DEPARTMENT OF PLANNING & ENVIRONMENT

CAMELLIA ROSEHILL PLACE STRATEGY

IWCMS IMPLEMENTATION REPORT

JULY 2022

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Camellia Rosehill Place Strategy
IWCMS Implementation Report

Department of Planning & Environment

WSP
Level 27, 680 George Street
Sydney NSW 2000
GPO Box 5394
Sydney NSW 2001

Tel: +61 2 9272 5100
Fax: +61 2 9272 5101
wsp.com

REV	DATE	DETAILS
A	June 2021	Draft for Enquiry by Design Workshop
B/C	July /August 2021	Draft following stakeholder consultation
D	November 2021	Final Draft
E	December 2021	Final for public exhibition
F	May 2022	Final Master Plan Version
G/H/I	June/July 2022	Display Master Plan Version

	NAME	DATE	SIGNATURE
Prepared by:	Karen Brakell; Sharni Lemaire	20/07/2022	
Reviewed by:	Rob Leslie	20/07/2022	
Approved by:	Alex McDonald	20/07/2022	

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GLOSSARY

Catchment	The area drainage by a stream or body of water or the area of land from which water is collected.
Flood prone land	Land susceptible to flooding by the probable maximum flood. Note that the flood prone land is also known as flood liable land.
Floodplain	Area of land which is inundated by floods up to and including the probable maximum flood event (ie flood prone land).
Freeboard	A factor of safety typically used in relation to the setting of floor levels, levee crest levels, etc. It is usually expressed as the difference in height between the adopted flood planning level and the peak height of the flood used to determine the flood planning level. Freeboard provides a factor of safety to compensate for uncertainties in the estimation of flood levels across the floodplain, such as wave action, localised hydraulic behaviour and impacts that are specific event related, such as levee and embankment settlement, and other effects such as 'greenhouse' and climate change. Freeboard is included in the Flood Planning Level.
PMF	Probable maximum flood. The flood that occurs as a result of the probable maximum precipitation on a study catchment. The probable maximum flood is the largest flood that could conceivably occur at a particular location, usually estimated from probable maximum precipitation coupled with the worst flood producing catchment conditions. Generally, it is not physically or economically possible to provide complete protection against this event. The probable maximum flood defines the extent of flood prone land (i.e. the floodplain).
Pollutant	Any measured concentration of solid or liquid matter that is not naturally present in the environment.
Runoff	The amount of rainfall that ends up as streamflow, also known as rainfall excess.
Treatment train	A sequence of stormwater treatment devices or methods throughout the catchment,

ABBREVIATIONS

AEP	Annual Exceedance Probability. The probability that a design event (rainfall or flood) has of occurring in any 1 year period.
AHD	Australian height datum
ARR	Australian Rainfall and Runoff
AIDR	Australian Institute for Disaster Resilience
AUSRIVAS	Australian River Assessment System
BoM	Bureau of Meteorology
DCP	Development Control Plan
EbD	Enquiry by Design
EC	Electrical Conductivity
EES	Environment, Energy and Science (NSW)
EPA	Environment Protection Authority
GPOP	Greater Parramatta and Olympic Peninsular
IWCMS	Integrated Water Cycle Management Strategy
PIC	Place-based Infrastructure Compact
PLR	Parramatta Light Rail
NSW WQO	NSW Water Quality Objectives
WSUD	Water Sensitive Urban Design

EXECUTIVE SUMMARY

New South Wales Department of Planning and Environment (DPE), in collaboration with City of Parramatta Council (Council), industry, the community and State agencies, is leading the development of the Camellia-Rosehill Place Strategy and Master Plan for the Camellia –Rosehill Precinct (the Precinct). The Precinct is defined by Parramatta River to the north, Duck River to the east, the M4 Motorway to the south and James Ruse Drive to the west, all of which form physical boundaries to the Precinct.

The Camellia Rosehill Precinct (the Precinct) is presently dominated by industrial activity, with large amounts of land also allocated to Rosehill Gardens Racecourse and stabling yards for Parramatta Light Rail and Sydney Metro. Its industrial legacy means that soils are heavily contaminated across most of the precinct.

Located in the geographic heart of Sydney, the precinct has an important strategic role in the Greater Parramatta and Olympic Peninsula (GPOP). Previous investigations have identified that the area should be retained for urban service land with a town centre, but that the costs of infrastructure and remediation should be carefully considered when making future land use decisions.

The Place Strategy and Master Plan has been prepared for the whole Precinct and draws on the substantial body of previous investigations, including ongoing collaboration with industry, the community and state agencies.

The overarching objective of the Place Strategy is to provide an integrated 20-year vision, which recognises the strategic attributes of the Precinct, guides future land use and infrastructure investment decisions and which can be delivered with the support of State and local agencies in an economically robust manner.

DPE engaged Golder Associates Pty Limited (a WSP company) to deliver technical studies for Environment Package, to inform the Place Strategy and Master Plan for the Precinct. The Environment package includes: Remediation Strategy; Air, Noise, and Odour Assessment; and Integrated Water Cycle Management Strategy (IWCMS). This Implementation Report has been prepared as a part of the IWCMS component of the Environment package.

The scope of this IWCMS is to develop an understanding of the baseline conditions for the precinct for flooding and stormwater quantity and quality, identify constraints, test the master plan against known flood risks and recommend planning conditions for the Place Strategy and future assessments for the Master Plan.

METHODOLOGY

Flood risk for the precinct has been informed through a review of available City of Parramatta Council's planning documents and flood studies and previous Precinct flood modelling.

An Enquiry by Design (EbD) process was also undertaken to inform the preparation of the Place Strategy and Master Plan. The EbD was an interactive process which explored a number of master plan options for Camellia-Rosehill which could deliver the vision for the precinct and resulted in a preliminary draft master plan which was the subject of public consultation as part of the Directions for Camellia-Rosehill Place Strategy paper. The draft Master plan was further refined to a master plan following exhibition of the Directions Paper and consideration of the submissions received.

The draft Place Strategy was publicly exhibited on 17 December 2021 until 4 March 2022. The draft master plan was further refined following exhibition of the draft place strategy and consideration of the submissions received. Refer to the Department of Planning and Environment's finalisation report for further information.

A part of the EbD process planning principles consistent with best practice, existing water management frameworks and consideration of future climate projections were developed which have informed this report.

Flood modelling has also been undertaken to understand how the flood risk would change across the precinct with the adoption of a capping strategy to manage contamination and therefore improve the viability of the Place Strategy and

Master Plan. The capping strategy is based on a Precinct wide approach of minimising contamination disturbance and generation of waste requiring offsite management, and balancing filling of land around existing flood risk.

KEY FINDINGS

The precinct is located at the confluence of Duck River and Parramatta River, where the upstream Parramatta River Catchment is about 170 km2. The precinct is subject to flooding from multiple sources, including local runoff and flooding from Parramatta River, Duck River, Duck Creek and A'Becketts Creek. City of Parramatta Council's existing flood inundation and hydraulic flood hazard mapping indicates that most of the Precinct is within a low risk area, the rivers and their foreshores and at the confluence of the Parramatta and Duck Rivers is high hazard including the wetland and a significant portion of the eastern end of the Precinct is within the medium risk area. Flood hazard risk mapping for the precinct is shown in Figure ES.1.

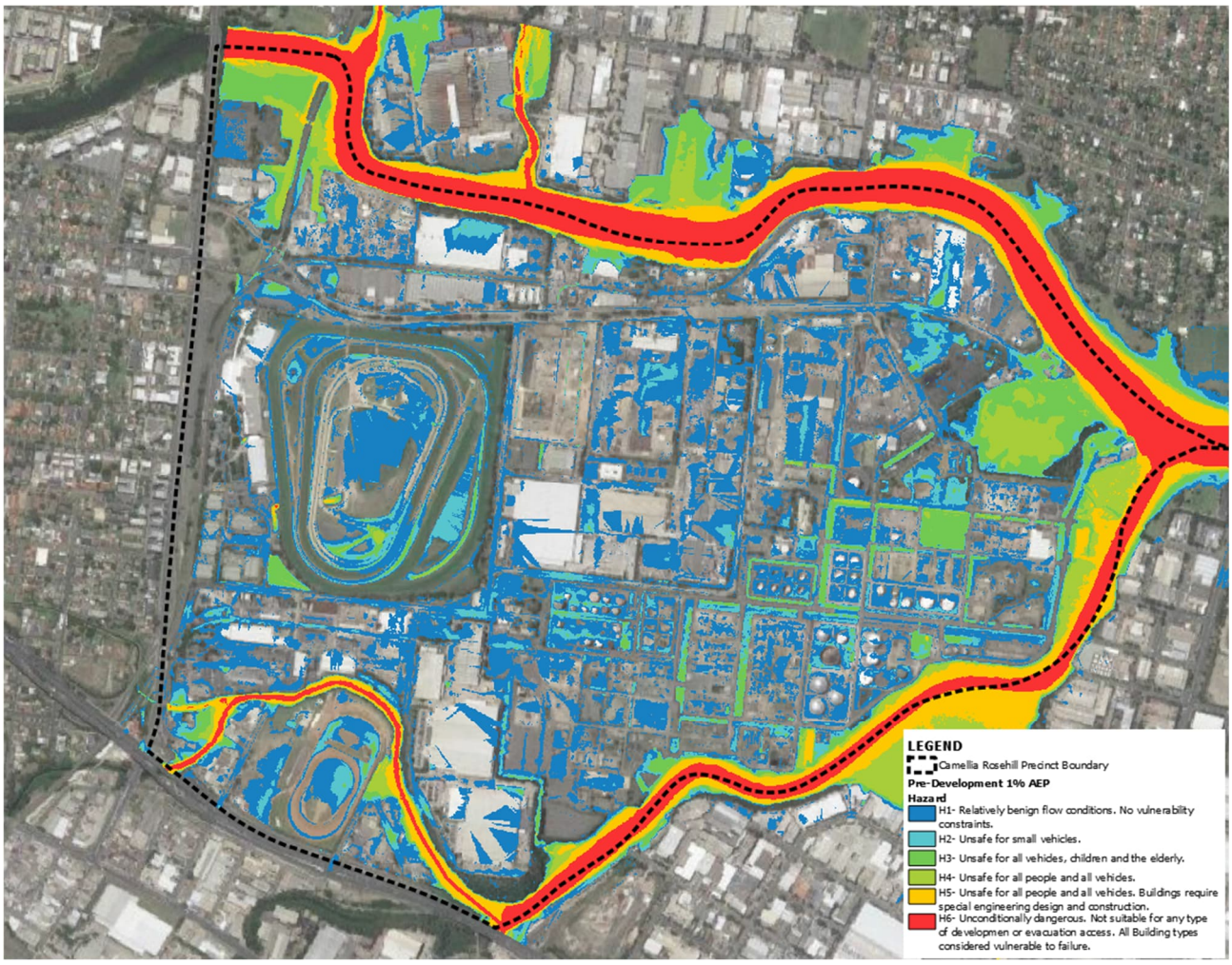


Figure ES.1 1% AEP Flood Hazard Mapping for Existing conditions

To inform the master plan and in conjunction with the flood hazard, the flood function hydraulic categories were developed to further understand the flood behaviour and risk within the precinct. The flood hydraulic categories across the precinct for the 1% AEP plus climate change flood event is presented in Figure ES.2 below and indicates that:

- there is a significant floodway in the North-West corner
- there are significant areas of low velocity but with depths of 200mm or greater throughout the precinct
- areas defined as significant floodways and flood storage correlate with previously described hazard zones H4-H6.

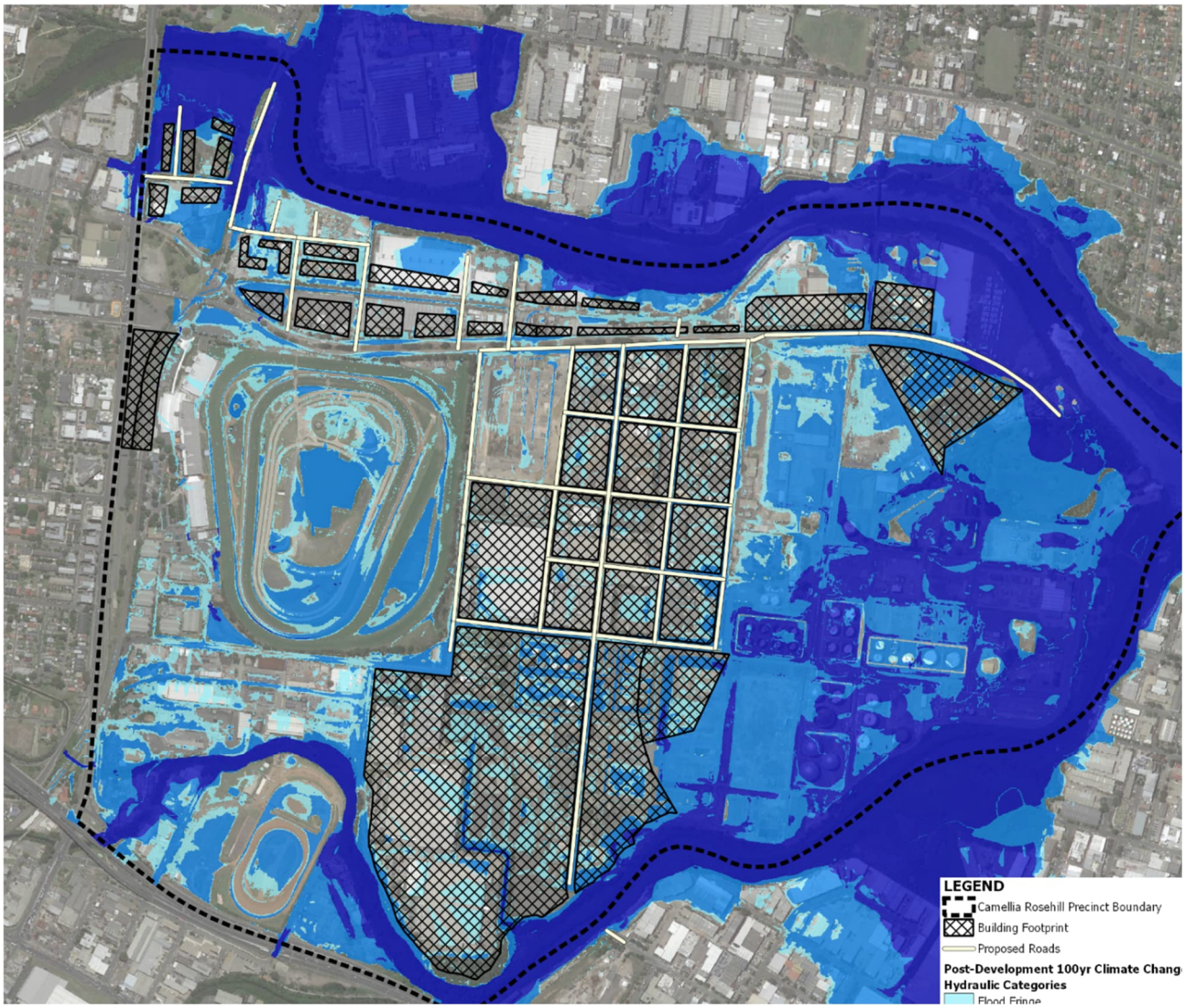


Figure ES.2 1% AEP plus climate change Hydraulic Categories for Master plan Conditions

Stormwater across the Precinct is managed via underground pit and pipe networks and do not currently provide for City of Parramatta Council's recommended minimum capacity for 'Street drainage' of 5% Annual Exceedance Probability. Stormwater is only harvested within the Rosehill Racecourse.

The Rosehill Recycled Water Scheme is a water recycling project that began operating October 2011. It was developed under the NSW Government's Metropolitan Water Plan with the aim to increase water recycled in Sydney by encouraging industrial and irrigation customers to use recycled water instead of drinking water. Many businesses in the precinct utilise this resource.

The key constraints for the water cycle across the precinct include the following:

- flood risk
- capacity of existing stormwater drainage network
- contaminated land – this reduces the ability to manage flood and stormwater with channels and basins
- stormwater runoff quality – this impacts the objectives to improve the quality of Parramatta River.

The flood modelling for the 5% and 1% AEP events predicts no impacts outside the precinct for private property. For the 1% AEP plus climate change scenario increases of 11 to 15 mm are predicted in sections of the Parramatta River and extending onto the northern bank across parkland as shown in Appendix C and in Figure ES.3. While these impacts are minimal, measures to mitigate them further will be investigated during future design stages for the Precinct.

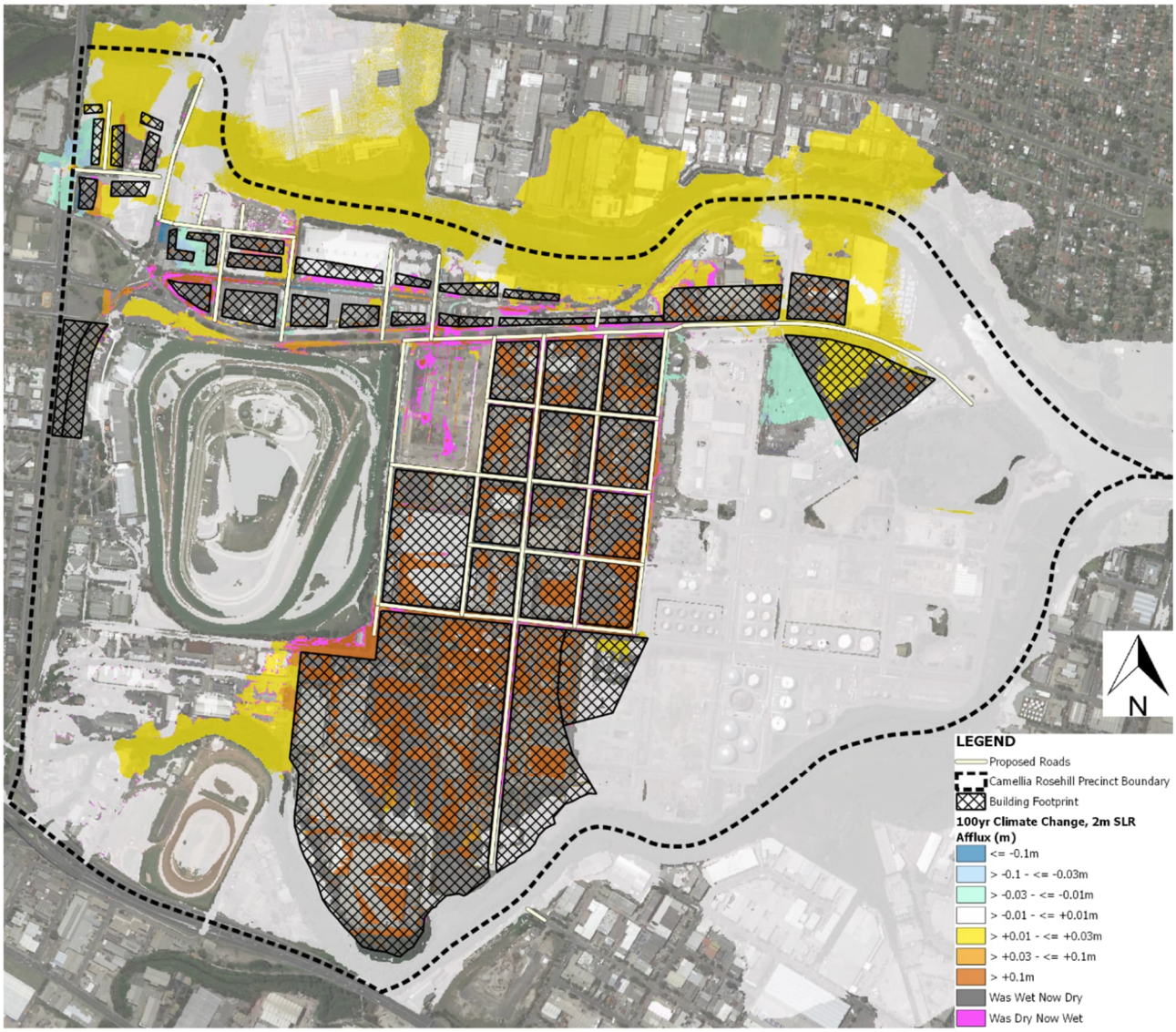


Figure ES.3 Impacts to the 1% AEP peak flood level including climate change

The outcomes of the flood modelling determined that a precinct wide capping strategy and precinct wide flood strategy that includes filling and flood storage should be implemented.

The existing flood risk and evacuation plan identified the need for a flood free evacuation route to be included in the future planning strategy and for future land uses to consider flood risks including consideration of climate change projections for sea level rise and rainfall intensity.

Stormwater collected via rainwater tanks could be investigated to provide small volumes of water for use but it would need to be supplemented from other sources.

Water quality treatment of stormwater runoff should focus on point source treatment that conform to water sensitive urban design (WSUD) principles and options that consider contamination and capping constraints. Precinct wide solutions could be considered to complement the green networks proposed across the Precinct and be used to promote a connection between the rivers.

The key planning controls include:

- Flood Planning Level (FPL) – set to the 1% AEP including consideration of climate change projections for rainfall and sea level rise through to 2150 with 500 mm freeboard.
- Land use planning to consider the Flood Hazard of the land as seen in Figure ES.1 above and avoid development within all floodways, including those identified in the north west areas of the Precinct.
- No net loss of flood storage due to cut and fill or loss of floodway conveyance as seen in Figure ES.2.
- Stipulate flood compatible building design.
- Foreshore area setback minimum of 40 m from mean high water level along waterways including Parramatta and Duck Rivers and Duck and A' Becketts Creeks
- Maintain existing levels across 9 Devon Street Rosehill to minimise impacts to surrounding areas.
- Provide for flood storage across the Precinct to capture local flood runoff.
- Provide for floodways or overland flow routes across the Precinct.
- Design of a flood free evacuation route.
- Provision of stormwater infrastructure to drain existing low areas of the precinct and that also incorporates storage, probably at the lot scale.
- Design of all drainage and storage infrastructure will need to consider site contamination and ensure any capping required is not breached.
- All new underground stormwater pit and pipe drainage design to capture and convey the 5% AEP design event.
- All overland flow paths to convey the 1% AEP flows plus 50% of underground pipe flows.
- Rainwater tanks – to be include on all new developments to supplement demands.
- Point source pollution control – as best as possible manage stormwater runoff at the source, such as along the edges of road and carparks, within new developments use the green spaces to treat stormwater runoff.

RECOMMENDATIONS

This IWCMS is a strategic analysis, and it is recommended that further assessment of flooding is undertaken to implement the Place Strategy and Master Plan:

- Prepare a precinct wide Flood Risk Study and Plan that includes:
  - A detailed flood model based on the best available 2-dimensional flood model for the site. The model should include all existing and known proposed developments (such as the Sydney Metro and Light Rail projects).
  - Identification of areas and where filling and capping can be considered to meet flood management performance criteria for the precinct.
  - Consideration of all flood events up to and including the PMF, as well as the current climate change projections.
  - Identification of areas and where filling can occur to meet flood management performance criteria for the precinct. The model should consider all flood events up to and including the probable maximum flood, as well as current change projections.
  - Identification of compatible land uses against flood hazard categorizations in accordance with the Managing the Floodplain: A guide to Best Practice in Flood Risk management in Australia (Handbook 7, Australian Institute for Disaster Resilience, 2017) and the NSW Government's Floodplain Development Manual (2022).
- Further engagement with the State Emergency Services (SES) to understand emergency management for the precinct and evacuation versus 'shelter in place' approaches to a flood emergency. Then ongoing engagement to inform updates to the Local Flood Plan, such as inclusion of any new roads that service the precinct.
- Preparation of an Evacuation Study for the precinct that considers the flood risks for the precinct.

1 INTRODUCTION

1.1 PROJECT DESCRIPTION AND SCOPE

New South Wales Department of Planning and Environment (DPE), in collaboration with City of Parramatta Council (Council), industry, the community and State agencies, is leading the development of the Camellia-Rosehill Place Strategy and Master Plan for the Camellia –Rosehill Precinct (the Precinct). The Precinct is defined by Parramatta River to the north, Duck River to the east, the M4 Motorway to the south and James Ruse Drive to the west, all of which form physical boundaries to the Precinct.

Figure 1.1 Camellia Rosehill Precinct

The Camellia Rosehill Precinct (the Precinct) is presently dominated by industrial activity, with large amounts of land also allocated to Rosehill Gardens Racecourse and stabling yards for Parramatta Light Rail and Sydney Metro. Its industrial legacy means that soils and groundwater are heavily contaminated across most of the precinct.

The Place Strategy and Master Plan has been prepared for the whole Precinct and draws on the substantial body of previous investigations, including ongoing collaboration with industry, the community and state agencies.

The overarching objective of the Place Strategy is to provide an integrated 20-year vision, which recognises the strategic attributes of the Precinct, guides future land use and infrastructure investment decisions and which can be delivered with the support of State and local agencies.

DPE has engaged WSP/Golder to deliver a number of technical studies as part of the Environment Package, including this Integrated Water Cycle Management Strategy (IWCMS). The scope of this report is to:

- outline the existing flooding and stormwater conditions for the site, including constraints for future development
- review the Master Plan against floodplain risk management legislation and best practice
- provide an understanding of the potential impacts of the Master Plan on flooding, stormwater, water supply and water quality in the receiving surface water environment
- recommend flood related management measures and planning conditions and principles for the Place Strategy
- make recommendations for future flood related studies and assessment to inform future development of the Precinct
- recommend water sensitive urban design (WSUD) measures and minimum stormwater management design criteria for the future development of the Precinct.

This report is structured as follows:

- Section 1 – Introduction.
- Section 2 – Provides overview of the legislation, guidelines and policies that govern management of flood risk, stormwater management and water sensitive urban design.
- Section 3 – Outlines the adopted methodology for the strategy.
- Section 4 – Describes the existing flood behaviour and risks, the existing stormwater infrastructure and limitations and the existing water quality for the waterways surrounding the Precinct.
- Section 5 – Documents the assessment of the masterplan against the known flood risks and details potential stormwater management measures for the masterplan including management of stormwater runoff, runoff quality and stormwater capture and reuse opportunities.
- Section 6 – Outlines the proposed planning conditions for the future development of the Precinct, criteria for assessing future development against and future investigations to inform the assessment of future conditions in the Precinct.

The appendices include additional background information and flood maps presenting findings from this strategy.

1.2 PROJECT BACKGROUND

The Camellia Rosehill Precinct (~321ha) plays a strategic role in the Greater Parramatta and the Olympic Peninsula (GPOP). Camellia was identified by the NSW Government as a priority growth area in 2014, resulting in precinct wide Land Use and Infrastructure Strategy in 2015 and subsequently development of a Town Centre Master Plan in 2018. Work on the Town Centre was paused pending outcomes of Greater Sydney's 2019 Draft Place-based Infrastructure Compact (PIC) Pilot which aimed to ensure infrastructure delivery was matched with growth across the 26 precincts in the GPOP corridor. The PIC recommended Camellia be retained for urban service land however noted the Government may proceed with the town centre (in its current or an amended form) once the broader issues including the costs of infrastructure, economic and social benefits have been further considered. In response it was determined that a coordinated and strategic approach be adopted, and a place strategy be prepared for the whole Precinct, drawing on previous work and including ongoing collaboration with industry, the community and state agencies.

The DPE, in collaboration with City of Parramatta Council (Council), industry, the community and State agencies, is leading the development of the Camellia-Rosehill Place Strategy and Master Plan.

The Place Strategy and Master Plan has been prepared for the whole Precinct and draws on the substantial body of previous investigations, including ongoing collaboration with industry, the community and state agencies.

The DPE has engaged a range of technical services to determine engineering and design opportunities and challenges at the site. These technical studies have informed the development of the Place Strategy and Master Plan for the precinct. This Integrated Water Cycle Management Implementation Report has been prepared as a part of the Environment package.

An Enquiry by Design (EbD) process was undertaken to inform the preparation of the Place Strategy. The EbD was an interactive process which explored a number of Master Plan options for Camellia-Rosehill which could deliver the vision for the precinct and resulted in a draft Master Plan which was the subject of public consultation as part of the Camellia-Rosehill Directions Paper. The draft Master Plan was further refined following exhibition of the Directions Paper and consideration of the submission received.

The draft place strategy was publicly exhibited on 17 December 2021 until 4 March 2022. The draft master plan was further refined following exhibition of the draft place strategy and consideration of the submissions received. Refer to the Department of Planning and Environment's finalisation report for further information.

1.3 CAMELLIA-ROSEHILL VISION

Camellia-Rosehill has an important strategic role as an industry and employment hub within the Greater Parramatta and Olympic Peninsula (GPOP) Economic Corridor. By 2041, the precinct will be enhanced with service and circular economy industries and new recreational and entertainment facilities, all enabled by better transport access via light rail, active transport and road connections.

A well-designed town centre next to the light rail stop will be the focus of community activity.

A new urban services precinct and retention of heavy industrial land will ensure Camellia-Rosehill fulfills its potential to be an employment powerhouse.

New homes and jobs will be close to public transport supported by new quality public spaces including public open spaces, public facilities high quality street infrastructure, and walking and cycling paths.

Key environmental features such as Parramatta River, Duck River and their wetlands will be protected and enhanced. Camellia's rich heritage will be preserved, celebrated and promoted.

Country and culture will be valued and respected with the renewal guided by Aboriginal people.

The precinct will be net zero ready and set a new standard for environmental sustainability with embedded renewable energy networks, integrated remediation and water management strategies, and circular economy industries.

Recycled water will be connected to all residences, businesses and public spaces and will support the integrated network of green infrastructure.

Camellia will be a showcase of recovery and restoration – a place of economic prosperity but also a place where people love to live, work and enjoy.

1.4 THE CAMELLIA-ROSEHILL MASTER PLAN

The Master Plan is shown in Figure 1.2 and forms the basis of the Place Strategy.

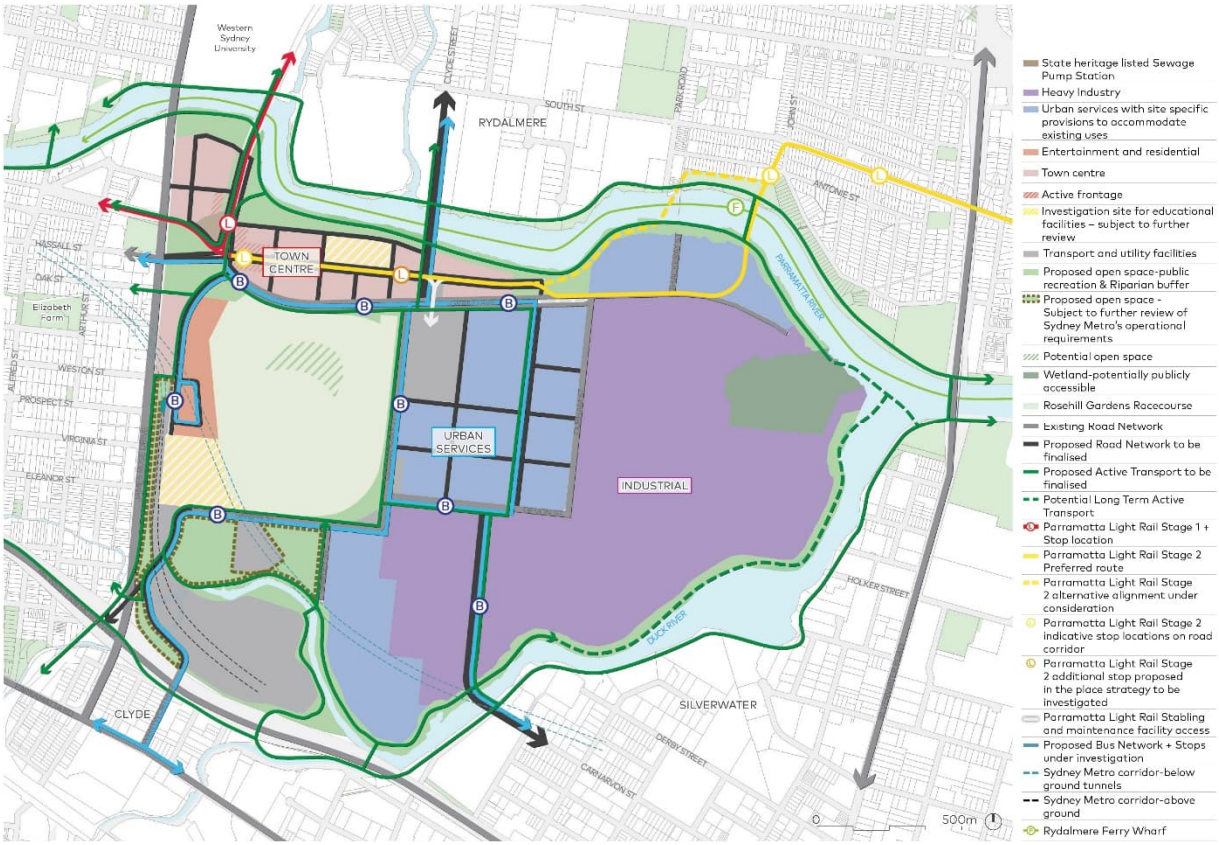


Figure 1.2 Camellia-Rosehill Precinct Master Plan

Key features of the master plan include:

- provision for approximately 10,000 dwellings within a Town Centre serviced by light rail
- provision for approximately 15,400 jobs
- a new primary school and primary and secondary high school
- district open space facilities
- introduction of a new entertainment precinct and an urban services area
- initiatives to Care for Country and continued protection of heritage listed sites
- retention of the existing state heritage sewerage pumping station (SPS) 067 within the town centre
- measures to mitigate land use conflicts and risks including buffers and setbacks from existing fuel pipelines and between the existing sewerage pumping station and future surrounding residential uses
- access to the Parramatta River, Duck River and Duck Creek foreshores and potentially the wetland
- new transport infrastructure including a local road network, potential bus services, additional connections into and out of the precinct, and opportunities to integrate Parramatta Light Rail Stage 2
- an extensive active transport network
- a comprehensive remediation strategy
- a sustainability strategy and IWCMS.

2 RELEVANT LEGISLATION AND GUIDELINES

The following legislation and guidelines provide key guidance to best practice flood assessment and management and water quality management and have been used to inform as part of this IWCMS.

2.1 FLOOD MANAGEMENT

2.1.1 AUSTRALIAN RAINFALL AND RUNOFF: A GUIDE TO FLOOD ESTIMATION

Australian Rainfall and Runoff Guidelines 2019 (ARR 2019) (Ball et al, 2019) is a national guideline for the estimation of design flood characteristics in Australia. The aim of the guide is to provide the best available guidance and information on design flood estimation in a manner suitable for use by Australian practitioners to be able to estimate the design flood problem, flood processes, and engineering hydrology. ARR 2019 has national application and is essential for policy decisions and projects in areas as diverse as:

- infrastructure such as roads, rail, bridges, dams and stormwater systems
- town planning
- mining
- developing flood management plan for urban and rural communities
- flood warnings and flood emergency management
- operation of regulated river systems
- prediction of extreme flood levels.

The ARR 2019 includes recent advances in knowledge regarding flood processes, the increased computational capacity available, expanding knowledge and application of hydrologic information technology, improved information about climate change and the use of stochastic inputs and Monte Carlo methods.

The estimation of flood flow, velocity and water levels and the models were developed following procedures in accordance with ARR 2019 but were prepared using the methods outlined in Australian Rainfall and Runoff 2016 (ARR 2016) (Ball et al, 2016). ARR 2019 is a final published version ARR 2016 with minor edits and corrections but no substantial changes to procedures used for this assessment.

