Advisian 2015) and the 'South Creek Floodplain Risk Management Study and Plan' (Advisian, 2020).



2 Description of the Study Area

South Creek is a tributary of the Hawkesbury-Nepean River that drains a 640 km² catchment in Western Sydney. Approximately 65% (414 km²) of the catchment falls upstream of Richmond Road forming the study area.

As shown in **Figure 2.1**, the South Creek catchment extends from its headwaters near Narellan in the south, to its confluence with the Hawkesbury River near Windsor. South Creek generally flows from south to north through the catchment with the Penrith and Blacktown Central Business Districts (CBD) located to the west and east, respectively. Large areas of the catchment have been urbanised including Oran Park, St Clair, Erskine Park, St Marys, Claremont Meadows, Jordan Springs and Ropes Crossing.

The major tributaries of South Creek within the study area include Ropes and Kemps creeks (refer **Figure 2.1**). Minor tributaries include Werrington, Claremont, Blaxland, Cosgroves, Badgerys and Thompsons creeks.

Flooding of South Creek typically occurs as a result of local catchment runoff breaking out of the main channel and spilling across the adjoining floodplain. However, the lower reaches of South Creek also serve as a large flood storage area during major flooding of the Hawkesbury-Nepean River system. As a result, floodwaters can 'back-up' along South Creek from its confluence with the Hawkesbury River, leading to inundation of areas of the South Creek floodplain to beyond the area that would typically be flooded in local catchment events.

The 'Updated South Creek Flood Study' (2015) considered the entire South Creek catchment, but the flood modelling only extended from Bringelly Road in the south to the Blacktown/Richmond Road Bridge crossing in the north. The current investigation extends the areas modelled along many of its tributaries, especially those within the Liverpool City Council LGA.



3 Review of Available Data

3.1 Topographic Data

The RMA-2 model that was originally developed as part of the 'South Creek Flood Study' (2015) and used during investigations for the *Floodplain Risk Management Study* for Penrith City Council was developed based on Aerial Laser Survey (ALS) that covered the South Creek floodplain downstream from Bringelly Road. The ALS data was obtained between 2003 and 2006 and comprises various data sets across the Penrith, Blacktown, Fairfield and Liverpool Local Government Areas (LGAs).

In 2019, newly acquired Light Detection and Ranging (LiDAR) topographic data was collected across the entire study area. This data was downloaded from the Geosciences Australia ELVIS online portal and is considered to provide the best available representation of the current landform across the catchment, including cut and fill related to the most recent precinct wide developments such as Marsden Park and Jordan Springs.

As part of the process of updating the existing flood model of South Creek, the 2019 LiDAR data has been compared to the ALS data from 2003-2006. Surface level difference mapping has been prepared and is presented in **Figures 3.1 to 3.4**.

The mapping shows that in the majority of locations the 2019 data is between 100 and 300 mm lower than the previous ALS data sets, particularly across the lower portion of the study area downstream from Elizabeth Drive. There are localised exceptions where significant works have been completed to raise terrain levels, such as the First Estate industrial development at Distribution Drive and the Marsden Park residential subdivisions.

The sub-catchment delineation within the existing XP-RAFTS hydrologic model was developed according to sub-catchment boundaries established as part of the original South Creek Flood Study prepared by the NSW Department of Water Resources Flood Study in 1990 and also via review of surface contours from orthophoto maps which were generated from photogrammetry gathered in the mid 1980s.

While the photogrammetry would have provided a good representation of the catchment condition at that time, contours derived from it would typically have had a vertical accuracy of ± 0.5 metres at best. The vertical accuracy of LiDAR is typically better than ± 0.15 m. Therefore, the 2019 LiDAR data provides a more reliable and detailed depiction of topography on which to base sub-catchment delineation.

3.2 Aerial Photography

Latest aerial photography has been obtained for the study area from Nearmap, which was used to confirm the extent of recent developments and thereby determine key hydrologic model and hydraulic model parameters such as the percentage of pervious area and floodplain roughness.

The Nearmap imagery also served to verify areas where large changes in terrain elevation were evident from the comparison of the 2003-2006 ALS to the 2019 LiDAR.



3.3 Previous Flood Investigations

A number of previous hydrologic and hydraulic investigations have been undertaken to examine the nature and extent of flooding along South Creek. These include the following reports:

- *'Flood Study Report, South Creek' (Department of Water Resources, 1990)*
- *'South Creek Floodplain Management Study' (Willing and Partners Pty Ltd, 1991)*
- *'ADI St Mary's Watercycle & Soil Management Study - Final Study Report' (Sinclair Knight Merz, 1998)*
- *'Austral Floodplain Risk Management Study and Plan' (Perrens Consultants, 2003)*
- *'South Creek Floodplain Risk Management Study and Plan' (Bewsher Consulting, 2004)*
- *'Upper South Creek Flood Study' (WMA Water, 2012)*
- *'Upper South Creek Floodplain Risk Management Study and Plan' (Cardno, 2014)*
- *'Updated South Creek Flood Study' (WorleyParsons, 2015)*
- *'South Creek Floodplain Risk Management Study and Plan' (Advisian, 2020)*

4 Flood Model Updates

4.1 XP-RAFTS Hydrologic Model

The XP-RAFTS model that was developed for the '*Updated South Creek Flood Study*' (2015) was based on the hydrologic model developed for the original Flood Study in 1990 (NSW Department of Water Resources). The sub-catchment layout that was adopted in the 2015 version of this model is shown in **Figure 4.1**.

The 1990 RAFTS hydrologic model was calibrated to the August 1986 and April 1988 floods. A good correlation between the recorded and simulated peak discharge, time of peak, flood volume and hydrograph shape was achieved by adjusting the 'BX' multiplier and the adopted values for initial and continuing losses.

The 2015 model was validated through simulation of the 36 hour duration 100 year Average Recurrence Interval (ARI) storm and comparison of the results with peak flows at several locations along South Creek that were documented in the original 1990 Flood Study. The typical variation in peak flows was about 5%.

4.1.1 XP-RAFTS Updates

The updates made to the 2015 XP-RAFTS hydrologic model are summarised in **Table 4.1** and discussed in further detail below.

Table 4.1 Overview of XP-RAFTS Hydrologic Model Updates

	XP-RAFTS Model Versions	
	2015	2020
Catchment delineation and Slopes	1:4,000 and 1:10,000 orthophoto mapping	2019 LiDAR
Percentage Impervious and Catchment Roughness	2007 Aerial Photography	2020 Nearmap Aerial Photography
Initial and Continuing Loss Rates	Values adopted within validated 1990 RAFTS model.	No change
Number of Sub-Catchments	76	284

Refined Sub-Catchment Delineation

The XP-RAFTS sub-catchment delineation was refined as part of the current investigation using the 2019 LiDAR data and information contained in recent flood modelling reports prepared for Liverpool City Council and the Western Sydney Airport. This resulted in a significant increase in the number of sub-catchments between Bringelly Road and Elizabeth Drive for Kemps Creek, Badgerys Creek, Thompson Creek and Cosgroves Creek, as shown in **Figure 4.2**.



Extensive catchment refinement refinement also occurred along the minor tributaries that feed Kemps Creek at Austral; and along Bonds Creek upstream of Bringelly Road.

The refined sub-catchment delineation allows more reliable representation of current and future developments at the Airport, Austral and Leppington. The adjustments also make allowance for additional inflow locations into the RMA-2 hydraulic model where it has been extended at the upstream end of tributaries (see **Section 4.2**).

Catchment boundaries were also reviewed to reflect the 2019 LiDAR. The catchment boundaries previously adopted and based on 1:4,000 and 1:10,000 orthophoto mapping were found to require localised adjustments that resulted in some transfer of catchment area between tributaries.

Changes to catchment extents can be seen in **Figure 4.1** by comparing the original sub-catchment boundaries to the updated coloured catchments.

Adjustment to Sub-Catchment Parameters

The catchment parameters in the XP-RAFTS model were also updated, including refinements to sub-catchment slopes, impervious fractions and catchment roughness.

These adjustments were made to account for the revised sub-catchment delineation (refer **Figure 4.2**) and also to account for changes in the extent of industrial and residential developments according to the latest aerial photography. Recent, current and future known developments are labelled in **Figure 4.2**.

Expanded views of those areas of the XP-RAFTS model where the greatest increase in sub-catchment delineation has occurred are provided in **Figures 4.3** to **4.6**. These figures highlight the amount of additional data that has been "built-into" the XP-RAFTS model and the modifications that have been made to allow flood hydrographs to be extracted at a greater range of locations along the upper reaches of South Creek and within a number of the upstream catchments where development has or is projected to occur.

Figure 4.3 shows the increased sub-catchment delineation for the section of South Creek extending upstream from Bringelly Road to the catchment divide. **Figure 4.4** shows the increased sub-catchment delineation across the Kemps, Bonds, Badgerys and Thompsons creeks catchments. **Figure 4.5** shows the increased sub-catchment delineation between Elizabeth Drive and the Warragamba Dam pipeline while **Figure 4.6** shows the latest XP-RAFTS model structure for areas north of the pipeline.

Sub-catchment parameters adopted as part of the updated XP-RAFTS hydrologic model are listed in **Table A1** in **Appendix A**.

As indicated in **Table 4.1**, the initial and continuing loss rates first adopted within the 1990 RAFTS model and maintained within the 2015 XP-RAFTS model were not changed as part of this study. Accordingly, the loss values shown in **Table A1** in **Appendix A** are the same as those adopted in previous versions of the hydrologic model.



4.2 RMA-2 Hydraulic Model

A two-dimensional (2D) hydrodynamic flood model was developed as part of the 2015 'Updated South Creek Flood Study' using the RMA-2 software package. The model was validated through simulation of the 100 year Average Recurrence Interval (ARI) flood and comparison of the results to flood levels documented in the original 1990 Flood Study (*NSW Department of Water Resources*), the 2003 Austral Floodplain Risk Management Study (*Liverpool City Council*) and the 2004 South Creek Floodplain Risk Management Study (*NSW Department of Water Resources*).

The RMA-2 model was developed using the available ALS collected between 2003 and 2006.

It covered the South Creek floodplain between Bringelly Road and the confluence with Eastern Creek at Vineyard. The model included the floodplains of all major tributaries in this area, including Badgerys Creek, Kemps Creek and Ropes Creek.

The extent of the 2015 RMA-2 flood model is shown in **Figure 4.7**. The 2015 model was based on topographic elevations defined at 58,280 nodes and floodplain roughness defined across 66,970 model elements.

4.2.1 Model Network Extensions

The existing RMA-2 model network was extended in several locations as shown by the blue areas in **Figure 4.7**. This included the following.

- The upper reaches of tributaries at Kemps Creek towards Bringelly Road.
- Extension of Bonds Creek upstream of Bringelly Road to the Liverpool LGA boundary.
- The upper reaches of Thompsons Creek and tributaries towards Bringelly Road.
- The upper reaches of Badgerys Creek and tributaries to beyond the future Western Sydney Airport site.
- The upper reaches of Cosgroves Creek and Oaky Creek to beyond Elizabeth Drive.
- Widening the model extent in the lower reaches of the study area in the vicinity of Marsden Park.

The extensions aim to incorporate all areas of potential future development and account for any potential backwater impacts from flooding along South Creek. Detailed mapping of the RMA-2 model extensions is provided in **Appendix B** as **Figures B1 to B4**.

4.2.2 Model Network Refinement

In addition to the extensions shown in **Figure 4.7**, the model network was also refined to account for the updated 2019 LiDAR topography and to allow for better representation of recent and future developments.

The updated network includes a finer network spacing, particularly in the vicinity of structures that act as hydraulic controls such as roads, impervious fences, buildings and channels.

This has led to an increase in the total number of nodes and elements from 58,280 and 66,970 to 174,960 and 213,770, respectively. This represents an increase in the number of elements of more than 200% (*i.e., approximately triple the size*).

4.2.3 Model Roughness

Roughness values adopted in the RMA-2 flood model were reviewed and updated according to the extent of developments shown in the aerial photographs and provided in the recent flood reports by WSA and Liverpool City Council.

This was completed in conjunction with refinements to the model network in order to capture the variation in hydraulic roughness across the floodplain in sufficient detail.

The adopted element types and associated roughness parameter values are listed in **Table 4.2**. The element types and roughness values are consistent with those adopted for the 2015 RMA-2 flood model.

Table 4.2 Adopted RMA-2 Element Roughness Values

ELEMENT ROUGHNESS TYPE	DESCRIPTION	ROUGHNESS PARAMETER VALUE
1	Clear creek channel or watercourse	0.035
2	Lightly vegetated creek channel	0.055
3	Moderately vegetated creek channel	0.100
4	Heavily vegetated creek channel	0.120
5	Grassed floodplain and sparse trees	0.050
6	Floodplain with moderate coverage of trees	0.080
7	Floodplain with dense trees	0.120
8	Urban Floodplain	0.040
9	Industrial Development	0.090
10	Roadways	0.015

4.2.4 Boundary Conditions

The upstream inflow boundaries of the RMA-2 model were adjusted to accommodate the extensions to the model at the tributaries near Bringelly Road.

The local inflow points down through the floodplain were also updated to reflect the increased sub-catchment delineation in the XP-RAFTS model (*refer Figures 4.2 and Figures 4.3 through Figure 4.7*).

The alignment of the downstream model boundary has not been altered from that adopted for the 2015 Updated South Creek Flood Study.



4.3 Australian Rainfall & Runoff 1987 vs 2019

Australian Rainfall & Runoff (ARR) 2019 has been released since completion of the 'Updated South Creek Flood Study' in 2015. For flood estimation, ARR2019 provides guidelines for approaches relying on rainfall based methods (*runoff-routing modelling*) and At-site Flood Frequency Analysis (FFA).

As per ARR2019 guidelines, FFA is to be considered for flood estimation for all catchments where it is available or a sufficient length of reliable data is available for one to be derived. Design discharges derived through rainfall based methods should therefore be calibrated to the FFA and reflect recorded data. This may involve adjustments to design inputs such as initial and continuing losses, temporal patterns, pre-burst rainfall, IFD and aerial reduction factors.

An FFA is available for the South Creek catchment for the Elizabeth Drive stream gauge (*Station Number 212320*). The FFA was derived for the gauge based on 49 years of records as part of work completed by WMA Water in preparation of the report titled 'Review of ARR Design Inputs for NSW' (OEH, 2019). The corresponding FFA curve for the gauge (*note that it is incorrectly referred to as being located at Mulgoa Road*) is included as **Appendix C**.

To assess the fit between runoff-routing modelling based on ARR1987 and ARR2019, to the available FFA, the ARR 2019 IFD data and methodologies were applied to the South Creek XP-RAFTS hydrologic model. This analysis and the findings are discussed in the following sections.

4.3.1 Application of ARR2019 IFD and Methodologies

ARR2019 IFD and methodologies were applied to the South Creek XP-RAFTS hydrologic model. This involved the download of rainfall temporal patterns and other information for South Creek from the ARR 2019 Data Hub. IFD data was sourced from the Bureau of Meteorology (BOM).

Similar to the ARR 1987 approach, multiple sets of IFD data were applied across different parts of the catchment. The total catchment area is greater than 75 km² and therefore, the applicable *East Coast South Areal Temporal Patterns* (ATPs) were used. Point Temporal Patterns were used for storm durations less than 12 hours.

Appropriate Areal Reduction Factors were applied to the IFD data to account for the total catchment area of 415 km².

An adjusted continuing rainfall loss rate was applied, and Probability Neutral Burst Initial Losses were adopted, as per ARR 2019 guidance for NSW catchments. This led to initial losses ranging between 7.9-17.2 mm/hour being adopted for pervious catchments for the range of storm durations assessed (*i.e., 6-36 hours*). The adopted impervious area rainfall initial and continuing losses were 1 mm and 0 mm/hr, respectively.

It is worth noting that the adopted initial losses for pervious catchments are lower than the losses determined through calibration and validation; typically, in the order of 37.1 mm/hour. Although initial modelling sought to adopt the calibrated losses, later comparisons of the peak flows generated against the FFA at Elizabeth Drive found that it produced a poorer comparison than the ARR2019 Probability Neutral Burst Initial Losses.



As per ARR 2019 methodology, 10 temporal patterns were assessed for each storm duration. The adopted temporal pattern was selected as providing the closest peak flow to the mean on the higher side according to a bias factor of two; i.e., the peak flow from the selected pattern was not further from the mean by more than two times the difference from the mean flow to the closest lower flow.

The critical duration storm under ARR 2019 was found to be 12 hours in the upper part of the catchment and 18 hours in the lower reaches; i.e., downstream of the Ropes Creek confluence.

4.3.2 Findings and Conclusions

The 1% AEP peak flows derived from simulations completed based on the ARR 2019 analysis procedures were compared to peak flows derived at Elizabeth Drive through FFA. A comparison was also made to the corresponding peak flows derived from the ARR 1987 results (refer **Table 4.3** and **Appendix C**).

Table 4.3 Comparison of Peak 1% AEP Flows at Elizabeth Drive (South Creek) based on ARR 1987 and ARR 2019 Hydrology to FFA

Approach Adopted for Estimation of Design 1% AEP Flows		
Flood Frequency Analysis	ARR 1987	ARR 2019
538 m ³ /s [^]	483 m ³ /s - 10%	381 m ³ /s - 29%

[^] Value extracted from FFA curve provided as Appendix A49 – 'Review of ARR Design Inputs for NSW' (OEHL, February 2019) prepared by WMA Water

Download link: <https://data.arr-software.org/static/pdf/appendix.pdf>

The comparison shows that the runoff-routing modelling based on ARR 1987 generates a peak flow for the 1% AEP event that matches more closely to the FFA than ARR 2019. These findings indicate that unless further calibration is made to the XP-RAFTS model and the adopted parameters (i.e., initial and continuing losses, temporal patterns, pre-burst rainfall, IFD and aerial reduction factors), then the modelling based on ARR 1987 provides a better validation to the available FFA.

Based on the above findings, it is recommended that ARR 1987 temporal patterns and IFD data continue to be adopted to define hydrology for the South Creek catchment. This reflects ARR 2019 guidelines which specify that flood hydrology should be based on observed data and FFA where possible and available.

5 Design Event Modelling

5.1 General

Design floods are hypothetical floods that are commonly used for planning and floodplain risk management investigations. Design floods are based on statistical analysis of rainfall and flood records and are defined by their probability of occurrence. For example, a 1% Annual Exceedance Probability (AEP) flood is the best estimate of a flood that will have one chance in 100 of occurring in any given year.

It should be noted that there is no guarantee that the design 1% AEP flood will occur just once in a one hundred year period. It may occur more than once, or at no time at all in the one hundred year period. This is because the design floods are based upon a statistical 'average'.