2.1.2 MANAGING THE FLOODPLAIN: A GUIDE TO BEST PRACTICE IN FLOOD RISK MANAGEMENT IN AUSTRALIA

The Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia, Handbook 7 (AIDR, 2017) has been developed to provide guidance on the national principles supporting disaster reliance in Australian through the management and publication of this Handbook and others for other types of hazards. This Handbook is supported by six additional guidelines that cover specific aspects of flood risk management and a practice note to assist with land use planning.

The Handbook is intended to provide broad advice and guidance on all important aspects of managing flood risk in Australia and it provides guidance on the best practice principles.

This Handbook has been considered when developing criteria for managing flood risk from the Master Plan and compliments the NSW Floodplain Development Manual (DIPNR, 2005) by outlining current best practices for flood risk management.

2.1.3 NSW GOVERNMENT'S FLOODPLAIN DEVELOPMENT MANUAL

The Floodplain Development Manual (DIPNR, 2005) was gazetted as the manual pertaining to the development of flood-liable land. The manual highlights the requirements consistent with the *Water Act 1912* to manage the risks resulting from natural hazards in order to reduce the impact of flooding on individual owners and occupiers of flood-prone property and to reduce private and public losses resulting from floods. The Floodplain Development Manual encourages the completion of floodplain works to be completed so that:

- the passage of floodwaters is unobstructed
- temporary pondage of floodwaters is maintained.

The primary objective of the Flood Prone Land Policy as outlined in the manual is to "reduce the impact of flooding and flood liability on individual owners and occupiers of flood prone property, and to reduce private and public losses resulting from floods, utilising ecologically positive methods where possible." This includes a merit-based approach to assessing development in the floodplain and the consideration of both mainstream and overland flooding.

2.1.3.1 NSW FLOODPLAIN DEVELOPMENT MANUAL - 2022 UPDATE

In February 2022 the NSW Government released a draft update to the Floodplain Development Manual. This draft was released as a package which includes the Flood Risk Management Manual (update to the 2005 manual) and a range of new flood risk management guides for the Flood Risk Management Toolkit. The flood prone land policy as outlined in the manual has not changed but the updated package provides further advice for managing flood prone land, and it considers lessons learnt from floods and the application of the flood risk management process and manual since 2005.

It is noted that this updated manual will need to be considered as part of the future development of the Precinct.

2.1.4 PLANNING CIRCULAR PS 21-006, CONSIDERING FLOODING IN LAND USE PLANNING: GUIDANCE AND STATUTORY REQUIREMENTS

This circular (14 July 2021) has been prepared to support the 2021 flood-prone land package, which included a revised local planning direction (Section 2.1.6) and a guideline (Considering flooding in land use planning) (section 2.1.5) The package provides information and requirements on land use planning on flood-prone land and discusses local planning direction 4.3 (discussed in section 2.1.5 below) on flooding, which affects planning proposals.

2.1.5 CONSIDERING FLOODING IN LAND USE PLANNING: GUIDELINE

The guideline (July 2021) provides guidance on defining the areas to which flood-related development controls apply, with consideration of defined flood events, freeboards, extreme flooding and emergency management considerations. The guideline outlines that areas that warrant development controls to address risk to life considerations include:

- areas with evacuation limitations
- where increases in dwelling densities would have a significant impact on the ability of the existing community to evacuate using existing evacuation routes within the available warning time
- where vertical evacuation for short duration flooding is required such as where the rate of rise of floodwater prohibits safe evacuation from the land
- behind flood levees which may have warning and/or evacuation limitations.
- impacted by either high hazard or/and H4 to H6 hazard vulnerability thresholds in the PMF as defined in the manual or its supporting guides, and unable to safely evacuate
- where subdivision layouts and connections to local or regional evacuation routes need to be consistent with the Hawkesbury Nepean Designing Safer Subdivisions Guide (refer to Section 2.4.2 for reference)
- areas indirectly affected by flooding where development may have for example outages of utility services
- areas isolated by floodwaters and/or terrain (such as high flood island or trapped perimeter).

2.1.6 LOCAL PLANNING DIRECTIONS, SECTION 9.1(2) OF THE ENVIRONMENTAL PLANNING AND ASSESSMENT ACT 1979

Direction 4.1 Flooding applies to all relevant planning authorities that are responsible for flood prone land when a planning proposal creates, removes or alters a zone or a provision that affects flood prone land which is will be the case for some areas of the Precinct. The objectives of the direction are:

(a) To ensure that development of flood prone land is consistent with the NSW Government's Flood Prone Land Policy and the principles of the Floodplain Development Manual 2005, and

(b) To ensure that the provisions of a local environmental plan (LEP) that apply to flood prone land are commensurate with flood behaviour and include consideration of the potential flood impacts on and off the subject land.

The Direction seeks to avoid certain development in Flood Planning Areas, which is approximately represented by the red and dark orange areas on Figure 4.6. For the Precinct, this has the potential to affect development of residential accommodation in high hazard areas, intensification of development, development of childcare facilities that cannot effectively evacuate, and hazardous materials storage, among others. Planning proposals must also avoid causing an increased requirement for government spending on emergency management services, flood mitigation and emergency response measures. Clause (4) of the Direction would not apply, because City of Parramatta Council has not elected to adopt the Special Flood Considerations LEP Clause.

The direction allows for inconsistency if the planning proposal is supported by a flood impact and risk assessment accepted by the relevant planning authority and is prepared in accordance with the principles of the Floodplain Development Manual 2005 and consistent with the relevant planning authorities' requirements. As outlined in Section 6.2.1, a precinct wide flood risk management study is to be prepared to support future planning for the Precinct and this will be prepared in accordance with the Floodplain Development Manual 2005 or in accordance with the latest edition of the manual (refer to Section 2.1.3). The flood risk management study or flood impact and risk assessment would need to address issues in the previous paragraph and would need to include detailed discussion on emergency management. A draft guideline (LU01) for flood impact and risk assessments was released with the update to the Floodplain Development Manual.

2.2 WATER QUALITY

2.2.1 NSW WATER QUALITY AND RIVER FLOW OBJECTIVES

The NSW Water Quality Objectives (NSW WQO) (Office of Environment and Heritage, 2006) are the agreed environmental values and long-term goals for NSW's surface waters. They are consistent with the agreed national framework for assessing water quality set out in the ANZG 2018 (the guidelines which have superseded the ANZECC 2000 Guidelines). The NSW WQO sets out:

- the community's environmental values and uses for rivers, creeks, estuaries and lakes (i.e. healthy aquatic life, water suitable for recreational activities like swimming and boating, and drinking water)
- a range of water quality objectives and indicators to help assess the current condition of waterways and whether they support those values and uses.

The water quality objectives (WQO) are the specific water quality targets agreed between stakeholders, or set by local jurisdictions, that become the indicators of management performance. These limits or descriptive statements are selected to support and maintain the environmental values of the catchment. The NSW WQO provide the environmental values, water quality objectives and indicators (trigger values) for NSW surface waters and refer to the ANZG 2018 for technical guidance in applying these values.

The Precinct is located in the Sydney Harbour and Parramatta River catchment. The environmental values for the Sydney Harbour and Parramatta River catchment are:

- aquatic ecosystems
- visual amenity
- primary and secondary contact recreation
- irrigation water supply – in general this objective is not applied to the Sydney Harbour and Parramatta River catchments, however, the objective may need to be considered where stormwater is harvested for irrigation of turf and recreation areas
- aquatic foods (cooked)
- industrial water supplies.

Each environmental value has associated water quality indicators and guideline trigger values or criteria. Table of objectives is included in Appendix A.

2.2.2 FRAMEWORK FOR CONSIDERING WATERWAY HEALTH OUTCOMES IN STRATEGIC LAND-USE PLANNING DECISIONS

The NSW Office of Environment and Heritage and the NSW Environmental Protection Authority have prepared a Risk based framework for waterway health (NSW OEH and EPA, 2017). This document outlines a framework for decision-makers, such as councils and environmental regulators, to develop management measures that meet waterway values. The Framework links the National Water Quality Management Strategy and other planning instruments to environmental values, land use activities and management measures.

The purpose of the Framework is to:

- ensure the community's environmental values and uses for our waterways are integrated into strategic land-use planning decisions
- identify relevant objectives for the waterways that support the community's environmental values and uses, and can be used to set benchmarks for design and best practice
- identify areas or zones in waterways that require protection
- identify areas in the catchment where management responses cost-effectively reduce the impacts of land-use activities on our waterways
- support management of land-use developments to achieve reasonable environmental performance levels that are sustainable, practical, and socially and economically viable.

2.2.3 PARRAMATTA RIVER MASTER PLAN

The Parramatta River Catchment Group (PRCG) is an alliance of councils, government agencies and community groups who have developed a master plan for the Parramatta River "DUBA, BUDU, BARRA: Ten Steps to a Living River – the Parramatta River Masterplan". The master plan outlines ten steps to improving all aspect of the river to make it suitable for swimming by 2025 (PRCG, 2017). The master plan makes ten recommendations for achieving the goal of a swimmable river by 2025 with the following relevant to the Precinct:

- establish a whole of catchment land use policy and statutory planning mechanisms
- adopt a regional approach to the installation, maintenance and reporting of stormwater infrastructure and water sensitive urban design infrastructure
- undertake joint community education and compliance activities focused on reducing stormwater and source pollution where it is linked to community behaviour and actions
- maintain, improve and create new habitats for the Parramatta River catchment's five iconic species mascots as indicators of water quality and catchment health.

2.3 INTEGRATED WATER CYCLE MANAGEMENT

The NSW Department of Industry has developed information sheets and checklists relating to IWCM to assist local water utilities with developing and evaluating IWCM strategies. These tools focus on enabling development of integrated systems that rely less on limited natural water sources, produce less pollutant loads to the environment, have strong pricing signals and demand management measures.

Other relevant documents would include:

- 2017 Metropolitan Water Plan (NSW Department of Industry, 2017)
- Integrated Water Management: Principles and best practice for water utilities (Skinner, R and Satur, P, 2020).

2.3.1 WATER SENSITIVE URBAN DESIGN

The following publications provide guidance for design of Water Sensitive Urban Design (WSUD) elements:

- Australian Runoff Quality (Engineers Australia 2005)
- Water Sensitive Urban Design Technical Guidelines for Western Sydney (NSW Government Stormwater Trust and UPRCT, May 2004)
- Adoption Guidelines for Stormwater Biofiltration Systems – Cities as Water Supply Catchments – Sustainable Technologies (CRC for Water Sensitive Cites, 2015).

2.4 REGIONAL PLANNING

2.4.1 STATE ENVIRONMENTAL PLANNING POLICY (BIODIVERSITY AND CONSERVATION) 2021

Chapter 10 – Sydney Harbour Catchment of the Biodiversity and Conservation SEPP 2021 contains provisions to manage and improve environmental outcomes for Sydney Harbour and its tributaries. It establishes a set of planning principles to be used by councils for the preparation of planning instruments and designates the waterways into nine different zones to suit the differing environmental characteristics and land uses of the harbour and its tributaries.

The Camellia Precinct, Parramatta River, Duck Creek, and Duck River all fall within the boundaries of Chapter 10 of the Biodiversity and Conservation SEPP. This contains specific provisions for the 'Foreshores and Waterways Area' (which is generally the area 'one-street back' from the foreshore), strategic foreshore sites, heritage items and wetlands protection areas. The Parramatta River and Duck River are both listed as Wetlands Protection Areas. The Biodiversity and Conservation SEPP contains wetland protection provisions to conserve and protect any wetland habitats (which include mangroves, seagrasses, salt marshes, sedgelands, wet meadows and mudflats).

Duck Creek and River are also listed as Zone W2 Environmental Protection – this provides for the protection, rehabilitation and long-term management of the natural and cultural values of the waterways and adjoining foreshores. Parramatta River is listed as Zone W1 – Maritime Waters which covers the main navigation channels, public transport, port and maritime industry.

2.4.2 EMERGENCY MANAGEMENT

The general arrangements for managing floods in NSW are outlined within the NSW State Flood Plan (2018). The SES are the key combat agency for managing a flood emergency supported by a number of other agencies depending on the location. The Hawkesbury Nepean Valley Flood Plan (SES, 2020) is the latest version of a flood subplans that provides some relevant points for consideration in the Camellia-Rosehill precinct. A Parramatta River Flood Plan does not exist at present, but the Hawkesbury Nepean Valley Flood Plan is relevant due to its proximity to Parramatta and similar planning and emergency management arrangements. These key points include:

- Regional Land use planning:
  - Recognise that all new development should be designed and built to ensure that emergency management action can be safely and efficiently implemented when a flood threatens.
  - Assist individuals and businesses to minimise the damage that would otherwise be done to their property when it is flooded. Houses and buildings cannot be moved as a flood approaches but basic modifications, some required at the time of construction, can make the difference between a total flood loss and a recoverable house and buildings.
- Regional Evacuation Routes, or for new evacuation routes, are to consider the following evacuation route objectives:
  - Extent – Regional evacuation routes are to extend firstly beyond the Probable Maximum Flood (PMF) extent and then to a point where the wider traffic network can absorb evacuation traffic without causing congestion back into the evacuation route network.
  - Increase capacity – Where relevant evacuation timelines extend beyond the limit of confident flood forecasting, provide more lane capacity on current routes or provide new additional routes to reduce the timeline to within the forecasting limit.
  - Resilience – Regional evacuation routes affected by local flooding from local streams crossing the route are protected where practicable up to 1:500year flood events on local streams crossing evacuation routes.
  - Higher evacuation route – Where the route is inundated by mainstream flooding and where practicable, raise the height of the lowest point/s on the route.
  - Independence – Routes should be independent where feasible to reduce or eliminate convergence of evacuation routes before merging into the wider traffic network.
  - Simplify traffic management – improvement in intersections, upgrading the type of road and ensuring traffic flows freely to safety without prolonged congestion or queuing.
  - Decouple evacuation from floodplains – Divert evacuation streams from the Hawkesbury River floodplain to reduce or eliminate convergence on evacuation routes in the Nepean River floodplain.
  - Redundancy – Provide an alternative route where possible to provide redundancy in case of serious incidents on the main route.

2.5 LOCAL PLANNING

2.5.1 CITY OF PARRAMATTA COUNCIL

Relevant City of Parramatta Council documents include the following with specific extracts included below.

- City of Parramatta Council Floodplain Risk Management Policy (2014)
- City of Parramatta Local Environmental Plan (LEP) (2011)
- City of Parramatta Council Relevant Flood related Planning and Development Control (DCP) (2011)
- City of Parramatta Council Local Flood Studies:
  - Lower Parramatta River Flood Study and Floodplain Risk Management Study and Plan, by SKM / Don Fox Planning 2005
  - Duck River Flood Study and Floodplain Risk Management Study and Plan, by WMAWater / Molino Stewart, 2012
  - A'Becketts Creek Flood Studies by Sydney Water 1990 and Draft study by GHD 2009.

The City of Parramatta Council Floodplain Risk Management Policy (2014) provides flood management principles from the NSW Government at the local level. It established the City of Parramatta Council strategic approach to floodplain risk management for the whole Parramatta local government area.

Section 6.3 of the Parramatta LEP 2011 outlines the minimum requirements for land lower than the Flood Planning Level (FPL) which is defined as land below the 100 year ARI (now referred to as the 1% Annual Exceedance Probability (AEP) event) flood level plus 0.5 metre freeboard.

Section 2.4.2.1 of the Parramatta DCP 2011 provides the development controls for flood prone land in the council area. The Precinct is defined as a Strategic Precinct under the DCP however no precinct specific development controls for flood prone land are identified under Section 4.3.1 of the Parramatta DCP 2011 and so the controls in Section 2.4.2.1 apply.

Section 2 of the Parramatta DCP 2011 also describes site planning considerations including design objectives, design principles and design controls. Table 2.4.2.1.2 provides a matrix that provides details of appropriate land use and requirements within different areas of the flood plain based on flood risk definition (high, medium or low risk categories). A copy of this table is presented below as Figure 2.1. The mapping of the flood risk precincts provides an indication of the development controls that are relevant throughout the Camellia Precinct. The flood risk precincts in the Camellia Precinct are shown in Figure 4.3.

Appendix A7 of the Parramatta Council DCP outlines the WSUD Strategy for the City of Parramatta Council local government area. The DCP provides an outline for preparation of WSUD Strategies and provides that modelling parameters for the determination of the size and configuration of WSUD elements must be in accordance with MUSIC Modelling Guidelines for New South Wales (eWater Corporative Research Centre, 2009).

PART 2
2.4

Table 2.4.2.1.2
Flood Plain Matrix Planning and Development Controls

Flood Risk Precincts (FRP's)	Planning Consideration	Floor Level	Building Components	Structural Soundness	Flood Affectation	Car Parking & Driveway Access	Evacuation	Management & Design
High Flood Risk	Concessional Development	4, 5	1	1	1	1, 5	3, 4, 6	2, 3, 4
	Open Space & Non-Urban	1, 5	1	1	1	2, 4, 6, 7	1, 4	2, 3, 4
	Tourist Related Development	X	X	X	X	X	X	X
	Commercial & Industrial	X	X	X	X	X	X	X
	Residential*	X	X	X	X	X	X	X
	Filling	X	X	X	X	X	X	X
	Subdivision	X	X	X	X	X	X	X
	Critical Uses & Facilities	X	X	X	X	X	X	X
	Sensitive Uses & Facilities	X	X	X	X	X	X	X
Medium Flood Risk	Concessional Development	4, 5	1	1	1	1, 5	3, 6	2, 3, 4
	Open Space & Non-Urban	1, 5	1	1	2	2, 4, 6, 7	1, 4	2, 3, 4
	Tourist Related Development	2, 5	1	1	1	1, 3, 5, 6, 7	3, 4, 6	2, 3, 4
	Commercial & Industrial	2, 5	1	1	1	1, 3, 5, 6, 7	3, 4, 6	2, 3, 4
	Residential*	2, 5	1	1	1	1, 3, 5, 6, 7	3, 4, 6	2, 3, 4
	Filling	X	X	X	X	X	X	X
	Subdivision				1		5, 3, 4	1
	Critical Uses & Facilities	X	X	X	X	X	X	X
	Sensitive Uses & Facilities	X	X	X	X	X	X	X
Low Flood Risk	Concessional Development							
	Open Space & Non-Urban					2, 4, 6, 7		
	Tourist Related Development	2, 5			2	1, 3, 5, 6	4	
	Commercial & Industrial	2, 5			2	1, 3, 5, 6	4	
	Residential*	2, 5			2	1, 3, 5, 6	3, 4	
	Filling				1			
	Subdivision				2		5	1
	Critical Uses & Facilities	3	2	2	2	1, 3, 5, 6	2, 4, 6	2, 3, 4
	Sensitive Uses & Facilities	X	X	X	X	X	X	X

*for redevelopment of existing dwellings refer also to 'Concessional Development Provisions"

Legend

Not Relevant X Unsuitable Land Use

i. Freeboard equals an additional height of 500mm.

ii. The Parramatta LEP 2011 identifies development permissible with consent in various zones. Notwithstanding, constraints specific to individual sites may preclude Council granting consent for certain forms of development on all or part of a site. The above matrix identifies where flood risks are likely to determine where certain development types will be considered "unsuitable" due to flood related risks.

iii. Filling of the site, where acceptable to Council, may change the FRP considered to determine the controls applied in the circumstances of individual applications.

iv. Any fencing that forms part of a proposed development is subject to the relevant Flood Effects and Structural Soundness planning considerations of the applicable land use category.

v. Development within the floodplain may be subject to Clause 6.7 Foreshore Building Line in the Parramatta LEP 2011.

Figure 2.1 City of Parramatta DCP Extract of Table 2.4.2.1.2

3 METHODOLOGY

The IWCMS Implementation Report has been developed based on the following methodology.

1 **Baseline Flooding conditions**

- Collate and review of existing legislation, policies, site data and previous studies, including City of Parramatta flood studies and flood risk precincts.
- Assess the flood risk to the Precinct. The flood models created for the Parramatta Light Rail Stage 1 Infrastructure Design & Construct Project have been used to understand existing flood risk.

2 **Baseline Stormwater conditions**

- Collate and review of existing legislation, policies site data and previous studies.
- Review current capacity and condition of existing stormwater, water quality and wastewater infrastructure within the Precinct and future upgrades planned by Sydney Water.

3 **Baseline Stormwater Water Supply**

- Collate and review of existing site data and previous studies.
- Review and analyse existing climate and rainfall conditions for the precinct.
- Investigate opportunities to harvest and reuse stormwater within the Precinct and integrate stormwater treatment systems within the Precinct in line with WSUD principles.

4 **Baseline flood model**

- Prepare a baseline flood model based on use of flood models created for the Parramatta Light Rail Stage 1 Infrastructure Design & Construct Project and the Duck River Flood Study and involved:
  - set up and run the following event scenarios: 5%, 1%, 0.5% Annual Exceedance Probability (AEP) events and process results
  - investigate future (2100 and 2150) climate change impacts of sea level rise and increases in rainfall intensity
  - prepare baseline flood maps and associated GIS data displaying flood extents, flood function (such as floodways), flood depths, velocities and hazard for all scenarios
  - identify existing flood evacuation paths and areas that cannot be safely evacuated
  - identify the constraints on development based on the flood model and feasible flood mitigation measures required to facilitate the Master Plan.
- Review of Parramatta Light Rail Stage 1 Infrastructure Design & Construct Project (PLR) TUFLOW models and minor adjustments to the models to ensure suitable for use. The PLR TUFLOW models were developed for detailed analysis and design purposes. Key changes made to the model was to remove detailed representation of individual buildings across the precinct. This was done to enable better comparisons to each scenario based on land fill rather than specific building locations. It is also important to note the following key limitation with use of the PLR TUFLOW models for this assessment:
  - the PLR TUFLOW model does not cover the entire precinct, with the south-west corner of the precinct being excluded from the model, although this section of the precinct was represented using data from the Duck River Flood model.
- Review of the Duck River Flood Study and Floodplain Risk Management Study and Plan, by WMAWater / Molino Stewart, 2012 in order to extend the model to the precinct boundary.

The Duck River Flood study data implemented includes:

- bathymetry of the Duck Creek and Duck River. Due to the flow paths being represented as 1D networks within the 2012 study a 2d representation was developed by utilising the inverts of each cross section within the 1d Channel
- inflow hydrographs of both Duck Creek and Duck River at the precinct boundary. Total inflow hydrographs were developed for the 1% and 5% using the existing XP-RAFTS models, the 0.5% event was developed using the XP-RAFTS ARR87 storm generator and provided IFD Data
- ALS data remained from the PLR Tuflow Model as this was a more recent dataset
- the Sydney Metro West site has not been altered due to limited information, but it is assumed that similarly to PLR, Sydney Metro West will manage impacts created beyond its boundary in accordance with site specific planning conditions.

- Due to when the initial PLR TUFLOW models were developed, the underlying hydrology used for the modelling is in accordance with Australian Rainfall and Runoff (ARR) 1987. These guidelines have been since been updated with ARR2019 guidelines currently reflecting best practice. It is noted that ARR 2019 hydrology generally has lower rainfall depths when compared to the ARR 1987 design rainfall. Sensitivity analysis to understand the difference in flooding response in the area based on changes within the guidelines was completed as part of the PLR detailed design. This found that use of ARR2019 produced lower water levels across the floodplain and smaller volumes of runoff from the local catchments in comparison to ARR1987 due to the lower rainfall intensities.
- The PLR PMF TUFLOW model was also utilised to inform the understanding of flood behaviour across the precinct as a result of the PMF event. The PLR PMF TUFLOW model covers the entire PLR project (including areas of the Parramatta River upstream of the precinct) but does not include Duck Creek and Duck River. This model was not updated to include Duck Creek and Duck River. However, this is considered to be acceptable for the purposes of assessing PMF for the precinct as the majority of the proposed changes across the precinct are occurring in the northern and central sections of the precinct which are predominantly affected by the Parramatta River.
- Prepare baseline flood maps and associated GIS data displaying flood extents, floodways, flood storage, flood fringe, flood depths, velocities and hazard for the master plan, shown in Appendix C.

5 Master Plan Flooding assessment

- Detailed review of each of the proposed scenarios developed during the Preliminary EbD workshop in the context of the baseline site IWCMS details (as presented within the IWCMS Baseline Report) and relevant legislation and guidelines.
- Enquiry by Design workshops. The EbD was an iterative process that allowed for the testing of ideas, solutions and concepts by almost 100 participants across all technical streams and a range of stakeholders. For flooding and stormwater management, this involved specific consultation with City of Parramatta Council and DPE Floodplain Managers to develop a set of criteria for assessment of the workshop scenario and planning conditions for the precinct.
- Indicative representation of the workshop master plan within the PLR TUFLOW and PLR PMF TUFLOW models based on provision of different levels of fill to meet capping requirements for contamination and to provide appropriate flood protection based on proposed land use. Fill to the capping requirements was limited to the building footprints in the north west corner and along the land on the edge of the Parramatta River (generally town centre zone) and assumed the rest of the site would have remediation that minimised changes to existing ground levels. The fill within the town centre building footprints has been included in the model as a blockage and therefore not available to fill with floodwaters. Overland flow paths between lots were also defined across the precinct. An overview of the fill locations (hatched areas) and level of capping (number showing fill depth in metres) and overland flow paths is shown in Figure 5.1 Details of capping requirements based on site

contamination across the precinct were obtained from contamination specialists working on this package of work and is discussed within the Remediation Implementation Report *(21465238-013-R-Rev2, Golder, November 2021).*

- Set up and run the following event scenarios: 5% and 1% Annual Exceedance Probability (AEP) events, an assessment of climate change and PMF event. The 2-hour storm duration event was adopted for this analysis as it was noted to be the key critical event in the vicinity of Camellia for the PLR assessments. A full suite of storm durations is not considered necessary for the level of modelling that has been conducted to inform this assessment. To understand the potential range of changes to the 1%AEP flood conditions due to climate change, the following two scenarios have been assessed combining potential rainfall intensity increase and future sea level rise:
  - Scenario 1: The 1%AEP inclusive of climate change (both rainfall intensity and sea level rise) – this scenario adopted a 30% increase in rainfall intensity and a 2 m rise in sea level. The ARR Data Hub documents an increase in rainfall intensity of approximately 20% for 2090 based in the very high Representative Concentration Pathway (RCP 8.5). The adopted 30% therefore provides a conservative assessment and has been adopted to be consistent with the PLR modelling approach. Projected future changes to global mean sea levels have also been modelled under various emissions scenarios. These models suggest that based on RCP8.5 sea level rise of around 2 m would be expected by 2150 (IPCC, 2019).
  - Scenario 2: 0.5%AEP with sea level rise – this climate change scenario adopted the rainfall intensities for the 0.5%AEP event as a representation of future rainfall conditions and again, a 2 m rise in sea level was applied.
- Prepare assessment flood maps and associated GIS data displaying flood extents, floodways, flood storage, flood fringe, flood depths, velocities and hazard for the master plan, shown in Appendix C.
- Identify existing flood evacuation paths and areas that cannot be safely evacuated.
- Identify the constraints on development based on the flood model and identify feasible flood mitigation measures required to facilitate the Master Plan.

6 Master Plan Stormwater Quality and Supply Assessment

- Investigate opportunities to harvest and reuse stormwater within the Precinct. This would include a simple MUSIC model to assess potential rainwater reuse available.
- Investigate opportunities to integrate stormwater treatment systems within the Precinct in line with WSUD principles.
- Make recommendations for future investigation and planning including further modelling where required.

4 EXISTING CONDITIONS

This section provides a summary of the conditions for the precinct with further detail provided in Appendix B.

4.1 FLOOD RISK

The precinct is located at the confluence of Duck River and Parramatta River, where the upstream Parramatta River Catchment is about 170 km^2. The precinct is subject to flooding from multiple sources, including local runoff and flooding from Parramatta River, Duck River, Duck Creek and A'Becketts Creek. City of Parramatta Council's adopted existing flood inundation and hydraulic flood hazard mapping used to inform planning is based on details from the following studies:

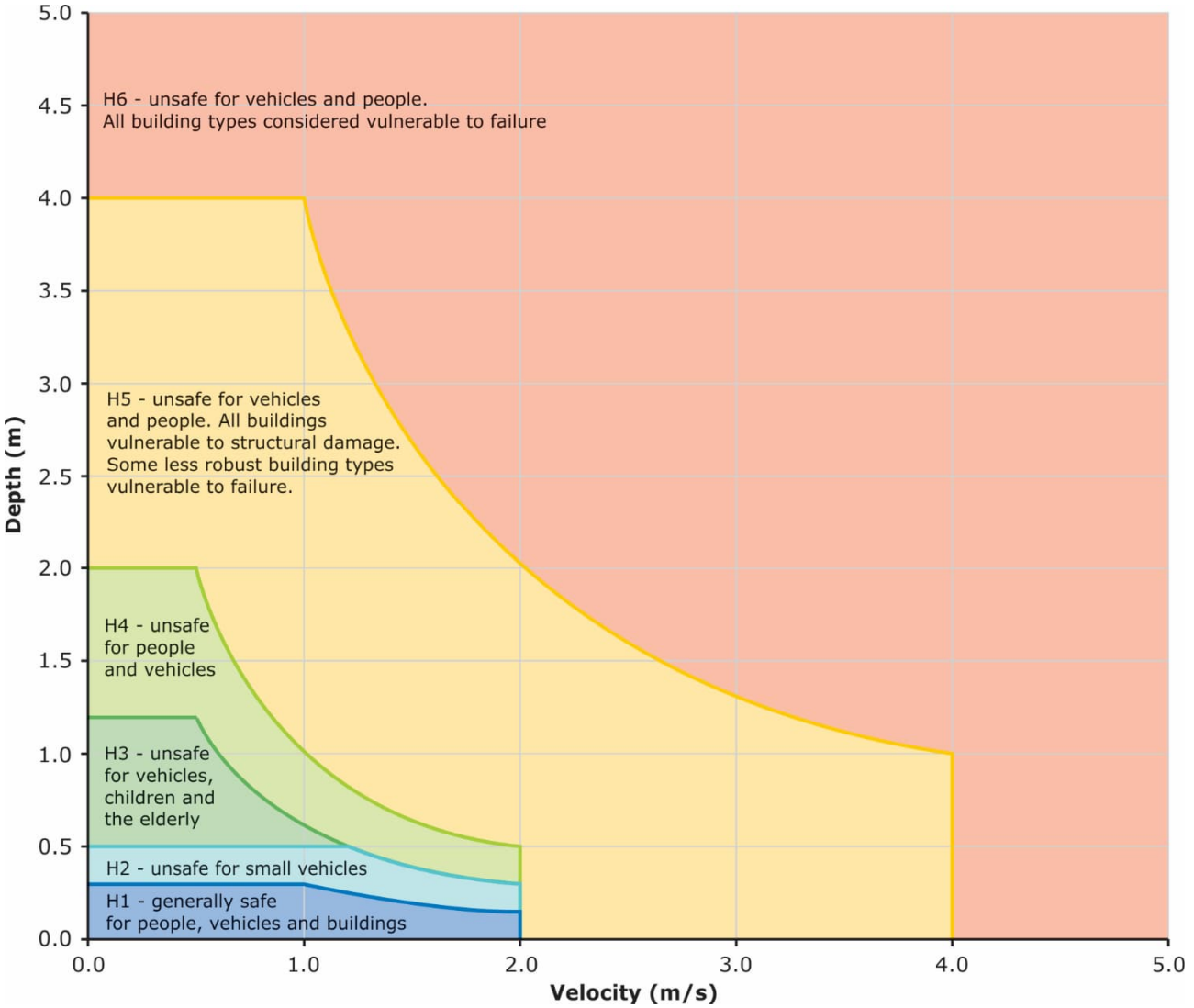
- Lower Parramatta River Flood Study and Floodplain Risk Management Study and Plan (SKM, 2005).
- Duck River Flood Study and Floodplain Risk Management Study and Plan, (WMAWater / Molino Stewart, 2012).
- Draft A'Becketts Creek Drainage Master Plan (GHD, 2009).
- A'Becketts Creek SWC No.46 Catchment Management Study, (Bewsher Consulting, 1990).
- Revision of Flood Levels as a Consequence of the Duck Creek SWC No.35 Catchment Management Study (Water Board, 1993).

For this assessment, the Parramatta Light Rail and Duck Creek models have been combined as they represent the most up to date flood models for the Precinct as described in Section 3.

The flood models have been used to understand the existing flood risk across the Precinct. A key parameter is the flood hazard, defined using depth, velocity and the product of depth and velocity. Hazard categories are defined in ARR2019 per Smith et al (2014). Flood hazard vulnerability curves and definitions are provided below in Figure 4.1 and Table 4.1.

In conjunction with the flood hazard, the flood function hydraulic categories have been documented to further understand the flood behaviour and risk within the precinct. The hydraulic categories are split into three:

1. Floodway – Areas where floodwater velocity (>1m/s) and depths (>0.2m) are both high
2. Flood Storage – Areas where floodwater depths are high (>0.2m) but velocities are low (<1m/s)
3. Flood Fringe – Remaining areas of floodwaters with relatively low depths (<0.2m) and velocities (<1m/s).



Source: Australian Rainfall and Runoff 2019, Book 6, Chapter 7, Figure 6.7.9

Figure 4.1 Hazard vulnerability curves

Table 4.1 Hazard curves – Vulnerability thresholds classification limits (Smith et al., 2014)

HAZARD VULNERABILITY CLASSIFICATION	DESCRIPTION	CLASSIFICATION LIMIT (D and V in combination)
H1	Generally safe for vehicles, people and buildings.	D*V≤0.3
H2	Unsafe for small vehicles.	D*V≤0.6
H3	Unsafe for vehicles, children and the elderly.	D*V≤0.6
H4	Unsafe for vehicles and people.	D*V≤1.0
H5	Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.	D*V≤4.0
H6	Unsafe for vehicles and people. All building types considered vulnerable to failure.	D*V>4.0

The flood hazard across the precinct for the 1% AEP flood event is presented in Figure 4.2 below and indicates that:

- H1 zones occur across the central areas of the precinct and within property boundaries where flood depths are generally less than 0.1 m.
- H2 zones occur at the Rosehill Racecourse, the former Speedway site, near the wetland in the east and along the northern edge of the precinct but separate from the Parramatta River.
- H3 zones occur in the wetland, some deep water areas of the Rosehill Racecourse, Viva Energy site in the south east and the north west corner.
- H4 zones occur along the fringes of Duck Creek, Duck River and the Parramatta River and the centre of the wetland in the east.
- H5-H6 zones occur in the A'Becketts Creek, Duck Creek, Duck River and Parramatta River.

The hazard vulnerability therefore indicates that the areas subject to high flood risk (zones H4 and above) are the main waterways, the northwest corner, the wetland and some areas of the Viva Energy site.

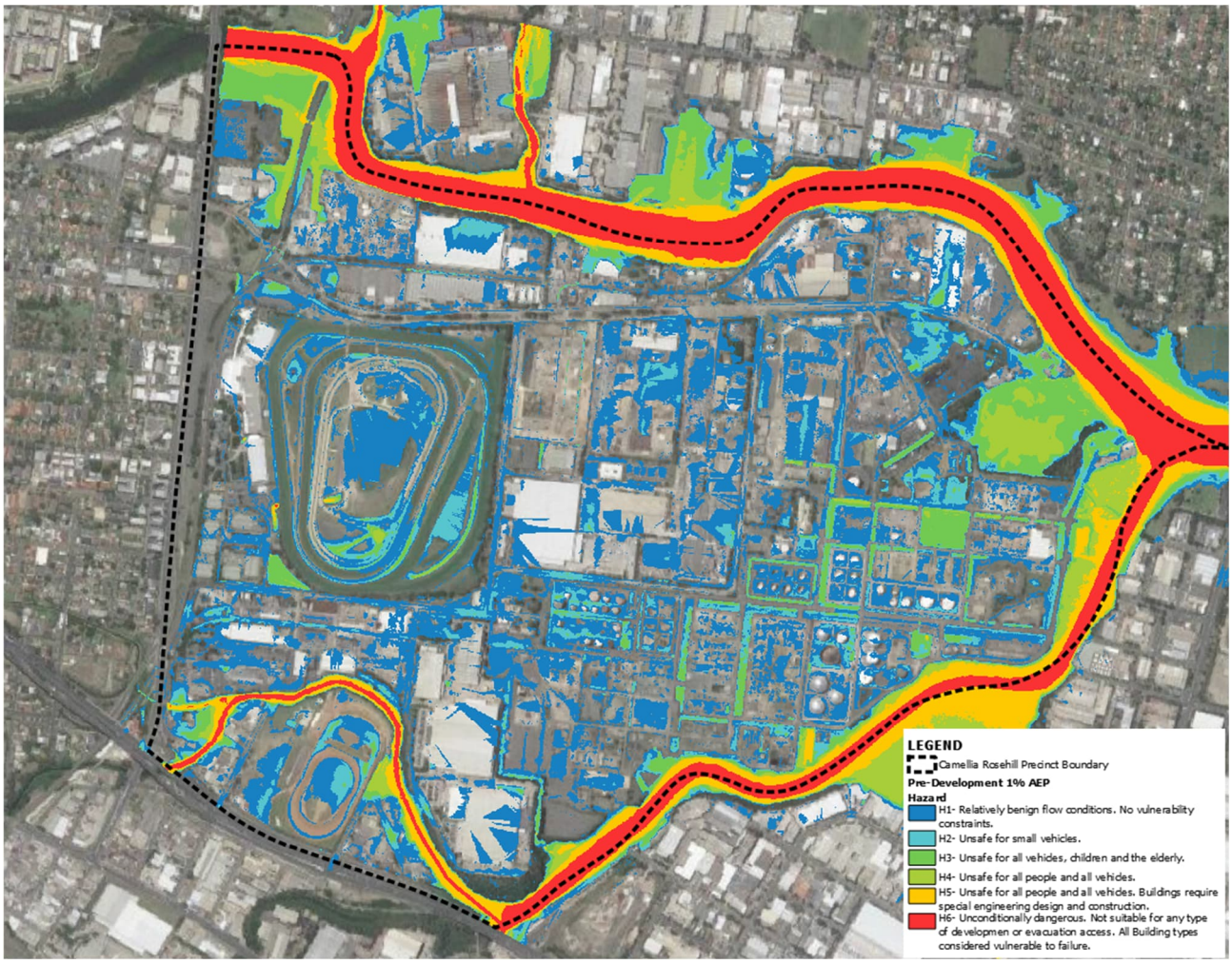


Figure 4.2 Flood hazard map 1% AEP event

The flood hydraulic categories across the precinct for the 1% AEP flood event is presented in Figure 4.3 below and indicates that:

- there is a significant floodway in the North-West corner
- there are significant areas of low velocity but with depths of 200mm or greater throughout the precinct
- areas defined as significant floodways and flood storage correlate with previously described hazard zones H4-H6.

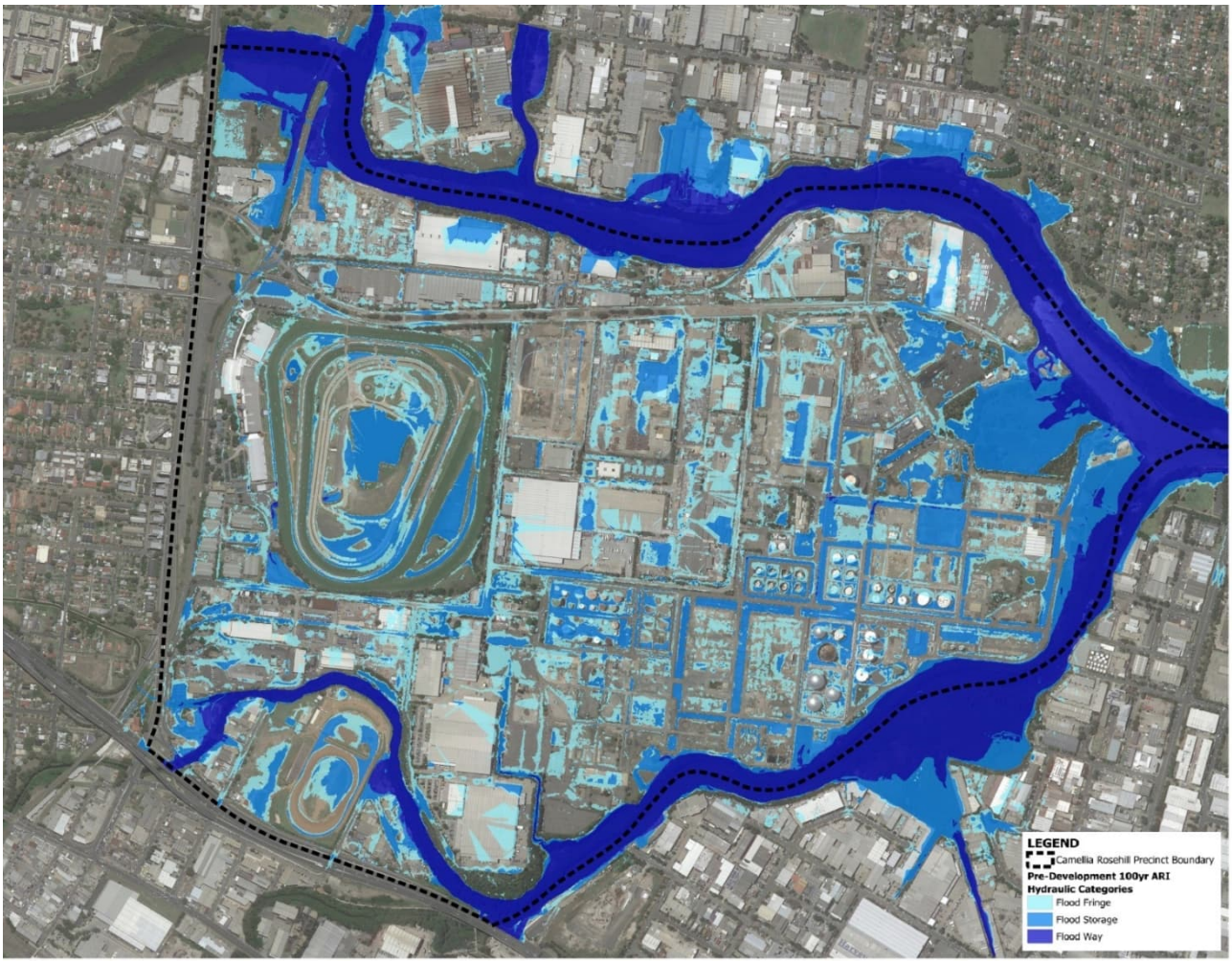


Figure 4.3 Flood Hydraulic Categories map 1% AEP event

Other models developed for the precinct were not available for this assessment. However, the results of the modelling were available, and they indicate similar levels of flood risk across the precinct as described above. The Cardno (2015) assessment developed a 1D/2D TUFLOW model for the precinct based on combining previously developed 1D/2D floodplain models as appropriate. The modelling was used to better understand flood extents and risk across the precinct for a study completed in 2015. Figure 4.4 shows the flood risk categorisation results from this modelling in line with City of Parramatta Council DCP 2011 categories.

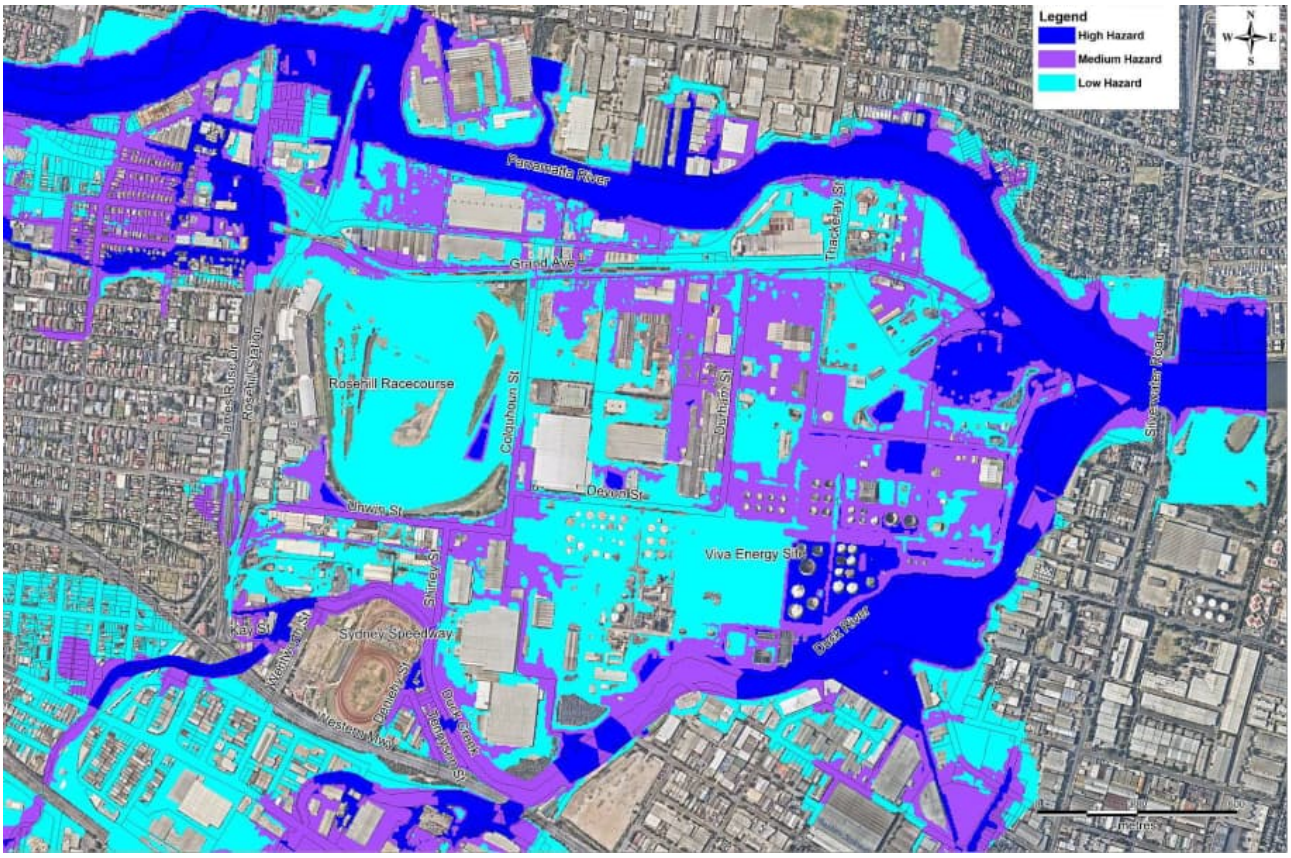


Figure 4.4 Camellia Precinct – Preliminary flood risk rating (Cardno, 2015)

The Probable Maximum Flood (PMF) event has been simulated in the PLR PMF TUFLOW model and the results indicate that the land north of the Grand Avenue and the entire eastern area of the precinct is subject to inundation in a PMF event. Refer to Figure 4.5 which shows that the PMF peak flood levels reach 8.0mAHD near James Ruse Drive and 5.5mAHD across the eastern portion of the precinct. Through the middle of the precinct depths of less than 0.6m are predicted.

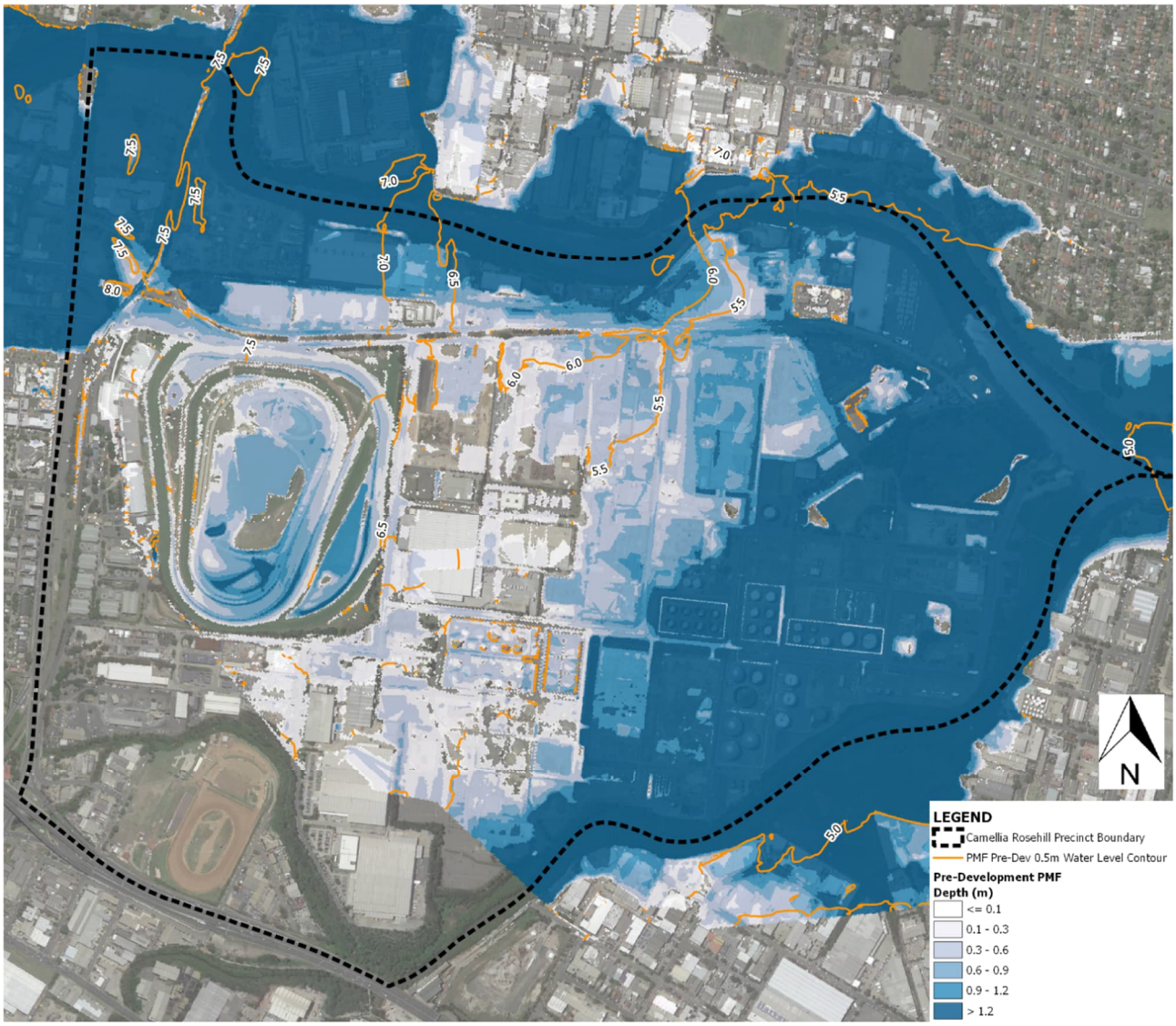


Figure 4.5 PMF Peak Flood depths and height contours

4.1.1 FLOOD EMERGENCY MANAGEMENT

Emergency evacuation is a key consideration for the Precinct. Currently there are only two westbound paths of evacuation, both of which cross through areas of high hazard flooding. The two primary westbound paths of evacuation are:

- Grand Avenue to James Ruse Drive via Hassall Street. The intersection of James Ruse Drive and Hassall Street is at a topological low point which is subject to flooding in a 1% AEP event. This intersection has been found to be unsafe for vehicles for around 5 hours and 20 minutes in a 1%AEP flood and around 7 hours and 50 minutes in a PMF. Hence this route is unsuitable for evacuation in major floods (Cardno, 2015b).
- Unwin Street to the Parramatta Road via Kay St and Wentworth St. This route crosses A'Becketts Creek and Duck Creek. The A'Becketts Creek crossing and Duck Creek crossing are vulnerable to flooding from the local creeks as well as the Parramatta River in extreme floods (Cardno, 2015b).

The current Parramatta Local Emergency Management Plan (EMPLAN) is dated September 2018 and lists the NSW State Flood Plan (March 2018) as a sub plan of the EMPLAN. Further floodplain planning for the area is documented within the Draft Update of Parramatta Floodplain Risk Management Plans (Molino Stewart for CoP, Feb 2016). This document identifies that the majority of the Parramatta CBD would fall within the category of "low flood island", meaning that evacuation routes (typically the road network) would be cut by flooding before the area itself is inundated. Also given the short time to peak for major flood events along the Parramatta River, the report supports a 'shelter in place strategy' for the Parramatta CBD. A 'shelter in place strategy' in combination with evacuation will need to be considered for the precinct.

The current flood mapping available from City of Parramatta Council has been included to assist with understanding the current flood emergency response classification for the Precinct. Refer to Figure 4.6.

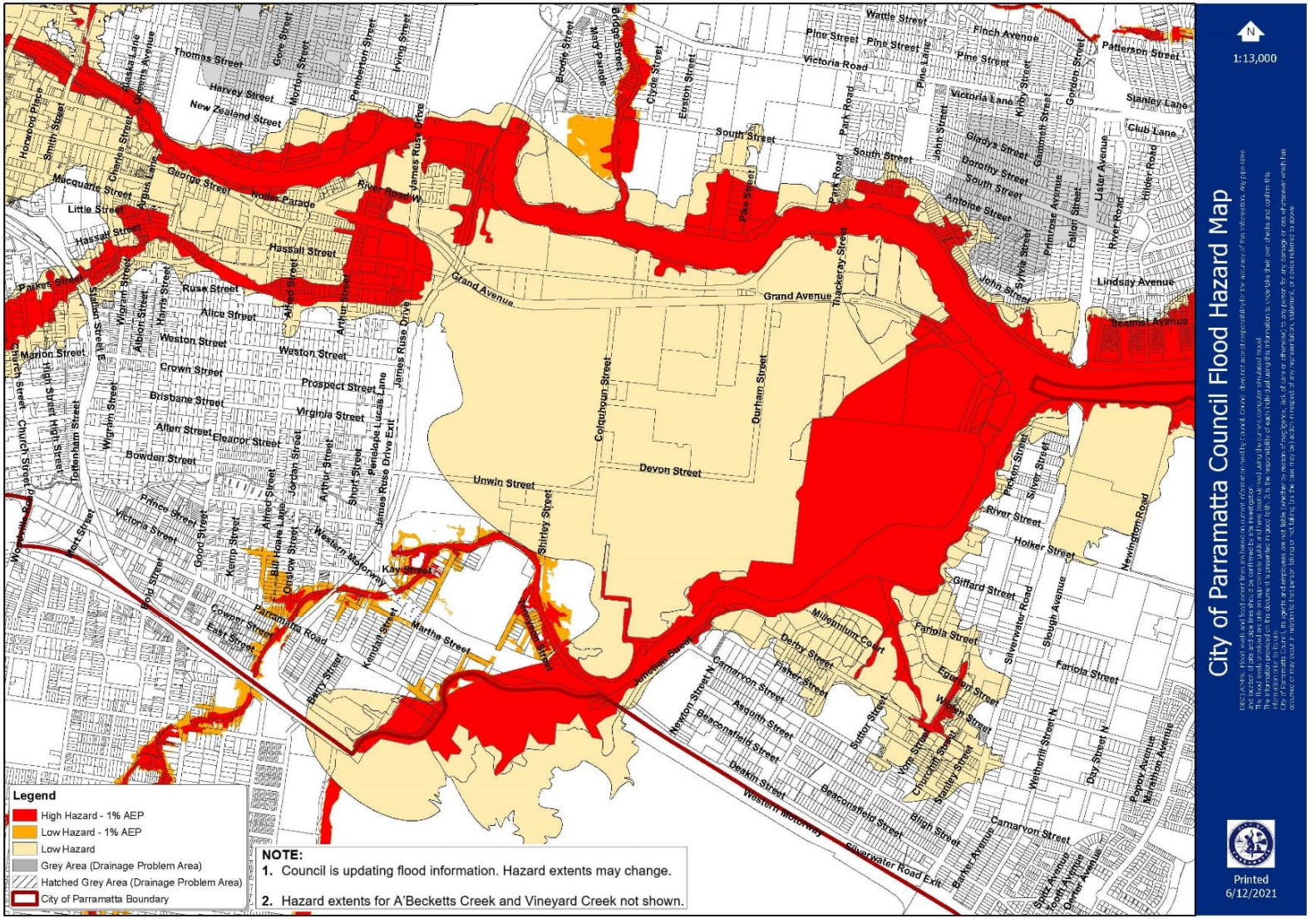


Figure 4.6 City of Parramatta Council Flood Hazard Map

4.2 STORMWATER DRAINAGE

An assessment (refer to Appendix B Section B1.4) of the current capacity of the public domain stormwater network found that over half of the sub-catchments within the precinct do not currently provide for Council's recommended minimum capacity for 'Street drainage' (capacity for 5%AEP).

4.3 STORMWATER QUALITY

The Parramatta River has been monitored at a number of locations by the City of Parramatta Council and Sydney Water. Monitoring frequency, indicators and length of the record varies between the sites. The Duck River also has several sites where water quality monitoring has occurred. Details of this monitoring data have been reported in both Strategic Analysis of Water Quality in the Parramatta River (Jacobs & UNSW 2016) and within Parramatta Light Rail Stage 1 Water Quality Working Paper (Jacobs, 2017). These reports note that generally, water quality in the vicinity of the Camellia precinct area is poor, especially with respect to nutrient concentrations.

The water quality monitoring records show that typically, following wet weather the water quality of the Parramatta River deteriorates. Elevated concentrations of nutrients and metals are noted to be recorded above the recommended limits for protection of aquatic ecosystems. Water quality of the Parramatta River following wet weather is poor due to catchment runoff and stormwater inflow (Jacobs, 2017).

Similarly, high levels of nutrients in Duck River are noted to be largely due to the highly industrialised and urbanised catchments surrounding this River. Additionally, Council have identified sites adjacent to the river containing unhealthy landfill and there are known sites of contamination near Duck River (Jacobs & UNSW, 2016).

In response to development of the Parramatta River Master Plan (2017) work has been done within the broader Parramatta River catchment to improve water quality (e.g. Sydney Water has invested significantly in its wastewater network to reduce the impact of stormwater inflows). However, water quality in the vicinity of the Camellia precinct area is still considered to be poor.

5 MASTER PLAN ASSESSMENT

5.1 OVERVIEW

The master plan aims to transform Camellia to a more productive, connected, sustainable and liveable place. This is achieved through provision of a series of connected sub precincts: an active/attractive town centre with high density residential and supporting local services and social infrastructure; an urban services precinct providing for a diversity of mix industry uses; and an industry precinct providing for heavier industrial uses with focus on water recycling, renewable energy generation, waste recovery and recycling. An overview of this plan for the precinct is shown in Figure 1.2.

5.2 ASSESSMENT

5.2.1 FLOODING ANALYSIS

Key flooding considerations for the precinct include:

- Avoiding fill within 'High hazard' and floodway areas of the precinct (refer Section 4.1 for further details). This is predominately the main Duck Creek, Duck River and Parramatta River watercourses but also includes the wetland area, parts of the Viva Energy Site and the north-west corner of the precinct which is affected by flooding from the Parramatta River. Setbacks from the main watercourses would be a key approach to minimising flood impacts to surrounding land.
- A setback of 40 m along the foreshore of the waterways including Parramatta and Duck Rivers and Duck and A' Becketts Creek.
- Parramatta DCP 2011 notes habitable floor levels are to be equal to or greater than the 1%AEP flood level plus freeboard (0.5 m). The DCP also provides a matrix (refer to Figure 2.1) showing suitable development controls based on land use and flood risk considerations that would all be suitable within the medium and low flood risk areas.
- Fill within the precinct to provide capping for contamination should be limited to proposed building footprints. Fill applied to other areas should be capped to existing ground level or as close to it as possible. Limiting the area capped above existing levels reduces blockage of flow paths and minimises impacts on floodplain storage, therefore minimising the impacts on flooding within the Precinct and surrounding areas.
- Roads were implemented to represent the overland flow paths within the precinct and as a means of providing floodways in major flood events.
- Provision of a flood free evacuation route via new crossing over Duck River. It is noted that PMF levels in this area are 5.2 mAHD (refer to Figure 4.5). The bridge and connecting road levels would need to be above this level to ensure a flood free route for all events. Appropriate road levels within the Precinct would also need to be implemented to provide flood free access to this new bridge.
- Even with provision of flood free evacuation route, the short warning time expected, and the typical pattern of flood producing rain events, can result in flooding and inundation lasting for several days. The long duration flood events in the area support the recommendation of an evacuation route in association with a 'shelter in place' strategy for emergency flood management of the Precinct residential areas.

A high-level landform representation of the master plan has been made within the flood model to provide an initial assessment of potential flood impacts. The model representation was based on an understanding of minimum capping requirement provided by the contamination specialists, indicative building footprints, provision of flood free land for land uses with higher sensitivities (residential areas and schools), and the above listed considerations. Figure 5.1 below shows a general setup of how this scenario was represented within the flood model, with numbers indicating depth of fill (in metres above existing ground levels) applied to different areas of the precinct. Key things to note in this representation:

- The areas around the proposed town centre have been represented to be raised above the PMF level to ensure flood free land for residential properties and educational facilities, hence higher depths of fill were modelled.
- The hydraulic behaviour of the Parramatta River results in the north west area of the precinct and the land on the edge of the Parramatta River (on the northern side of Precinct) being more sensitive to flood impacts. For this reason, representation of fill within these areas has been incorporated at a more detailed level, with fill limited to an approximation of future building footprints and an assumption that any capping surrounding the buildings would be finished at existing ground levels.
- Across the remainder of the precinct fill was applied more generally to areas based on capping requirements provided by contamination specialists. These areas may not need to be raised in their entirety as has been represented, however they are designated to provide for service and industrial zone uses which would typically have larger building footprints/ larger areas of the site requiring capping to allow for future use.

The model has then been run to assess flooding and flood impacts for the 5% and 1%AEP events, a 1% AEP event inclusive of climate change (based on RCP8.5) and a 0.5% AEP event inclusive of sea level rise (refer to Section 3 for further details of climate change scenario assumptions) and PMF event.

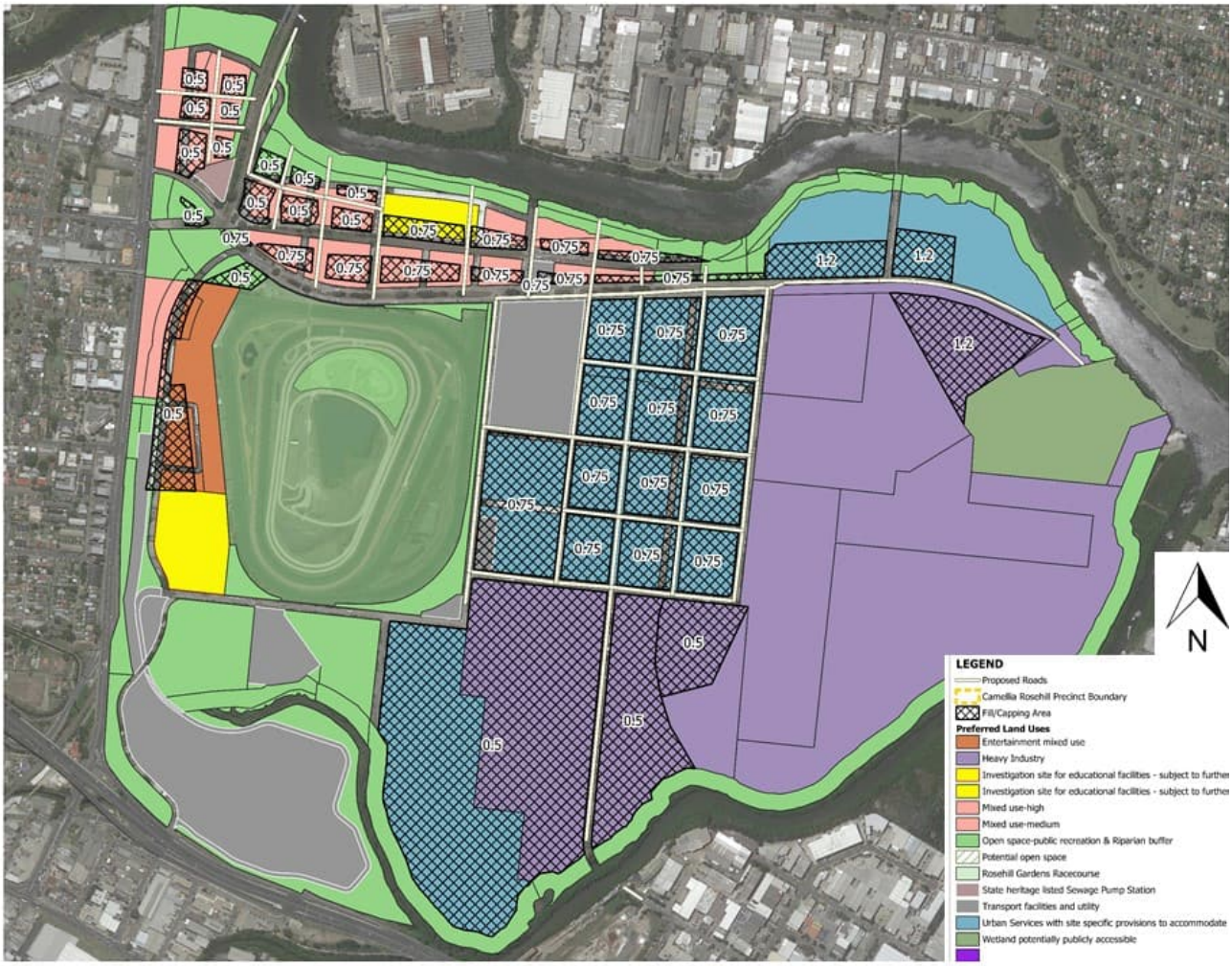


Figure 5.1 Master plan – Flood modelling representation

5.2.1.1 FLOOD IMPACTS

Flood impacts of the master plan during a 1% AEP and the 1% AEP climate change scenario are shown in Figure 5.2 and Figure 5.3 respectively. For the master plan modelling indicates there is no impact outside of the precinct for the 1% AEP and 5% AEP event. For the 1% AEP climate change scenario increases of 11 to 14 mm are seen along the Parramatta River, with this afflux extending onto properties on the northern bank of the Parramatta River, opposite the precinct. For the 0.5% AEP with sea level rise event, the modelling indicates the scenario would cause an afflux of 10 to 12 mm along the Parramatta River. Flood impact maps for the 5% AEP, 1% AEP with climate change, 0.5% AEP with sea level rise and PMF are provided in Appendix C.

To provide minimal impacts to surrounding areas under future climate change conditions the following were included in the model:

- increase setbacks from the Parramatta River and Duck River by capping the building footprint
- provide land for flood storage within the precinct. Key areas where this has benefited include the area within the 9 Devon Street site, in the vicinity of the wetlands, the north east corner (adjacent to 14-16 Grand Ave, Camellia) and the north west corner of the site where the residential area is proposed. All of these additional flood storage areas are assumed to be capped to existing ground level to mitigate contamination
- reduced the footprint of the residential area in the north west corner of the site and allow larger setback from the river and capping above existing ground levels at building footprints.

Within the precinct the current modelling indicates isolated areas within lots with an increase in flood levels in the order of 100–300 mm for the 1%AEP. It is noted that the current modelling representation is lacking in detail regarding precinct drainage and stormwater management infrastructure. It is anticipated that the afflux within the precinct as shown in Figure 5.3 would be managed through provision of a combination of measures including drainage infrastructure, allocation of sub-areas for flood storage and raising building levels as required on a lot by lot basis.