5.2 Hydrologic Modelling

The updated XP-RAFTS flood model was used to simulate the catchment hydrology for the following design events:

- and 1% AEP;
- Probable Maximum Flood (PMF).

A 36 hour critical storm duration was adopted for all events except the PMF, which was simulated with a 6 hour duration according to the approach adopted for the 'Updated South Creek Flood Study' in 2015.

A 2 hour and 9 hour storm duration were also adopted for the 1% AEP events in order to simulate the critical duration along many of the smaller tributaries.

Flow hydrographs were extracted from the XP-RAFTS model results for each event at the upstream inflow boundary and local inflow points in the RMA-2 flood model.

5.3 Hydrodynamic Modelling

5.3.1 Design Simulations

The updated RMA-2 flood model was used to simulate flooding across the floodplain extent shown in **Figure 4.3** for the 1% AEP and the PMF. Boundary condition data is described in the following sections.

5.3.2 Inflow Hydrographs

The hydrographs from XP-RAFTS corresponding to sub-catchments for South Creek, Bonds Creek, Kemps Creek and Thompsons Creek at Bringelly Road were incorporated as the upstream boundary condition to the model.

More than 160 local inflow points were also incorporated into the model down through the floodplain to account for the sub-catchment delineation shown in **Figure 4.2**.

5.3.3 Hawkesbury River Tailwater Levels

The adopted tailwater levels at the downstream boundary of the RMA-2 model vary according to the design event (refer **Table 5.1**). Peak flood levels for Hawkesbury River design events have been extracted from modelling completed as part of the 'Hawkesbury-Nepean Valley Regional Flood Study' (Infrastructure NSW, 2019) prepared by WMA Water.

As shown, the 1% and 0.2% AEP events were simulated with two tailwater levels.

Table 5.1 Adopted Tailwater Conditions for Design Event Simulations

Design Event (36 hour critical storm duration, except where noted)	Hawkesbury River Tailwater Condition [^]
1% AEP (2, 9 and 36 hour durations)	1% AEP – 17.30 mAHd
PMF (6 hour)	PMF – 26.72 mAHd

[^] Peak flood levels extracted from 'Hawkesbury-Nepean Valley Regional Flood Study' (Infrastructure NSW, 2019) prepared by WMA Water

5.4 Design Flood Modelling Results

All mapping for the 1% AEP events is based on a 'peak-of-peaks' flood surface generated from simulations of the 2, 9 and 36 hour storm durations. Flood Extents

Peak flood level estimates were extracted from the modelling results and were used to generate flood extent.

Mapping for the 1% AEP event is presented in **Appendix D** and PMF is presented in **Appendix E**.

Table 5.2 Peak Flood Levels Upstream of Major Crossings

Location (listed from south to north)	Peak Flood Level (mAHd)				
	20% AEP	5% AEP [^]	1% AEP [^]	0.2% AEP	PMF
U/S of Elizabeth Drive					
- Cosgroves Creek	58.65	58.74	58.82	58.93	59.24
- Oaky Creek	56.44	57.58	58.06	58.06	58.43
- Badgerys Creek	46.03	46.48	46.76	46.91	47.37
- South Creek	42.37	42.8	43.1	43.32	44.05
- Kemps Creek	46.64	47.12	47.9	48.01	48.97

[^] Peak flood levels are based on the 'peak-of-peaks' flood surface; i.e., adopting levels from simulations of either the 2, 9 and 36hr durations



6 Conclusions

The hydrologic and hydraulic flood models developed for the '*Upper South Creek Flood Study*' (2015) have been updated to account for the latest available LiDAR data, information from other recent flood investigations and recent industrial and urban developments that have occurred in parts of the catchment. This has included extensions to the RMA-2 flood model in the upper reaches of the study area, particularly in the vicinity of Bringelly Road.

The updated XP-RAFTS hydrologic modelling generates similar flows throughout the catchment for the 1% AEP 36 hour critical duration compared to the 2015 modelling. Flows along South Creek are generally within 2% changes along tributaries have greater variability with a maximum change of up to 15%.

The 36 hour storm duration has been confirmed to be critical for the study area generating the largest peak flows along South Creek and at many of the major bridge crossings throughout the study area. Although shorter storm durations such as the 2 and 9 hour storms generate the largest flows along many of the smaller tributaries.

The updated XP-RAFTS hydrologic model was also used to simulate the 1% AEP flood based on ARR 2019 inputs and procedures. Peak flows at the Elizabeth Drive crossing derived based on ARR 1987 and ARR 2019 simulations were compared to peak flows derived at Elizabeth Drive through Flood Frequency Analysis (FFA).

The comparison shows that the modelling based on ARR 1987 generated a peak flow for the 1% AEP event that matched more closely (*10% lower*) to the FFA than ARR 2019 (*29% lower*). Based on this, it is recommended that the hydrology continue to be based on ARR 1987 temporal patterns and Intensity-Frequency-Duration (IFD) data.

The updated flood models are considered to suitably represent the contemporary conditions across the South Creek catchment and floodplain. The models are therefore considered fit for purpose to be used for this project.

7 References

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Figures



FIGURE 2.1

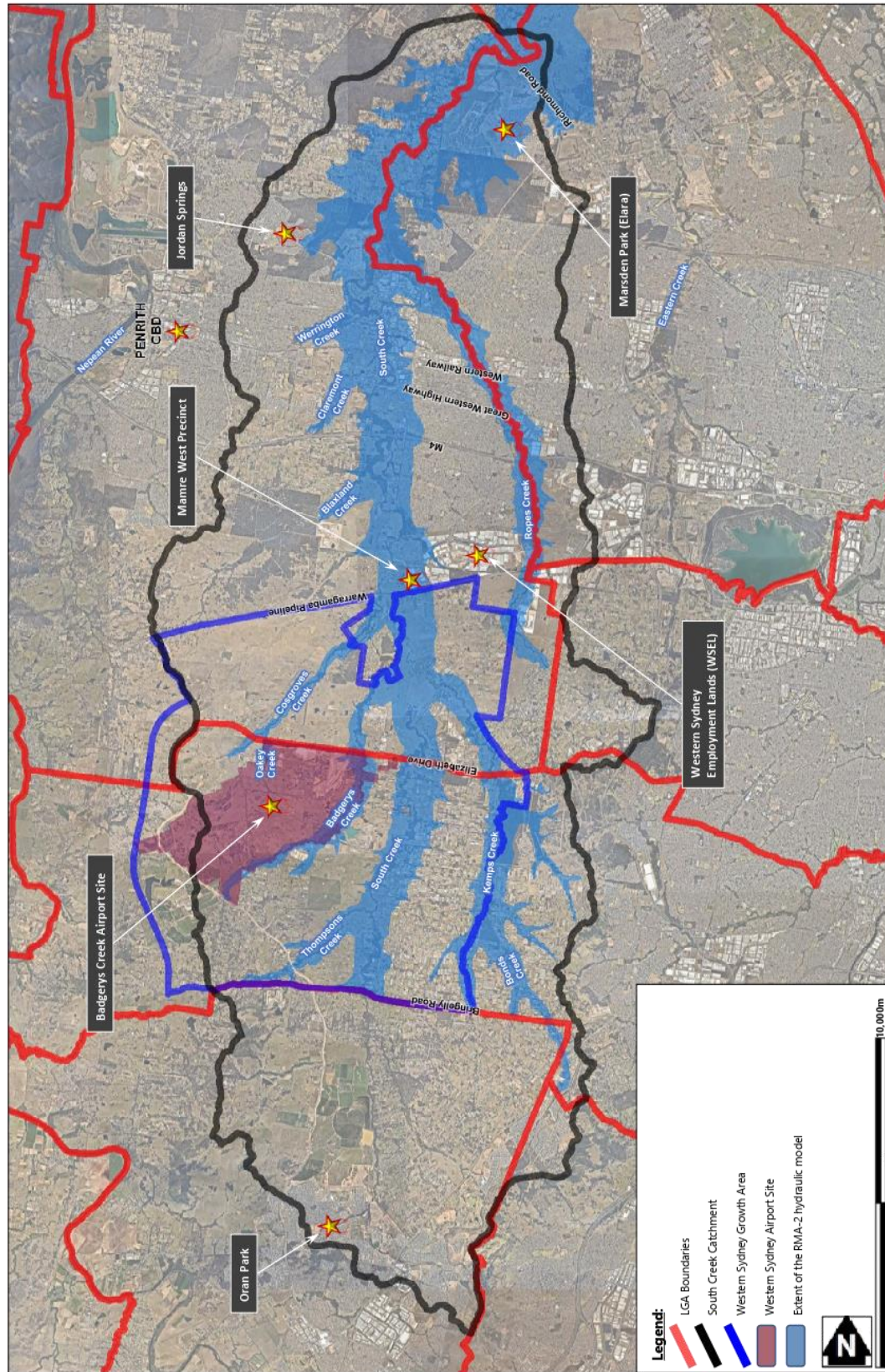
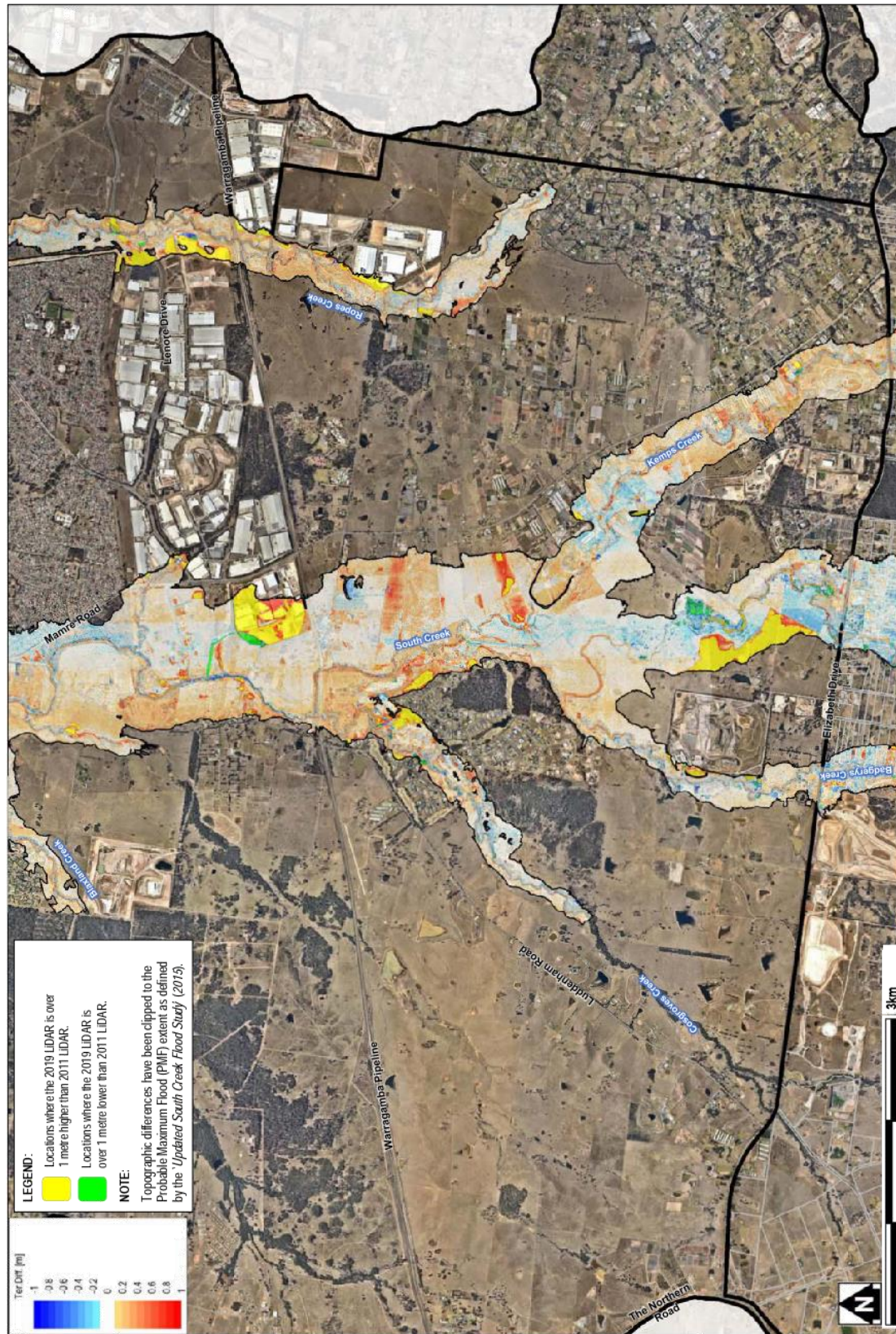
STUDY AREA FOR THE
SOUTH CREEK SECTOR REVIEW

FIGURE 3.1



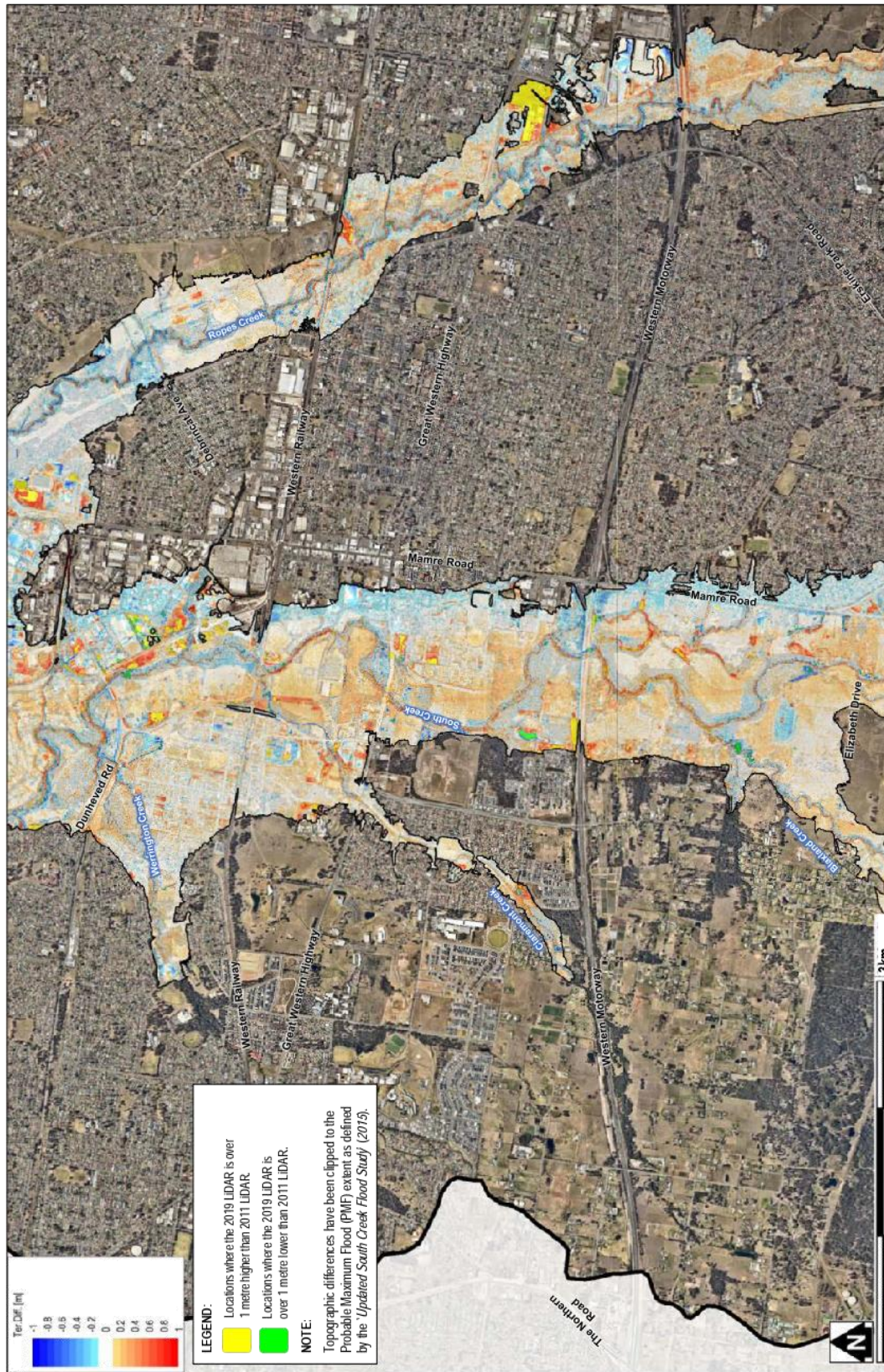
TOPOGRAPHIC DIFFERENCE MAPPING
COMPARING 2019 LIDAR and 2003-2005 ALS
[View 1 of 4]

FIGURE 3.2



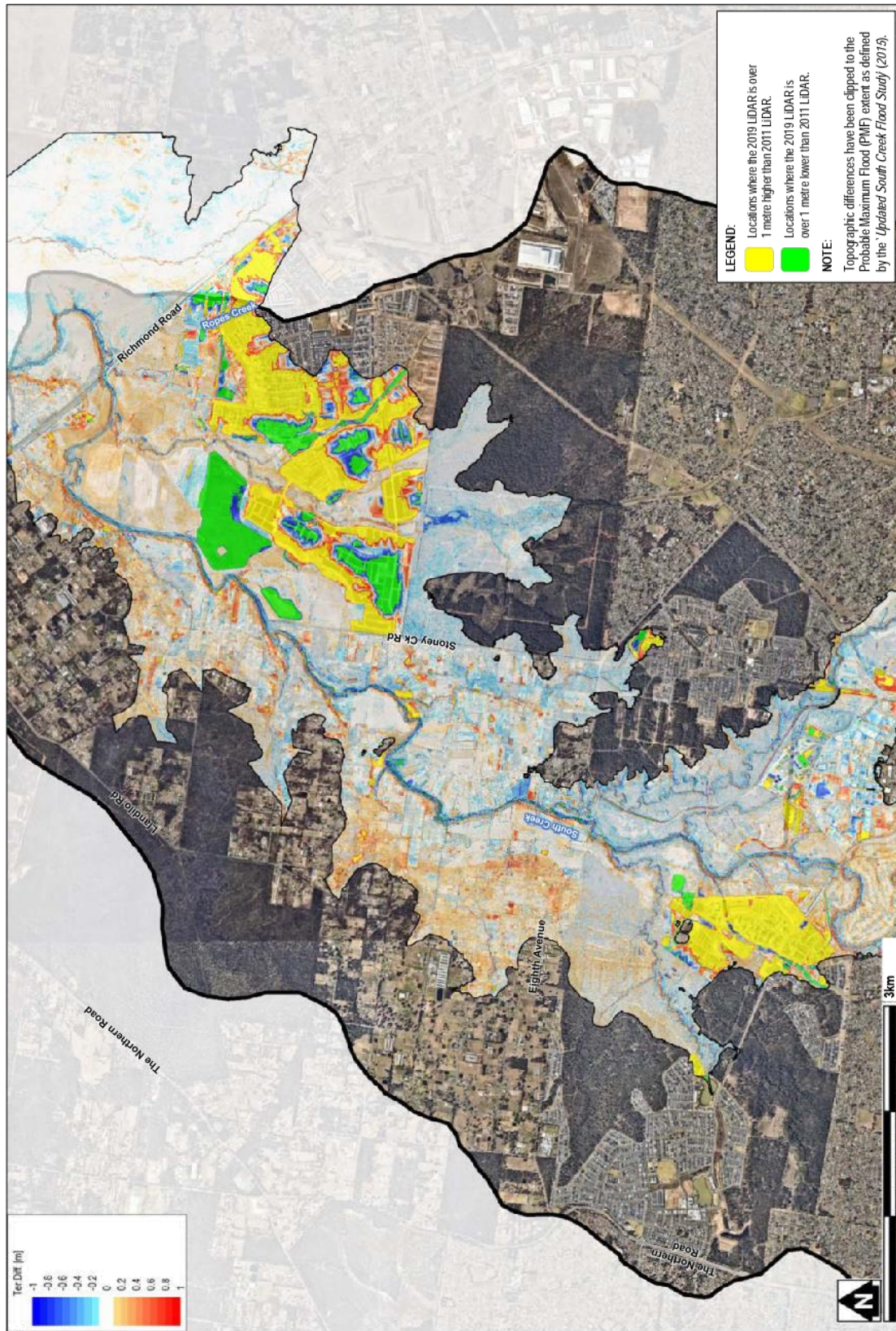
TOPOGRAPHIC DIFFERENCE MAPPING
COMPARING 2019 LIDAR and 2003-2005 ALS
[View 2 of 4]