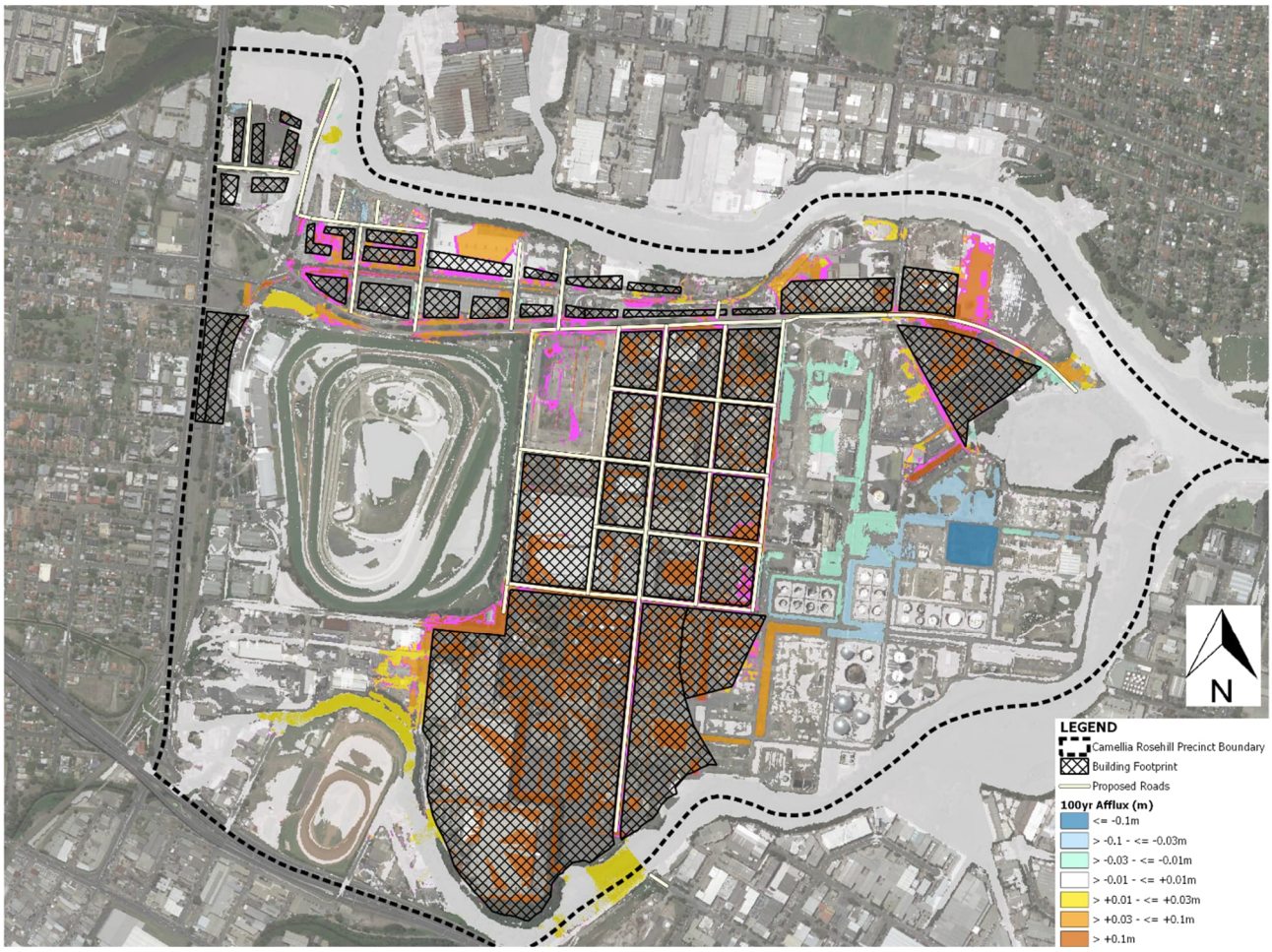


Figure 5.2 Master plan: 1% AEP afflux

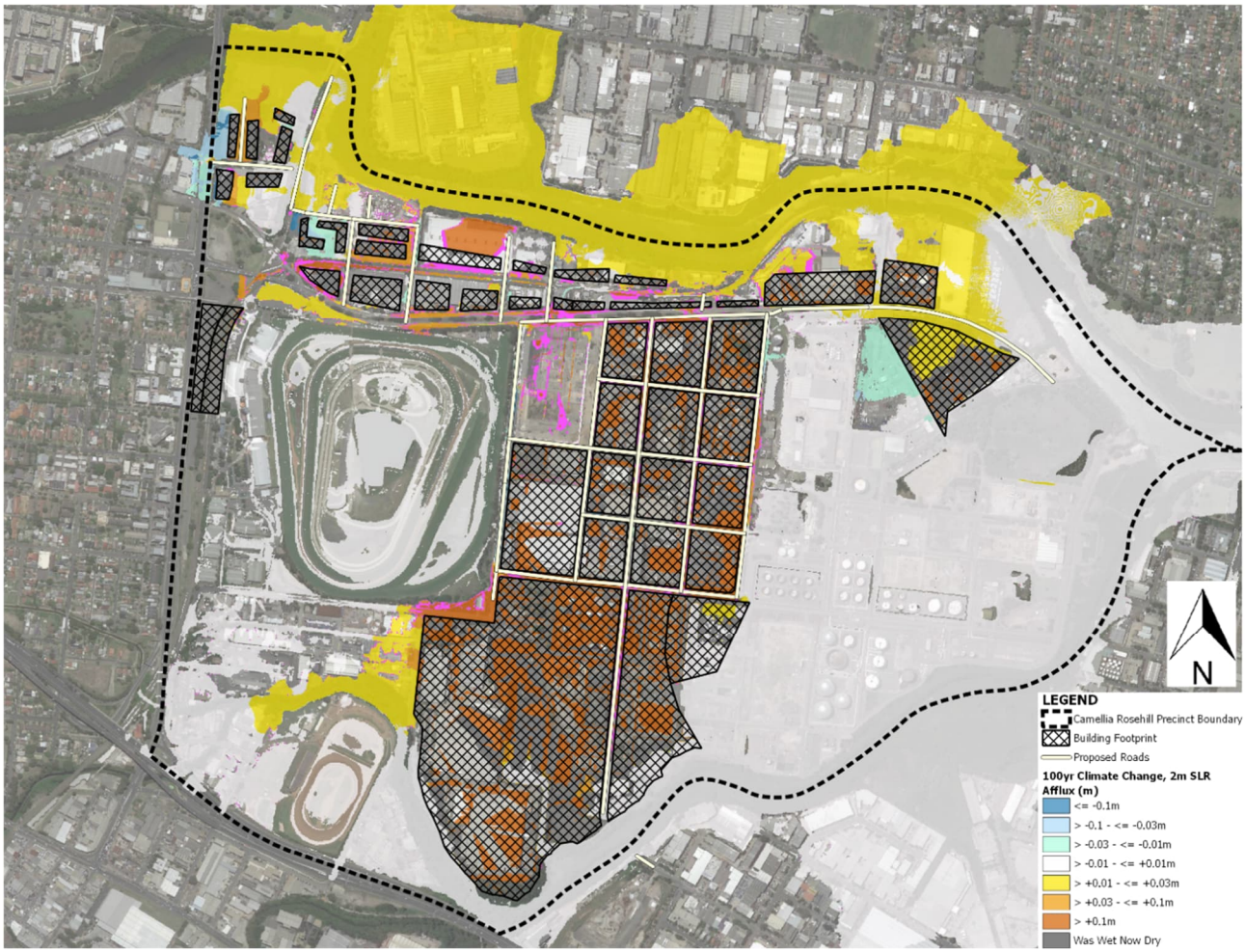


Figure 5.3 Master plan: 1% AEP with climate change and 2 m sea level rise afflux

Within the areas where buildings and/or site fill is proposed (black hatched areas indicated in the figure below), it is anticipated that fill could go higher/buildings be constructed without increased impact to areas surrounding the Precinct. Further detailing at the lot level that ensures appropriate drainage, flood storage and elevated floor levels should be incorporated as required.

In summary, the flooding analysis shows that the master plan is a feasible option from a flooding perspective. Careful planning and design will be required to ensure flooding considerations are incorporated within the Precinct. Key recommendations would be to:

- ensure setbacks are provided from main waterways/river areas to ensure impacts to surrounding areas are minimised under future climate change conditions
- maintain existing levels across9 Devon Street Rosehill and in the wetland adjacent to 14-16 Grand Avenue Rosehill to minimise impacts to surrounding areas
- provide for flood storage across the Precinct to capture local flood runoff – retaining proposed open space throughout the precinct to be set aside for this purpose. Any storage provided will need to consider contamination issues and ensure required capping is not breached
- provide a flood free evacuation route, the proposed Duck River crossing would need to be set at a minimum of 5.2 mAHD. Bridge design will need to look at minimising impact of the structure on Duck River, with key considerations such as minimising piers in the waterway and ensuring waterway flow on the either side of the main waterway opening.

In relation to the PMF event, the flood model indicates there will be an increase in predicted PMF flood levels in the vicinity of the proposed educational facility near the town centre but there will be a decrease at the western end of the proposed facility and therefore this will need to be considered as part of the planning for the facility. For beyond the precinct, that impacts are up to 150mm to the north of the Parramatta River and in areas upstream of the Precinct. These impacts are expected due to the significant size of the PMF event across the catchment but they are not considered to be unacceptable because they do not result in any changes to flood function or flood hazard category beyond the Precinct. The depths experienced in the areas of afflux for the PMF event are generally greater than 3m upstream of the precinct and up to 2.5m north of the Parramatta River, and therefore the additional 150mm of flood depth does not materially affect the PMF flood risks and hazards. The proposed flood planning conditions and performance criteria have been established to manage flood risks up to the PMF event with further work proposed to minimise impacts. Refer to Appendix C for the full set of maps.

5.2.1.2 FLOOD HAZARD ASSESSMENT

The flood modelling results have been reviewed to understand the flood hazard for the master plan conditions to inform the Master Plan. The flood hazard classifications as described in Section 4.1 and been summarised across the Precinct below and they are similar to the existing conditions except in a few locations which are included in bold.

The master plan flood hazard across the Precinct for the 1% AEP flood event plus climate change (2.0 m sea level rise and 30% increase in rainfall intensity) is shown in Figure 5.4 and indicates:

- H1 zones occur across the central areas of the precinct and within property boundaries where flood depths are generally less than 0.1 m
- H2 zones occur at the Rosehill Racecourse, the former Speedway site, near the wetland in the east and along the northern edge of the precinct but separate from the Parramatta River
- H3 zones occur in the wetland, some deep water areas of the Rosehill Racecourse, Viva Energy site in the south east and the north west corner
- H2-H3 zones occur along roads through the central parts of the precinct and along the northern edge of the precinct as these have been defined as overland flow paths to direct water away from the filled/capped lots
- H4 zones occur along the fringes of Duck Creek, Duck River and the Parramatta River and the centre of the wetland in the east
- H5-H6 zones occur in the A'Becketts Creek, Duck Creek, Duck River and Parramatta River.

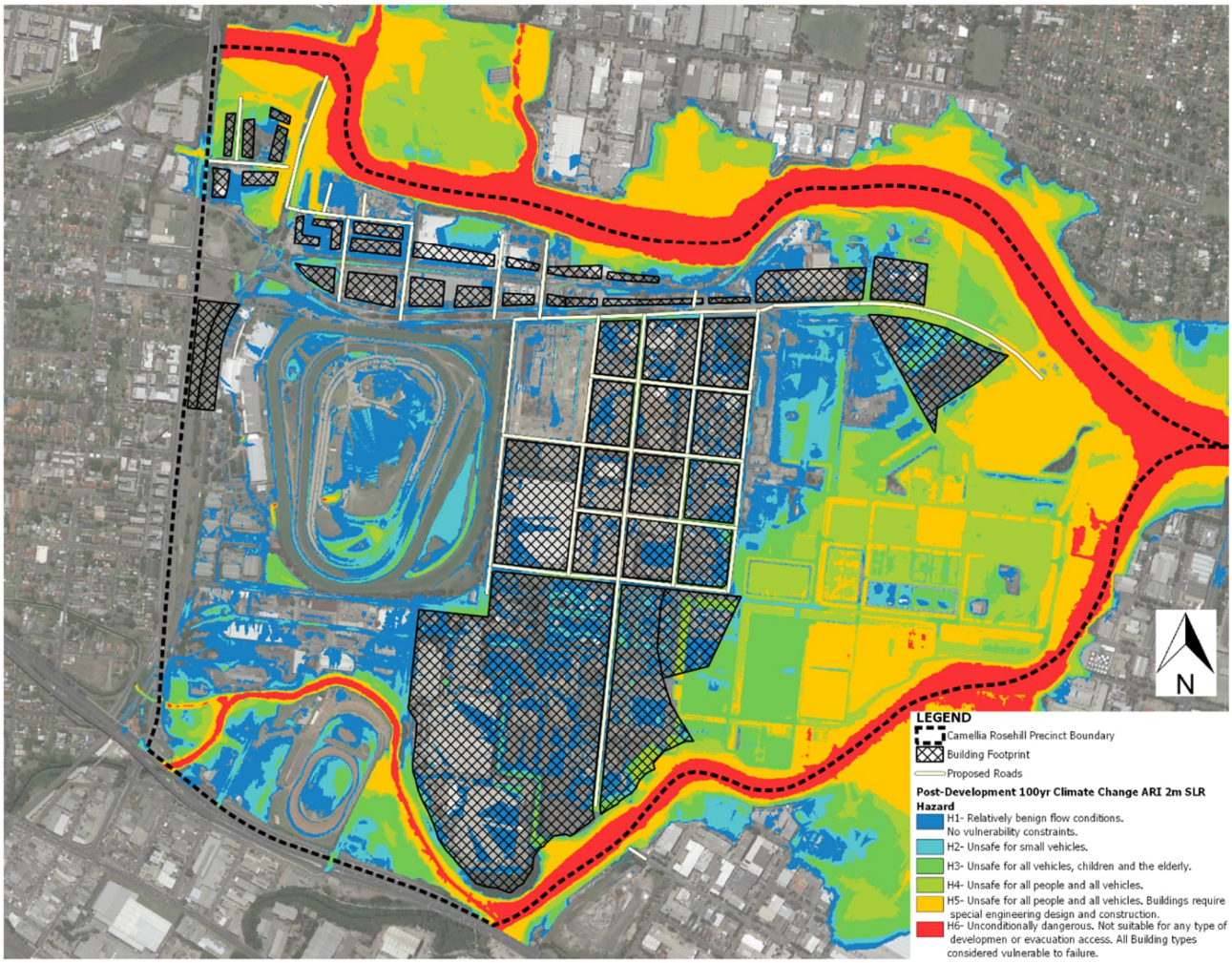


Figure 5.4 Flood hazard 1% AEP plus climate change (2.0 m SLR and 30% increase intensity)

The flood modelling results have been reviewed to understand the flood function for the master plan conditions to further inform the Master Plan. The flood functions are outlined in Section 4.1 and been summarised across the Precinct below and they are similar to the existing conditions except in a few locations which are described below:

- floodway has reduced in the North-Eastern corner below Grand Ave
- floodway reduced in North-East corner, along the boundary of the proposed building footprints
- flood storage has reduced within the centre of the precinct
- no changes along Duck Creek/River.

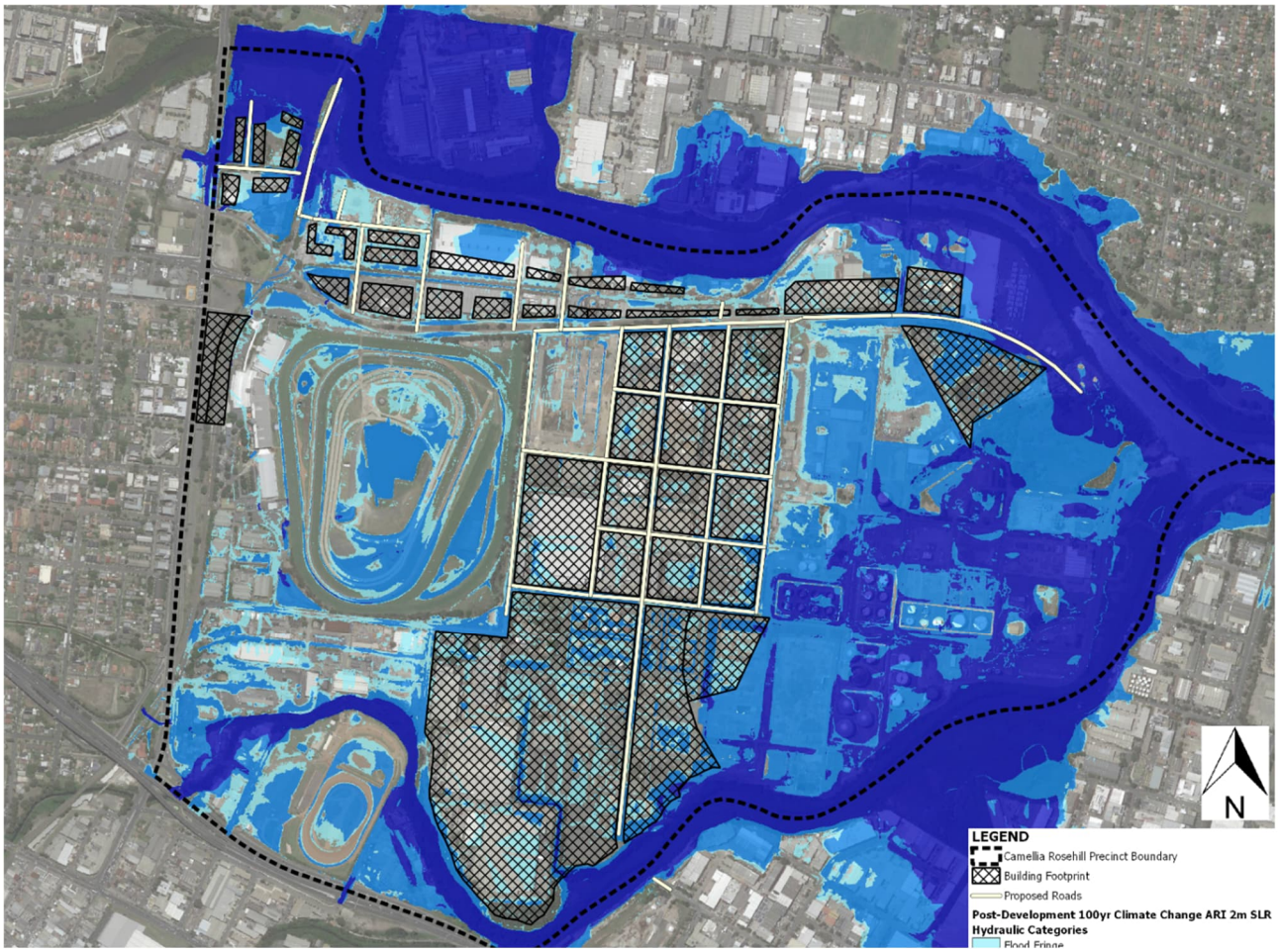


Figure 5.5 Hydraulic Categories 1% AEP plus climate change (2.0 m SLR and 30% increase intensity)

5.2.2 STORMWATER CONSIDERATIONS

The existing Council stormwater network does not provide capacity to meet City of Parramatta Council requirement of providing for 5%AEP event (see Appendix B for further details). The drainage network would need to be upgraded through installation of additional inlets and additional or larger drainage lines to ensure that Council's recommended capacity is achieved throughout the precinct. The Council stormwater pipe network largely follows existing road corridors. It is anticipated that this would remain in the same locations but be amplified to meet Council requirements.

Additional considerations for precinct stormwater network planning include:

- any new development would be expected to implement On-Site Detention to limit site discharges to no greater than existing conditions. This is typically required on a per lot scale to ensure details of all local site changes are captured
- minimum cover requirements for upgraded network need considering, and constraints posed by any contaminated soils considered. Changes to ground surface levels due to fill/capping of contamination will be key considerations to ensure the upgraded network works. The change in capping fill level required across the precinct will need to be carefully assessed in design of the upgraded stormwater network
- stormwater management scale considerations – precinct vs. lot scale, consideration needs to be given to the ultimate ownership of assets.

Further, it is noted that there are local sub-catchments which are assumed to not drain to Council's drainage system:

- Rosehill Racecourse: The Rosehill racetrack currently drains to the water body at the centre of the race track. It is assumed that runoff from this catchment is harvested for local irrigation by the Australian Turf Club and that this would continue.
- Rosehill East: the eastern portion of Rosehill racecourse is assumed to drain to two low-lying water bodies within the site. This provides opportunity for this to incorporate stormwater harvesting and promote stormwater reuse within the racecourse.
- The future maintenance facility for Sydney Metro West: The now decommissioned Sydney speedway is surrounded by an elevated bund for spectators, therefore run-off from the site is trapped in the centre of the racetrack. This site is proposed for future use as a maintenance and stabling facility for Sydney Metro West. Stormwater drainage from the site would be upgraded to cater for this future use.

5.2.3 STORMWATER QUALITY MANAGEMENT

Available stormwater quality management devices include gross pollutant traps, proprietary treatment devices, detention basins and treatment tanks, vegetated swales, wetlands and bioretention filters. Treatment measures that have not been considered include infiltration systems and any unlined treatment systems because of the known contamination issues across the precinct and these types of devices are not suitable for land impacted by contamination.

The workshop scenario includes up to 50% of the land use marked for research and urban services. There is potential to capture water from hard surfaces such as carparks in these areas for both reuse and to prevent it from entering the contaminated soils. Surface water runoff from carparks would be likely to include hydrocarbons, oil, grease and sediments and would require separators and potential filtration. Additionally, this solution would likely require pumping to enable reuse as treatment and storage tanks would be located below ground level noting capping of land to manage contamination. At industrial sites, runoff may include heavy metals, and treatment of these heavy metals would be required prior to reuse.

A small percentage of the precinct in the master plan is identified as open space, reducing the potential for basins and wetlands in landscaped areas, however there may be opportunities for water quality treatment measures such as raingardens in the residential and retail areas.

A major constraint to placement and feasibility of water quality treatment devices in the precinct is contamination present in the soils. A capping layer will be applied of a minimum depth of 0.5 m. If water quality treatment devices are to be located above this capping layer, this may restrict where they may be applied. Lined treatment devices such as lined swales and lined bioretention basins may be feasible if there is provision for adequate depth in the capping layer. Sheet or shallow flow options for water quality treatment may be feasible rather than channelled solutions.

There is potential for inclusion of proprietary underground water quality treatment units. These units would require depths deeper than 0.5 m of capping for installation so would need to be sealed when applied and assessed for feasibility in terms of depth.

It is unlikely that water quality treatment devices will be feasible near the river due to contamination, flooding and tidal influence. The edge of the river has noted contamination including cadmium and asbestos as well as some protected mangrove populations. It is likely to be more feasible to include source controls for water quality treatment rather than end of pipe solutions due to flooding and tidal influences constraints.

There may be an opportunity to operate a number of precinct scale water quality treatment measures such as bioretention basins or wetlands. This would reduce the maintenance and operational requirements for the treatment measures as compared to smaller measures distributed throughout the catchment, however, as noted above these would be constrained based on available depths of uncontaminated land and space. It should be noted that any additional water treatment measures would also work towards the aspiration of making the Parramatta River swimmable in the future.

The Parramatta River Catchment Group (PRCG), an alliance of councils, government agencies and community groups, has been formed with the aim to revitalise the Parramatta River into a swimmable waterway. As noted in Section 4.3 the river experiences poor water quality due to pollutants from diffuse sources including chemical contaminants from roads and industrial areas, sewer wet weather overflows and from potential legacy contaminants in the soils and groundwater.

5.2.4 STORMWATER CYCLE MANGEMENT

Section 3.3.6.2 of the Parramatta DCP requires rainwater tanks or other alternative water sources to be installed to meet 80% of the toilet and laundry sites at non-residential developments. The conditions of approval for these should consider the existing council requirements and rainwater tanks should be included to capture rainwater runoff from roof areas.

As assessment of the potential rainwater available was completed using the MUSIC software. The MUSIC model assessed the potential supply volumes of rainfall available from a roof area of 1000 m^2. The model used historic 6 minute rainfall data for the Parramatta (station 66124) for the period of 1984 to 2010. The results indicate for the period of assessment, on average less than 20 kilolitres of rainwater could be captured per day or 7 megalitres per year. Refer to Figure 5.6 which shows the output of rainfall over the assessment period.

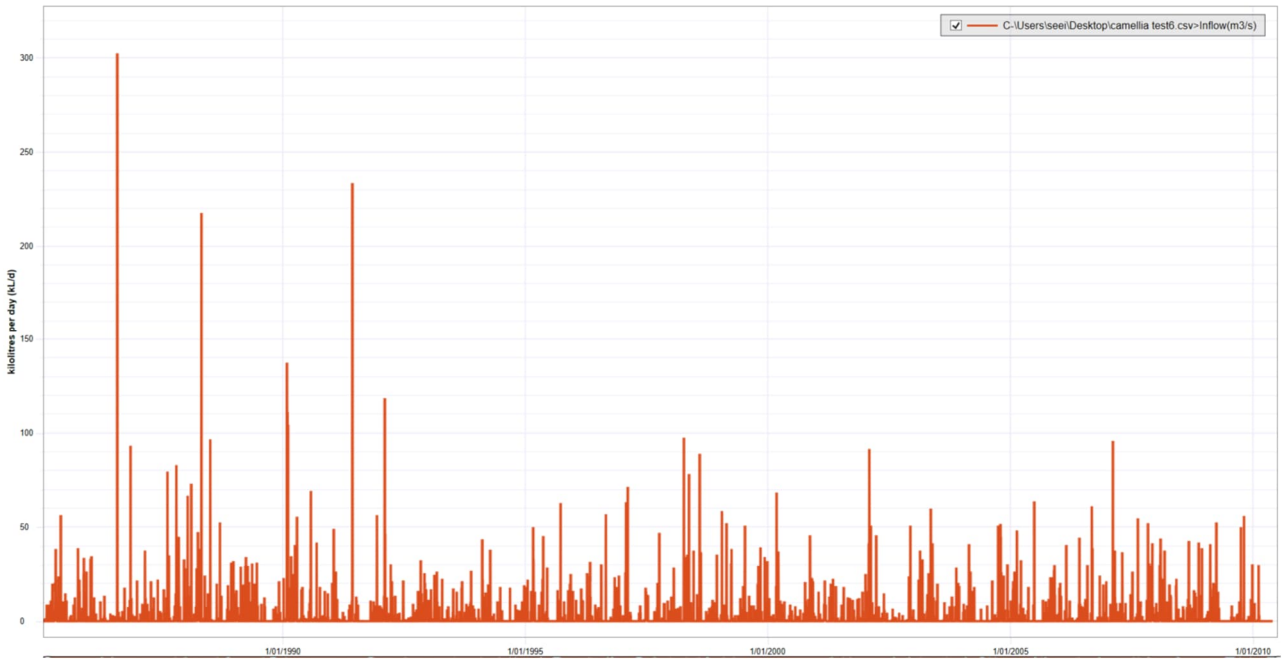


Figure 5.6 Rainwater capture kilolitres per day

6 PLANNING CONSIDERATIONS

The flood modelling and stormwater management planning considerations were developed in consultation with the City of Parramatta Council, DPE Floodplain Managers, remediation technical specialists and stakeholders in attendance at the EbD workshops. Advice has also been provided by State Emergency Services (SES). A list of recommended planning conditions has been developed as well as performance criteria that set limiting criteria on changes to flood behaviour and water quality as well as next steps to further inform any future rezoning.

6.1 RECOMMENDED PLANNING CONDITIONS

Proposed planning conditions for the precinct:

- Flood Planning Level – set the flood planning level for all habitable floor levels for the precinct to the 1% AEP including consideration of climate change projections for rainfall and sea level rise through to 2150 with 500mm freeboard.
- Land use planning to consider the Flood Hazard of the land. The table below provides development types that are compatible with each hazard category.

Table 6.1 Hazard classification and land use types

HAZARD VULNERABILITY CLASSIFICATION	DESCRIPTION	LAND USE COMPATIBILITY
H1	Generally safe for vehicles, people and buildings.	All types
H2	Unsafe for small vehicles.	All types
H3	Unsafe for vehicles, children and the elderly.	Commercial, Industrial, Hazardous industries or hazardous storage establishments, Open Space, Riparian and Wetland
H4	Unsafe for vehicles and people.	Industrial, Hazardous industries or hazardous storage Establishments, Open Space, Riparian and Wetland
H5	Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.	Open Space, Riparian and Wetland
H6	Unsafe for vehicles and people. All building types considered vulnerable to failure.	Open Space, Riparian and Wetland

- No net loss of flood storage due to cut and fill or loss of flood conveyance or significant diversion of flood flows or significant changes to hydraulic flood hazard conditions that impact on private property or impact on safe access or on evacuation routes.
- Stipulate flood compatible building design – including types of materials, fencing types around overland flow paths
- Ensure setbacks are provided from main waterways/ river areas to ensure areas of fill avoid ‘high hazard’ flood areas and for maintenance/enhancement of riparian habitats, with a minimum of 40 m from mean high water level.
- Maintain existing levels across 9 Devon Street Rosehill to minimise impacts to surrounding areas.
- Provide for flood storage across the Precinct to capture local flood runoff within impacts to be within proposed flood management objectives.
- Provide for floodways or overland flow routes across the Precinct.

- Design of a flood free evacuation route will need to look at minimising impact of the structure on Duck River, with key considerations such as minimising piers in the waterway and ensuring waterway flow on the either side of the main waterway opening. Shelter in place strategies should also be considered key to incorporate into Precinct planning.
- Investigate the creation of an area within the town centre that will remain flood–free under all circumstances and continue to provide essential community services and infrastructure.
- Provision of stormwater infrastructure to drain existing low areas of the precinct and that also incorporates storage, probably at the lot scale. Design of all drainage and storage infrastructure will need to consider site contamination and ensure any capping required is not breached.
- All new underground stormwater pit and pipe drainage design needs to be designed to capture and convey the 5% AEP design event. All overland flow paths need to be designed to safely convey the 1% AEP flows plus 50% of underground pipe flows (based on the assumption that the underground pipe has a reduced capacity of 50% due to blockage).
- Further assessment and implementation measures should be informed by the Weber and Ramilo (2022) methodology which covers sustainable supply options, improved wastewater treatment, stormwater quality improvement and hydrologic management as overarching objectives.
- IWCMS – collection of stormwater, treatment of stormwater and more natural flow release, capture of rainwater and reuse, stormwater is a resource. Development of a treatment train approach, i.e., a sequence of stormwater treatment devices or methods throughout the catchment, for stormwater quality and quantity management with a focus on prevention before treatment.
- Rainwater tanks – to provide some water to meet demands, but ensure piping and pumps are protected from contamination.
- Point source pollution control – as best as possible manage stormwater runoff at the source, such as along the edges of road and carparks, within new developments use the green spaces to treat stormwater runoff.

6.2 PERFORMANCE CRITERIA

Recommended performance criteria have been developed based on utilising the existing planning legislation and guidelines and incorporation of additional best practice conditions. The recommended performance criteria include:

- all structures to have flood compatible building components below 1% AEP flood level inclusive of climate change projections to 2150 plus 500 mm freeboard or the PMF whichever is higher
- all emergency and evacuation infrastructure to have flood compatible building components below PMF flood level plus 500 mm freeboard
- all structures are to be designed to withstand the forces of floodwater, debris and buoyancy up to the PMF
- all emergency and evacuation infrastructure structures are to be designed to withstand forces of floodwater, debris and buoyancy up to PMF flood plus 500 mm freeboard
- development must be sited, designed and located to avoid or mitigate the flood risk to people, property and infrastructure
- development should mitigate the impacts of local overland flooding through the provision of adequate site drainage systems
- development must consider and plan for emergency evacuation situations to ensure the safety of all areas within the Probably Maximum Flood extent
  - where possible, a flood-free evacuation route to a flood-free area should be provided
  - where it is not possible to provide a route to a flood-free area, every new building should be built using shelter in place principles
  - consider if a landform above the PMF flood level can be built as an area of refuge
- remediation strategy for capping and filling to be developed in unison with the flooding assessment to meet the following conditions:

  - no adverse impacts to flood levels, flood storage and flood conveyance up to the FPL and consider changes to all events up to the PMF
  - consider changes to flood hazard for all events up to the PMF
  - consider changes to water velocity where these would have impacts on scour potential and mitigate if necessary
- identify stormwater infrastructure that considers the connections of the traditional owners to the surrounding waterways
- development should be designed to meet the NSW Government's Water Quality Objectives for Parramatta River and contribute to the aspiration of the Parramatta River Catchment Group's vision for a swimmable river.
- the following strategies should be applied to the planning and design of new development to meet necessary water quality objectives:
  - maximise pervious area and vegetation coverage
  - maximise rainwater harvesting
  - maximise infiltration and evapotranspiration
  - treat any remaining runoff.

6.2.1 NEXT STEPS

The recommended next step to implement the Master Plan and Place Strategy is to prepare a precinct wide Flood Risk Study and Plan. The Flood Risk Study and Plan should include:

- a detailed flood model based on the best available 2-dimensional flood model for the site. The model should include all existing and known proposed developments (such as the Metro and Light Rail projects). The model should consider all flood events up to and including the PMF, as well as the current climate change projections. The model must extend sufficiently far upstream and downstream of the Precinct to capture all potential impacts caused by development within the Precinct.
- identification of filling and areas and where filling can occur to meet flood management performance criteria for the Precinct
- identification of compatible land uses against flood hazard categorisations in accordance with the Managing the Floodplain: A guide to Best Practice in Flood Risk management in Australia (Handbook 7, Australian Institute for Disaster Resilience, 2017) and the NSW Government's Floodplain Development Manual (2005)
- further engagement with the SES to understand emergency management for the Precinct, including both evacuation and 'shelter in place' strategies. Then ongoing engagement to inform updates to the Local Flood Plan, such as inclusion of any new roads that service the Precinct
- preparation of an Evacuation Study for the precinct that considers the flood risks for the precinct. The study would consider the proposed evacuation route over Duck River, onward evacuation route(s) from this new bridge and ultimate destinations. Evacuees from existing areas should not be placed at greater risk due to the proposal and its new evacuation route.
- further engagement with City of Parramatta Council regarding the progress of the Parramatta River Flood Study and A'Becketts Creek Flood Study and any relevant developments in flood policy, such as the Parramatta CBD Planning Proposal and Parramatta City Centre DCP.

7 LIMITATIONS

Key limitations to the assessment presented in this report include:

- this assessment provides a high-level assessment of each of the master plan developed during Enquiry by Design workshop in June 2021. More detailed assessment will follow at a later stage as per the recommendations
- flood modelling analysis is based on methodologies from Australian Rainfall and Runoff (ARR) 1987 guidelines (which have now been updated to ARR19).

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APPENDIX A

WATER QUALITY OBJECTIVES

A1 WATER QUALITY OBJECTIVES

Table A.1 shows the current environmental values and water quality objectives for the Precinct. It is noted that the Parramatta River and Duck River do not achieve the WQO for primary contact recreation, however, given the City of Parramatta Council initiative 'Our Living River' which aims to revitalise the Parramatta River to make it safe and swimmable, the WQO for the Primary Contact Recreation environmental value are included in Table A.2.

Table A.1 Water quality objectives in the Sydney Harbour and Parramatta River catchment

WATER QUALITY OBJECTIVE	INDICATOR	TRIGGER VALUE OR CRITERIA
Aquatic ecosystems (Lowland rivers)		
Maintaining or improving the ecological condition of waterbodies and their riparian zones over the long term	Total phosphorus	25 µg/L for rivers flowing to the coast; 50 µg/L for rivers in the Murray-Darling Basin
	Total nitrogen	350 µg/L for rivers flowing to the coast; 500 µg/L for rivers in the Murray-Darling Basin
	Chlorophyll-a	5 µg/L
	Turbidity	6–50 NTU
	Salinity (electrical conductivity)	125–2200 µS/cm
	Dissolved oxygen	85–110%
	pH	6.5–8.5
	Temperature	See ANZECC 2000 Guidelines, table 3.3.1.
	Chemical contaminants or toxicants	See ANZECC 2000 Guidelines, chapter 3.4 and table 3.4.1.
	Biological assessment indicators	This form of assessment directly evaluates whether management goals for ecosystem protection are being achieved (e.g. maintenance of a certain level of species diversity, control of nuisance algae below a certain level, protection of key species, etc). Many potential indicators exist and these may relate to single species, multiple species or whole communities. Recognised protocols using diatoms and algae, macrophytes, macroinvertebrates, and fish populations and/or communities may be used in NSW and interstate (e.g. AusRivAS).
Visual amenity		
Aesthetic qualities of waters	Visual clarity and colour	Natural visual clarity should not be reduced by more than 20%. Natural hue of the water should not be changed by more than 10 points on the Munsell Scale. The natural reflectance of the water should not be changed by more than 50%.
	Surface films and debris	Oils and petrochemicals should not be noticeable as a visible film on the water, nor should they be detectable by odour. Waters should be free from floating debris and litter.
	Nuisance organisms	Macrophytes, phytoplankton scums, filamentous algal mats, blue-green algae and sewage fungus and leeches should not be present in unsightly amounts.

WATER QUALITY OBJECTIVE	INDICATOR	TRIGGER VALUE OR CRITERIA
Secondary contact recreation		
Maintaining or improving water quality for activities such as boating and wading, where there is a low probability of water being swallowed	Faecal coliforms	Median bacterial content in fresh and marine waters of < 1000 faecal coliforms per 100mL, with 4 out of 5 samples < 4000/100mL (minimum of 5 samples taken at regular intervals not exceeding one month).
	Enterococci	Median bacterial content in fresh and marine waters of < 230 enterococci per 100mL (maximum number in any one sample: 450-700 organisms/100mL).
	Algae & blue-green algae	< 15 000 cells/mL
	Nuisance organisms	Use visual amenity guidelines. Large numbers of midges and aquatic worms are undesirable.
	Chemical contaminants	Waters containing chemicals that are either toxic or irritating to the skin or mucous membranes are unsuitable for recreation. Toxic substances should not exceed values in Tables 5.2.3 and 5.2.4 of the ANZECC 2000 Guidelines.
	Visual clarity and colour	Use visual amenity guidelines.
	Surface films	Use visual amenity guidelines.
Irrigation water supply		
Protecting the quality of waters applied to crops and pasture	Algae & blue-green algae	Should not be visible. No more than low algal levels are desired to protect irrigation equipment.
	Salinity (electrical conductivity)	To assess the salinity and sodicity of water for irrigation use, several interactive factors must be considered including irrigation water quality, soil properties, plant salt tolerance, climate, landscape and water and soil management. For more information, refer to Chapter 4.2.4 of ANZECC 2000 Guidelines.
	Thermotolerant coliforms (faecal coliforms)	Trigger values for thermotolerant coliforms in irrigation water used for food and non-food crops are provided in Table 4.2.2 of the ANZECC Guidelines
	Heavy metals and metalloids	Long term trigger values (LTV) and short-term trigger values (STV) for heavy metals and metalloids in irrigation water are presented in Table 4.2.10 of the ANZECC 2000 Guidelines.

WATER QUALITY OBJECTIVE	INDICATOR	TRIGGER VALUE OR CRITERIA
Aquatic foods (cooked)		
Refers to protecting water quality so that it is suitable for the production of aquatic foods for human consumption and aquaculture activities. (Note: The ANZECC 2000 Guidelines lists this environmental value as Aquaculture and human consumption of aquatic foods)	Algae & blue-green algae	No guideline is directly applicable, but toxins present in blue-green algae may accumulate in other aquatic organisms.
	Faecal coliforms	Guideline in water for shellfish: The median faecal coliform concentration should not exceed 14 MPN/100mL; with no more than 10% of the samples exceeding 43 MPN/100mL. Standard in edible tissue: Fish destined for human consumption should not exceed a limit of 2.3 MPN E Coli /g of flesh with a standard plate count of 100,000 organisms /g.
	Toxicants (as applied to aquaculture activities)	Copper: less than 5 µgm/L. Mercury: less than 1 µgm/L. Zinc: less than 5 µgm/L. Organochlorines: Chlordane: less than 0.004 µgm/L (saltwater production) PCB's: less than 2 µgm/L.
	Physico-chemical indicators (as applied to aquaculture activities)	Suspended solids: less than 40 5 µgm/L (freshwater) Temperature: less than 2 degrees Celsius change over one hour.
Industrial water supplies	The high economic value of water taken from rivers and lakes for use by industry needs recognition in water quality planning and management. It has been identified as an important environmental value through community consultation. As industry water supply needs are diverse, relevant water quality criteria are not summarised here and the ANZECC 2000 Guidelines do not provide guidance on the water quality needed for various industries. Sources of water used for industry invariably have other environmental values, which mostly need water of a higher quality than that needed by industry. Further, individual industries generally have the capacity to monitor and treat the available water resources to meet their own needs.	

Table A.2 Primary contact WQO

WATER QUALITY OBJECTIVE	INDICATOR	TRIGGER VALUE OR CRITERIA
Primary contact recreation		
Maintaining or improving water quality for activities such as swimming in which there is a high probability of water being swallowed	Turbidity	A 200mm diameter black disc should be able to be sighted horizontally from a distance of more than 1.6m (approximately 6 NTU).
	Faecal coliforms	Beachwatch considers waters are unsuitable for swimming if: — The median faecal coliform density exceeds 150 colony forming units per 100 millilitres (cfu/100mL) for five samples taken at regular intervals not exceeding one month, or — The second highest sample contains equal to or greater than 600 cfu/100mL (faecal coliforms) for five samples taken at regular intervals not exceeding one month. ANZECC 2000 Guidelines recommend: — Median over bathing season of < 150 faecal coliforms per 100mL, with 4 out of 5 samples < 600/100mL (minimum of 5 samples taken at regular intervals not exceeding one month).
	Enterococci	Beachwatch considers waters are unsuitable for swimming if: — The median enterococci density exceeds 35 cfu/100mL for five samples taken at regular intervals not exceeding one month, or — The second highest sample contains equal to or greater than 100 cfu/100mL (enterococci) for five samples taken at regular intervals not exceeding one month. ANZECC 2000 Guidelines recommend: — Median over bathing season of < 35 enterococci per 100 mL (maximum number in any one sample: 60-100 organisms/100 mL).
	Protozoans	Pathogenic free-living protozoans should be absent from bodies of fresh water. (Note, it is not necessary to analyse water for these pathogens unless temperature is greater than 24 degrees Celsius).
	Algae & blue-green algae	< 15 000 cells/mL
	Nuisance organisms	Use visual amenity guidelines.
	Faecal coliforms	Large numbers of midges and aquatic worms are undesirable.
	pH	5.0-9.0
	Temperature	15°-35°C for prolonged exposure.
	Chemical contaminants	Waters containing chemicals that are either toxic or irritating to the skin or mucus membranes are unsuitable for recreation. Toxic substances should not exceed the concentrations provided in Tables 5.2.3 and 5.2.4 of the ANZECC 2000 Guidelines 2000.
	Nuisance organisms	Use visual amenity guidelines. Large numbers of midges and aquatic worms are undesirable
	Visual clarity and colour	Use visual amenity guidelines
	Surface films	Use visual amenity guidelines

APPENDIX B

EXISTING CONDITIONS

B1 SITE DESCRIPTION/CONTEXT

B1.1 LOCALITY

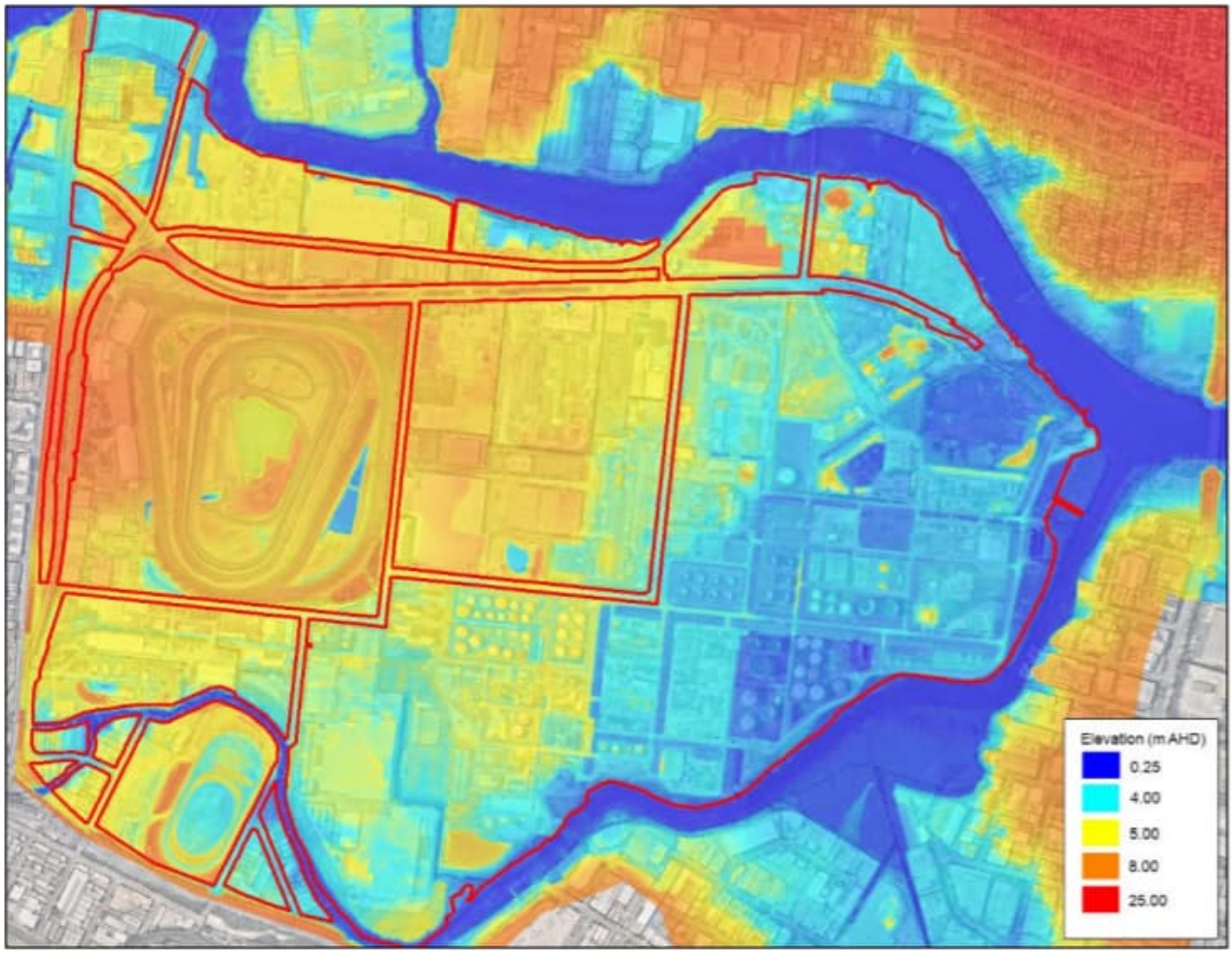
The Camellia-Rosehill precinct is bounded by the Parramatta River to the North, by Duck River and the M4 Motorway to the South, and to the west by James Ruse Drive. It consists of the suburbs of Camellia and parts of Rosehill and Clyde. Existing land use within the precinct is predominately industrial. The Rosehill Gardens Racecourse and now decommissioned Sydney speedway are also located within the precinct. The old speedway site is proposed for use as a maintenance facility for the proposed Sydney Metro West. There is one existing residential development within the precinct.

Figure B.1 Camellia Precinct and waterways

At the confluence of Duck River and Parramatta River, the Parramatta River catchment is about 170 km^2. The Precinct is subject to flooding from the surrounding waterways. Details of flooding constraints are provided in Section B2.2.

B1.2 SITE TOPOGRAPHY

The Precinct comprises low lying land sloping from a high point of along James Ruse Drive, falling to approximately 8 mAHD at Rosehill Gardens Racecourse and falling further to less than 4 mAHD in the east near the confluence of the Parramatta and Duck Rivers. The Precinct drains naturally to the Parramatta River and the Duck River. The south-west corner of the Precinct is also drained by Duck Creek, a tributary of Duck River, and a small section of A'Becketts Creek which drains into Duck Creek. The precinct topography is shown in Figure B.2 below.



Source: Camellia Precinct - Drainage and Flooding Study Stage 2 report (Cardno, 2015)

Figure B.2 Camellia Precinct topography

B1.3 CLIMATE AND RAINFALL

Camellia's climate is classified as warm and temperate. Climatic condition in the area are moderate with a warm summer, cool to cold winter and reliable rainfall throughout the year. The mean monthly maximum temperature is 28ºC in summer and mean monthly minimum of around 7ºC in winter (Bureau of Meteorology, station 066124).

The average annual rainfall in this area was 966 mm between 1965 and 2021 (Bureau of Meteorology, station 066124). The annual average evaporation in the area is around 1200 mm based on data from between 1961 and 1990 and the average areal actual evapotranspiration is around 600 mm (Source: BOM average evaporation and average actual areal evapotranspiration maps, www.bom.gov.au).

B1.3.1 CLIMATE CHANGE

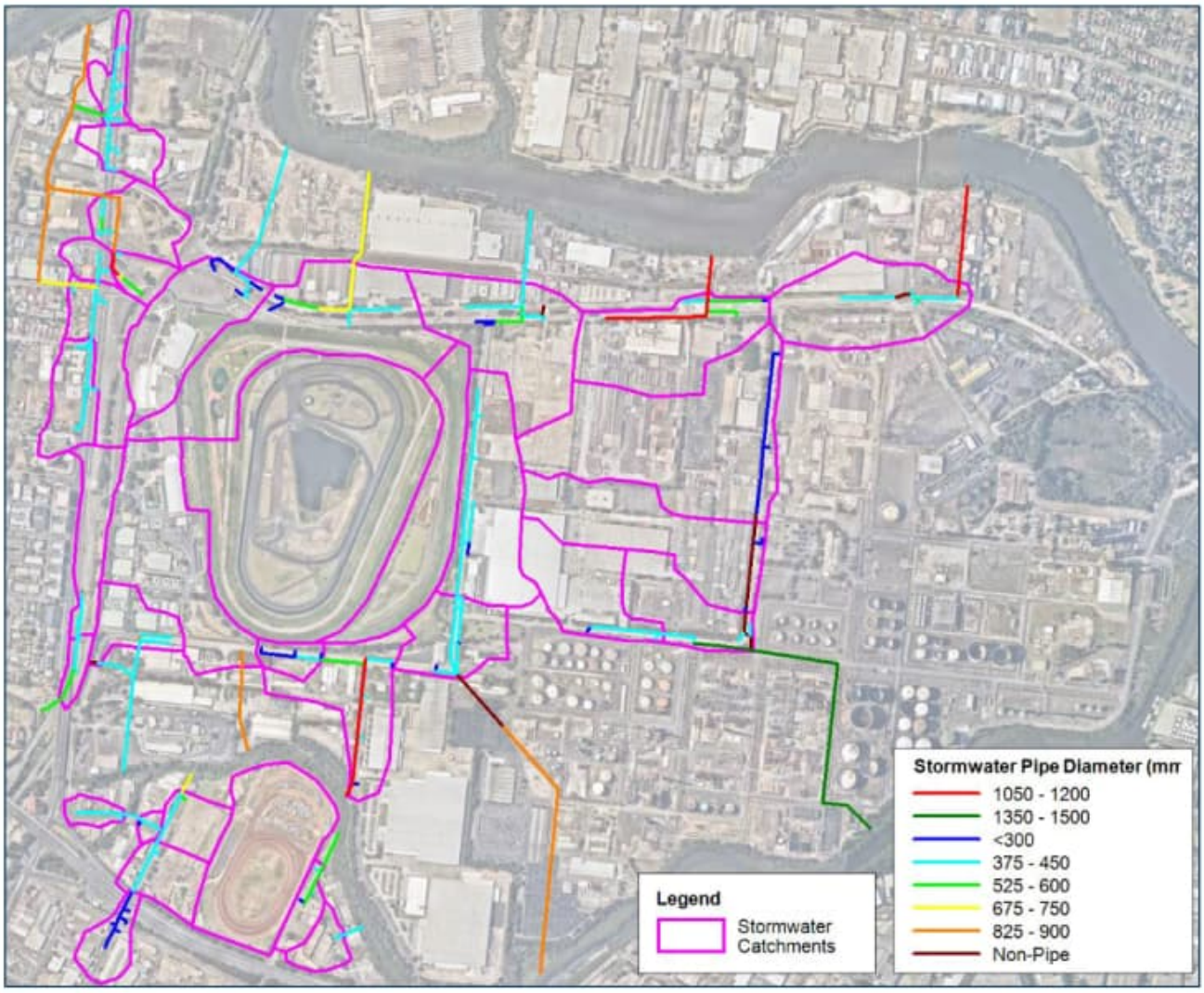
There is now widespread acceptance that human activities are contributing to observed climate change. Australian Rainfall and Runoff (ARR2019) provides guidance on understanding these changes specific to different areas across Australia based on predictions from the Climate Futures web tool developed by the CSIRO. Information within this tool is based on the CSIRO Natural Resource Management (NRM) 'clusters' for which the Camellia Precinct is located within the NSW East Coast South Cluster. The CSIRO information indicates that for this area the Global Climate Models (GCMs) are predicting a temperature increase of 2.9 to 4.6 degrees by 2090 for high emission scenario (RCP 8.5). Under an intermediate scenario (RCP4.5) the projected warming is 1.3 to 2.5 degrees (CSIRO and Bureau of Meteorology, Climate Change in Australia website, accessed 5/5/21).

In relation to rainfall, the models predict possible overall decrease in rainfall, particularly in winter months within the cluster, with possible greater time spent in drought conditions. They also predict with high confidence an increase in rainfall intensity during extreme events. ARR 2019 provides a procedure for estimating the increase in rainfall intensity due to these climate change projections. Using this procedure, under the intermediate emissions scenario (RCP4.5) rainfall intensities at the Camellia precinct are predicted to increase by approximately 4% by 2030 and by 10% by 2090. Under the high emission scenario (RCP 8.5), this increases to 5% and 20% by 2030 and 2090 respectively. The flood modelling developed for design of the PLR adopted a 30% increase in rainfall intensity as representative of 2090 climate change impacts (WSPAJV, 2020). This assumption will also be used for this study as it provides a consistent approach and a slightly conservative analysis.

Projected future changes to global mean sea levels have also been modelled under various emissions scenarios. These models suggest that based on RCP8.5 sea level rise of 0.9m would be expected by 2100 and around 2 m by 2150 (IPCC, 2019). Assessment of the impacts that these predictions would have on flood levels across the precinct will be considered for both the 2100 and 2150 sea level rise scenarios. Further considerations will be given to combined impact of the sea level rise and increased rainfall intensity for 2100 and 2150.

B1.4 STORMWATER NETWORK

City of Parramatta Council owned stormwater pipes within the Camellia precinct are shown in Figure B.3 below.



Source: Camellia Precinct - Drainage and Flooding Study Stage 2 report (Cardno, 2015)

Figure B.3 Council stormwater network – Camellia Precinct

An assessment of the current capacity of the public domain stormwater network found that:

- of the 31 assessed subcatchments in Camellia Precinct, 23 of these subcatchments do not currently provide for Council's recommended minimum capacity for 'Street drainage' (capacity for 5%AEP); and
- assessing the inlet capacity against Council's requirement for 5%AEP capacity, 18 of the 31 subcatchments in Camellia Precinct do not have sufficient inlet capacity to capture the 5%AEP runoff (Cardno,2015).

Local subcatchments which are assumed to not drain to Council's drainage system include:

- Rosehill Racecourse: The Rosehill racetrack drains to the water body at the centre of the race track. It is assumed that runoff from this catchment is harvested for local irrigation by the Australian Turf Club
- Rosehill East: Similarly, the eastern portion of Rosehill racecourse is assumed to drain to two low-lying water bodies within the site; Rosehill Racecourse

- Sydney Speedway: The now decommissioned Sydney speedway is surrounded by an elevated bund for spectators, therefore run-off from the site is trapped in the centre of the racetrack. This site is proposed for future use as a maintenance facility for Sydney Metro West. This would see large portions of this area which are currently grassed or bare dirt being paved. Paving of currently extensive pervious areas would increase site runoff rates and volumes, with potential to increase peak flood flows and levels downstream. The Sydney Metro West EIS Hydrology and flooding Technical paper notes that on-site stormwater detention would be provided for the Clyde stabling and maintenance facility site to manage peak site runoff rates and volumes due to increased imperviousness of the site (Jacobs, 2020).

Limited data is available on stormwater drainage within private industrial properties. The 2015 assessment of the drainage network assumed these areas would drain following natural topography, with flow reaching the public drainage systems as overland flow and that no substantial diversion of runoff occurs within the area. It also noted that drainage on private land downstream of the public drainage network (i.e. closer to the banks of the watercourse) drain directly to the receiving watercourse (Cardno, 2015).

B1.5 WATER QUALITY

The Parramatta River has been monitored at a number of locations by the City of Parramatta Council and Sydney Water. Monitoring frequency, indicators and length of the record varies between the sites. The Duck River also has several sites where water quality monitoring has occurred. Details of this monitoring data have been reported in both Strategic Analysis of Water Quality in the Parramatta River (Jacobs & UNSW 2016), Parramatta Light Rail Stage 1 Water Quality Working Paper (Jacobs, 2017) and within Chapter 19 of Sydney Metro West EIS (Jacobs 2020). These reports note that generally, water quality in the vicinity of the Camellia precinct area is poor, especially with respect to nutrient concentrations.

The Parramatta River catchment has a long history of urbanisation and development, including heavy industrial development. The catchment is known to contain contaminated sediments, with high concentrations typically associated with point sources (e.g. former industrial sites) or where creeks and stormwater outlets enter the estuary (Cardno, 2008). In addition to contaminated sediments, there are areas that have a high probability of occurrence for Acid Sulfate Soils (ASS) throughout the catchment with Parramatta LEP 2011 maps showing affectation across the entire precinct (Parramatta LEP, 2011 & Jacobs, 2017). Contamination specific to the Precinct is discussed within the *Remediation Strategy Baseline Analysis Report* being prepared as part of this package of work. This report notes that due to a long history of industrial land use, contamination should be considered a potential constraint across the entire Precinct. Industrial contaminants across the precinct may include, but are not limited to hexavalent chromium, asbestos, petroleum hydrocarbons, chlorinated hydrocarbons and arsenic.

The water quality monitoring records show that typically, following wet weather the water quality of the Parramatta River deteriorates. Elevated concentrations of nutrients and metals are noted to be recorded above the recommended limits for protection of aquatic ecosystems. Water quality of the Parramatta River following wet weather is poor due to catchment runoff and stormwater inflow (Jacobs, 2017).

Similarly, high levels of nutrients in Duck River are noted to be largely due to the highly industrialised and urbanised catchments surrounding this River. Additionally, Council have identified sites adjacent to the river containing unhealthy landfill and there are known sites of contamination near Duck River (Jacobs & UNSW, 2016).

As with many waterways, there is a push to improve the quality of the Parramatta River catchment. The Parramatta River Catchment Group has developed the *Parramatta River Masterplan – ten steps to a living river*, which aims to improve water quality such that the river is swimmable once again. This plan promotes improving water quality through implementation of catchment management measures and ensuring a detailed water quality monitoring network to support management decisions (Parramatta River Catchment Group, https://www.ourlivingriver.com.au/, accessed 5/5/21).

B1.6 WATER SUPPLY AND WASTEWATER MANAGEMENT

B1.6.1 DRINKING WATER

Water supply (drinking water quality) to the Camellia-Rosehill Precinct is currently provided through Sydney Water's Prospect East Trunk Water Delivery System. The Ryde Gravity Water Reservoir Zone forms part of this system and currently services the precinct.

It is understood that the Sydney Water network would have capacity within the existing system to service initial development in the Precinct. However, full development of the Precinct would require amplification to the trunk water network to ensure water demand is met (NSW Planning & Environment, 2015).

B1.6.2 WASTEWATER

The Camellia-Rosehill Precinct is sewered as part of Sydney Water's North Head Wastewater System. This system services an equivalent population of 1.1 million people and serves the area from Seven Hills in the west, south to Bankstown and north to Ku-ring-gai and Collaroy. Sewage Pumping Station 67 (SP0067) is located within the Precinct near the Camellia light rail Station and currently services 195,000 people. There are also a number of smaller private pumping stations located in the Precinct.

Sydney Water have indicated that there would be capacity in the existing system to service initial development in the Precinct. However, amplification of the pumping station and downstream assets would likely be required for the full development of the Precinct (NSW Planning & Environment, 2015).

B1.6.3 ROSEHILL RECYCLED WATER SCHEME

The Rosehill Recycled Water Scheme is a water recycling project that began operating October 2011. It was developed under the NSW Government's Metropolitan Water Plan with the aim to increase water recycled in Sydney by encouraging industrial and irrigation customers to use recycled water instead of drinking water.

The scheme takes secondary treated wastewater from Sydney Water's Liverpool to Ashfield Pipeline and provides further treatment by ultrafiltration and reverse osmosis. This high-quality recycled water then supplied for use in cooling towers, boilers and some manufacturing processes, as well as for irrigation and firefighting. The scheme initially supplied over three billion litres of high-quality recycled water to six foundation customers – these customers include the Australian Turf Club (Rosehill Gardens Racecourse) and five of Sydney's largest industrial water users in the in the Rosehill and Smithfield areas (Sydney Water, 2012).

AquaNet Sydney (part of the Water Utilities Australia), built and owns the pipelines and operates the recycled water supply network. The Fairfield Recycled Water Plant was built and is owned and operated by Veolia Water. Sydney Water provides the secondary treated wastewater to the Fairfield plant, and then purchases the high-grade recycled water from AquaNet Sydney to sell it to the six foundation customers, who have recycled water supply agreements with Sydney Water.

AquaNet are also supplying recycled water to three extra customers in the nearby areas of Rosehill, Camellia and Yennora, and will retail recycled water directly to other future customers. They have the capacity to produce up to 7.3 billion litres per annum of recycled water (https://wua.com.au/our-business/aquanet, accessed 5/5/21).

B2 CONSTRAINTS

B2.1 STORMWATER NETWORK

As discussed in section B1.4, the existing Council stormwater network does not provide capacity to meet Parramatta Council's requirement of providing for 5%AEP event. The drainage network would need to be upgraded to ensure that Council's recommended capacity is achieved. Additional considerations for upgrade to stormwater network include:

- any new development would be expected to implement On-Site Detention to limit site discharges to greater than existing conditions
- minimum cover requirements for upgraded network need considering, and constraints posed by any contaminated soils
- multiple existing and future land uses posing challenges for consistent stormwater treatment approach
- stormwater management scale considerations – are these at precinct vs. lot scale, consideration needs to be given to the ultimate ownership of assets.

B2.2 FLOODING

B2.2.1 FLOOD RISK

The precinct is subject to flooding from multiple sources. These include:

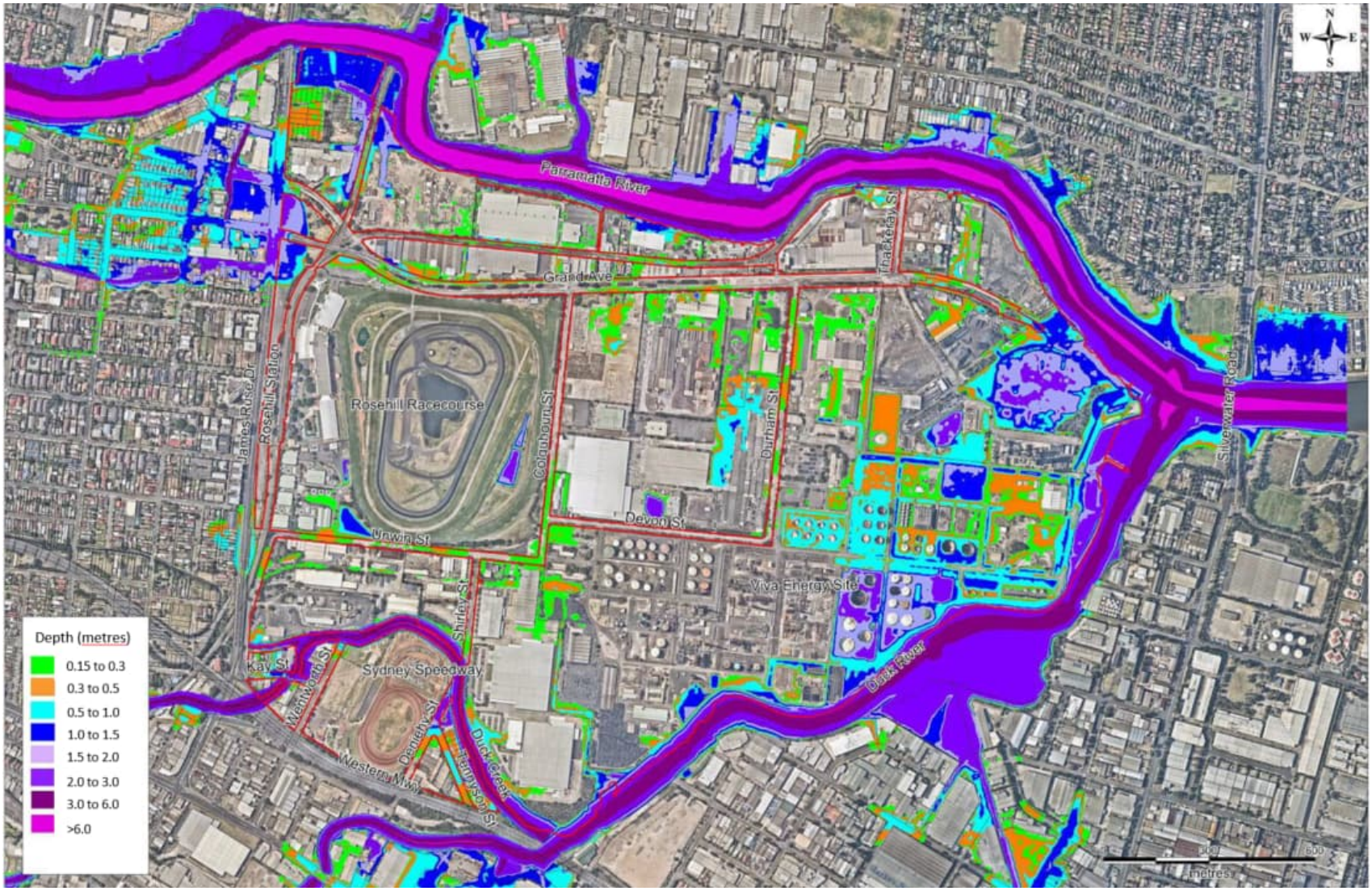
- local runoff
- Parramatta River
- Duck River
- Duck Creek
- A'Becketts Creek.

City of Parramatta Council's existing flood inundation and hydraulic flood hazard mapping used to inform planning is based on details from the following studies:

- Lower Parramatta River Flood Study and Floodplain Risk Management Study and Plan (SKM/ Don Fox Planning, 2005). This study was commissioned by City of Parramatta Council to update the previous data (from a 1986 study) on flood levels and extents and focused on the reach between Charles Street weir and Ryde Bridge. The study updated catchment hydrology and updated detail within the widely used and accepted MIKE-11 hydraulic model. City of Parramatta Council adopted the design flood levels from this duty for planning purposes in 2005.
- Duck River Flood Study and Floodplain Risk Management Study and Plan, (WMAWater / Molino Stewart, 2012). This study reviewed and extended previous flood studies of the Duck Creek and Duck River floodplain and provided a consistent flood modelling approach within Auburn and Parramatta LGAs along Duck River.
- Draft A'Becketts Creek Drainage Master Plan (GHD, 2009).
- A'Becketts Creek SWC No.46 Catchment Management Study, (Bewsher Consulting, 1990).
- Revision of Flood Levels as a Consequence of the Duck Creek SWC No.35 Catchment Management Study (Water Board, 1993).

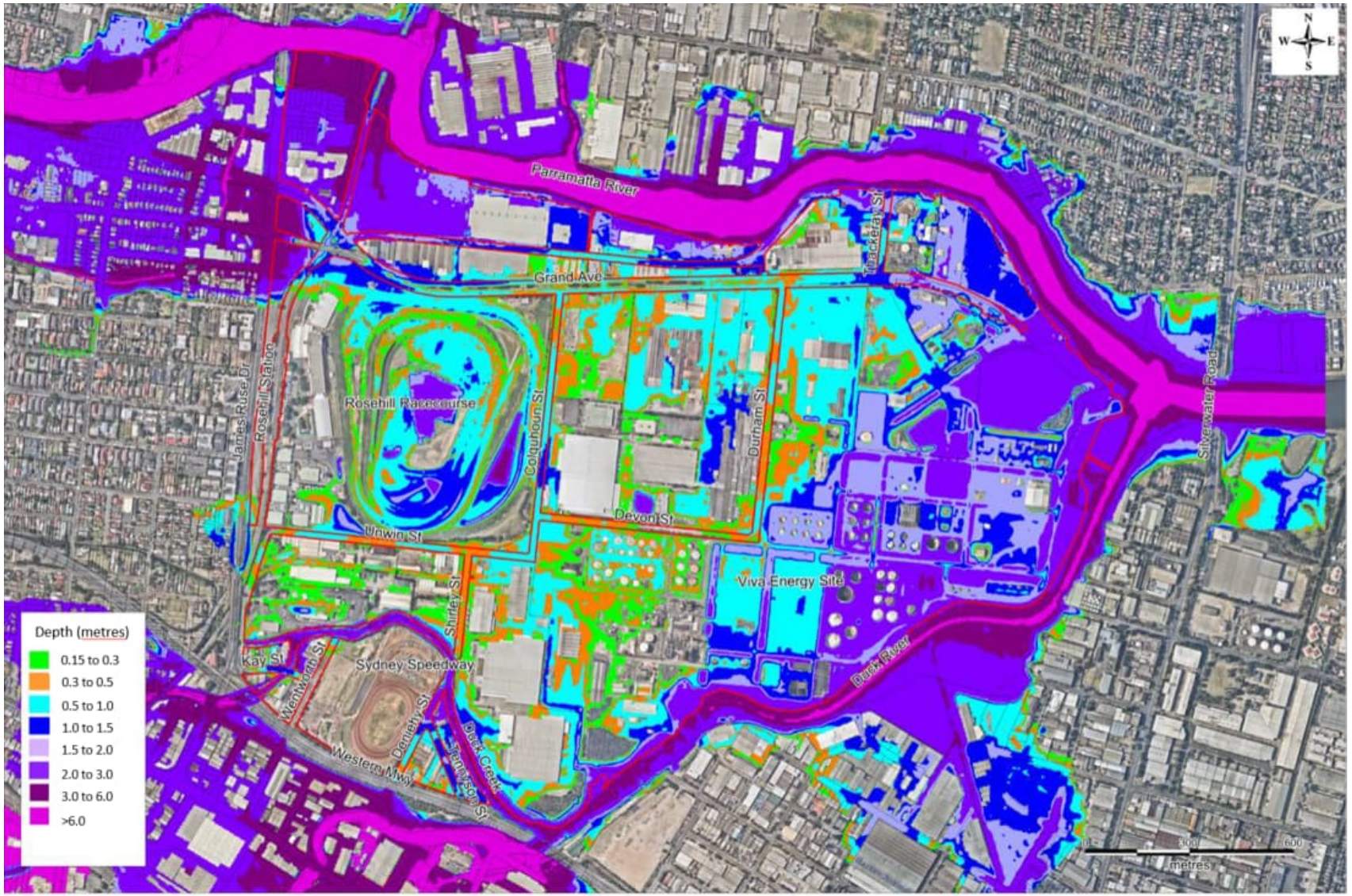
To gain a better understanding of existing flood conditions specific to the precinct, a flooding assessment of the Camellia Precinct was completed as part of site background & future land use investigations (Cardno, 2015). This assessment developed a 1D/2D TUFLOW model for the precinct based on combining previously developed 1D/2D floodplain models of the lower Clay Cliff Creek, Duck Creek and Duck River floodplains and the MIKE-11 Parramatta River sections, ALS data and site survey and boundary conditions obtained from Council's MIKE-11 model as appropriate. The modelling was used to better understand flood extents and risk across the precinct.

The estimated 1%AEP and PMF flood extents and depths across the precinct based on the Camellia Precinct modelling are shown in Figure B.4 and Figure B.5 below. It is noted that this modelling was completed in 2015 was based on Australian Rainfall and Runoff (ARR) 1987 procedures. ARR was updated in 2019 and now provides updated guidance and recommendations relating to hydrologic and hydraulic modelling. It is noted that ARR 2019 hydrology generally has lower rainfall depths when compared to the ARR 1987 design rainfall. Sensitivity analysis to understand the difference in flooding response in the area based on changes within the guidelines was completed as part of the PLR detailed design. This found that use of ARR2019 produced lower water levels across the floodplain and smaller volumes of runoff from the local catchments in comparison to ARR1987 due to the lower rainfall intensities (WSPAPJV, 2020). Use of ARR87 approaches for this analysis is therefore considered to provide a slightly conservative flood assessment.