FIGURE 3.3



TOPOGRAPHIC DIFFERENCE MAPPING
COMPARING 2019 LIDAR and 2003-2005 ALS
 [View 3 of 4]

FIGURE 3.4



TOPOGRAPHIC DIFFERENCE MAPPING
COMPARING 2019 LIDAR and 2003-2005 ALS
[View 4 of 4]

FIGURE 4.1

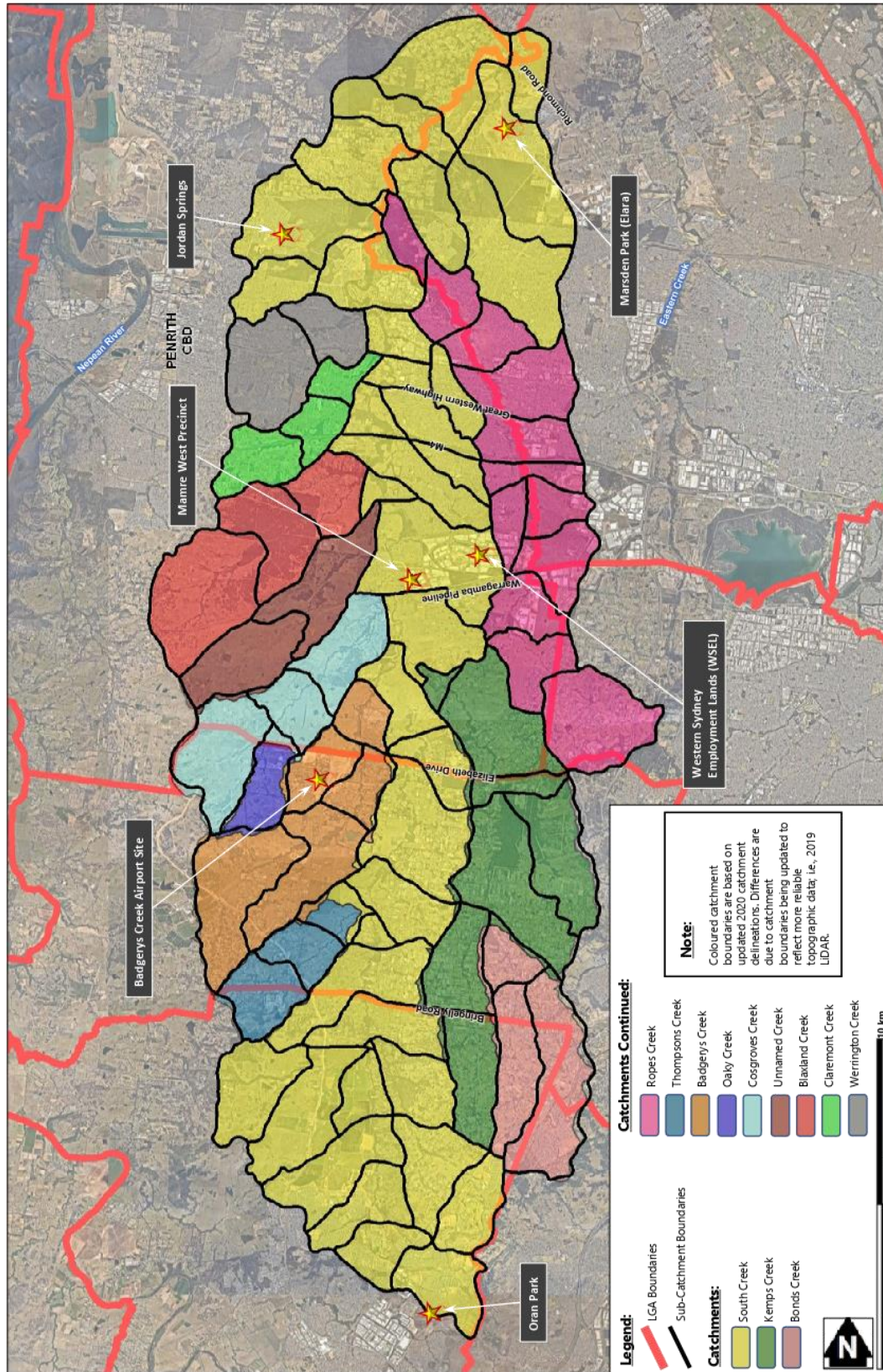
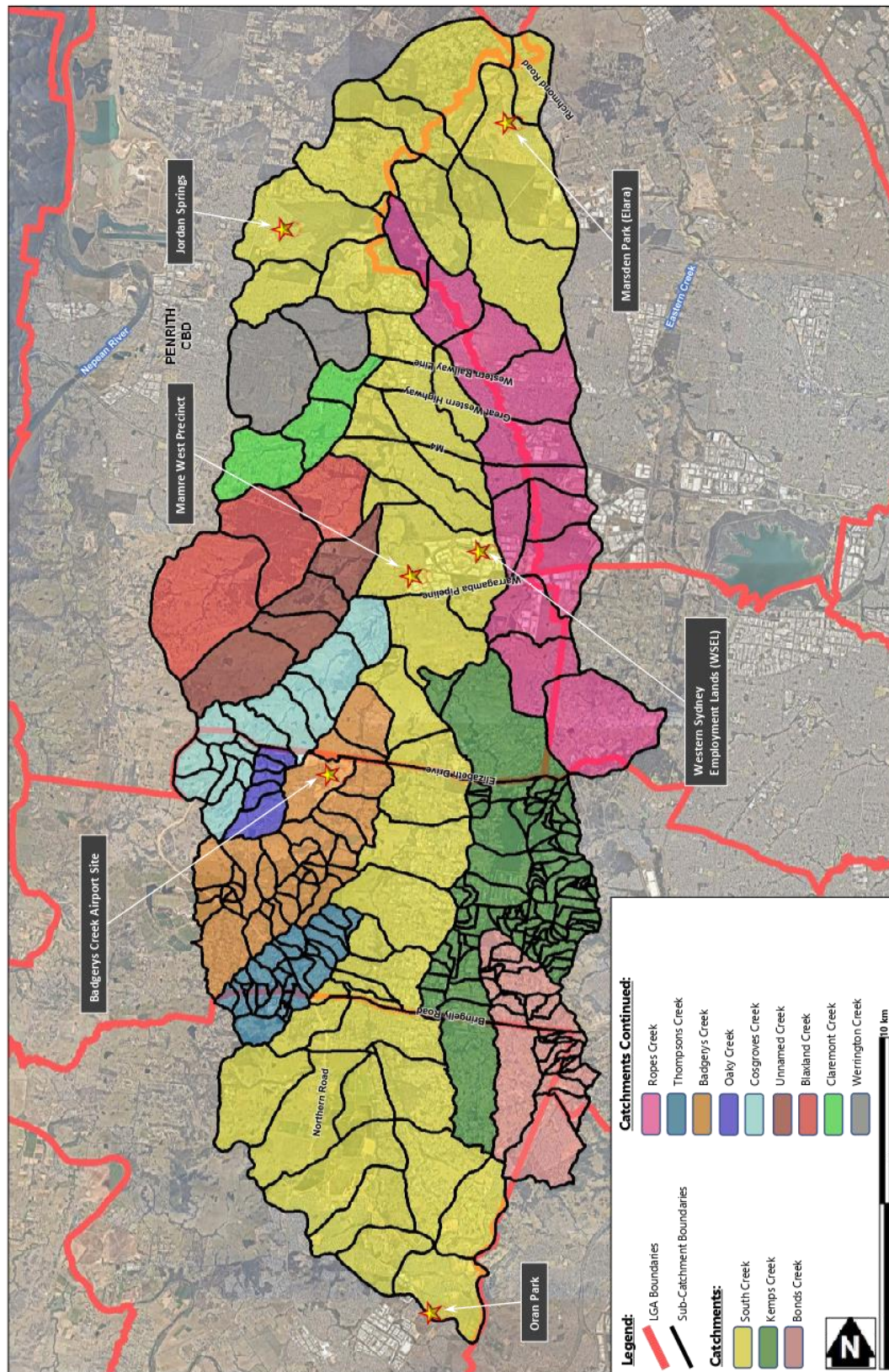
SOUTH CREEK SUB-CATCHMENT BOUNDARIES
BASED ON THE 'UPDATED SOUTH CREEK
FLOOD STUDY' (2015)

FIGURE 4.2



**SOUTH CREEK SUB-CATCHMENT BOUNDARIES
UPDATED AS PART OF SOUTH CREEK
SECTOR INVESTIGATIONS (2020)**

FIGURE 4.3

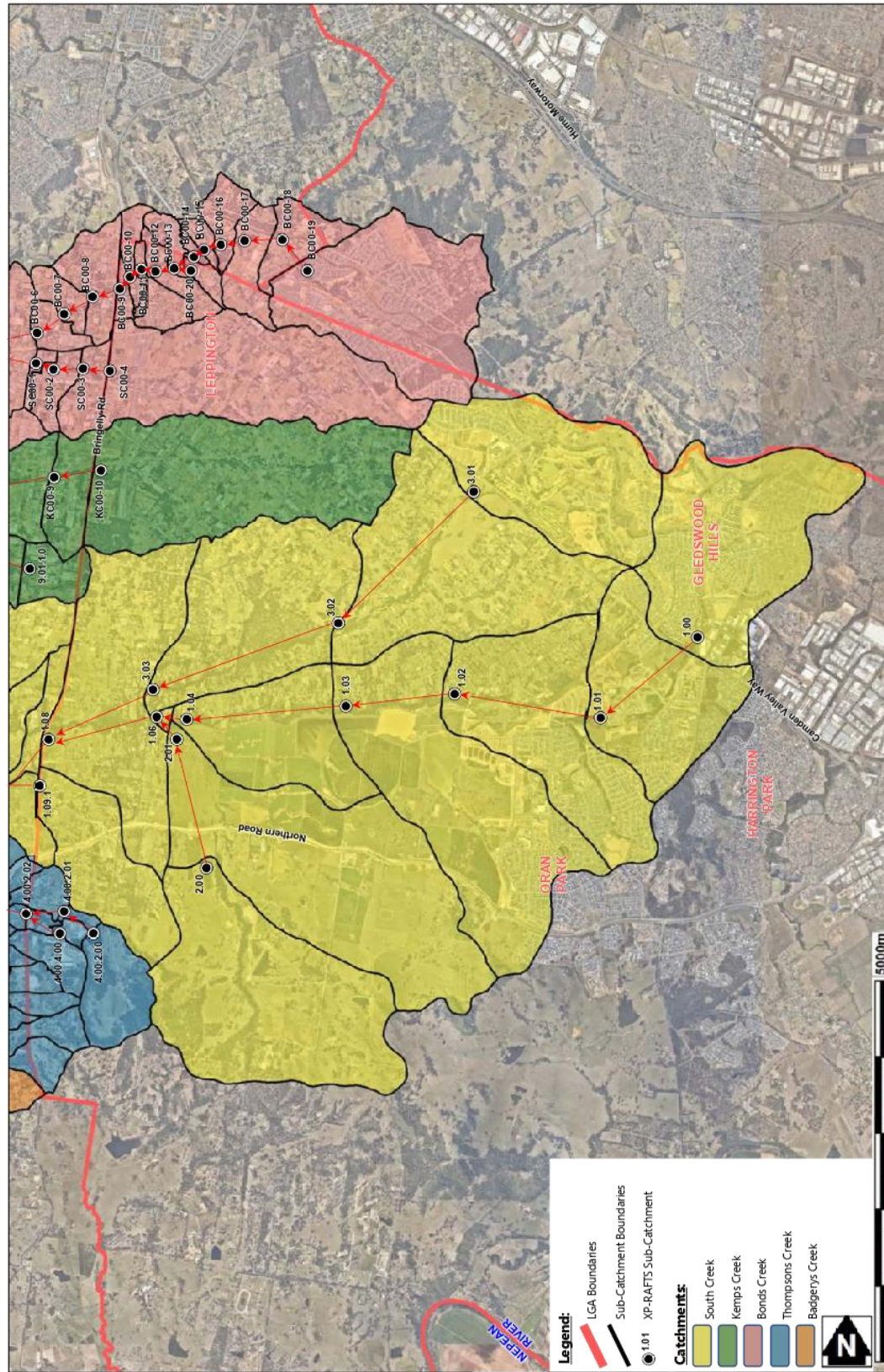
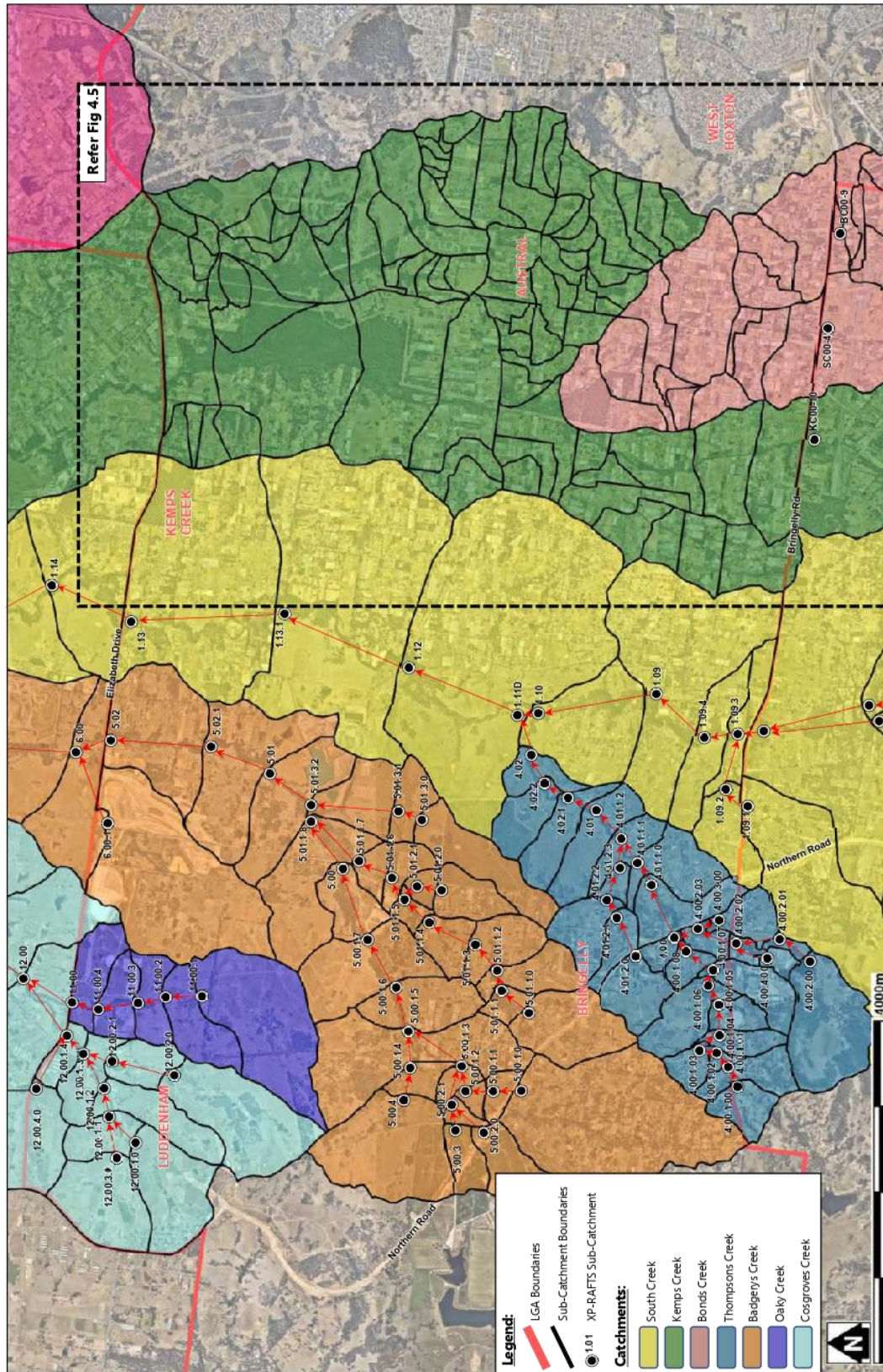
SOUTH CREEK SUB-CATCHMENT BOUNDARIES
UPDATED AS PART OF SOUTH CREEK
SECTOR INVESTIGATIONS (2020)