Source: Camellia Precinct - Drainage and Flooding Study Stage 2 report (Cardno, 2015)

Figure B.4 1%AEP flood depths Camellia Precinct



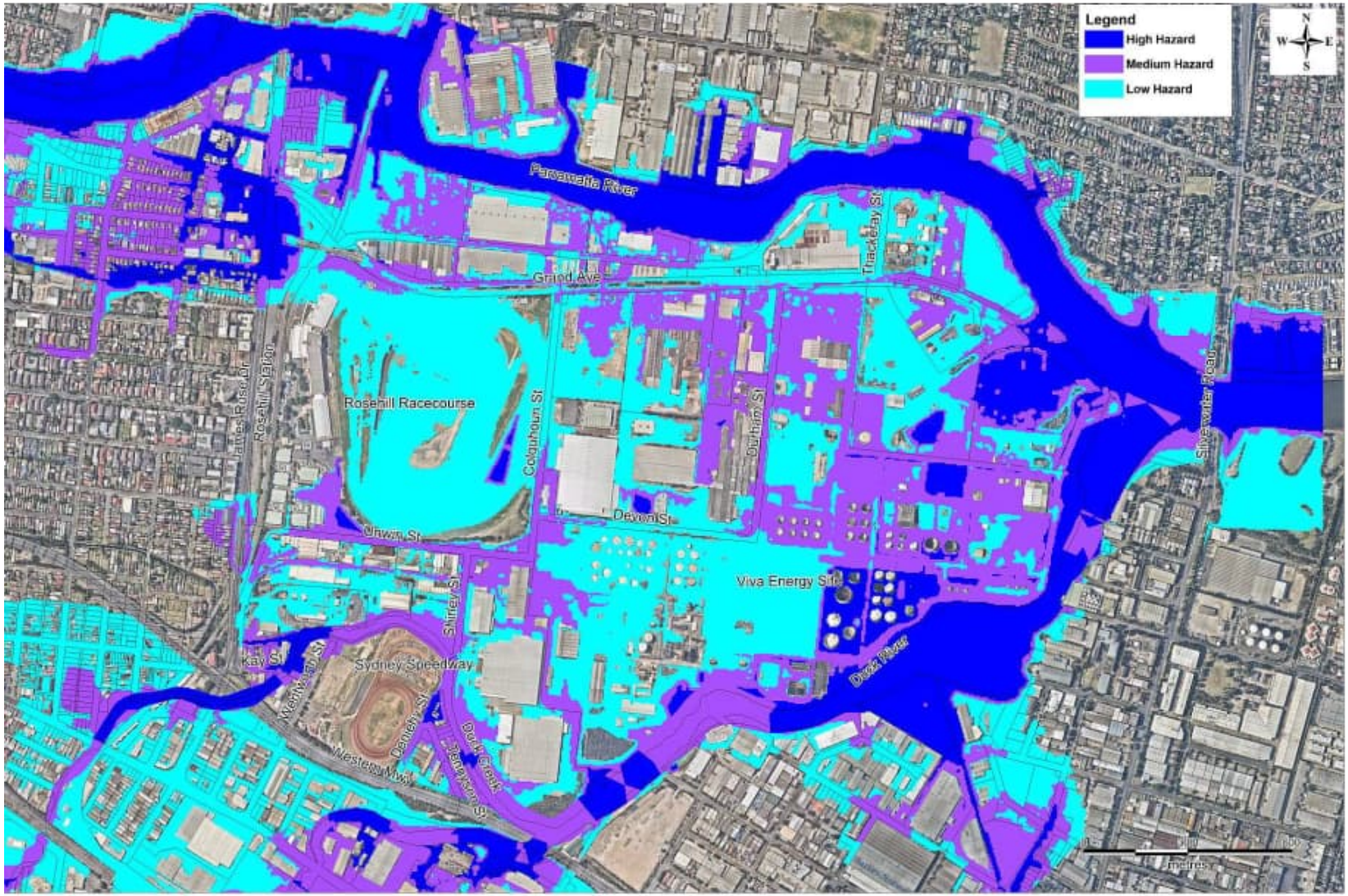
Source: Camellia Precinct - Drainage and Flooding Study Stage 2 report (Cardno, 2015)

Figure B.5 PMF flood depths Camellia Precinct

Flood affectation can be categorised into three preliminary risk categories which provide the basis for strategic planning and development controls. Preliminary findings from the Cardno 2015 modelling identified the following (refer to Figure B.6):

- High risk – predominantly restricted to Duck Creek, Duck River and Parramatta River watercourses but also includes:
  - south-west area of the precinct near Kay Street affected by flooding from Duck Creek
  - the southern side of Duck Creek affecting parts of Deniehy Street and Tennyson Road, as well as adjoining industrial land
  - significant proportions of the eastern portion of the Viva Energy site near confluence of Duck River and Parramatta River
  - low-lying area along the western boundary of the precinct adjoining Clay Cliff Creek bounded by Grand Ave to the north and the rail line to the east; and
  - the north-west corner of the precinct.
- Medium risk – predominantly fringes the high-risk areas, but also includes:
  - Shirley Street near Duck Creek as well as an overland flowpath within the Viva Energy site to the east of Shirley Street that discharges to Duck River; and
  - flood runner originating from the Parramatta River near Thackeray Street which flows through industrial properties to the eastern end of Grand Avenue, re-connecting with the Parramatta River near Clyde Wetland.
- Low risk – the majority of the remainder of the precinct is located in the low risk precinct with the exception of the western portion of the Rosehill Racecourse.

Current flood planning controls applicable to the Camellia Precinct provide minimum requirements which will need to be taken into consideration during the precinct planning stage. Section 2 of the Parramatta DCP 2011 describes site planning considerations including design objectives, design principles and design controls. Within Section 2, Table 2.4.2.1.2 provides a matrix that provides details of appropriate land use and requirements within different areas of the floodplain based on flood risk definition (high, medium or low risk categories). The mapping of the flood risk precincts (Figure B.6) provides an indication of the development controls that are relevant throughout the Camellia Precinct. As an indication, within the high-risk category a number of land uses are unsuitable including residential and commercial development without appropriate mitigation.



Source: Camellia Precinct - Drainage and Flooding Study Stage 2 report (Cardno, 2015)

Figure B.6 Camellia Precinct – Preliminary flood risk rating

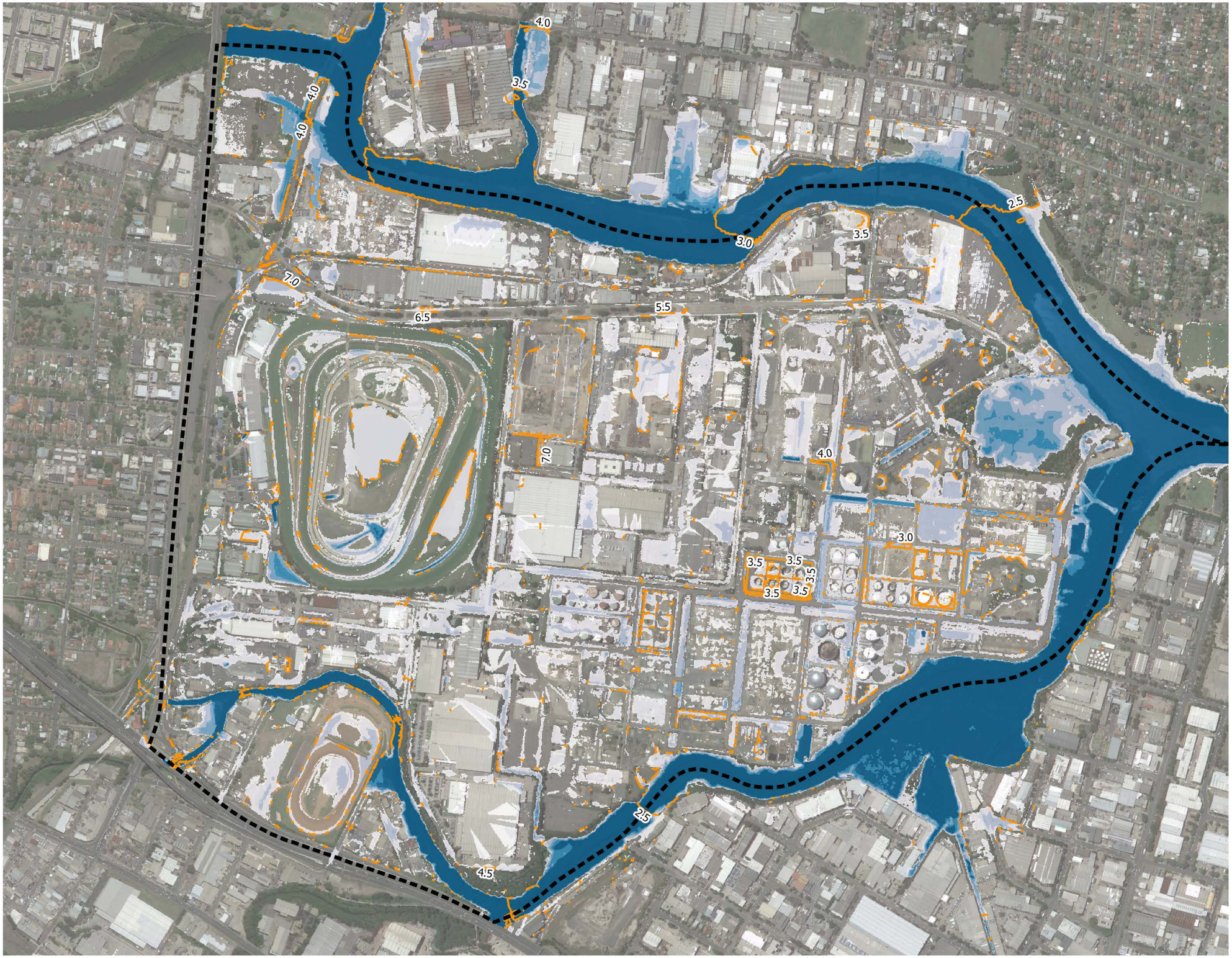
B2.3 WATER QUALITY

As noted in Section B1.5, water quality in the Parramatta River and Duck River is known to deteriorate during and immediately following wet weather. Managing and appropriately treating stormwater from the precinct prior to it entering the waterways will be vital in helping improve the quality of the local waterways. There are key constraints at the Camellia precinct to managing water quality. These include:

- limited space for incorporating Water Sensitive Urban Design features such as wetlands (which are particularly useful for nutrient removal)
- there is contaminated land within the precinct – need to ensure contaminants do not enter waterways with any stormwater runoff.

APPENDIX C

FLOOD MAPS



LEGEND

Camellia Rosehill Precinct Boundary

20yr Pre-Dev 0.5m Water Level Contour

Pre-Development 20yr ARI
Depth (m)

- <= 0.1
- 0.1 - 0.3
- 0.3 - 0.6
- 0.6 - 0.9
- 0.9 - 1.2
- > 1.2

REV	Description	Date	Approved
B	FINAL MASTERPLAN	2022-05-09	KB
A	ISSUED	2021-12-14	KB

Scale 1:10000

0 0.2 0.4 0.6 km

STATUS

Oringinal Size	A3	Drawn	QGIS
Coordinate System	MGA56	Designed	SL
Height Datum	AHD	Date Printed	09/05/2022

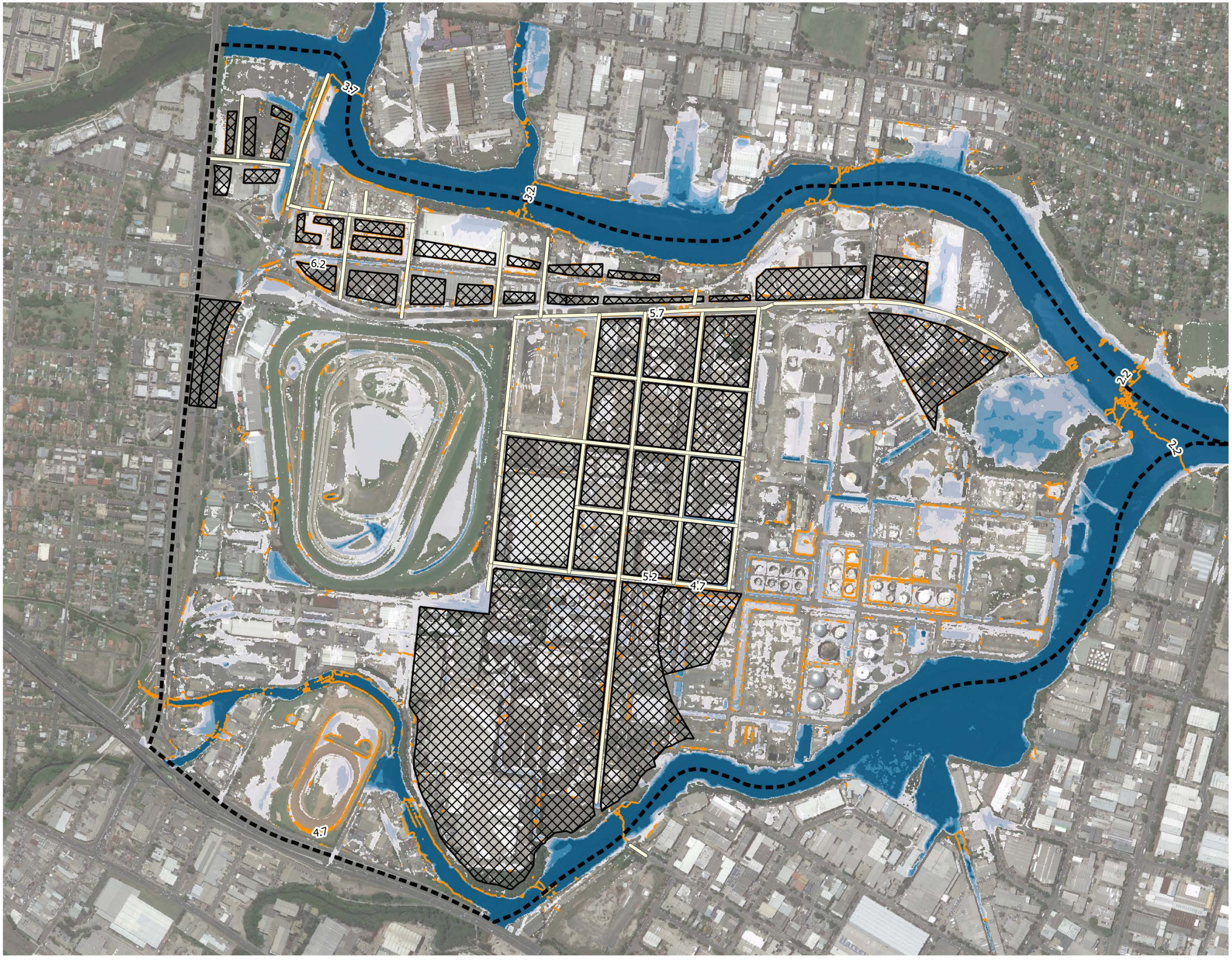
N

5% AEP Depths and Water Level Contours

Camellia Rosehill Place Strategy

Pre-Development

Figure 1 Appendix A



wsp

LEGEND

- Camellia Rosehill Precinct Boundary
- Building Footprint
- Proposed Roads
- 20yr Post-Dev 0.5m Water Level Contour

Post-Development 20yr ARI Depth (m)

- <= 0.1
- 0.1 - 0.3
- 0.3 - 0.6
- 0.6 - 0.9
- 0.9 - 1.2
- > 1.2

REV	Description	Date	Approved
B	FINAL MASTERPLAN	2022-05-09	KB
A	ISSUED	2021-12-14	KB

Scale 1:10000

0 0.2 0.4 0.6 km

STATUS

Oringinal Size	A3	Drawn	QGIS
Coordinate System	MGA56	Designed	SL
Height Datum	AHD	Date Printed	09/05/2022

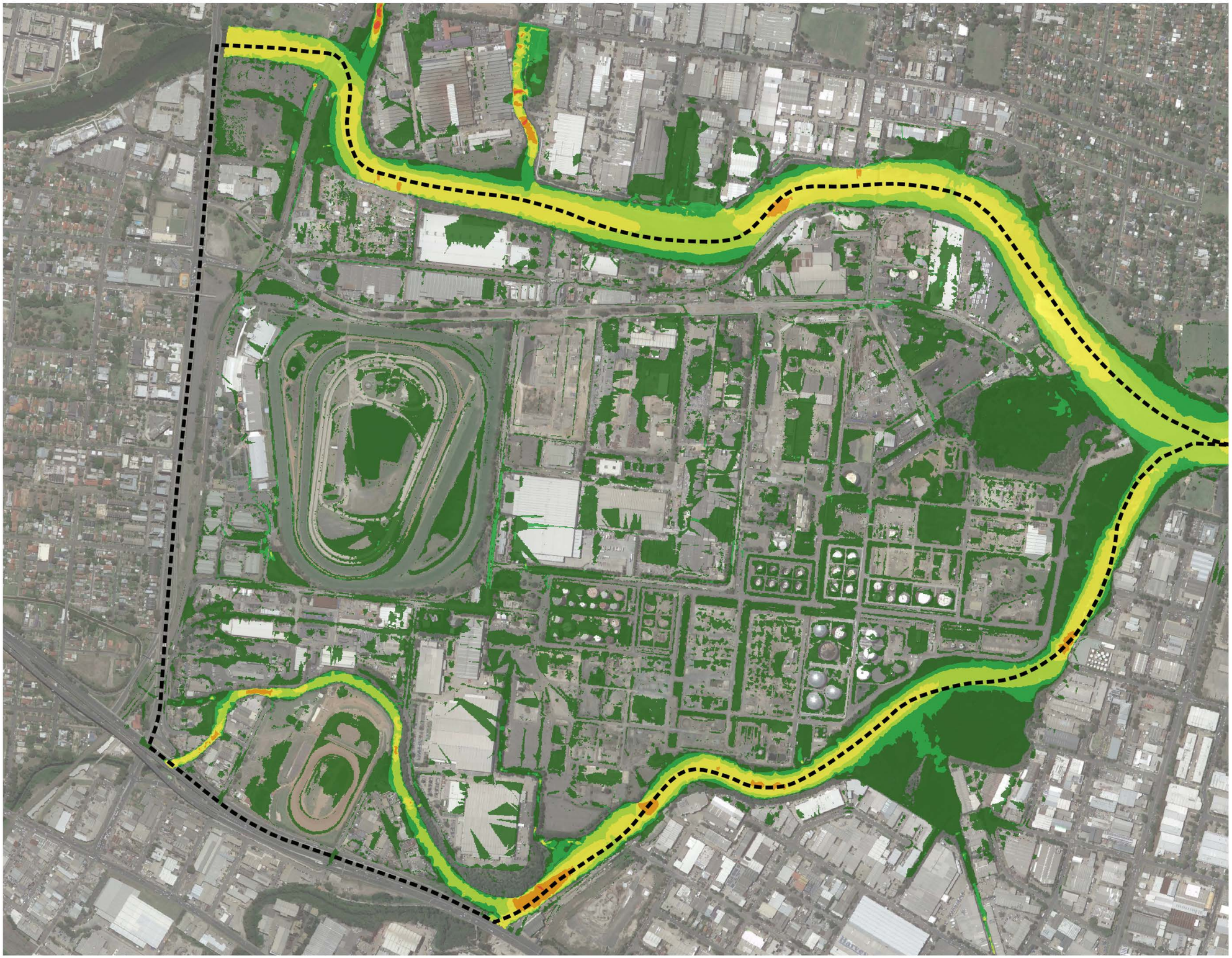
N

5% AEP Depths and Water Level Contours

Camellia Rosehill Place Strategy

Post-Development

Figure 2 Appendix A



LEGEND

Camellia Rosehill Precinct Boundary

Pre-Development 20yr ARI

Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

REV	Description	Date	Approved
B	FINAL MASTERPLAN	2022-05-09	KB
A	ISSUED	2021-12-14	KB

Scale 1:10000

0 0.2 0.4 0.6 km

STATUS

Oringinal Size	A3	Drawn	QGIS
Coordinate System	MGA56	Designed	SL
Height Datum	AHD	Date Printed	09/05/2022

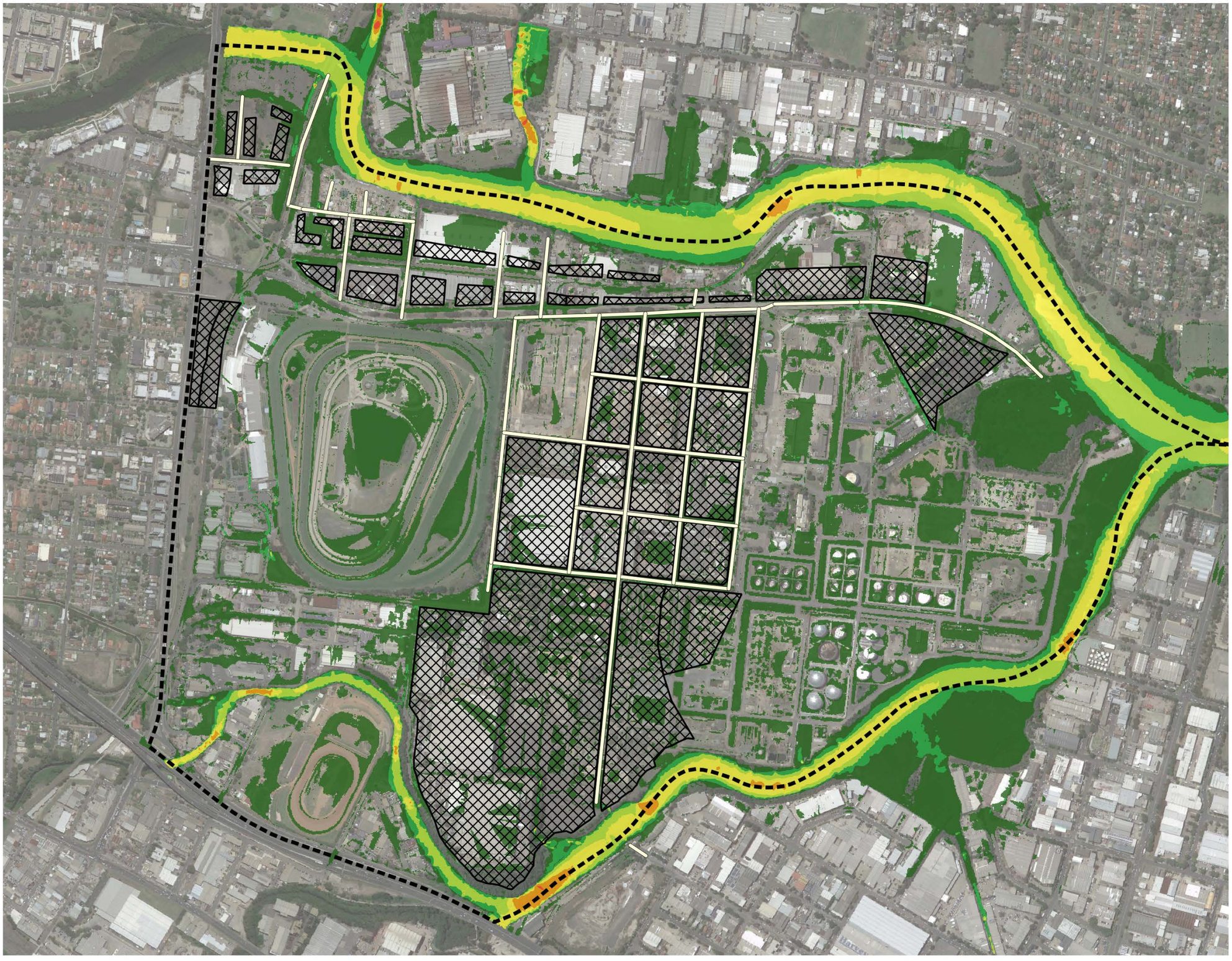
N

5% AEP Velocity

Camellia Rosehill Place Strategy

Pre-Development

Figure 3 Appendix A



LEGEND

- Camellia Rosehill Precinct Boundary
- Building Footprint
- Proposed Roads

Post-Development 20yr ARI
Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

REV	Description	Date	Approved
B	FINAL MASTERPLAN	2022-05-09	KB
A	ISSUED	2021-12-14	KB

Scale 1:10000

0 0.2 0.4 0.6 km

STATUS

Oringinal Size	A3	Drawn	QGIS
Coordinate System	MGA56	Designed	SL
Height Datum	AHD	Date Printed	09/05/2022

N

5% AEP Velocity

Camellia Rosehill Place Strategy

Post-Development

Figure 4 Appendix A

LEGEND

Camellia Rosehill Precinct Boundary

Pre-Development 20yr ARI

Hazard

- H1- Relatively benign flow conditions. No vulnerability constraints.
- H2- Unsafe for small vehicles.
- H3- Unsafe for all vehicles, children and the elderly.
- H4- Unsafe for all people and all vehicles.
- H5- Unsafe for all people and all vehicles. Buildings require special engineering design and construction.
- H6- Unconditionally dangerous. Not suitable for any type of developmen or evacuation access. All Building types considered vulnerable to failure.

REV	Description	Date	Approved
B	FINAL MASTERPLAN	2022-05-09	KB
A	ISSUED	2021-12-14	KB

Scale 1:10000

0 0.2 0.4 0.6 km

STATUS

Oringinal Size	A3	Drawn	QGIS
Coordinate System	MGA56	Designed	SL
Height Datum	AHD	Date Printed	09/05/2022

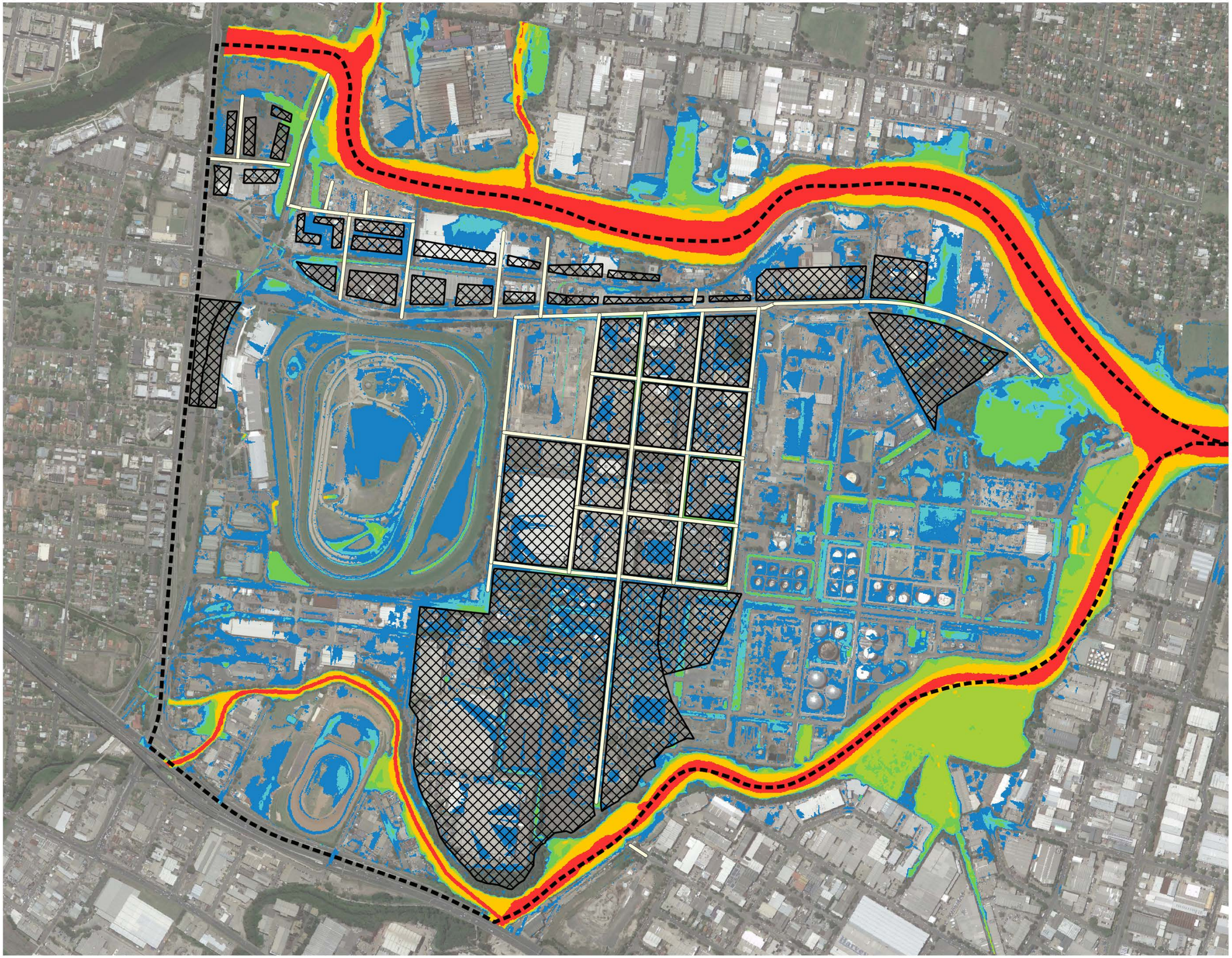
N

5% AEP Hazard

Camellia Rosehill Place Strategy

Pre-Development

Figure 5 Appendix A



LEGEND

- Camellia Rosehill Precinct Boundary
- Building Footprint
- Proposed Roads

Post-Development 20yr ARI
Hazard

- H1- Relatively benign flow conditions. No vulnerability constraints.
- H2- Unsafe for small vehicles.
- H3- Unsafe for all vehicles, children and the elderly.
- H4- Unsafe for all people and all vehicles.
- H5- Unsafe for all people and all vehicles. Buildings require special engineering design and construction.
- H6- Unconditionally dangerous. Not suitable for any type of developmen or evacuation access. All Building types considered vulnerable to failure.

REV	Description	Date	Approved
B	FINAL MASTERPLAN	2022-05-09	KB
A	ISSUED	2021-12-14	KB

Scale 1:10000

0 0.2 0.4 0.6 km

STATUS

Oringinal Size	A3	Drawn	QGIS
Coordinate System	MGA56	Designed	SL
Height Datum	AHD	Date Printed	09/05/2022

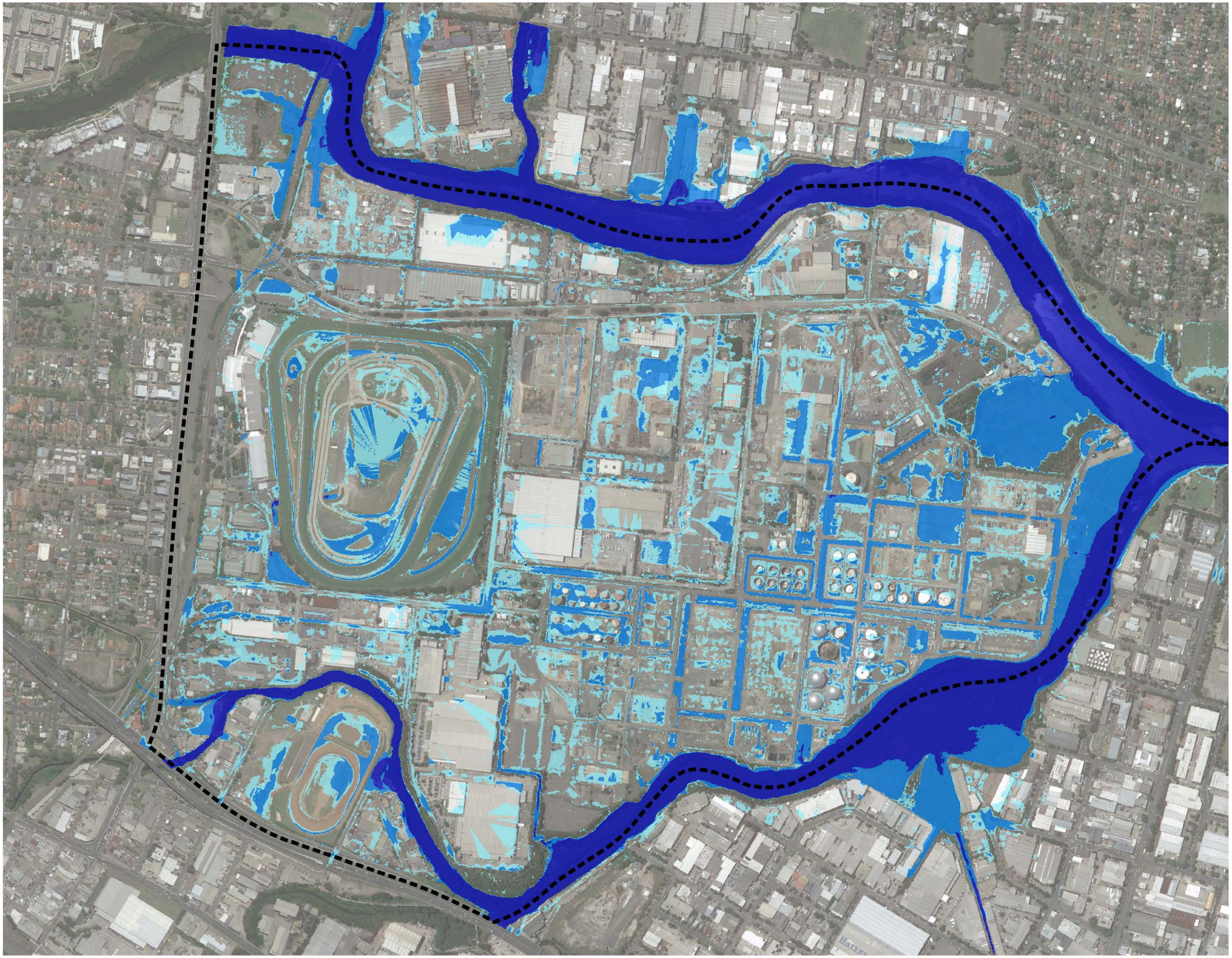
N

5% AEP Hazard

Camellia Rosehill Place Strategy

Post-Development

Figure 6 Appendix A



LEGEND

Camellia Rosehill Precinct Boundary

Pre-Development 20yr ARI

Hydraulic Categories

- Flood Fringe
- Flood Storage
- Flood Way

REV	Description	Date	Approved
B	FINAL MASTERPLAN	2022-05-09	KB
A	ISSUED	2021-12-14	KB

Scale 1:10000

0 0.2 0.4 0.6 km

STATUS

Oringinal Size	A3	Drawn	QGIS
Coordinate System	MGA56	Designed	SL
Height Datum	AHD	Date Printed	09/05/2022