FIGURE 4.4



**SOUTH CREEK SUB-CATCHMENT BOUNDARIES
UPDATED AS PART OF SOUTH CREEK
SECTOR INVESTIGATIONS (2020)**

FIGURE 4.5

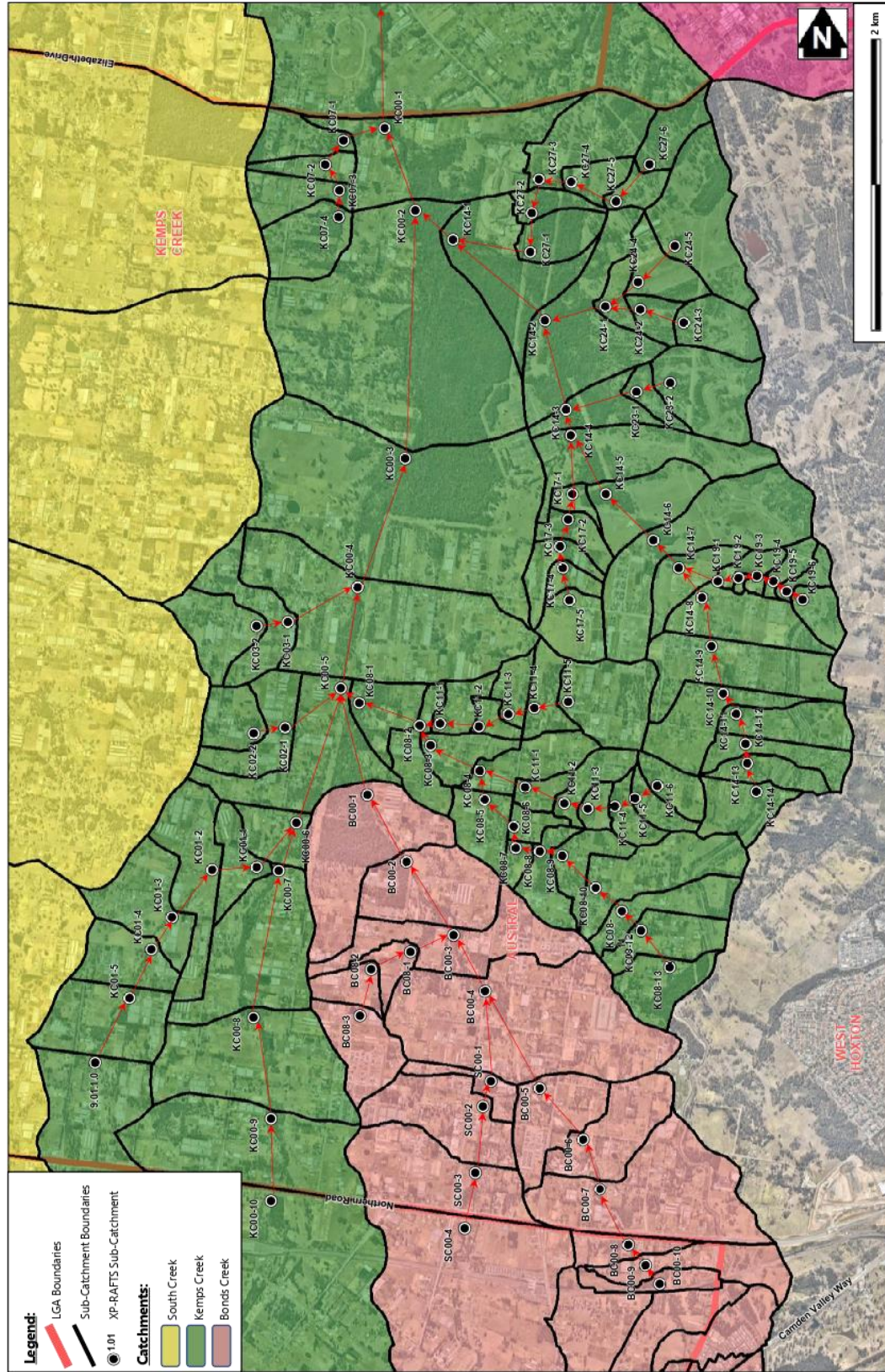
SOUTH CREEK SUB-CATCHMENT BOUNDARIES
UPDATED AS PART OF SOUTH CREEK
SECTOR INVESTIGATIONS (2020)

FIGURE 4.6

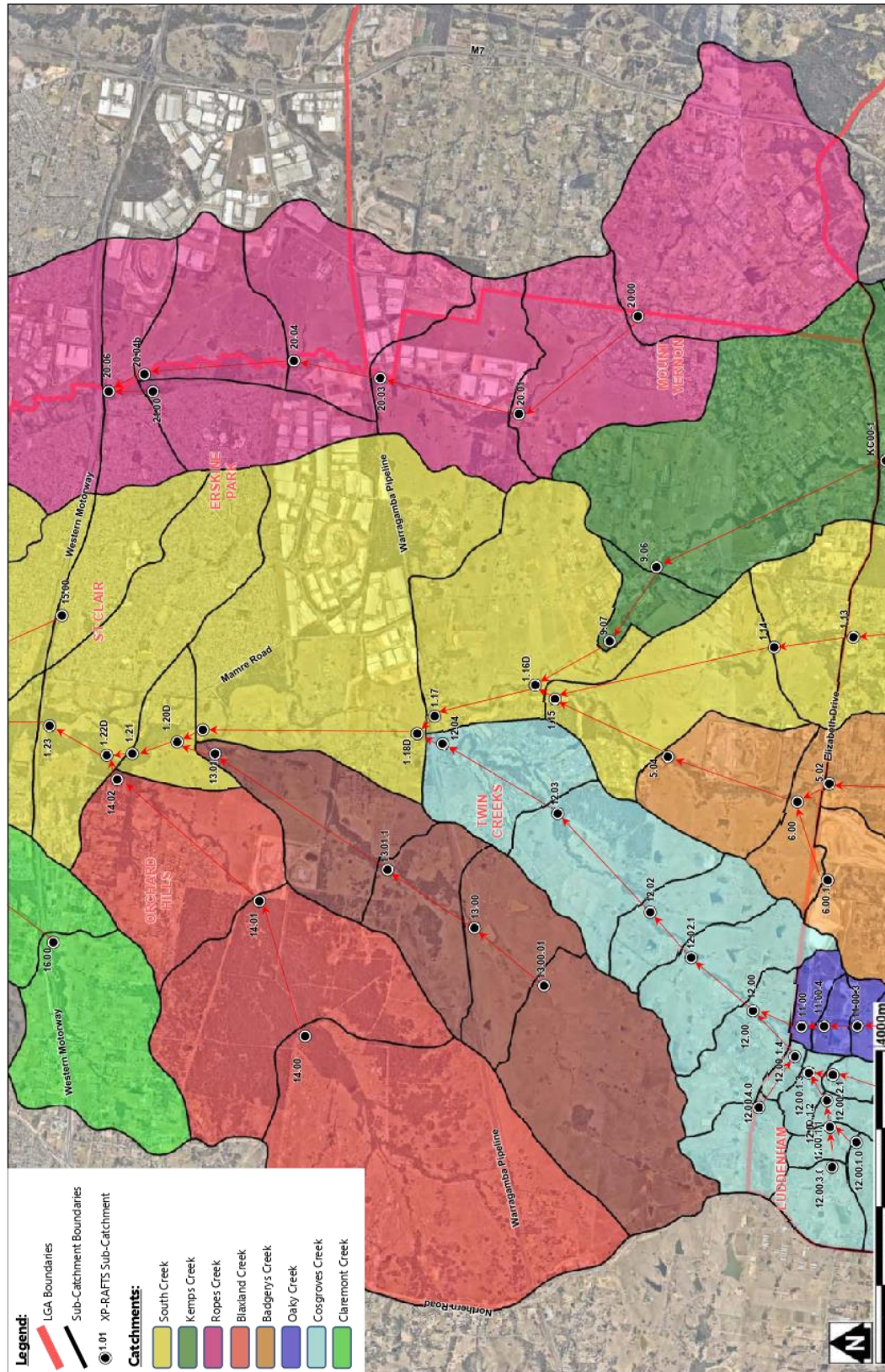
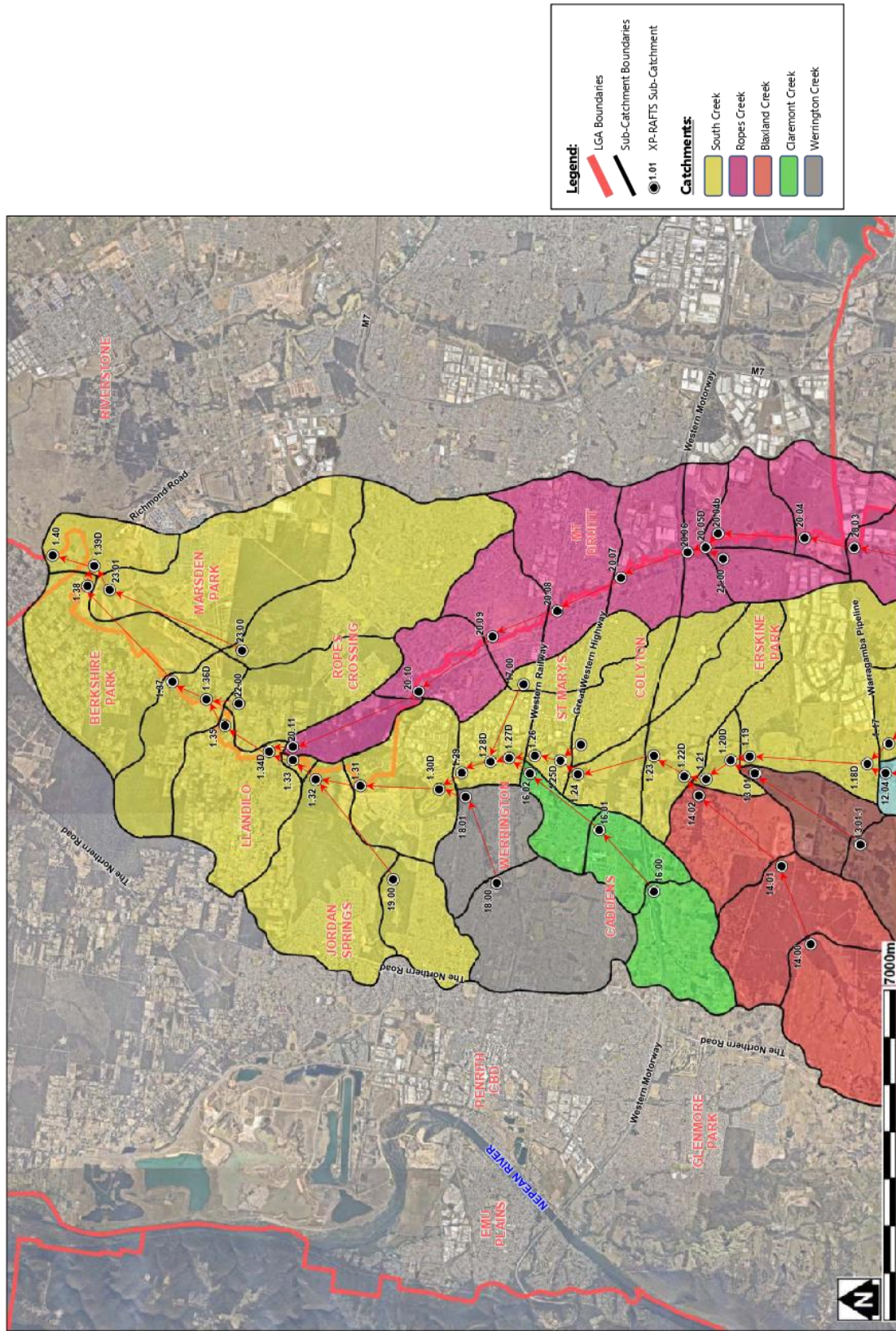
SOUTH CREEK SUB-CATCHMENT BOUNDARIES
UPDATED AS PART OF SOUTH CREEK
SECTOR INVESTIGATIONS (2020)

FIGURE 4.7

SOUTH CREEK SUB-CATCHMENT BOUNDARIES
UPDATED AS PART OF SOUTH CREEK
SECTOR INVESTIGATIONS (2020)

**Wianamatta (South) Creek Catchment
Existing Flood Risk Assessment**

Extract for Liverpool City Council

Appendix A

Updated XP-RAFTS Sub-Catchment Parameters




**Wianamatta (South) Creek Catchment
Existing Flood Risk Assessment**

Extract for Liverpool City Council

Table A1 Updated XP-RAFTS Sub-Catchment ParametersRefer **Figures 4.3 to 4.6** for Schematic of the XP-RAFTS Hydrologic Model

Catchment ID	Sub-Catchment No	Area (ha)	Vectored Slope	% Impervious	Roughness (Manning's n)	Initial Loss (mm)	Continuing Loss (mm)
1.00	1	300	1.9	0	0.055	35.9	0.94
	2	200	1.9	100	0.02	1	0
1.01	1	223.2	1.1	0	0.055	35.9	0.94
	2	148.8	1.1	100	0.02	1	0
1.02	1	252.6	1.25	0	0.055	35.9	0.94
	2	168.4	1.25	100	0.02	1	0
1.03	1	519.75	0.73	0	0.045	35.9	0.94
	2	173.25	0.73	100	0.02	1	0
1.04	1	307	0.95	8	0.045	35.9	0.94
1.05D	1	0.1	0.1	0	0.045	0	0
2.00	1	625	1.3	7	0.045	35.9	0.94
2.01	1	726	1	5	0.045	35.9	0.94
1.06	1	13	0.31	5	0.025	35.9	0.94
1.07D	1	0.1	0.1	0	0.02	0	0
3.00	1	376.6	1.6	0	0.045	35.9	0.94
	2	66.4	1.6	100	0.02	1	0
3.01	1	522	1.05	0	0.045	35.9	0.94
	2	58	1.05	100	0.02	1	0
3.02	1	425.7	0.96	0	0.045	35.9	0.94
	2	47.3	0.96	100	0.02	1	0
1.08	1	446	1.75	0	0.045	35.9	0.94
	2	49.5	1.75	100	0.02	1	0
1.09	1	275.1	0.9	0	0.045	35.9	0.94
	2	30.6	0.9	100	0.02	1	0
1.1.0	1	124.7	0.65	0	0.045	35.9	0.94
	2	13.9	0.65	100	0.02	1	0
1.11D	1	0.1	0.1	0	0.02	0	0
4.00	1	12.971	1.5	5	0.045	15	0.94
4.01	1	63.1	1.2	5	0.045	15	0.94
1.12	1	529.6	1.35	0	0.045	35.9	0.94
	2	132.4	1.35	100	0.02	1	0
1.13	1	337.8	0.8	0	0.045	35.9	0.94
	2	84.4	0.8	100	0.02	1	0
1.14	1	210.9	1.45	0	0.045	37.1	0.94
	2	23.4	1.45	100	0.02	1	0
1.15	1	332.1	0.15	0	0.045	37.1	0.94
	2	36.9	0.15	100	0.02	1	0


**Wianamatta (South) Creek Catchment
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Extract for Liverpool City Council

Catchment ID	Sub-Catchment No	Area (ha)	Vectored Slope	% Impervious	Roughness (Manning's n)	Initial Loss (mm)	Continuing Loss (mm)
5.00	1	46.5	5.8	5	0.055	37.1	0.94
5.01	1	91	0.9	0	0.055	37.1	0.94
	2	16.1	0.9	100	0.02	1	0
5.02	1	134.3	0.75	0	0.055	37.1	0.94
	2	14.9	0.75	100	0.02	1	0
5.03D	1	0.1	0.1	0	0.02	0	0
6.00	1	116.9	1.1	5	0.045	37.1	0.94
5.04	1	303	0.41	5	0.045	37.1	0.94
1.16D	1	0.1	0.1	0	0.02	0	0
KC00-1	1	72.51	1.2	0	0.065	33.9	0.94
	2	8.06	1.3	100	0.02	1	0
9.06	1	727	1.35	0	0.045	33.9	0.94
	2	181.8	1.35	100	0.02	1	0
9.07	1	71.4	0.65	0	0.045	33.9	0.94
	2	30.6	0.65	100	0.02	1	0
9.08D	1	0.1	0.1	0	0.02	0	0
1.17	1	548.1	0.53	0	0.045	37.1	0.94
	2	60.9	0.53	100	0.02	1	0
1.18D	1	0.1	0.1	0	0.02	0	0
11.00	1	48	0.95	5	0.045	37.1	0.94
12.02	1	154.3	0.85	0	0.045	37.1	0.94
	2	13.4	0.85	100	0.02	1	0
12.00	1	143.6	1.45	0	0.045	37.1	0.94
	2	16	1.45	100	0.02	1	0
12.03	1	314.9	0.5	5	0.06	37.1	0.94
1.19	1	577	0.31	0	0.045	37.1	0.94
	2	498	0.31	100	0.02	1	0
1.20D	1	0.1	0.1	0	0.02	0	0
13.00	1	244.8	1.2	5	0.045	37.1	0.94
13.01	1	316.7	0.95	5	0.045	37.1	0.94
1.21	1	122	0.78	0	0.045	37.1	0.94
	2	21	0.78	100	0.02	1	0
1.22D	1	0.1	0.1	0	0.02	0	0
14.00	1	1150	0.62	5	0.035	37.1	0.94
14.02	1	450	0.52	0	0.045	37.1	0.94
	2	50	0.52	100	0.02	1	0
1.23	1	337.2	0.73	0	0.045	37.1	0.94
	2	224.8	0.73	100	0.02	1	0
14.02	1	450	0.52	0	0.045	37.1	0.94
	2	50	0.52	100	0.02	1	0


**Wianamatta (South) Creek Catchment
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Extract for Liverpool City Council

Catchment ID	Sub-Catchment No	Area (ha)	Vectored Slope	% Impervious	Roughness (Manning's n)	Initial Loss (mm)	Continuing Loss (mm)
1.23	1	337.2	0.73	0	0.045	37.1	0.94
	2	224.8	0.73	100	0.02	1	0
1.24	1	164	0.56	0	0.045	37.1	0.94
	2	41	0.56	100	0.02	1	0
1.25D	1	0.1	0.1	0	0.02	0	0
15.00	1	78	0.93	0	0.035	37.1	0.94
	2	117	0.93	100	0.02	1	0
15.01	1	125.2	0.74	0	0.035	37.1	0.94
	2	187.8	0.74	100	0.02	1	0
1.26	1	96.8	0.7	0	0.045	36.6	0.94
	2	79.2	0.7	100	0.02	1	0
1.27D	1	0.1	0.1	0	0.02	0	0
16.00	1	356	0.74	0	0.035	36.6	0.94
	2	89	0.075	100	0.02	1	0
16.01	1	145.2	0.68	0	0.045	15	0.94
	2	96.8	0.68	100	0.025	1	0
1.28D	1	0.1	0.1	0	0.02	0	0
17	1	103	0.72	0	0.035	36.6	0.94
	2	155	0.72	100	0.02	1	0
1.29	1	134.5	0.39	0	0.045	36.6	0.94
	2	134.5	0.39	100	0.02	1	0
1.30D	1	0.1	0.1	0	0.02	Zero	
18.01	1	196	0.71	0	0.035	15	0.94
	2	196	0.71	100	0.02	1	0
1.31	1	384.2	0.66	0	0.055	36.6	0.94
	2	206.9	0.66	100	0.02	1	0
1.32	1	369.2	0.65	0	0.06	36.6	0.94
	2	198.8	0.65	100	0.02	1	0
19.00	1	193.1	0.76	0	0.045	36.6	0.94
	2	158	0.76	100	0.02	1	0
1.33	1	20	0.42	5	0.045	36.6	0.94
1.34D	1	0.1	0.1	0	0.02	0	0
20.00	1	712.8	0.67	3	0.04	32.6	0.94
	2	178.2	0.67	100	0.02	1	0
20.03	1	259	0.56	0	0.045	32.6	0.94
	2	73.1	0.56	100	0.02	32.6	0.94
20.04	1	264.6	0.47	0	0.045	32.6	0.94
	2	176.4	0.45	100	0.02	32.6	0.94
20.05D	1	0.1	0.1	0	0.02	0	0


**Wianamatta (South) Creek Catchment
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Extract for Liverpool City Council

Catchment ID	Sub-Catchment No	Area (ha)	Vectored Slope	% Impervious	Roughness (Manning's n)	Initial Loss (mm)	Continuing Loss (mm)
21.00	1	59	0.67	0	0.045	32.6	0.94
	2	177	0.67	100	0.02	1	0
20.06	1	146.9	1.26	0	0.045	32.6	0.94
	2	69.1	1.26	100	0.02	1	0
20.07	1	220.5	0.82	0	0.045	32.6	0.94
	2	220.5	0.82	100	0.02	1	0
20.08	1	235.2	0.88	0	0.045	32.6	0.94
	2	352.8	0.88	100	0.02	1	0
20.09	1	269.3	1.25	0	0.045	32.6	0.94
	2	126.7	1.25	100	0.02	1	0
20.10	1	237.3	0.75	0	0.055	36.6	0.94
	2	127.8	0.75	100	0.02	1	0
20.11	1	140.8	0.6	0	0.08	36.6	0.94
	2	66.2	0.6	100	0.02	1	0
1.35	1	588.2	0.46	0	0.045	36.6	0.94
	2	103.8	0.46	100	0.02	1	0
1.36D	1	0.1	0.1	0	0.02	0	0
22.00	1	355.6	0.68	0	0.06	36.6	0.94
	2	191.5	0.68	100	0.02	1	0
1.37	1	429.3	0.76	0	0.06	36.6	0.94
	2	47.7	0.76	100	0.02	1	0
1.38	1	684.8	0.36	0	0.045	36.6	0.94
	2	171.2	0.36	100	0.02	1	0
1.39D	1	0.1	0.1	0	0.025	0	0
23.00	1	577	0.48	0	0.045	36.6	0.94
	2	472.1	0.48	100	0.02	1	0
23.01	1	666.3	0.41	0	0.06	36.6	0.94
	2	358.8	0.41	100	0.02	1	0
1.40	1	178	0.53	5	0.025	36.6	0.94
	2	114	0.53	100	0.025	1	0
20.01	1	413.9	0.44	0	0.04	32.6	0.94
	2	46	0.42	100	0.02	1	0
20.02D	1	0.001	0.002	0	0.025	0	0
12.01D	1	0.1	0.1	0	0.02	0	0
14.01	1	660	0.52	2	0.08	37.1	0.94
18.00	1	378	0.71	0	0.035	5	0.94
	2	402	0.71	100	0.025	1	0
16.02	1	146.9	0.68	9	0.035	15	0.94
	2	79.1	0.68	100	0.02	1	0


**Wianamatta (South) Creek Catchment
Existing Flood Risk Assessment**

Extract for Liverpool City Council

Catchment ID	Sub-Catchment No	Area (ha)	Vectored Slope	% Impervious	Roughness (Manning's n)	Initial Loss (mm)	Continuing Loss (mm)
20.04b	1	252.1	0.47	0	0.045	32.6	0.94
	2	21.9	0.47	100	0.02	1	0
4.02	1	28.7	1.2	5	0.045	15	0.94
1.09.1	1	233.8	2.05	3	0.045	35.9	0.94
1.09.2	1	55.6	2.15	5	0.045	35.9	0.94
1.09.3	1	45.4	0.85	5	0.045	35.9	0.94
1.09.4	1	66.1	0.85	0	0.045	35.9	0.94
	2	7.3	0.85	100	0.045	1	0
1.13.1	1	427.3	0.8	0	0.045	35.9	0.94
	2	106.8	0.8	100	0.02	1	0
11.00.1	1	177.9	2.2	5	0.045	37.1	0.94
11.00.2	1	59.8	1.25	5	0.045	37.1	0.94
11.00.3	1	38.9	1.35	5	0.045	37.1	0.94
11.00.4	1	38.6	1.55	5	0.045	37.1	0.94
12.00.1.0	1	79	3.85	0	0.045	37.1	0.94
	2	19.7	3.85	100	0.02	1	0
12.00.1.1	1	37.6	2.9	5	0.045	37.1	0.94
12.00.1.2	1	62.2	2	5	0.045	37.1	0.94
12.00.1.3	1	41.2	2.7	5	0.045	37.1	0.94
12.00.1.4	1	19	1.15	0	0.045	37.1	0.94
	2	4.7	1.15	100	0.02	1	0
12.00.2.0	1	140.8	4.55	5	0.045	37.1	0.94
12.00.2.1	1	33.6	1.85	0	0.045	37.1	0.94
	2	3.7	1.85	100	0.02	1	0
12.00.3.0	1	82.3	4.1	0	0.045	37.1	0.94
	2	14.5	4.1	100	0.02	1	0
12.00.4.0	1	102.7	4.3	0	0.045	37.1	0.94
	2	18.1	4.3	100	0.02	1	0
12.02.1	1	211.7	1.65	0	0.045	37.1	0.94
	2	23.5	1.65	100	0.02	1	0
13.00.1	1	592.6	1.6	2	0.045	37.1	0.94
13.01.1	1	229.2	2.4	2	0.045	37.1	0.94
4.01.1.0	1	51.8	1.05	5	0.045	15	0.94
4.01.1.1	1	62.3	0.95	5	0.045	15	0.94
4.01.1.2	1	33.8	1.15	5	0.045	15	0.94
4.01.2.0	1	51.5	2.05	5	0.045	15	0.94
4.01.2.1	1	27.9	1.65	5	0.045	15	0.94
4.01.2.2	1	46.5	1.5	5	0.045	15	0.94
4.01.2.3	1	12.7	1.45	5	0.045	15	0.94


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Catchment ID	Sub-Catchment No	Area (ha)	Vectored Slope	% Impervious	Roughness (Manning's n)	Initial Loss (mm)	Continuing Loss (mm)
4.02.1	1	50	1.05	5	0.045	15	0.94
4.02.2	1	43.9	1.2	5	0.045	15	0.94
5.00.1.0	1	230.3	0.8	0	0.055	37.1	0.94
	2	76.8	0.8	100	0.02	1	0
5.00.1.1	1	17.9	1	5	0.045	37.1	0.94
5.00.1.2	1	9.5	1.4	5	0.045	37.1	0.94
5.00.1.3	1	15.9	1.2	5	0.045	37.1	0.94
5.00.1.4	1	22.2	1.6	5	0.045	37.1	0.94
5.00.1.5	1	152.4	0.8	0	0.055	37.1	0.94
	2	16.9	0.8	100	0.02	1	0
5.00.1.6	1	59.5	1.2	0	0.045	37.1	0.94
	2	10.5	1.2	100	0.02	1	0
5.00.1.7	1	109.1	1.4	5	0.045	37.1	0.94
5.00.2.0	1	47.2	1	5	0.045	37.1	0.94
5.00.3	1	30.5	1.1	5	0.045	37.1	0.94
5.00.4	1	154.8	1.3	5	0.045	37.1	0.94
5.00.2.1	1	10.4	1	5	0.045	37.1	0.94
5.01.1.0	1	77.6	1.05	0	0.055	37.1	0.94
	2	13.7	1.05	100	0.02	1	0
5.01.1.1	1	17.2	1.4	5	0.055	37.1	0.94
5.01.1.2	1	41.6	2.55	0	0.045	37.1	0.94
	2	4.6	2.55	100	0.02	1	0
5.01.1.3	1	45.3	1.2	0	0.045	37.1	0.94
	2	5	1.2	100	0.02	1	0
5.01.1.4	1	29.7	2.15	0	0.045	37.1	0.94
	2	5.2	2.15	100	0.02	1	0
5.01.1.5	1	13.2	2.25	5	0.045	37.1	0.94
5.01.1.6	1	25.4	1.1	5	0.045	37.1	0.94
5.01.1.7	1	19.9	1.6	5	0.045	37.1	0.94
5.01.1.8	1	120.4	0.85	5	0.055	37.1	0.94
5.01.2.0	1	36.2	0.85	0	0.045	37.1	0.94
	2	6.4	0.85	100	0.02	1	0
5.01.2.1	1	13	1.45	5	0.045	37.1	0.94
5.01.3.0	1	81.5	1.2	5	0.045	37.1	0.94
5.01.3.1	1	30.9	1	0	0.045	37.1	0.94
	2	3.4	1	100	0.02	1	0
5.01.3.2	1	61.2	1.05	5	0.045	37.1	0.94
5.02.1	1	143.3	1.2	0	0.055	37.1	0.94
	2	12.5	1.2	100	0.02	1	0


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6.00.1	1	268	1.05	0	0.045	37.1	0.94
	2	23.3	1.05	100	0.02	1	0
9.01.1.0	1	47.3	1.3	0	0.045	33.9	0.94
	2	11.8	1.3	100	0.02	1	0
9.01.1.1	1	33.3	1.4	0	0.045	33.9	0.94
	2	11.8	1.4	100	0.02	1	0
4.00.1.00	1	36.7	3.3	5	0.045	15	0.94
4.00.1.01	1	40.3	4.7	5	0.045	15	0.94
4.00.1.02	1	6.8	3.2	5	0.045	15	0.94
4.00.1.03	1	19.9	2.4	5	0.045	15	0.94
4.00.1.04	1	24.2	4.1	5	0.045	15	0.94
4.00.1.05	1	23.4	3.2	5	0.045	15	0.94
4.00.1.08	1	19.2	4.1	5	0.045	15	0.94
4.00.2.00	1	118.5	2.8	5	0.045	15	0.94
4.00.2.01	1	8.0	1.5	5	0.045	15	0.94
4.00 D	1	0.1	0.1	0	0.025	0	0
4.00.2.0.2	1	10.	2.1	5	0.045	15	0.94
4.00.2.03	1	16.12	0.3	5	0.045	15	0.94
4.00.3.00	1	34.2	2.3	5	0.045	15	0.94
4.00.4.00	1	7.8	1.5	0	0.045	15	0.94
	2	3.4	1.5	100	0.02	1	0
4.00.1.06	1	54.0	2.5	5	0.045	15	0.94
4.00.1.07	1	41.9	1.3	0	0.045	15	0.94
	2	4.7	1.3	100	0.02	1	0
19.01D	1	0.1	0.1	0	0.02	0	0
1.29D	1	0.1	0.1	0	0.02	0	0
12.04	1	196	0.5	0	0.045	37.1	0.94
	2	84	0.5	100	0.02	1	0
BC00-19	1	272	2.2	0	0.06	35.9	0.94
	2	181.3	2.2	100	0.02	1	0
BC00-18	1	60.2	2.41	0	0.055	35.9	0.94
	2	10.6	2.41	100	0.02	1	0
BC00-17	1	61.4	2.4	0	0.045	35.9	0.94
	2	10.8	2.4	100	0.02	1	0
BC00-16	1	39.1	2.3	0	0.045	35.9	0.94
	2	6.9	2.3	100	0.02	1	0
BC00-15	1	10.3	2.22	0	0.045	35.9	0.94
	2	5.6	2.22	100	0.02	1	0
BC00-14	1	3.9	4.21	0	0.045	35.9	0.94
	2	3.1	4.21	100	0.02	1	0


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BC00-12	1	16.4	3.25	0	0.045	35.9	0.94
	2	8.9	3.25	100	0.02	1	0
BC00-11	1	36.4	2.19	0	0.045	35.9	0.94
	2	1.9	2.19	100	0.02	1	0
BC00-10	1	10.3	2.05	0	0.045	35.9	0.94
	2	1.1	2.05	100	0.02	1	0
BC00-9	1	20.4	1.87	0	0.045	35.9	0.94
	2	6.8	1.87	100	0.02	1	0
BC00-8	1	10.4	4.18	0	0.045	35.9	0.94
	2	2.6	4.18	100	0.02	1	0
BC00-7	1	70.3	1.93	0	0.055	35.9	0.94
	2	12.4	1.93	100	0.02	1	0
BC00-6	1	24.9	2.59	0	0.045	35.9	0.94
	2	10.7	2.59	100	0.02	1	0
BC00-5	1	23.0	1.88	0	0.045	35.9	0.94
	2	9.9	1.88	100	0.02	1	0
BC00-4	1	104.5	2	0	0.05	35.9	0.94
	2	26.1	2	100	0.02	1	0
BC00-3	1	44.2	2.5	0	0.045	35.9	0.94
	2	4.9	2.5	100	0.02	1	0
BC00-2	1	41.1	1.81	0	0.045	35.9	0.94
	2	4.6	1.81	100	0.02	1	0
BC00-1	1	53.1	1.4	0	0.065	35.9	0.94
	2	13.3	1.4	100	0.02	1	0
KC00-5	1	48.3	1.67	0	0.055	35.9	0.94
	2	7.2	1.67	100	0.02	1	0
KC00-4	1	80.8	1.94	0	0.06	35.9	0.94
	2	43.5	1.94	100	0.02	1	0
KC00-3	1	160.9	1.5	0	0.065	35.9	0.94
	2	40.2	1.5	100	0.02	1	0
KC00-2	1	170.1	1.15	0	0.065	35.9	0.94
	2	39.6	1.15	100	0.02	1	0
BC00-20	1	28.9	2	0	0.065	35.9	0.94
	2	3.2	2	100	0.02	1	0
BC00-13	1	11.2	2.5	0	0.045	35.9	0.94
	2	4.8	2.5	100	0.02	1	0
BC08-2	1	9.7	2.6	0	0.045	35.9	0.94
	2	2.4	2.6	100	0.02	1	0
BC08-1	1	8.3	1.88	0	0.045	35.9	0.94
	2	0.6	1.88	100	0.02	1	0


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KC13-5	1	25.7	2.06	0	0.055	35.9	0.94
	2	8.6	2.06	100	0.02	1	0
KC13-4	1	13.9	3.26	0	0.055	35.9	0.94
	2	1.0	3.26	100	0.02	1	0
KC13-3	1	9.8	2.93	0	0.045	35.9	0.94
	2	0.5	2.93	100	0.02	1	0
KC13-2	1	5.9	1.6	0	0.045	35.9	0.94
	2	0.3	1.6	100	0.02	1	0
KC13-1	1	10.1	4.09	0	0.045	35.9	0.94
	2	1.1	4.09	100	0.02	1	0
KC14-14	1	14.4	3.5	0	0.05	35.9	0.94
	2	6.2	3.5	100	0.02	1	0
KC14-13	1	9.0	3.5	0	0.04	35.9	0.94
	2	4.8	3.5	100	0.02	1	0
KC14-12	1	11.1	3.5	0	0.05	35.9	0.94
	2	6.0	3.5	100	0.02	1	0
KC14-11	1	16.2	2.27	0	0.045	35.9	0.94
	2	6.9	2.27	100	0.02	1	0
KC14-10	1	24.7	3.07	0	0.045	35.9	0.94
	2	4.4	3.07	100	0.02	1	0
KC14-9	1	20.8	3.8	0	0.055	35.9	0.94
	2	25.5	3.8	100	0.02	1	0
KC14-8	1	18.9	2.66	0	0.05	35.9	0.94
	2	12.6	2.66	100	0.02	1	0
KC14-7	1	11.4	2.9	0	0.055	35.9	0.94
	2	7.6	2.9	100	0.02	1	0
KC14-6	1	55.5	2.13	0	0.055	35.9	0.94
	2	18.5	2.13	100	0.02	1	0
KC14-5	1	28.9	3.02	0	0.055	35.9	0.94
	2	1.5	3.02	100	0.02	1	0
KC14-4	1	48.0	2.75	0	0.065	35.9	0.94
	2	2.5	2.75	100	0.02	1	0
KC14-3	1	17.6	1.93	0	0.065	35.9	0.94
	2	0.9	1.93	100	0.02	1	0
KC14-2	1	60.7	1.72	0	0.065	35.9	0.94
	2	3.2	1.72	100	0.02	1	0
KC14-1	1	40.8	1.06	0	0.065	35.9	0.94
	2	10.2	1.06	100	0.02	1	0
KC27-2	1	7.7	2.31	0	0.065	35.9	0.94
	2	1.4	2.31	100	0.02	1	0


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KC27-1	1	16.6	2.11	0	0.065	35.9	0.94
	2	0.9	2.11	100	0.02	1	0
KC27-5	1	8.4	3.23	0	0.055	35.9	0.94
	2	0.4	3.23	100	0.02	1	0
KC27-4	1	9.4	1.62	0	0.055	35.9	0.94
	2	1.0	1.62	100	0.02	1	0
KC27-3	1	28.5	1.95	0	0.065	35.9	0.94
	2	7.1	1.95	100	0.02	1	0
KC27-6	1	14.6	6.7	0	0.065	35.9	0.94
	2	0.8	6.7	100	0.02	1	0
KC24-5	1	47.2	4.26	0	0.055	35.9	0.94
	2	2.5	4.26	100	0.02	1	0
KC24-4	1	16.1	2.55	0	0.055	35.9	0.94
	2	1.8	2.55	100	0.02	1	0
KC24-1	1	8.2	2.34	0	0.055	35.9	0.94
	2	0.4	2.34	100	0.02	1	0
KC24-3	1	19.0	5.18	0	0.055	35.9	0.94
	2	1.0	5.18	100	0.02	1	0
KC24-2	1	8.6	3.1	0	0.065	35.9	0.94
	2	0.5	3.1	100	0.02	1	0
KC23-2	1	35.7	6.39	0	0.065	35.9	0.94
	2	1.9	6.39	100	0.02	1	0
KC23-1	1	7.5	2.71	0	0.065	35.9	0.94
	2	0.4	2.71	100	0.02	1	0
KC17-5	1	13.4	4.5	0	0.045	35.9	0.94
	2	5.7	4.5	100	0.02	1	0
KC17-4	1	4.1	3.04	0	0.045	35.9	0.94
	2	2.7	3.04	100	0.02	1	0
KC17-3	1	8.2	3.5	0	0.055	35.9	0.94
	2	4.4	3.5	100	0.02	1	0
KC17-2	1	10.6	2.24	0	0.055	35.9	0.94
	2	0.6	2.24	100	0.02	1	0
KC17-1	1	5.2	6.54	0	0.055	35.9	0.94
	2	0.3	6.54	100	0.02	1	0
KC19-7	1	9.9	6.39	0	0.045	35.9	0.94
	2	1.1	6.39	100	0.02	1	0
KC19-6	1	4.5	2.87	0	0.045	35.9	0.94
	2	1.5	2.87	100	0.02	1	0
KC19-4	1	5.0	5	0	0.045	35.9	0.94
	2	2.2	5	100	0.02	1	0