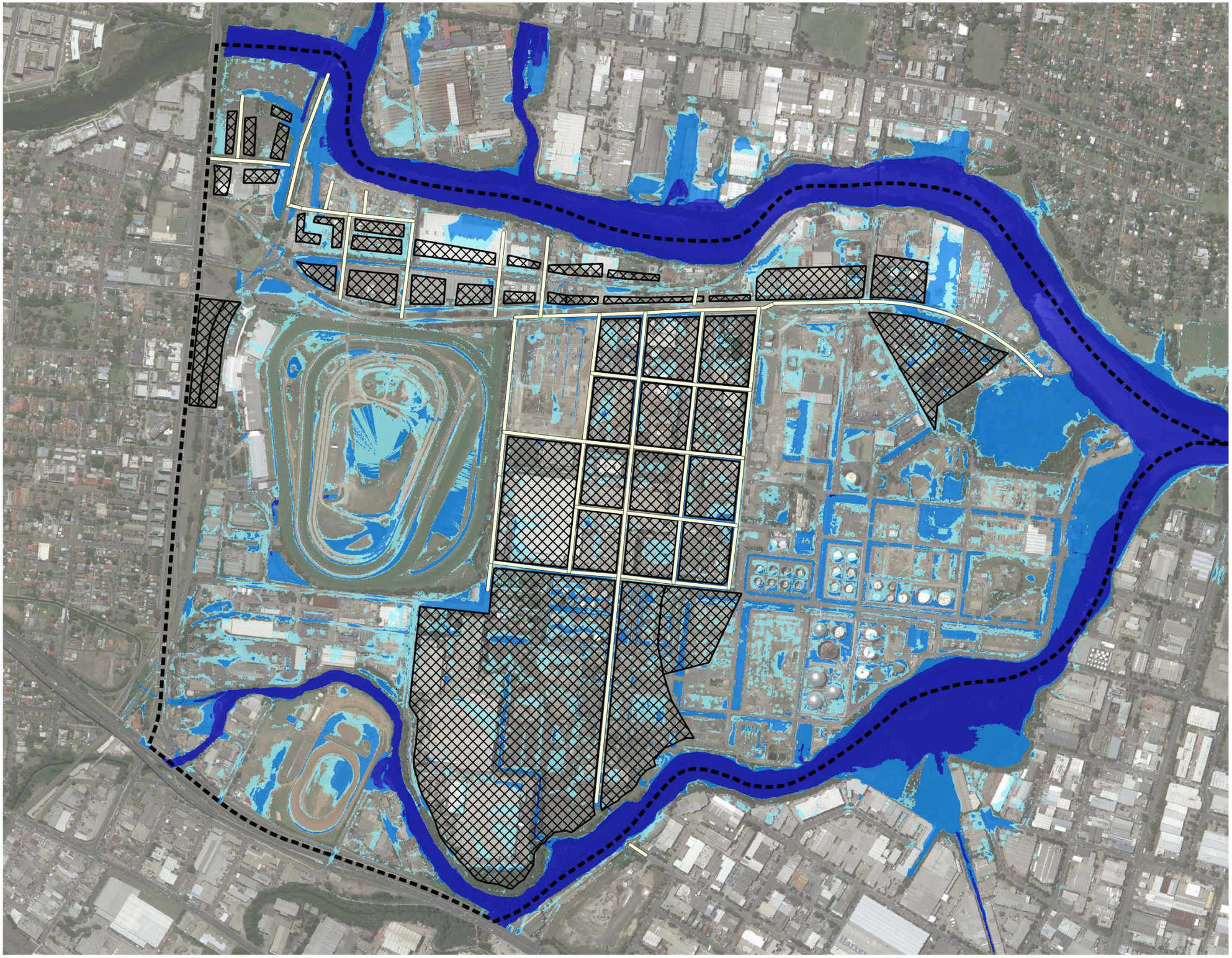
N

5% AEP Hydraulic Categories

Camellia Rosehill Place Strategy

Pre-Development

Figure 7 Appendix A



LEGEND

- Camellia Rosehill Precinct Boundary
- Building Footprint
- Proposed Roads

Post-Development 20yr ARI
Hydraulic Categories

- Flood Fringe
- Flood Storage
- Flood Way

REV	Description	Date	Approved
B	FINAL MASTERPLAN	2022-05-09	KB
A	ISSUED	2021-12-14	KB

Scale 1:10000

0 0.2 0.4 0.6 km

STATUS

Oringinal Size	A3	Drawn	QGIS
Coordinate System	MGA56	Designed	SL
Height Datum	AHD	Date Printed	09/05/2022

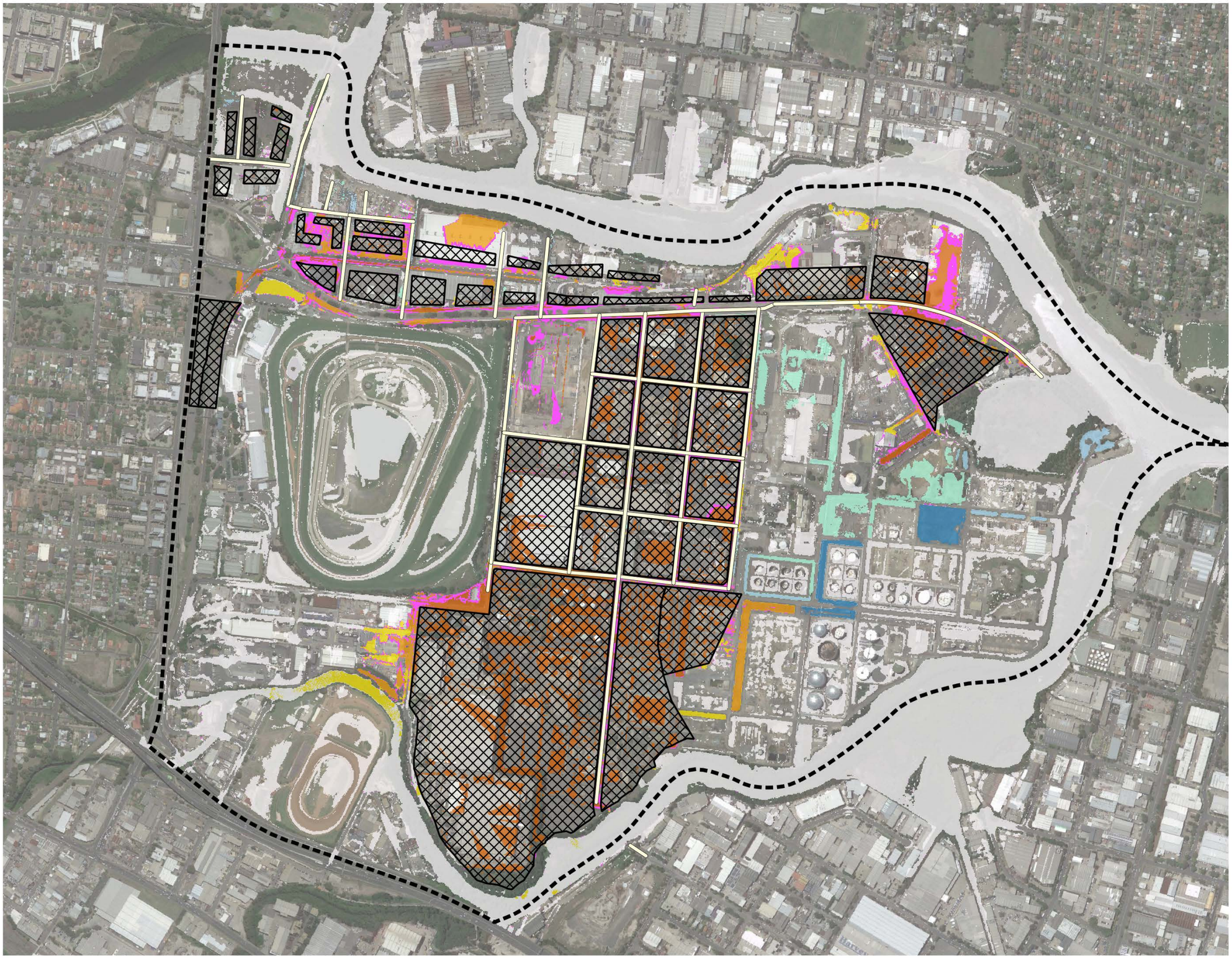
N

5% AEP Hydraulic Categories

Camellia Rosehill Place Strategy

Post-Development

Figure 8 Appendix A



LEGEND

- Camellia Rosehill Precinct Boundary
- Building Footprint
- Proposed Roads

20yr Afflux (m)

- <= -0.1m
- > -0.1 - <= -0.03m
- > -0.03 - <= -0.01m
- > -0.01 - <= +0.01m
- > +0.01 - <= +0.03m
- > +0.03 - <= +0.1m
- > +0.1m
- Was Wet Now Dry
- Was Dry Now Wet

REV	Description	Date	Approved
B	FINAL MASTERPLAN	2022-05-09	KB
A	ISSUED	2021-12-14	KB

Scale 1:10000

0 0.2 0.4 0.6 km

STATUS

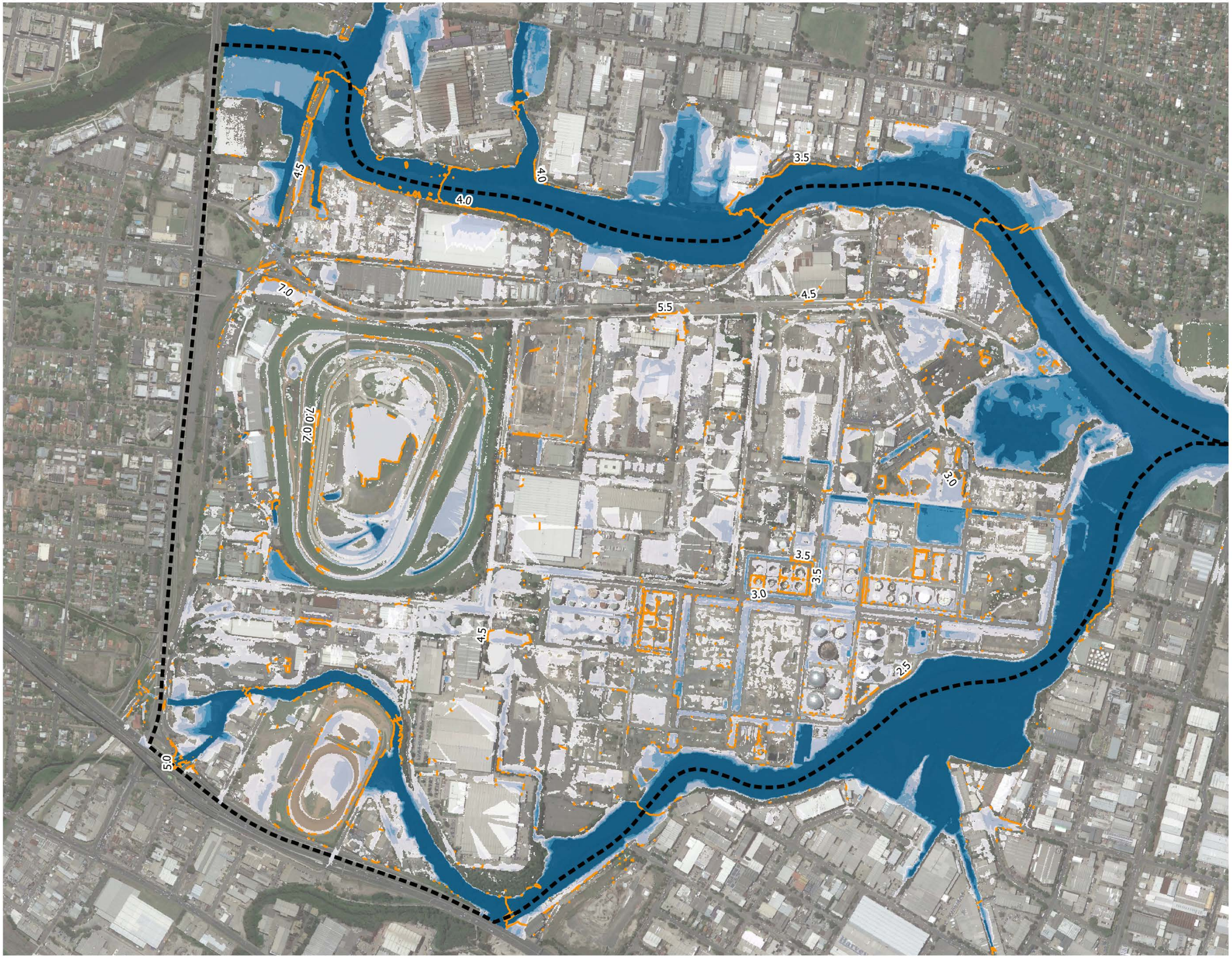
Oringinal Size	A3	Drawn	QGIS
Coordinate System	MGA56	Designed	SL
Height Datum	AHD	Date Printed	09/05/2022

N

5% AEP Water Level Difference

Camellia Rosehill Place Strategy

Figure 9 Appendix A



LEGEND

Camellia Rosehill Precinct Boundary

100yr Pre-Dev 0.5m Water Level Contour

Pre-Development 100yr ARI Depth (m)

- <= 0.1
- 0.1 - 0.3
- 0.3 - 0.6
- 0.6 - 0.9
- 0.9 - 1.2
- > 1.2

REV	Description	Date	Approved
B	FINAL MASTERPLAN	2022-05-09	KB
A	ISSUED	2021-12-14	KB

Scale 1:10000

0 0.2 0.4 0.6 km

STATUS

Oringinal Size	A3	Drawn	QGIS
Coordinate System	MGA56	Designed	SL
Height Datum	AHD	Date Printed	09/05/2022

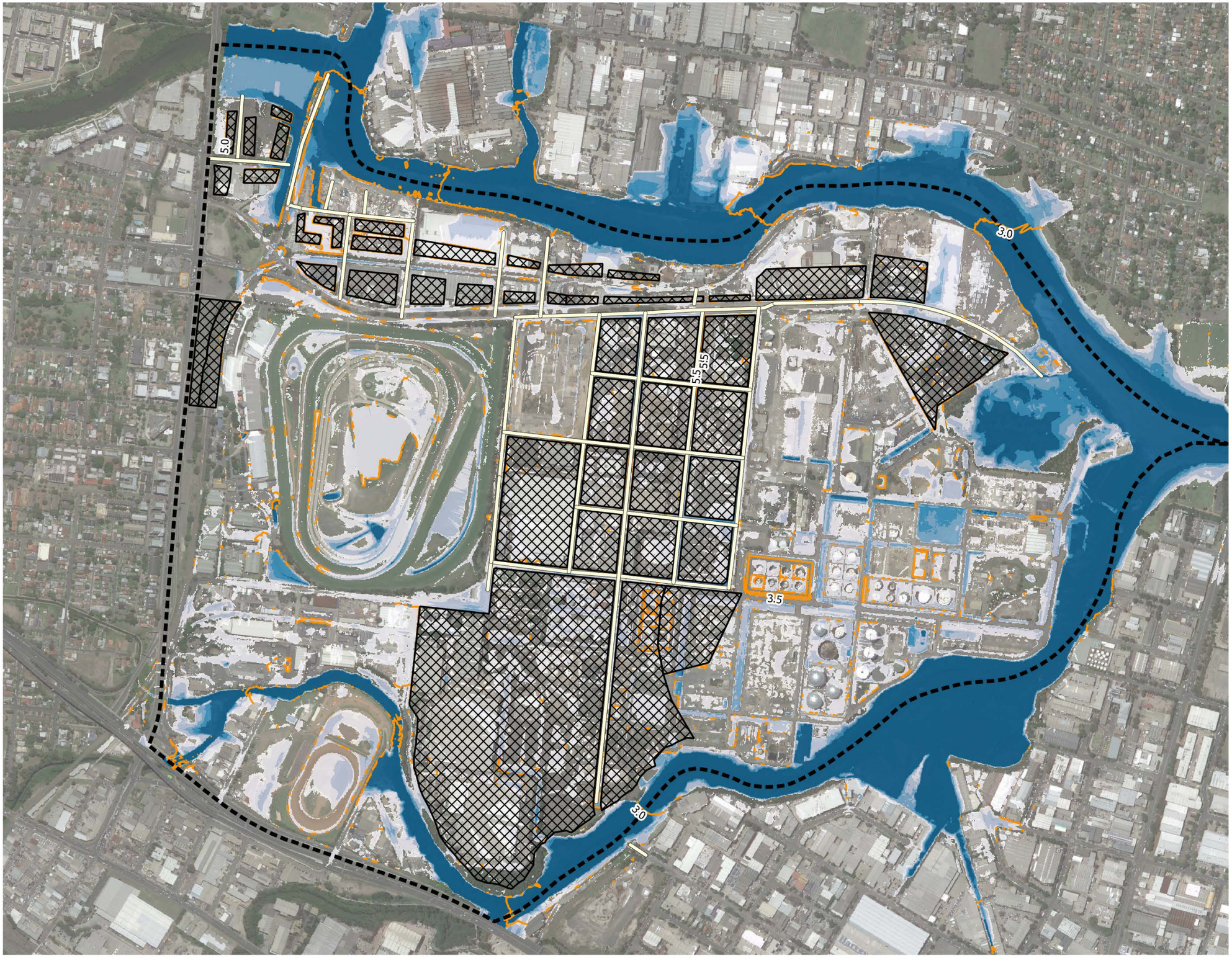
N

1% AEP Depths and Water Level Contours

Camellia Rosehill Place Strategy

Pre-Development

Figure 10 Appendix A



LEGEND

- Camellia Rosehill Precinct Boundary
- Building Footprint
- Proposed Roads
- 100yr Post-Dev 0.5m Water Level Contour

Post-Development 100yr ARI Depth (m)

- <= 0.1
- 0.1 - 0.3
- 0.3 - 0.6
- 0.6 - 0.9
- 0.9 - 1.2
- > 1.2

REV	Description	Date	Approved
B	FINAL MASTERPLAN	2022-05-09	KB
A	ISSUED	2021-12-14	KB

Scale 1:10000

0 0.2 0.4 0.6 km

STATUS

Oringinal Size	A3	Drawn	QGIS
Coordinate System	MGA56	Designed	SL
Height Datum	AHD	Date Printed	09/05/2022

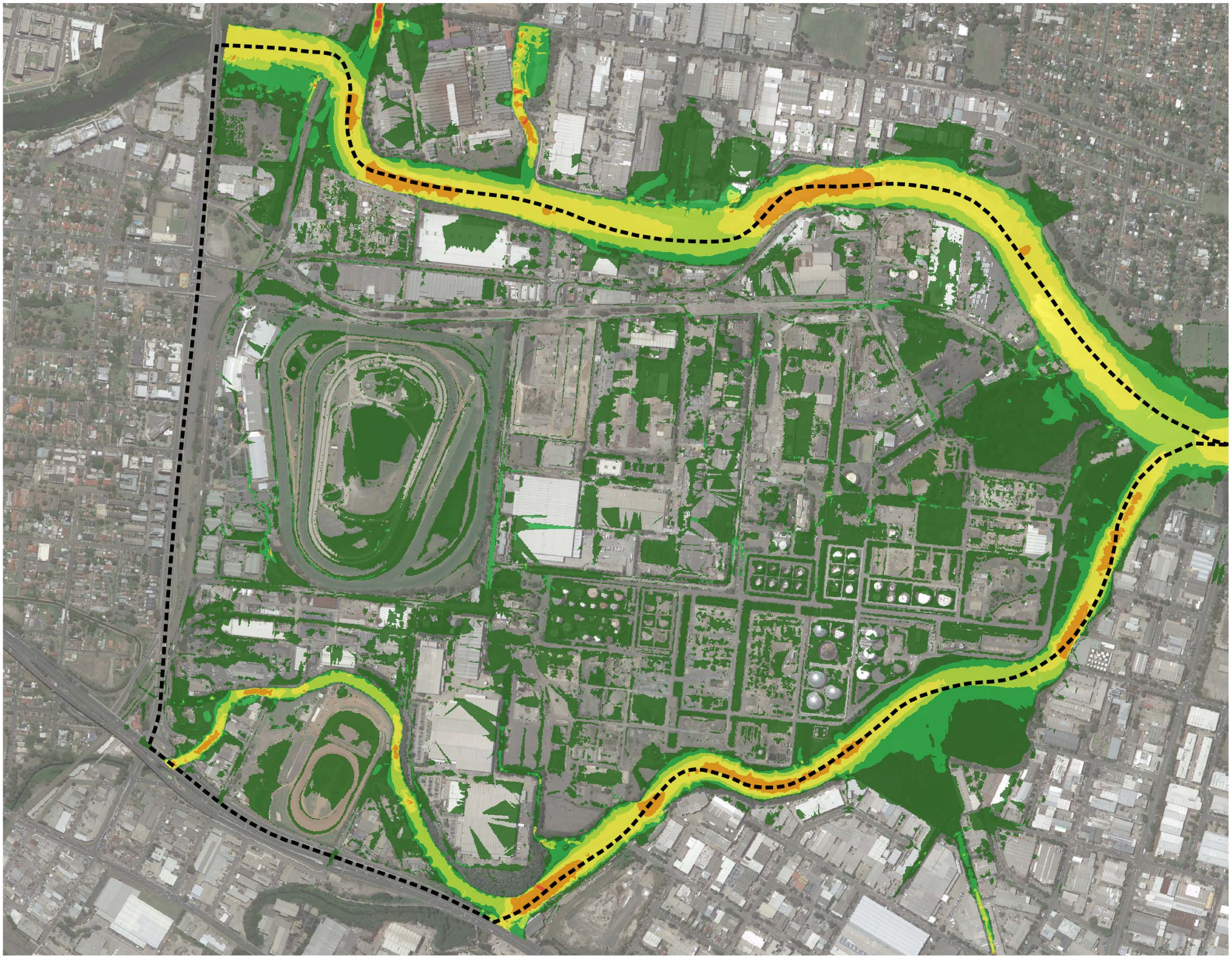
N

1% AEP Depths and Water Level Contours

Camellia Rosehill Place Strategy

Post-Development

Figure 11 Appendix A



LEGEND

Camellia Rosehill Precinct Boundary

Pre-Development 100yr ARI

Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

REV	Description	Date	Approved
B	FINAL MASTERPLAN	2022-05-09	KB
A	ISSUED	2021-12-14	KB

Scale 1:10000

0 0.2 0.4 0.6 km

STATUS

Oringinal Size	A3	Drawn	QGIS
Coordinate System	MGA56	Designed	SL
Height Datum	AHD	Date Printed	09/05/2022

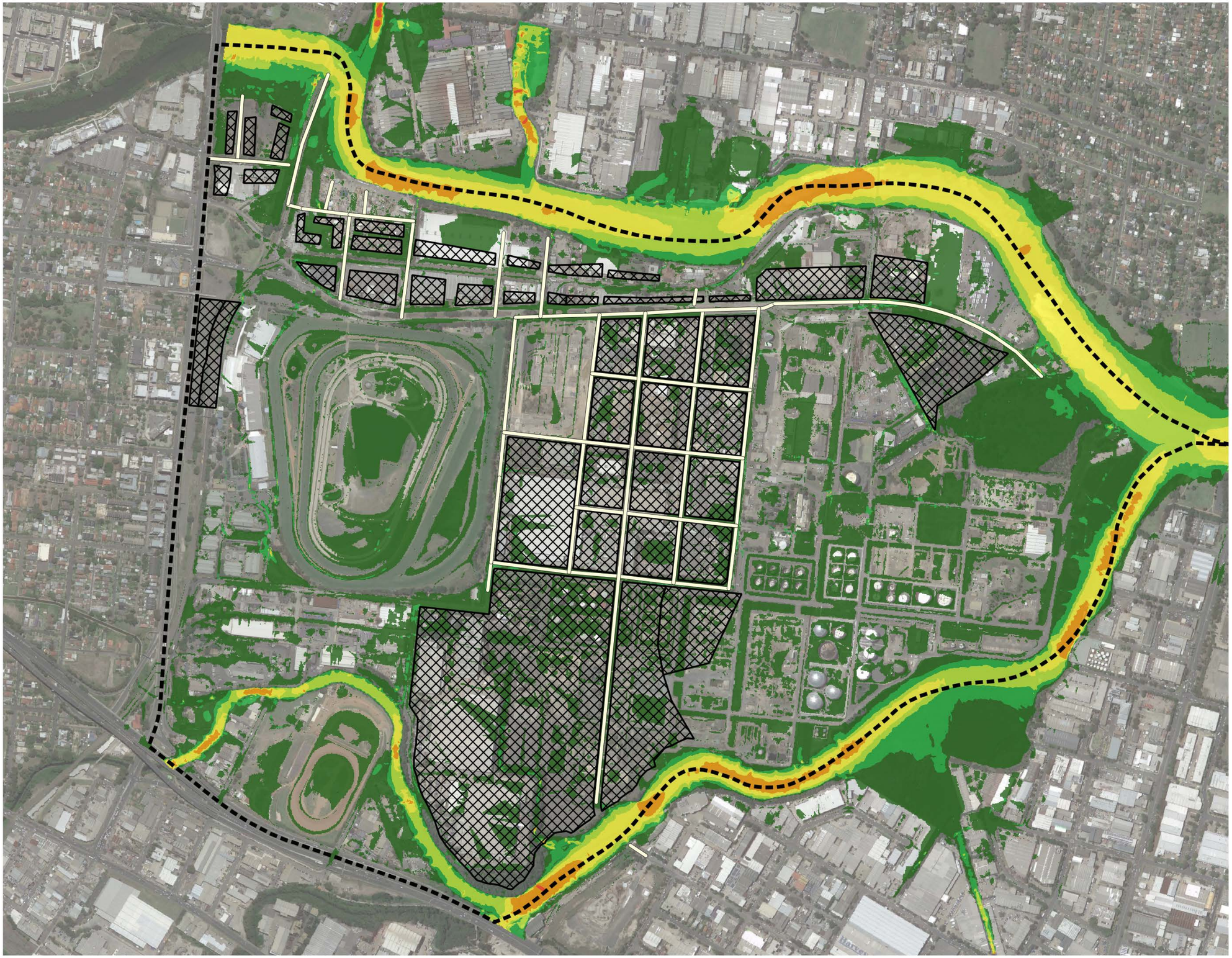
N

1% AEP Velocity

Camellia Rosehill Place Strategy

Pre-Development

Figure 12 Appendix A



LEGEND

- Camellia Rosehill Precinct Boundary
- Building Footprint
- Proposed Roads

Post-Development 100yr ARI
Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

REV	Description	Date	Approved
B	FINAL MASTERPLAN	2022-05-09	KB
A	ISSUED	2021-12-14	KB

Scale 1:10000

0 0.2 0.4 0.6 km

STATUS

Oringinal Size	A3	Drawn	QGIS
Coordinate System	MGA56	Designed	SL
Height Datum	AHD	Date Printed	09/05/2022

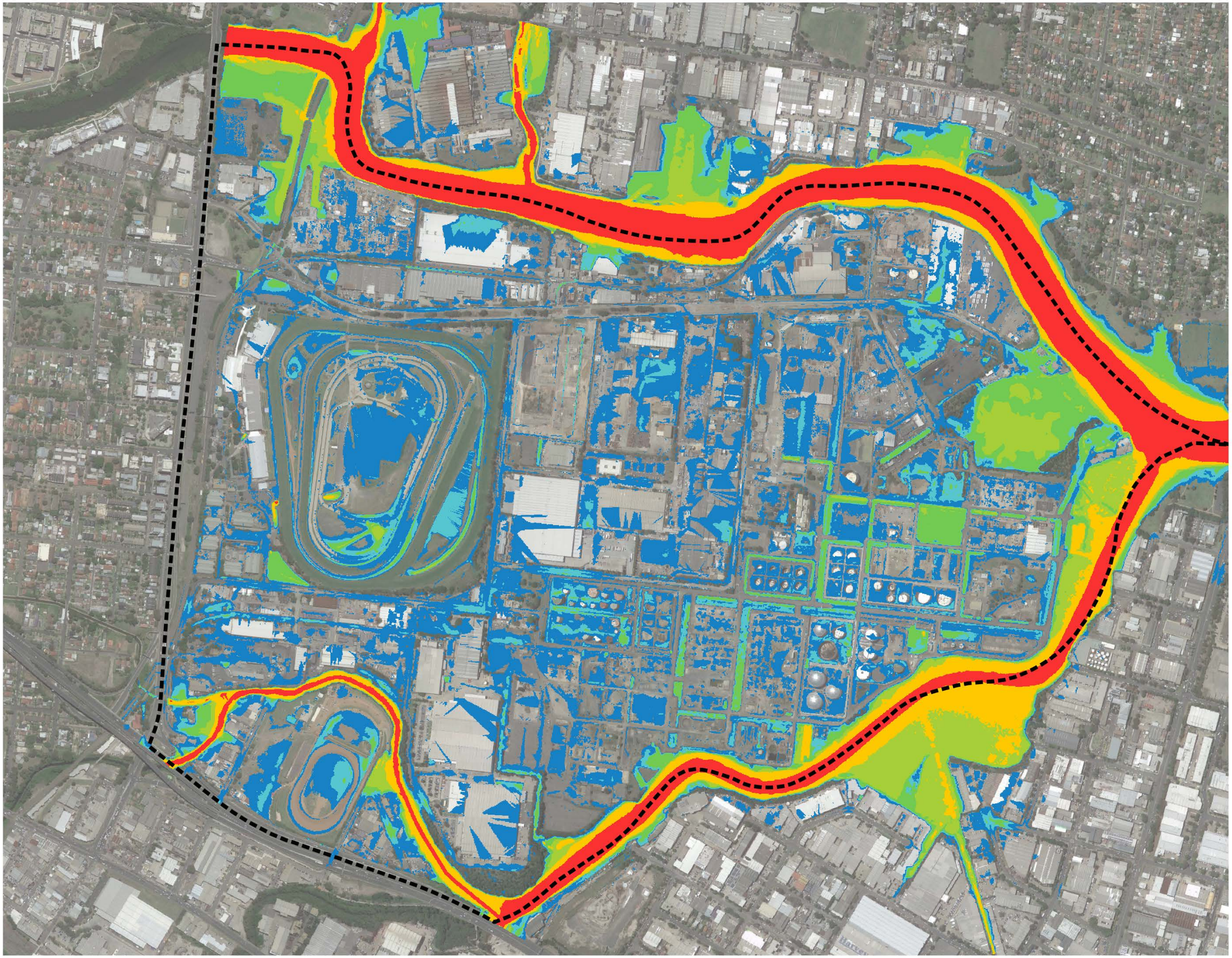
N

1% AEP Velocity

Camellia Rosehill Place Strategy

Post-Development

Figure 13 Appendix A



wsp

LEGEND

Camellia Rosehill Precinct Boundary

Pre-Development 100yr ARI

Hazard

- H1- Relatively benign flow conditions. No vulnerability constraints.
- H2- Unsafe for small vehicles.
- H3- Unsafe for all vehicles, children and the elderly.
- H4- Unsafe for all people and all vehicles.
- H5- Unsafe for all people and all vehicles. Buildings require special engineering design and construction.
- H6- Unconditionally dangerous. Not suitable for any type of developmen or evacuation access. All Building types considered vulnerable to failure.

REV	Description	Date	Approved
B	FINAL MASTERPLAN	2022-05-09	KB
A	ISSUED	2021-12-14	KB

Scale 1:10000

0 0.2 0.4 0.6 km

STATUS

Oringinal Size	A3	Drawn	QGIS
Coordinate System	MGA56	Designed	SL
Height Datum	AHD	Date Printed	09/05/2022

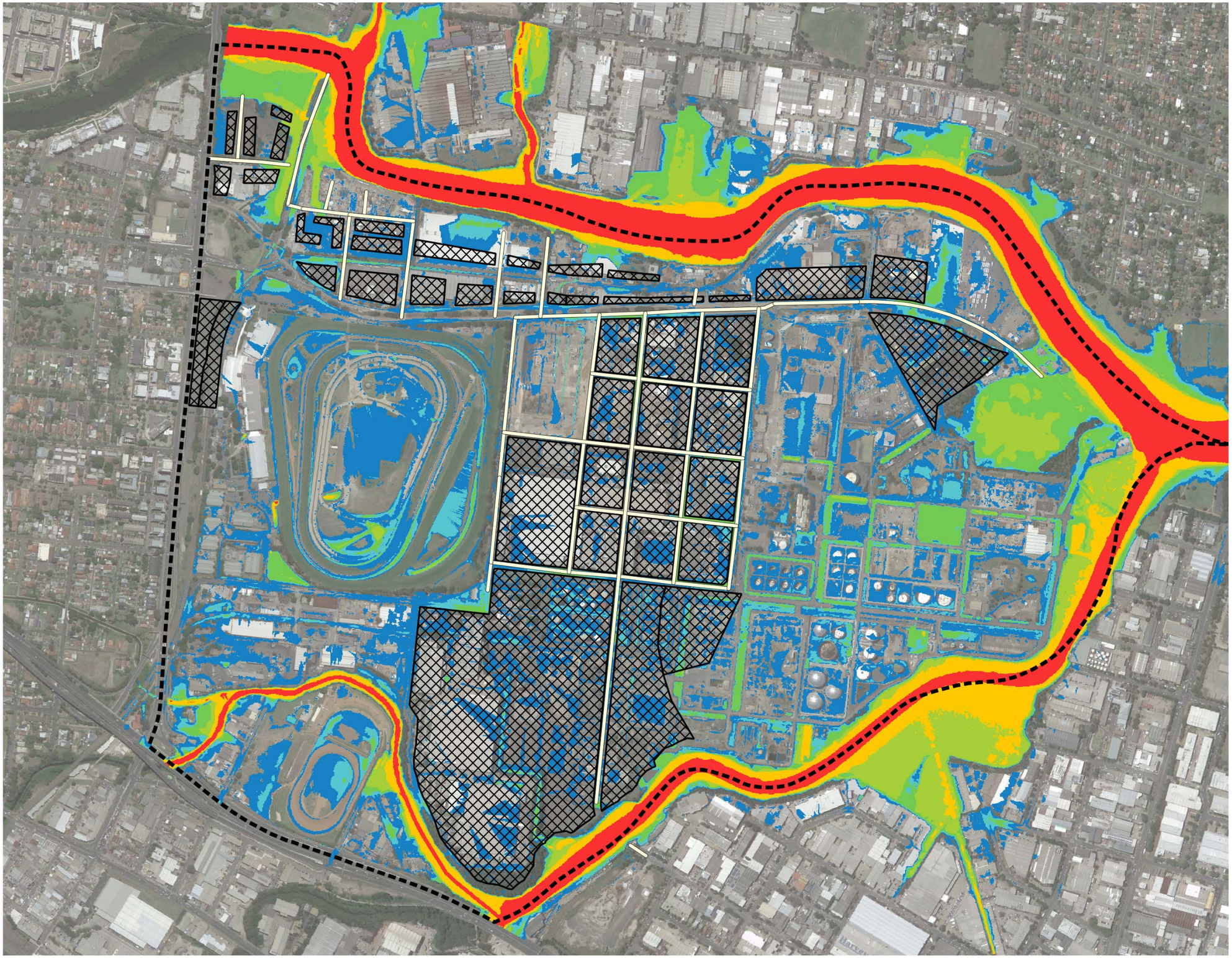
N

1% AEP Hazard

Camellia Rosehill Place Strategy

Pre-Development

Figure 14 Appendix A



LEGEND

- Camellia Rosehill Precinct Boundary
- Building Footprint
- Proposed Roads

Post-Development 100yr ARI
Hazard

- H1- Relatively benign flow conditions. No vulnerability constraints.
- H2- Unsafe for small vehicles.
- H3- Unsafe for all vehicles, children and the elderly.
- H4- Unsafe for all people and all vehicles.
- H5- Unsafe for all people and all vehicles. Buildings require special engineering design and construction.
- H6- Unconditionally dangerous. Not suitable for any type of developmen or evacuation access. All Building types considered vulnerable to failure.