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KC19-3	1	1.2	3.61	0	0.045	35.9	0.94
	2	0.5	3.61	100	0.02	1	0
KC19-2	1	1.1	3.15	0	0.065	35.9	0.94
	2	0.1	3.15	100	0.02	1	0
KC19-1	1	6.1	2.31	0	0.065	35.9	0.94
	2	0.7	2.31	100	0.02	1	0
KC11-6	1	11.3	3.32	0	0.055	35.9	0.94
	2	1.3	3.32	100	0.02	1	0
KC11-5	1	7.5	4.48	0	0.055	35.9	0.94
	2	1.3	4.48	100	0.02	1	0
KC11-4	1	8.4	2.99	0	0.045	35.9	0.94
	2	1.5	2.99	100	0.02	1	0
KC11-3	1	5.8	2.87	0	0.045	35.9	0.94
	2	0.4	2.87	100	0.02	1	0
KC11-2	1	11.4	3.1	0	0.045	35.9	0.94
	2	2.0	3.1	100	0.02	1	0
KC11-1	1	7.0	2.14	0	0.045	35.9	0.94
	2	0.4	2.14	100	0.02	1	0
SC00-4	1	376.3	1.55	0	0.045	35.9	0.94
	2	94.1	1.55	100	0.02	1	0
SC00-3	1	33.1	2.85	0	0.045	35.9	0.94
	2	22.0	2.85	100	0.02	1	0
SC00-2	1	29.4	2.43	0	0.045	35.9	0.94
	2	12.6	2.43	100	0.02	1	0
SC00-1	1	6.3	3.04	0	0.045	35.9	0.94
	2	4.2	3.04	100	0.02	1	0
KC00-10	1	512.7	1.08	0	0.055	35.9	0.94
	2	69.9	1.08	100	0.02	1	0
KC00-9	1	437.0	1.79	0	0.045	35.9	0.94
	2	145.7	1.79	100	0.02	1	0
KC00-8	1	64.4	1.96	0	0.045	35.9	0.94
	2	16.1	1.96	100	0.02	1	0
KC00-7	1	52.9	1.35	0	0.055	35.9	0.94
	2	13.2	1.35	100	0.02	1	0
KC00-6	1	15.3	1.56	0	0.055	35.9	0.94
	2	1.7	1.56	100	0.02	1	0
KC01-4	1	18.0	2.09	0	0.055	35.9	0.94
	2	6.0	2.09	100	0.02	1	0
KC01-3	1	25.8	3	0	0.045	35.9	0.94
	2	8.6	3	100	0.02	1	0


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Catchment ID	Sub-Catchment No	Area (ha)	Vectored Slope	% Impervious	Roughness (Manning's n)	Initial Loss (mm)	Continuing Loss (mm)
KC01-2	1	32.9	1.06	0	0.045	35.9	0.94
	2	8.2	1.06	100	0.02	1	0
KC01-1	1	12.8	1.9	0	0.045	35.9	0.94
	2	3.2	1.9	100	0.02	1	0
KC02-2	1	8.4	4.95	0	0.055	35.9	0.94
	2	8.4	4.95	100	0.02	1	0
KC02-1	1	16.3	3.43	0	0.055	35.9	0.94
	2	8.8	3.43	100	0.02	1	0
KC03-2	1	20.3	2.58	0	0.055	35.9	0.94
	2	5.1	2.58	100	0.02	1	0
KC03-1	1	23.9	2.5	0	0.055	35.9	0.94
	2	4.2	2.5	100	0.02	1	0
KC07-4	1	23.5	2.27	0	0.065	35.9	0.94
	2	2.6	2.27	100	0.02	1	0
KC07-3	1	16.6	2.54	0	0.045	35.9	0.94
	2	0.9	2.54	100	0.02	1	0
KC07-2	1	8.3	2.42	0	0.045	35.9	0.94
	2	2.1	2.42	100	0.02	1	0
KC07-1	1	16.1	2.68	0	0.055	35.9	0.94
	2	0.8	2.68	100	0.02	1	0



**Wianamatta (South) Creek Catchment
Existing Flood Risk Assessment**

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Appendix B

RMA-2 Model Extensions and Network Refinement



FIGURE B1

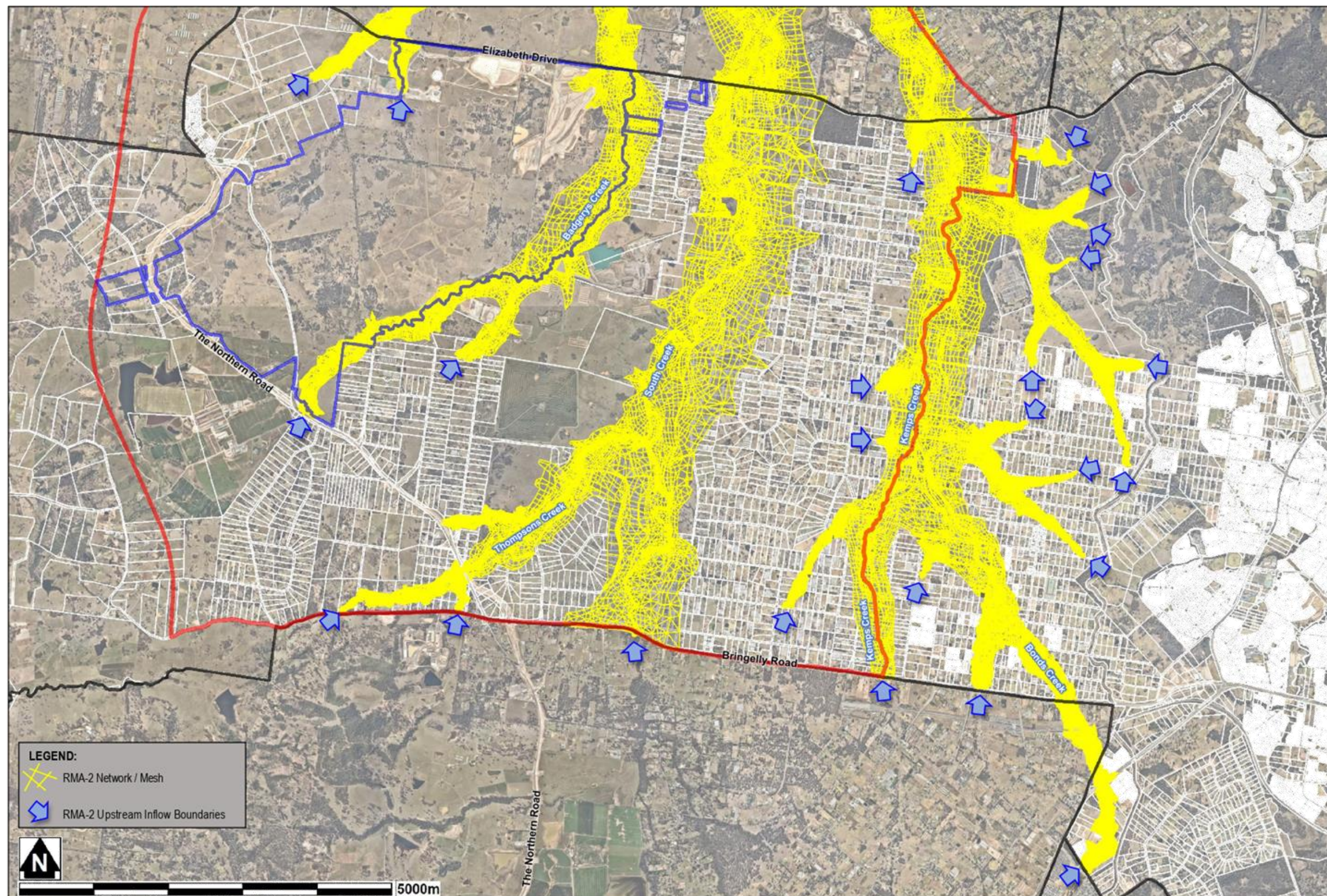
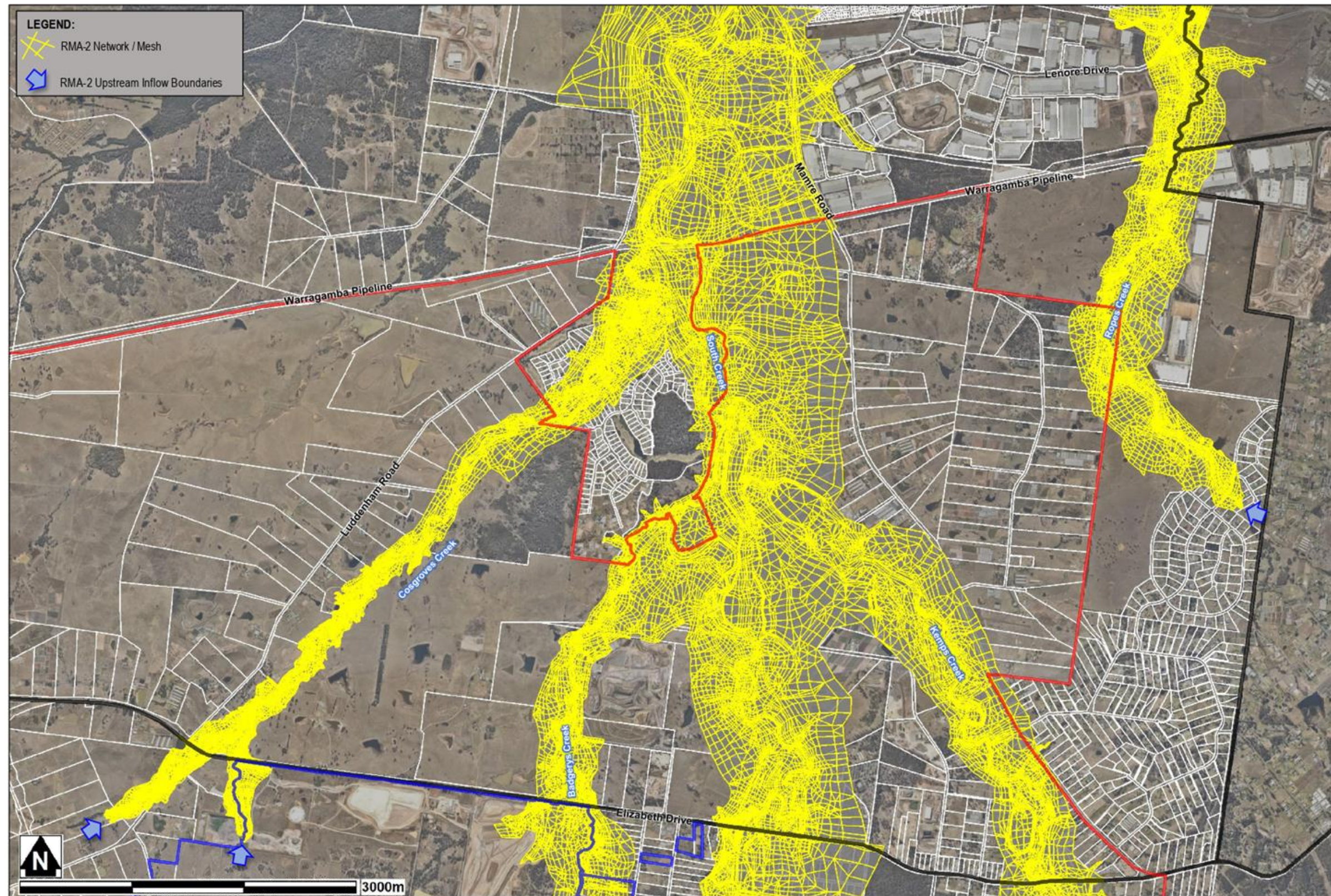


FIGURE B2



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**UPDATED RMA-2 MODEL NETWORK
AND UPSTREAM INFLOWS**
[View 2 of 4]

FIGURE B3

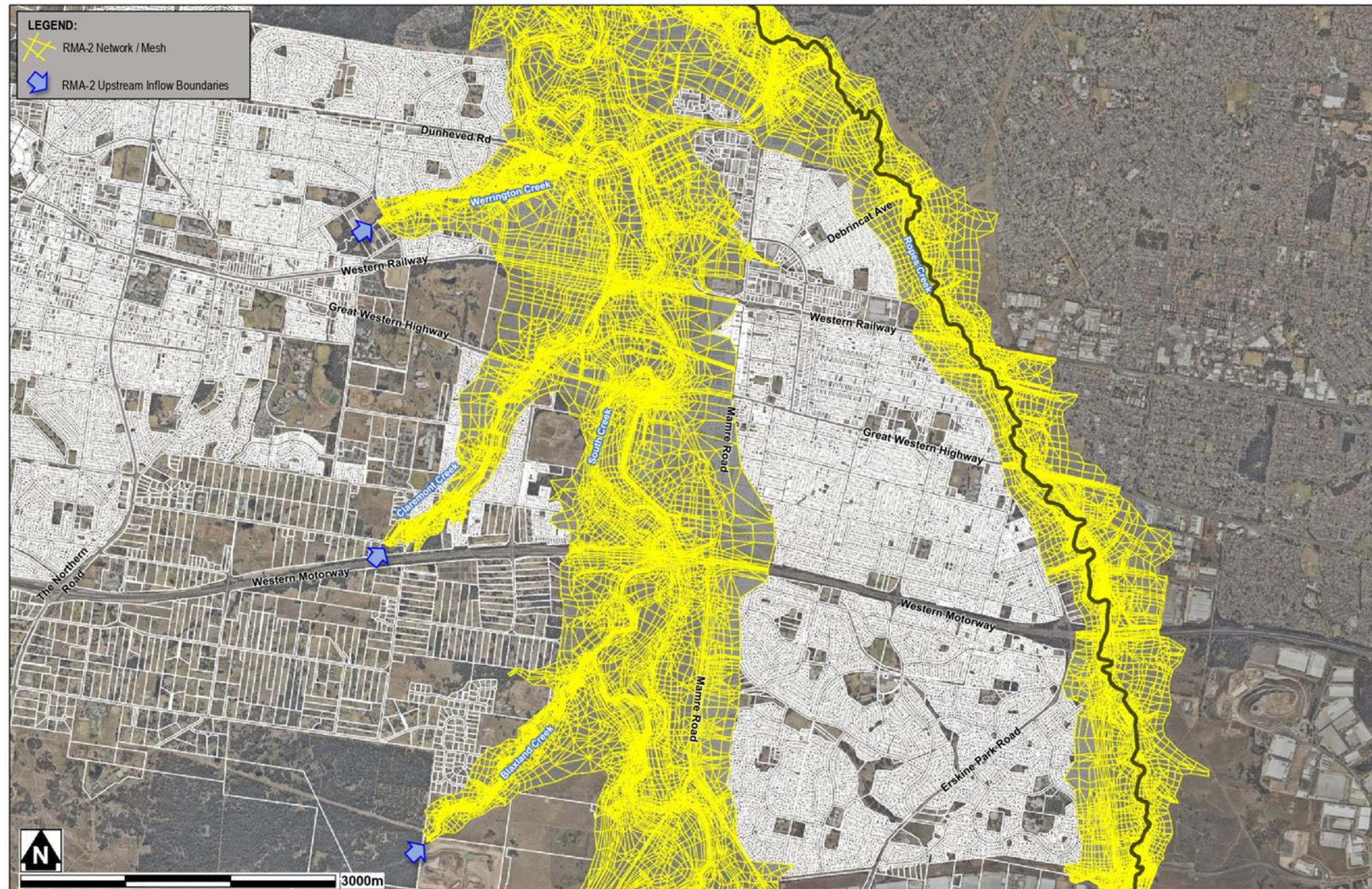
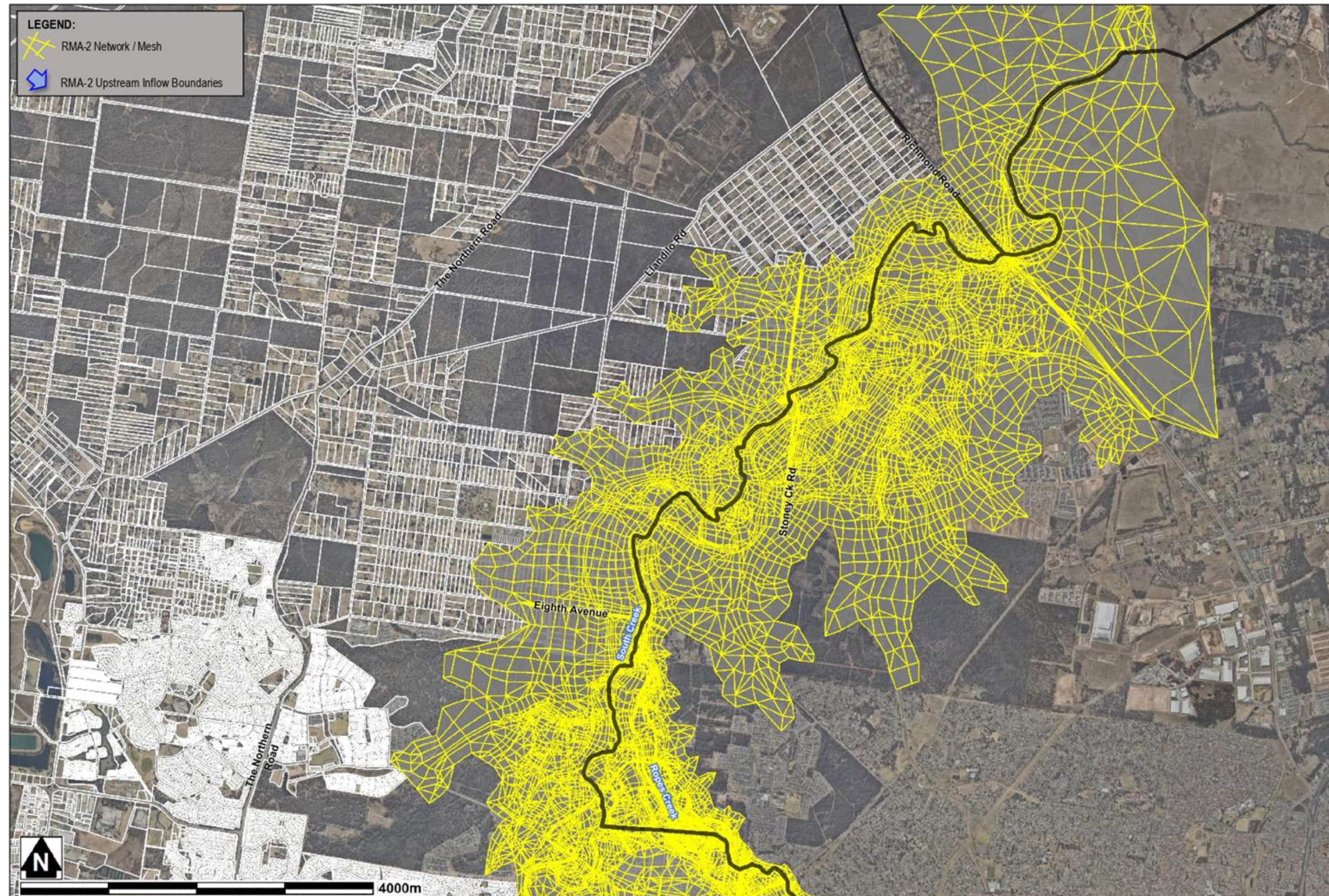


FIGURE B4



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**UPDATED RMA-2 MODEL NETWORK
AND UPSTREAM INFLOWS**
[View 4 of 4]



**Wianamatta (South) Creek Catchment
Existing Flood Risk Assessment**

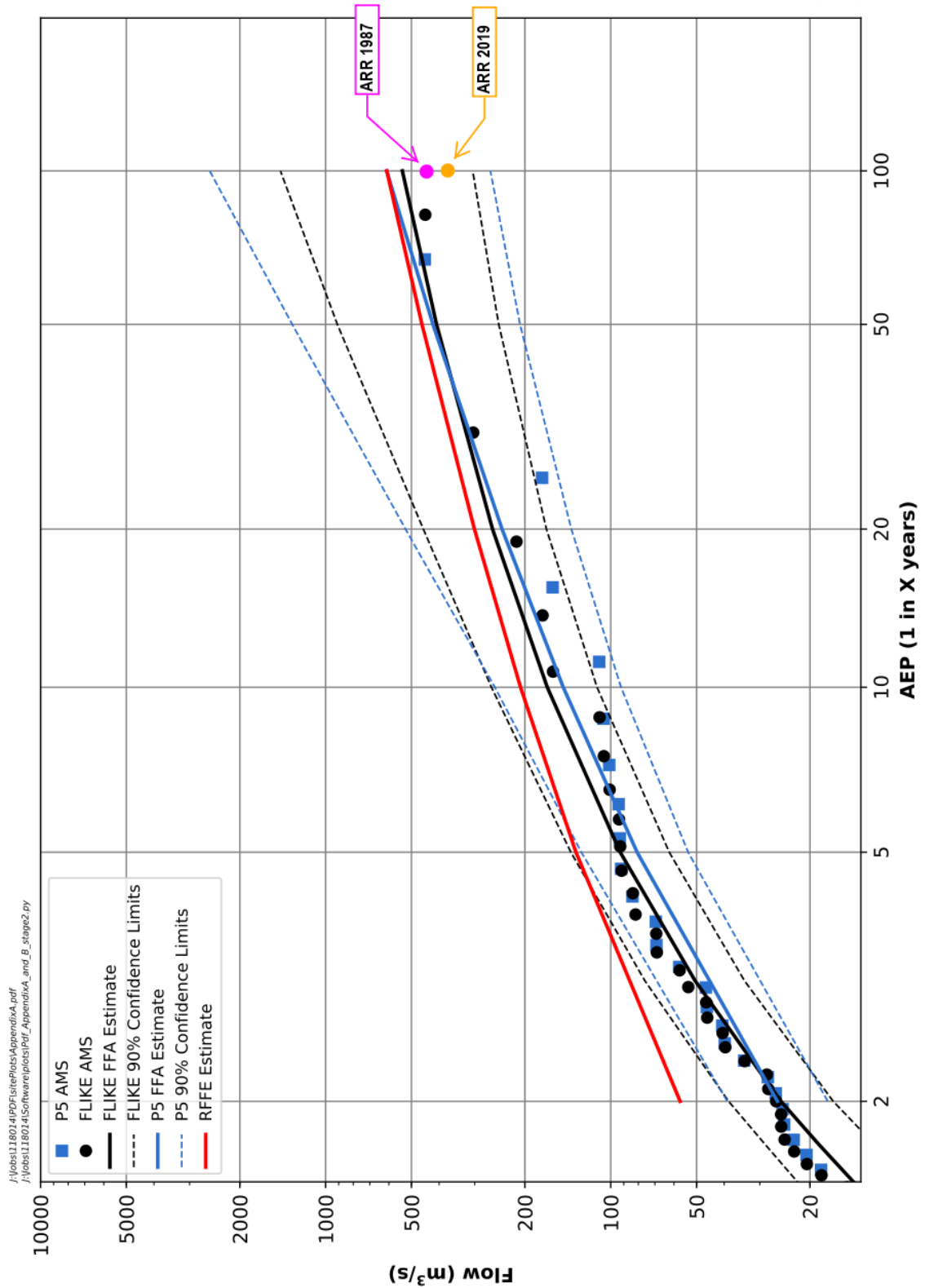
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Appendix C

Comparison of Peak Flows to Flood Frequency Analysis (Elizabeth Drive)



APPENDIX A49

**FFA VARIANTS
MULGOA RD - 212320 [F4]**

**Wianamatta (South) Creek Catchment
Existing Flood Risk Assessment**

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Appendix D

Flood Extent

1% AEP



FIGURE D1

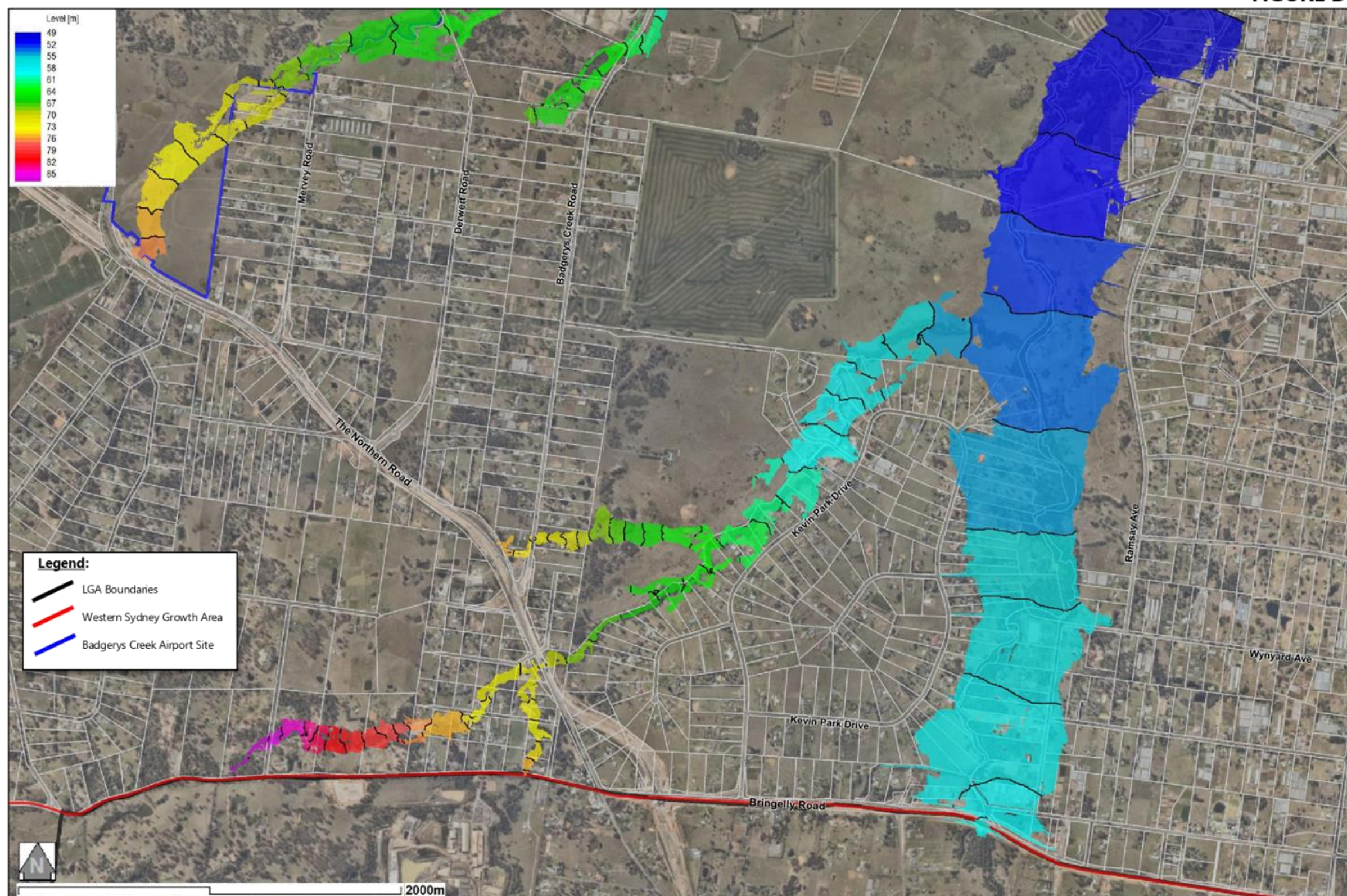
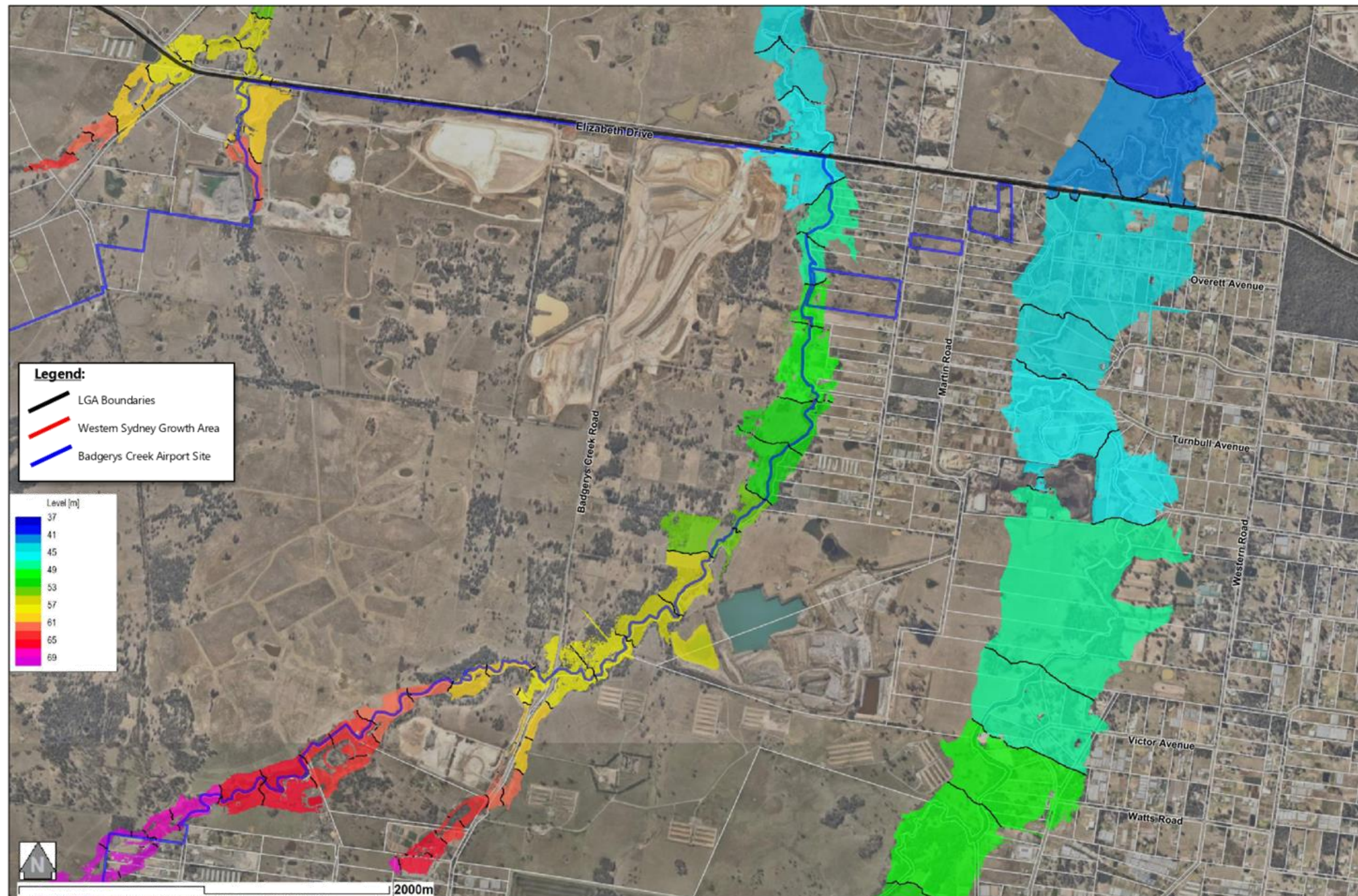


FIGURE D2



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Note:

Peak 1% AEP flood levels are based on a 'Peak-of-Peaks' surface generated from simulations of 2, 9 and 36 hour duration 1% AEP events.

**PREDICTED FLOOD LEVELS AT THE
 PEAK OF THE 1% AEP FLOOD
 [BASE CASE - EXTENT 2 of 8]**

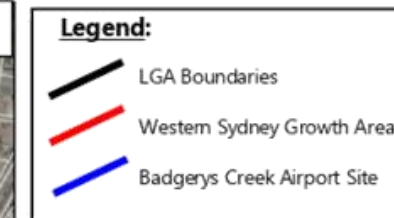
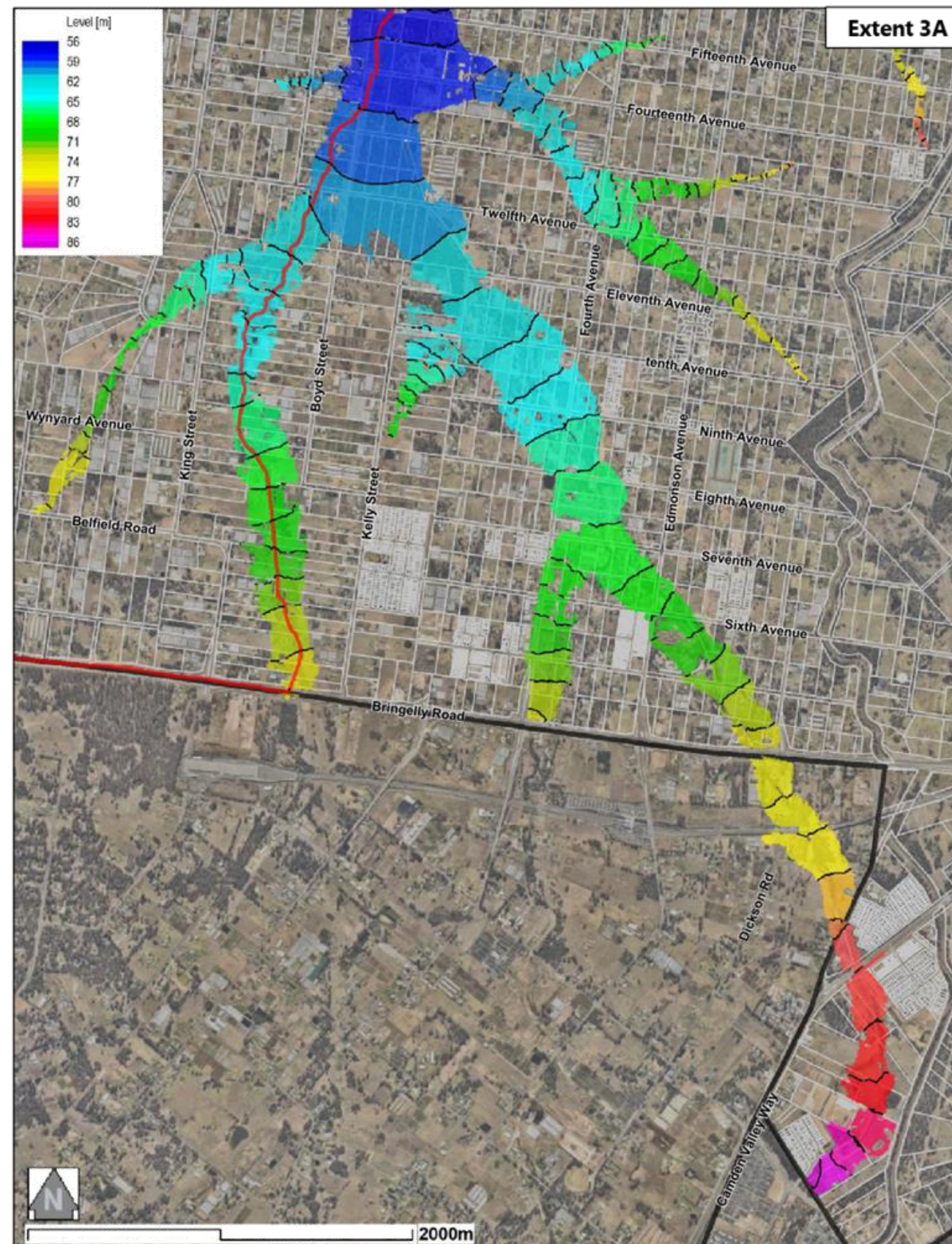
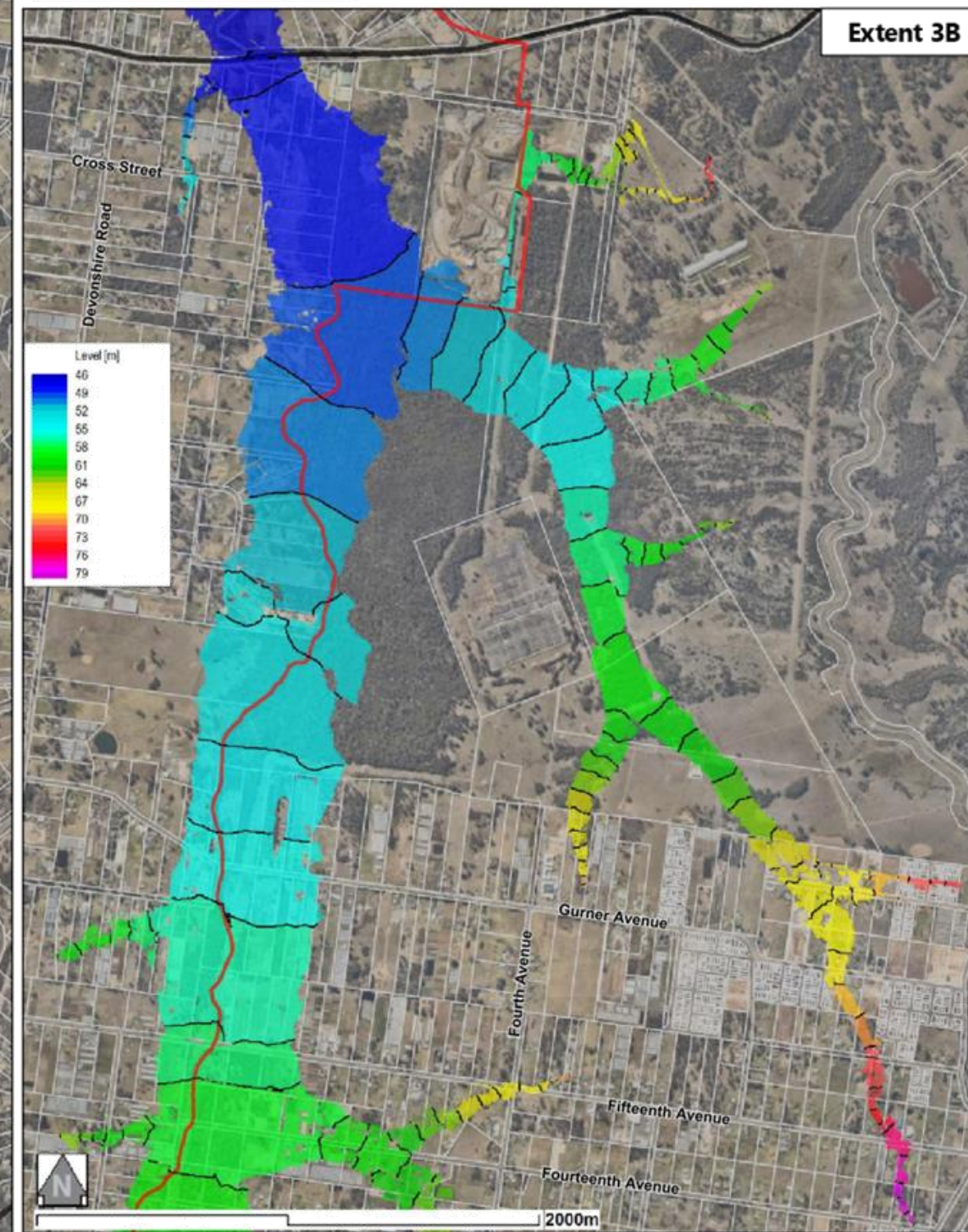


FIGURE D3



Note:
 Peak 1% AEP flood levels are based on a 'Peak-of-Peaks' surface generated from simulations of 2, 9 and 36 hour duration 1% AEP events.

**PREDICTED FLOOD LEVELS AT THE
 PEAK OF THE 1% AEP FLOOD
 [BASE CASE - EXTENT 3 of 8]**

**Wianamatta (South) Creek Catchment
Existing Flood Risk Assessment**

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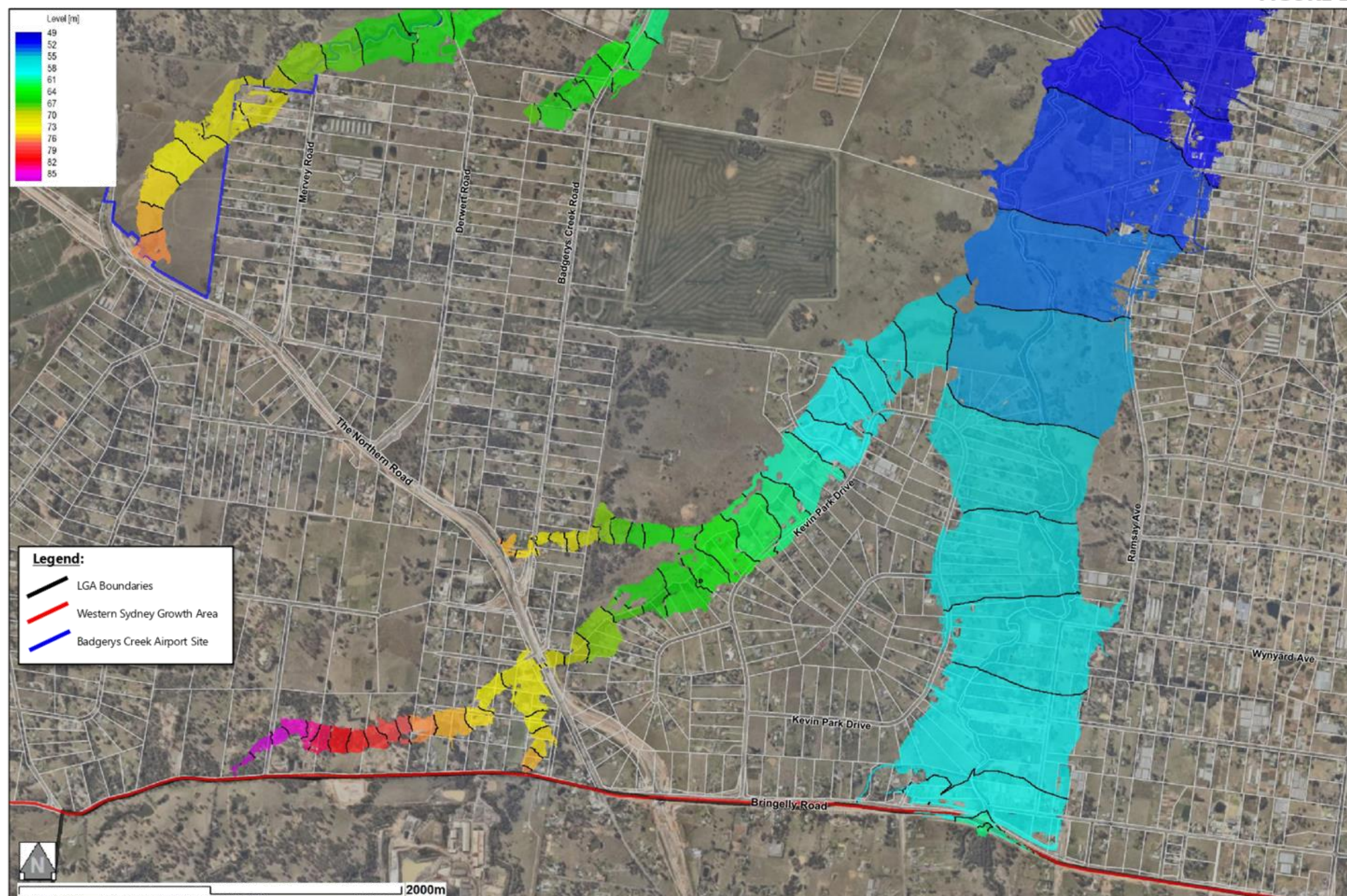
Appendix E

Flood Extent

PMF



FIGURE E1

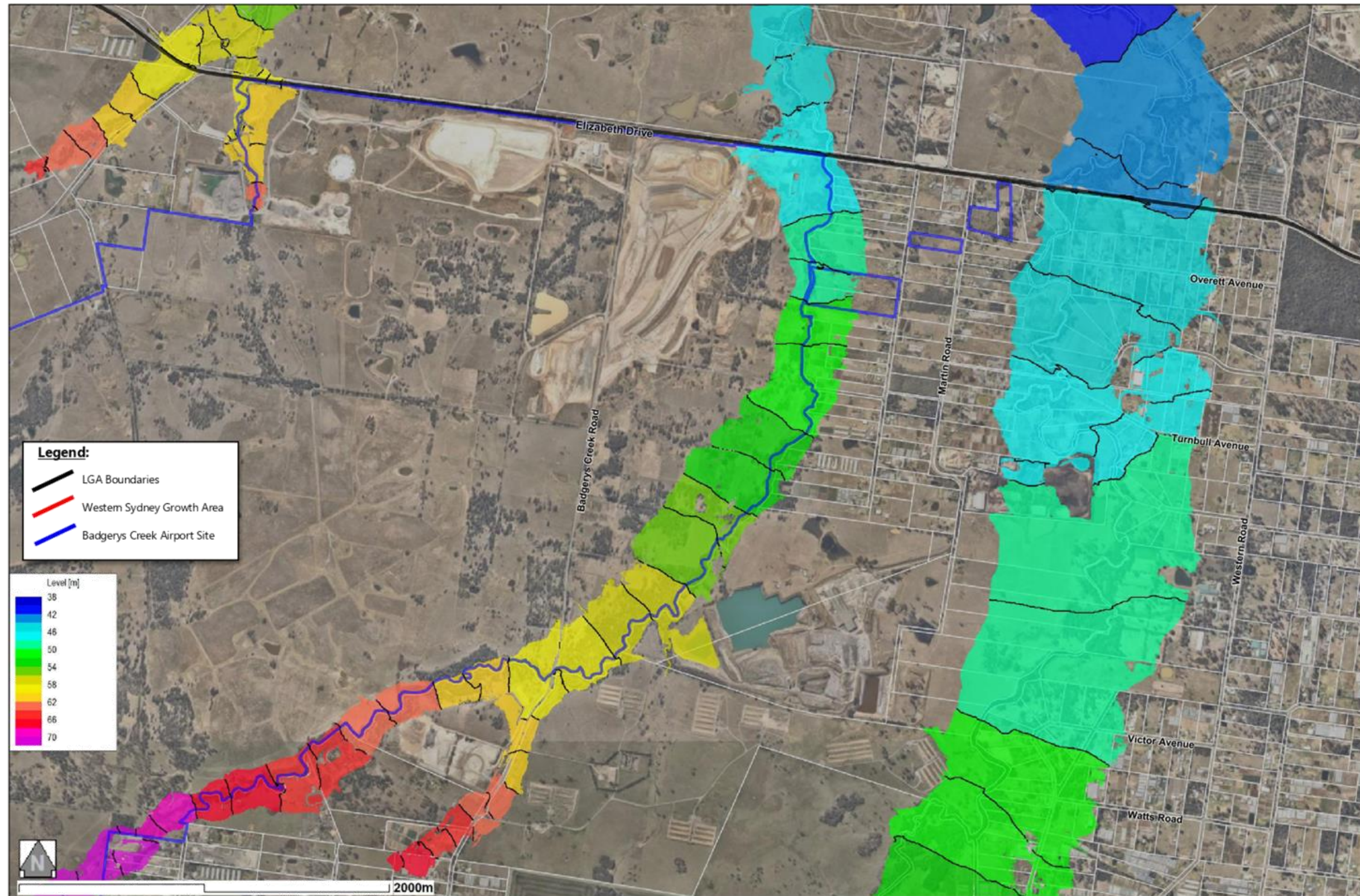


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**PREDICTED FLOOD LEVELS AT THE
 PEAK OF THE PROBABLE MAXIMUM FLOOD**
 [BASE CASE - EXTENT 1 of 8]

FIGURE E2



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fg311015-00033_2019 VS 2011/2017 LIDAR.pptx

**PREDICTED FLOOD LEVELS AT THE
PEAK OF THE PROBABLE MAXIMUM FLOOD
[BASE CASE - EXTENT 2 of 8]**

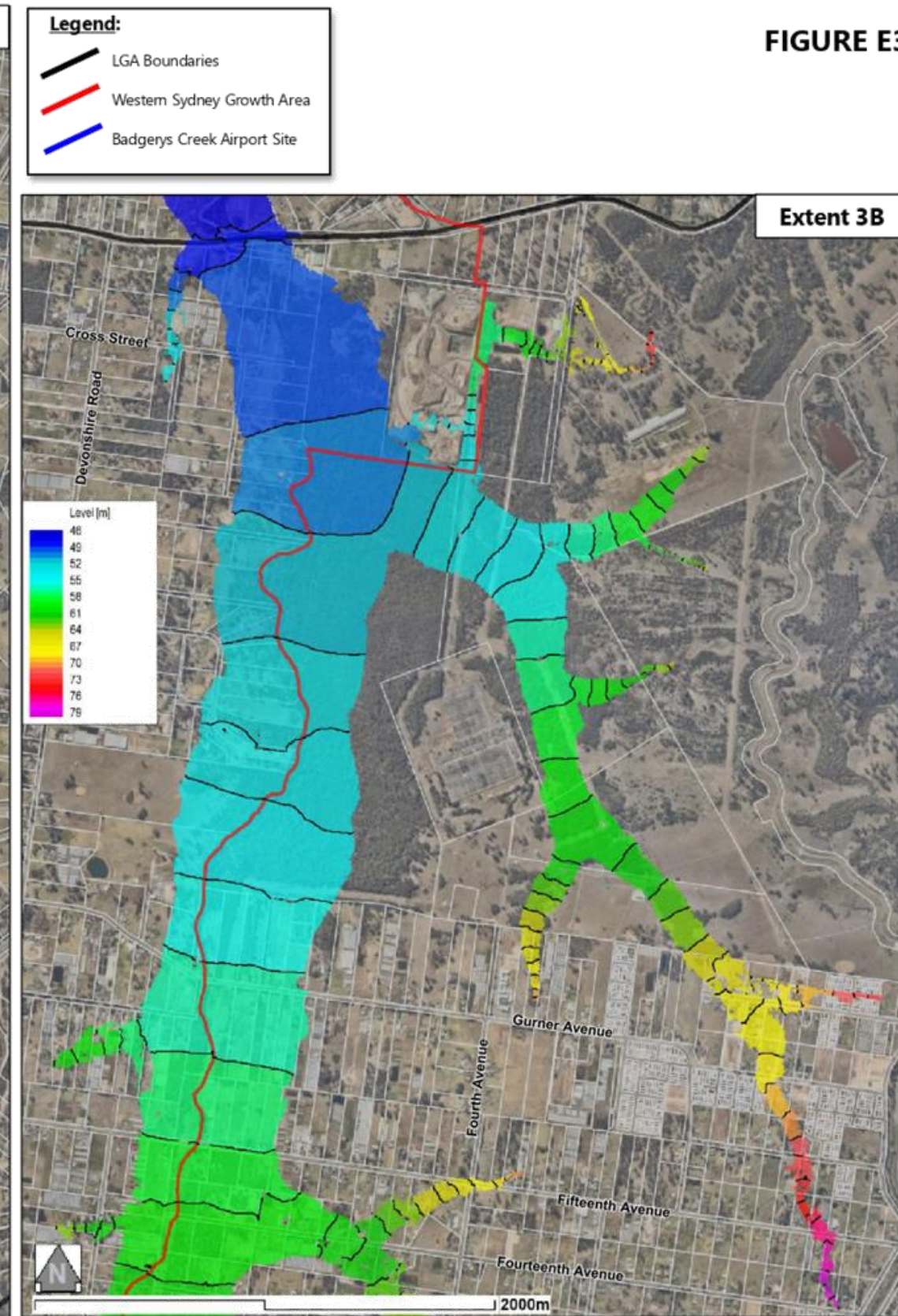
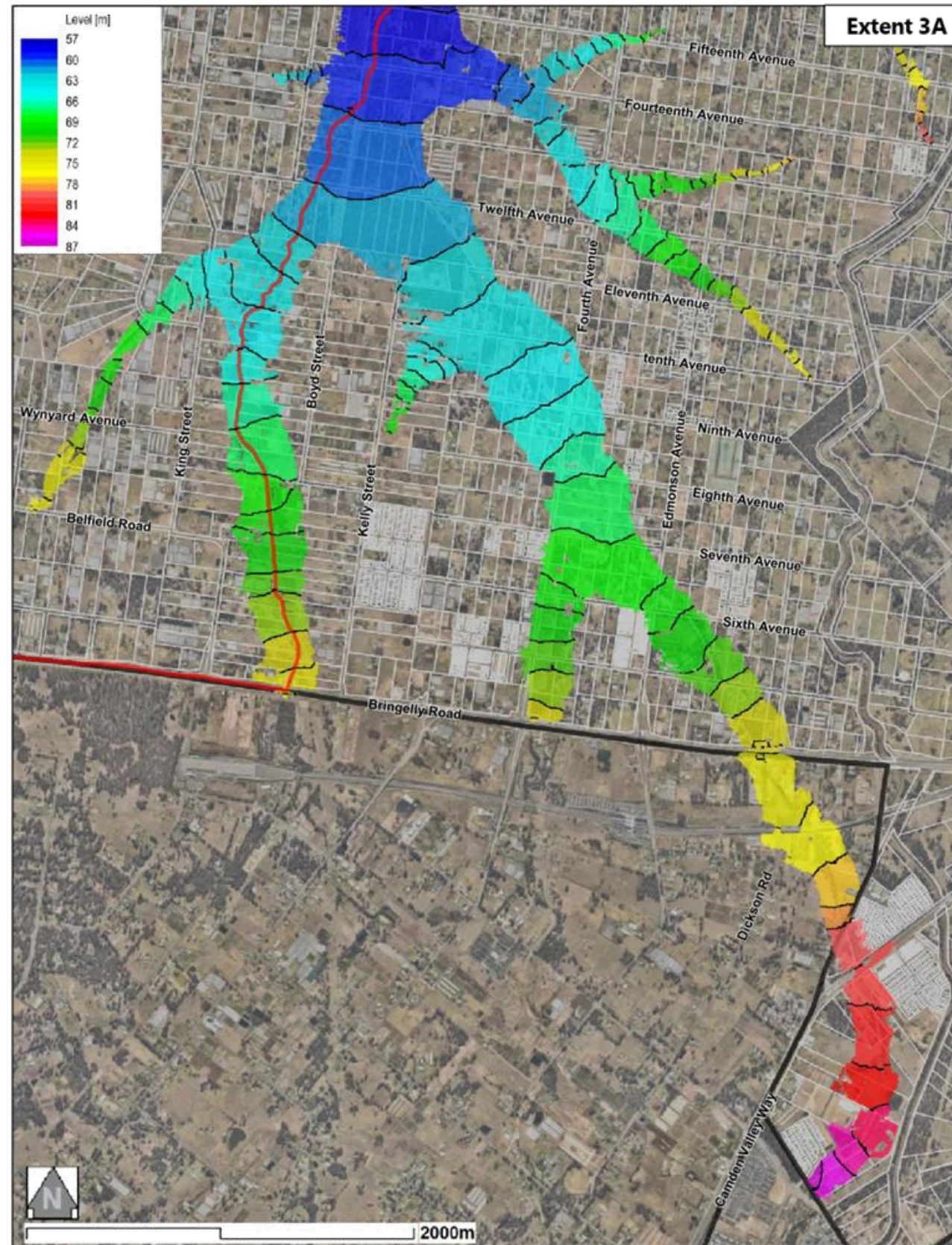


FIGURE E3

**PREDICTED FLOOD LEVELS AT THE
 PEAK OF THE PROBABLE MAXIMUM FLOOD
 [BASE CASE - EXTENT 3 of 8]**