REV	Description	Date	Approved
B	FINAL MASTERPLAN	2022-05-09	KB
A	ISSUED	2021-12-14	KB

Scale 1:10000

0 0.2 0.4 0.6 km

STATUS

Oringinal Size	A3	Drawn	QGIS
Coordinate System	MGA56	Designed	SL
Height Datum	AHD	Date Printed	09/05/2022

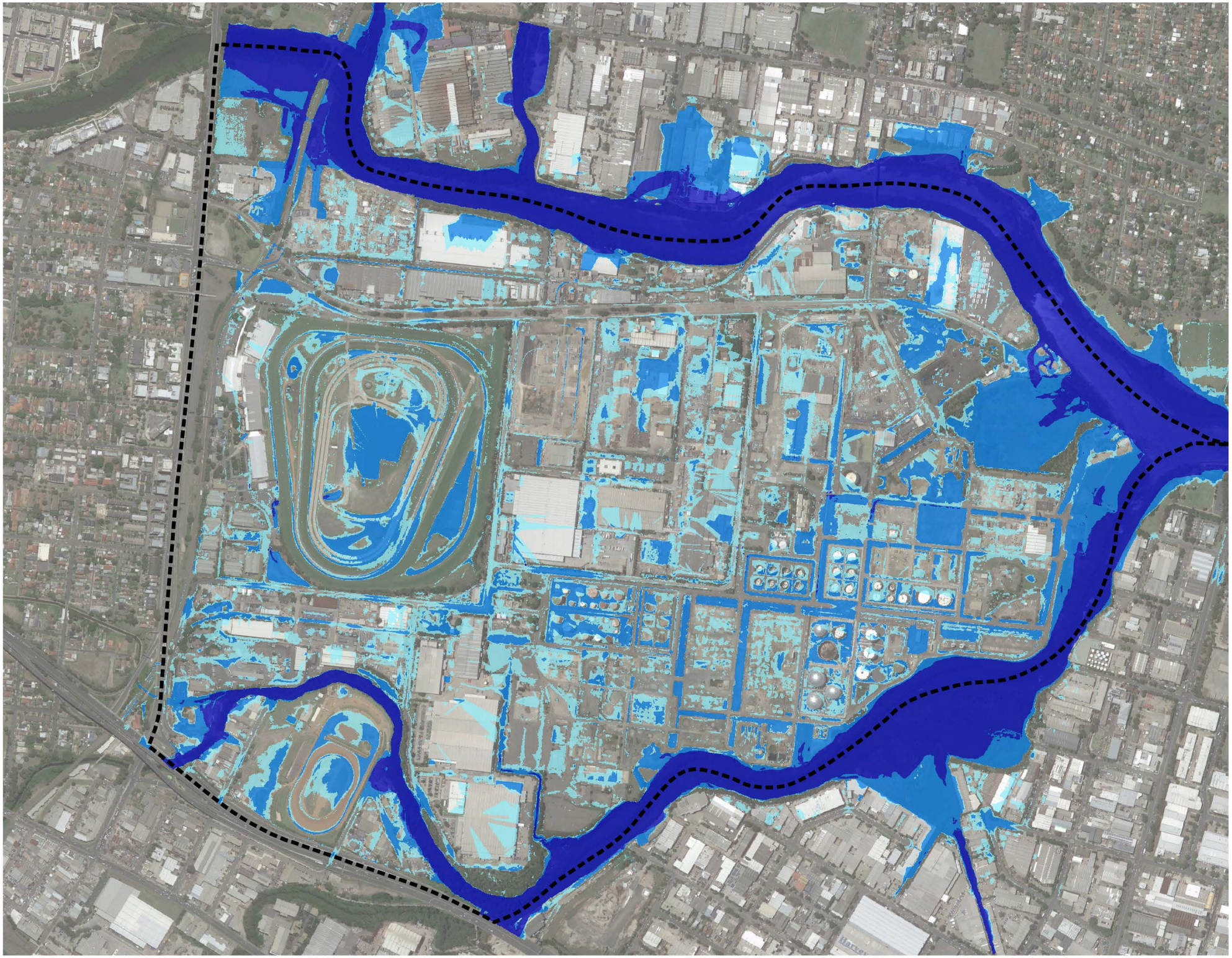
N

1% AEP Hazard

Camellia Rosehill Place Strategy

Post-Development

Figure 15 Appendix A



LEGEND

- Camellia Rosehill Precinct Boundary

Pre-Development 100yr ARI
Hydraulic Categories

- Flood Fringe
- Flood Storage
- Flood Way

REV	Description	Date	Approved
B	FINAL MASTERPLAN	2022-05-09	KB
A	ISSUED	2021-12-14	KB

Scale 1:10000

0 0.2 0.4 0.6 km

STATUS

Oringinal Size	A3	Drawn	QGIS
Coordinate System	MGA56	Designed	SL
Height Datum	AHD	Date Printed	09/05/2022

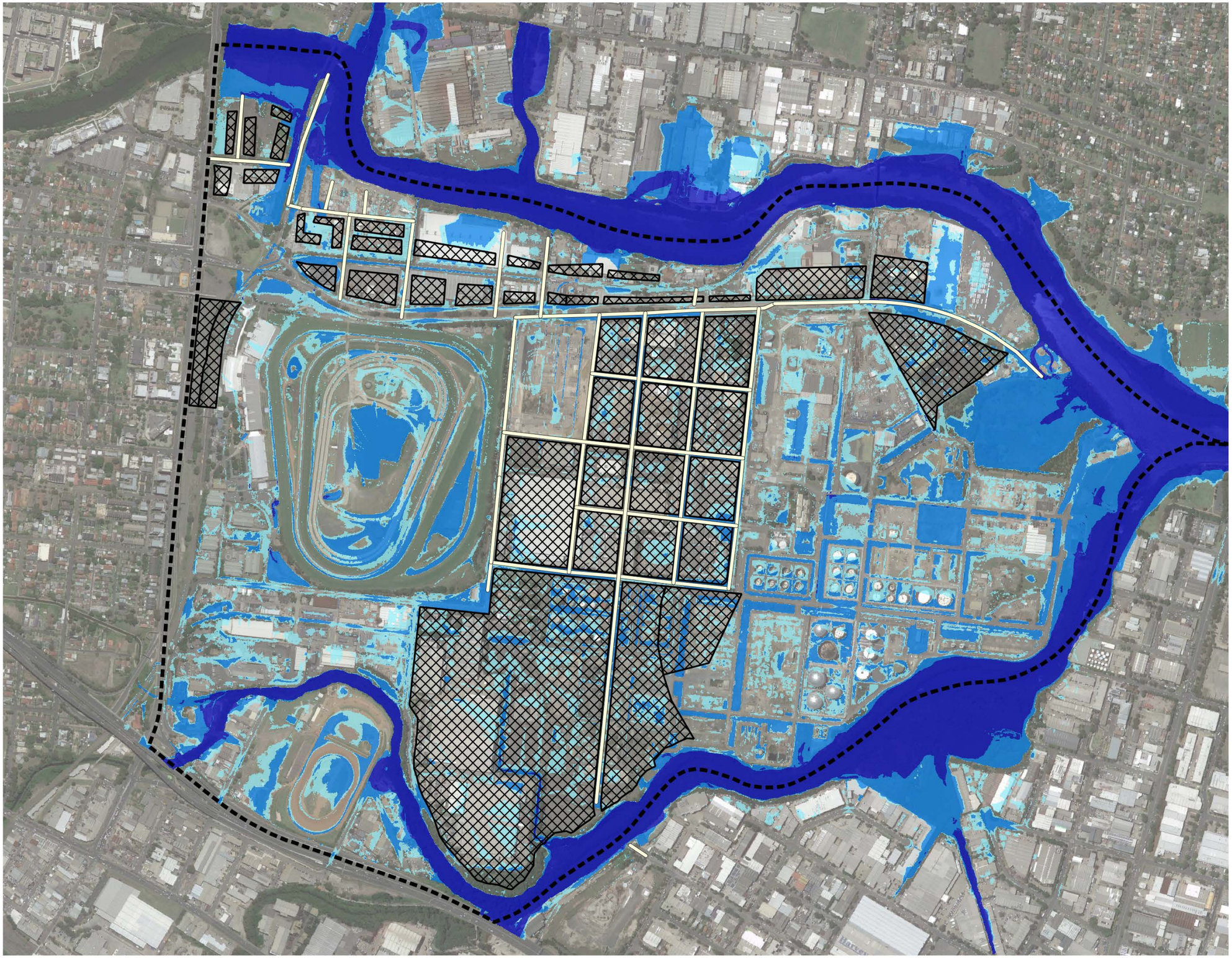
N

1% AEP Hydraulic Categories

Camellia Rosehill Place Strategy

Pre-Development

Figure 16 Appendix A



LEGEND

- Camellia Rosehill Precinct Boundary
- Building Footprint
- Proposed Roads

Post-Development 100yr ARI
Hydraulic Categories

- Flood Fringe
- Flood Storage
- Flood Way

REV	Description	Date	Approved
B	FINAL MASTERPLAN	2022-05-09	KB
A	ISSUED	2021-12-14	KB

Scale 1:10000

0 0.2 0.4 0.6 km

STATUS

Oringinal Size	A3	Drawn	QGIS
Coordinate System	MGA56	Designed	SL
Height Datum	AHD	Date Printed	09/05/2022

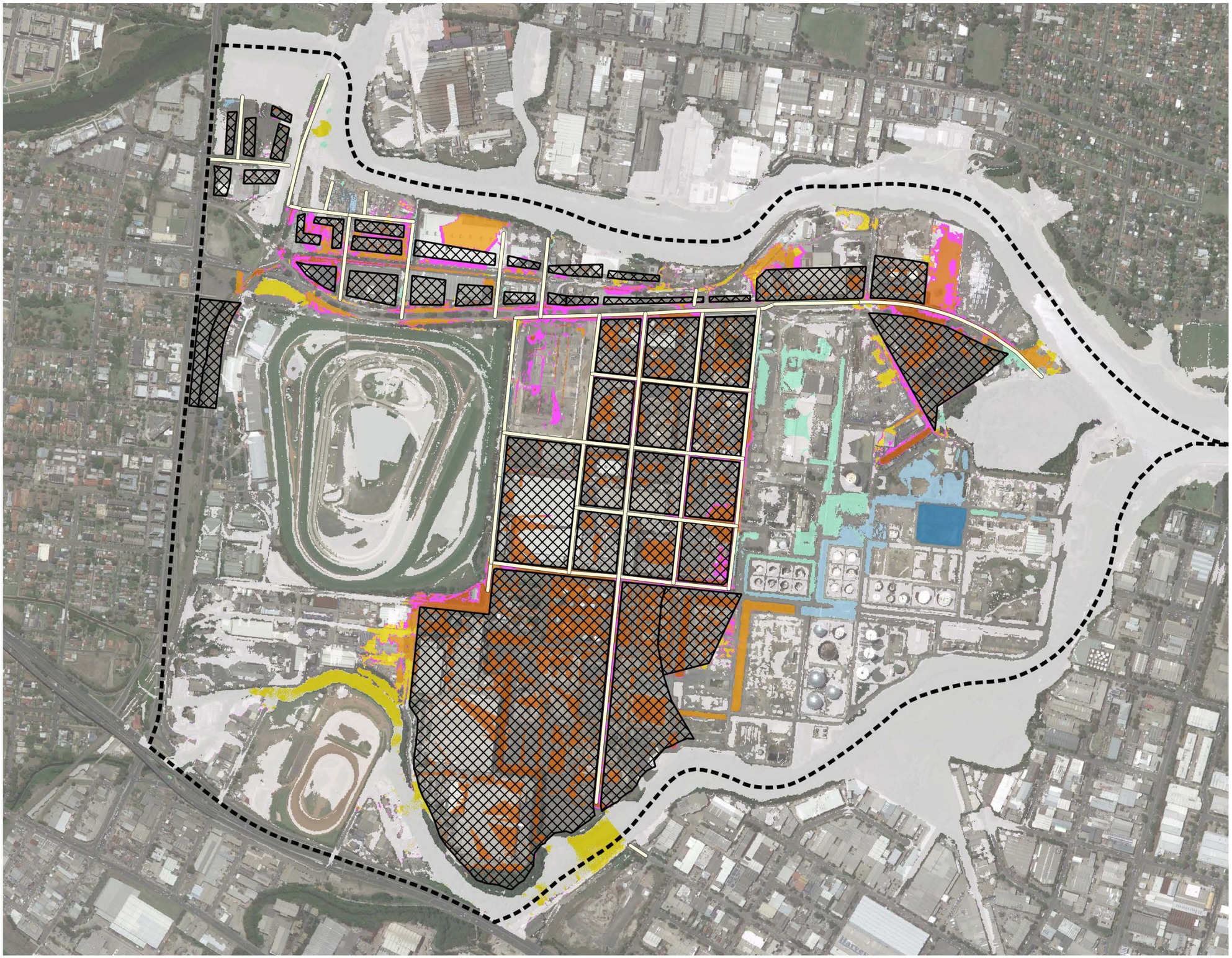
N

1% AEP Hydraulic Categories

Camellia Rosehill Place Strategy

Post-Development

Figure 17 Appendix A



LEGEND

- Camellia Rosehill Precinct Boundary
- Building Footprint
- Proposed Roads

100yr Afflux (m)

- <= -0.1m
- > -0.1 - <= -0.03m
- > -0.03 - <= -0.01m
- > -0.01 - <= +0.01m
- > +0.01 - <= +0.03m
- > +0.03 - <= +0.1m
- > +0.1m
- Was Wet Now Dry
- Was Dry Now Wet

REV	Description	Date	Approved
B	FINAL MASTERPLAN	2022-05-09	KB
A	ISSUED	2021-12-14	KB

Scale 1:10000

0 0.2 0.4 0.6 km

STATUS

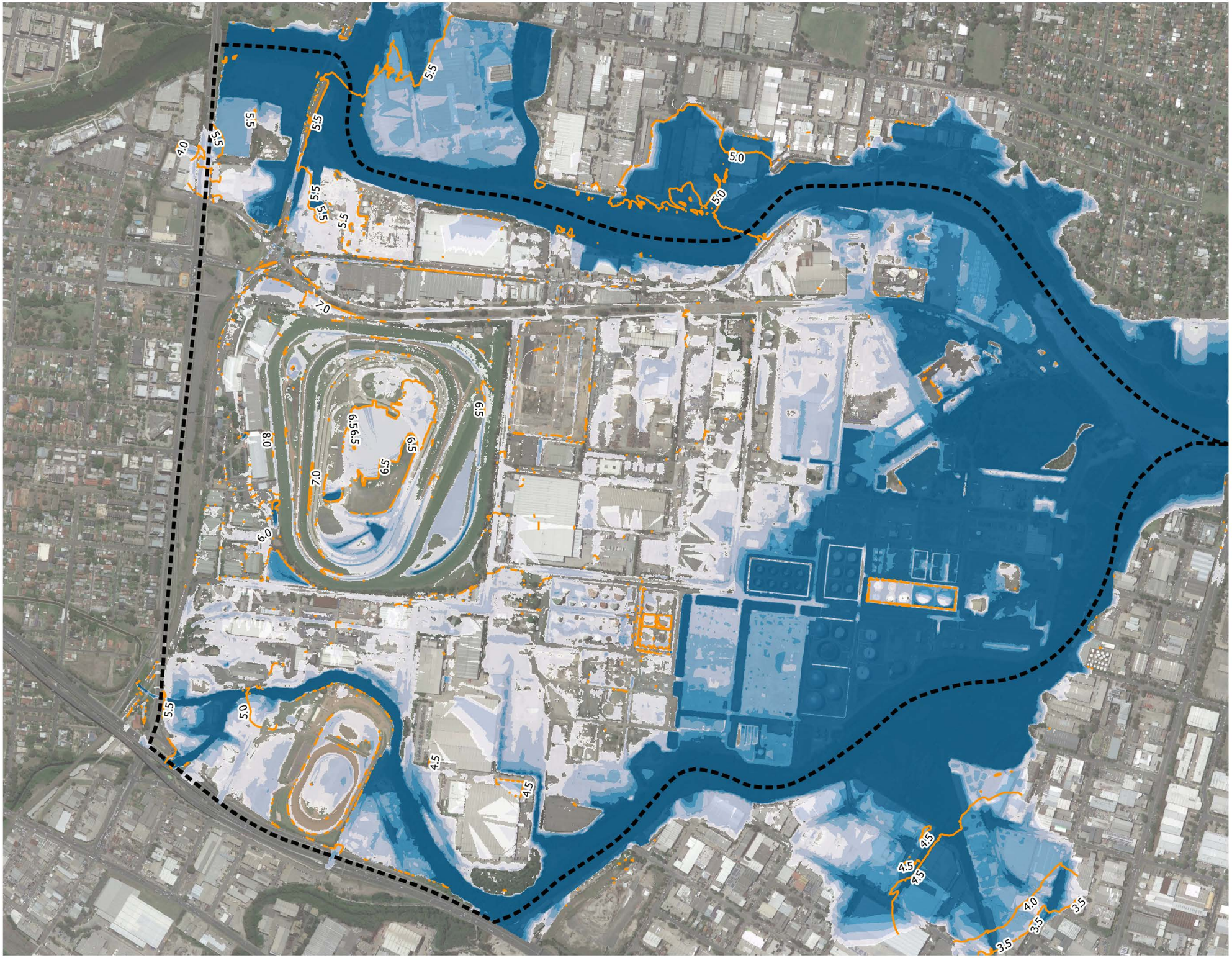
Oringinal Size	A3	Drawn	QGIS
Coordinate System	MGA56	Designed	SL
Height Datum	AHD	Date Printed	09/05/2022

N

1% AEP Water Level Difference

Camellia Rosehill Place Strategy

Figure 18 Appendix A



LEGEND

Camellia Rosehill Precinct Boundary

100yrCCSLR Pre-Dev 0.5m Water Level Contour

Pre-Development 100yr Climate Change ARI 2m SLR Depth (m)

- <= 0.1
- 0.1 - 0.3
- 0.3 - 0.6
- 0.6 - 0.9
- 0.9 - 1.2
- > 1.2

REV	Description	Date	Approved
B	FINAL MASTERPLAN	2022-05-09	KB
A	ISSUED	2021-12-14	KB

Scale 1:10000

0 0.2 0.4 0.6 km

STATUS

Oringinal Size	A3	Drawn	QGIS
Coordinate System	MGA56	Designed	SL
Height Datum	AHD	Date Printed	09/05/2022

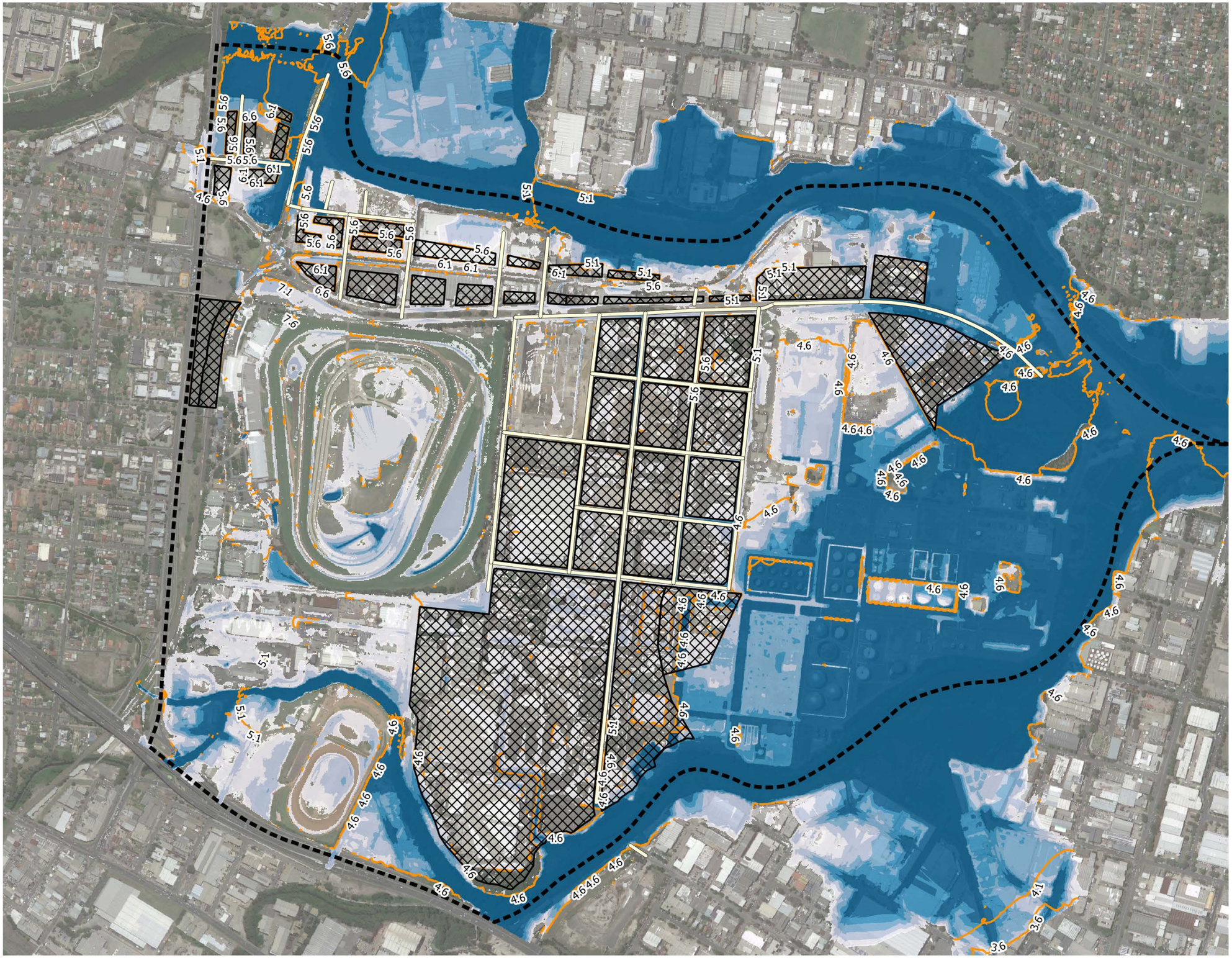
N

1% AEP Climate Change and 2m SLR Depths and Water Level Contours

Camellia Rosehill Place Strategy

Pre-Development

Figure 19 Appendix A



LEGEND

- Camellia Rosehill Precinct Boundary
- Building Footprint
- Proposed Roads
- 100yrCCSLR Post-Dev 0.5m Water Level Contour

Post-Development 100yr Climate Change ARI 2m SLR Depth (m)

- <= 0.1
- 0.1 - 0.3
- 0.3 - 0.6
- 0.6 - 0.9
- 0.9 - 1.2
- > 1.2

REV	Description	Date	Approved
B	FINAL MASTERPLAN	2022-05-09	KB
A	ISSUED	2021-12-14	KB

Scale 1:10000

0 0.2 0.4 0.6 km

STATUS

Oringinal Size	A3	Drawn	QGIS
Coordinate System	MGA56	Designed	SL
Height Datum	AHD	Date Printed	09/05/2022

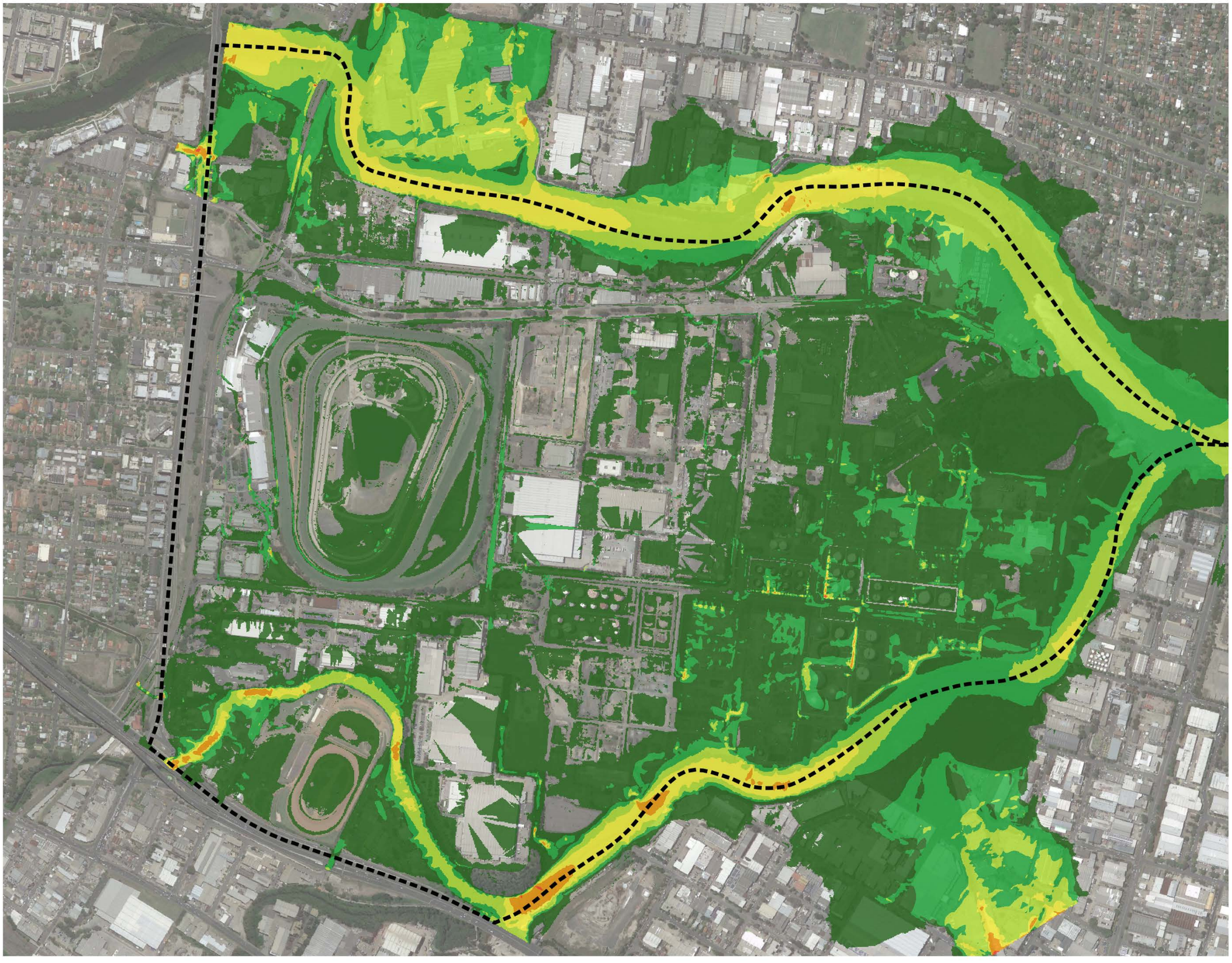
N

1% AEP Climate Change and 2m SLR Depths and Water Level Contours

Camellia Rosehill Place Strategy

Post-Development

Figure 20 Appendix A



LEGEND

Camellia Rosehill Precinct Boundary

Pre-Development 100yr Climate Change ARI 2m SLR Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

REV	Description	Date	Approved
B	FINAL MASTERPLAN	2022-05-09	KB
A	ISSUED	2021-12-14	KB

Scale 1:10000

0 0.2 0.4 0.6 km

STATUS

Oringinal Size	A3	Drawn	QGIS
Coordinate System	MGA56	Designed	SL
Height Datum	AHD	Date Printed	09/05/2022

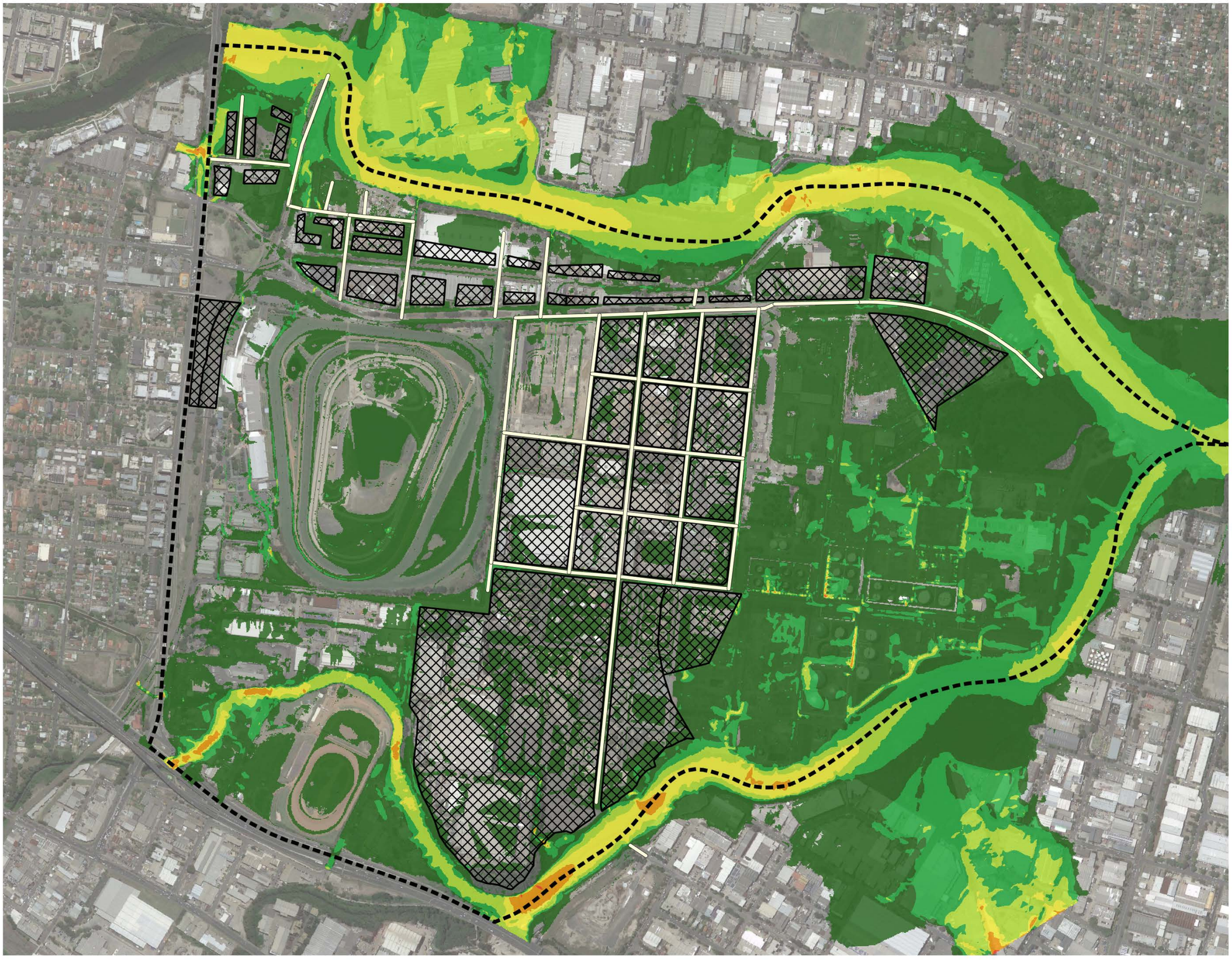
N

1% AEP Climate Change and 2m SLR Velocity

Camellia Rosehill Place Strategy

Pre-Development

Figure 21 Appendix A



LEGEND

- Camellia Rosehill Precinct Boundary
- Building Footprint
- Proposed Roads

Post-Development 100yr Climate Change ARI 2m SLR Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

REV	Description	Date	Approved
B	FINAL MASTERPLAN	2022-05-09	KB
A	ISSUED	2021-12-14	KB

Scale 1:10000

0 0.2 0.4 0.6 km

STATUS

Oringinal Size	A3	Drawn	QGIS
Coordinate System	MGA56	Designed	SL
Height Datum	AHD	Date Printed	09/05/2022

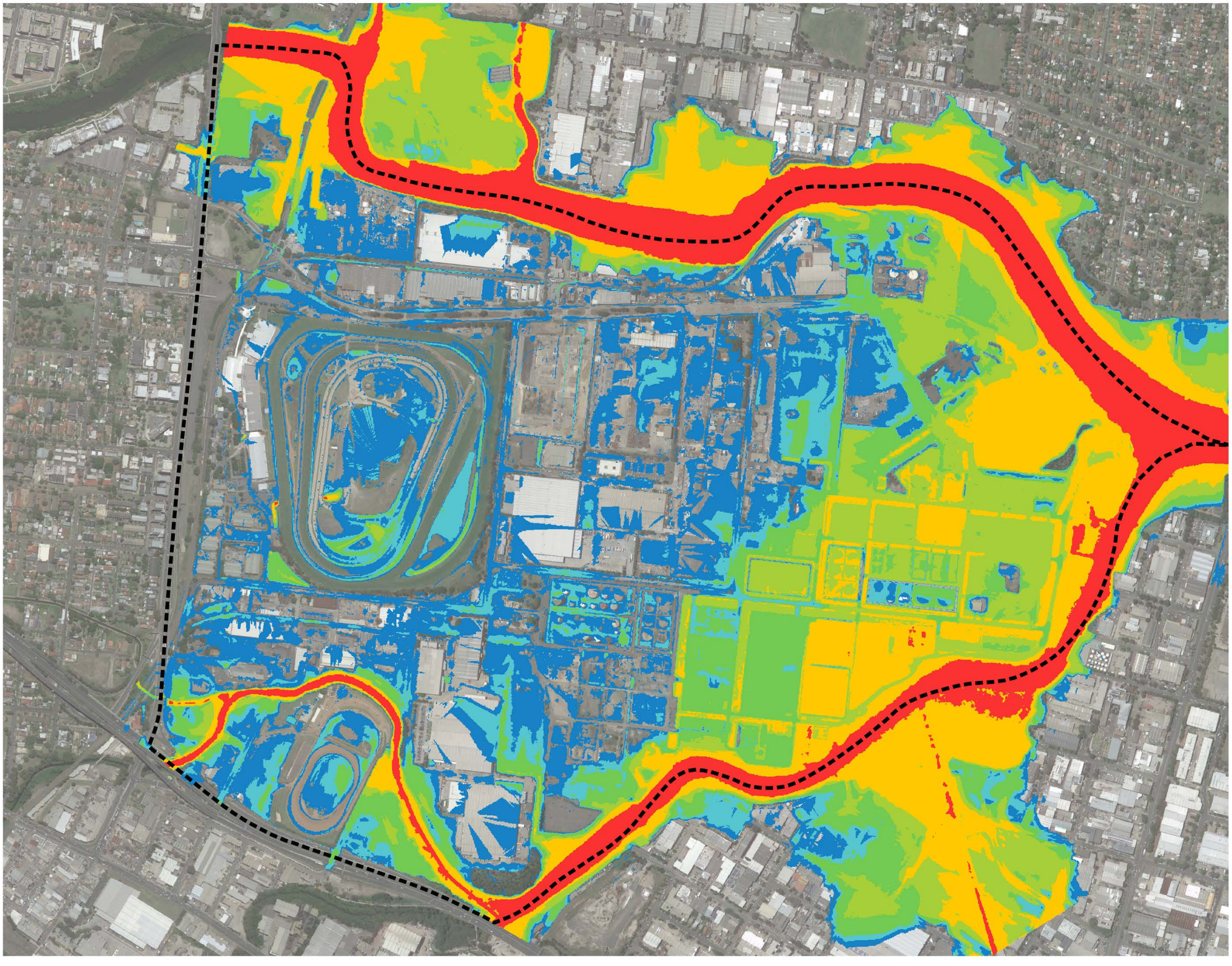
N

1% AEP Climate Change and 2m SLR Velocity

Camellia Rosehill Place Strategy

Post-Development

Figure 22 Appendix A



LEGEND

Camellia Rosehill Precinct Boundary

Pre-Development 100yr Climate Change ARI 2m SLR Hazard

- H1- Relatively benign flow conditions. No vulnerability constraints.
- H2- Unsafe for small vehicles.
- H3- Unsafe for all vehicles, children and the elderly.
- H4- Unsafe for all people and all vehicles.
- H5- Unsafe for all people and all vehicles. Buildings require special engineering design and construction.
- H6- Unconditionally dangerous. Not suitable for any type of developmen or evacuation access. All Building types considered vulnerable to failure.

REV	Description	Date	Approved
B	FINAL MASTERPLAN	2022-05-09	KB
A	ISSUED	2021-12-14	KB

Scale 1:10000

0 0.2 0.4 0.6 km

STATUS

Oringinal Size	A3	Drawn	QGIS
Coordinate System	MGA56	Designed	SL
Height Datum	AHD	Date Printed	09/05/2022

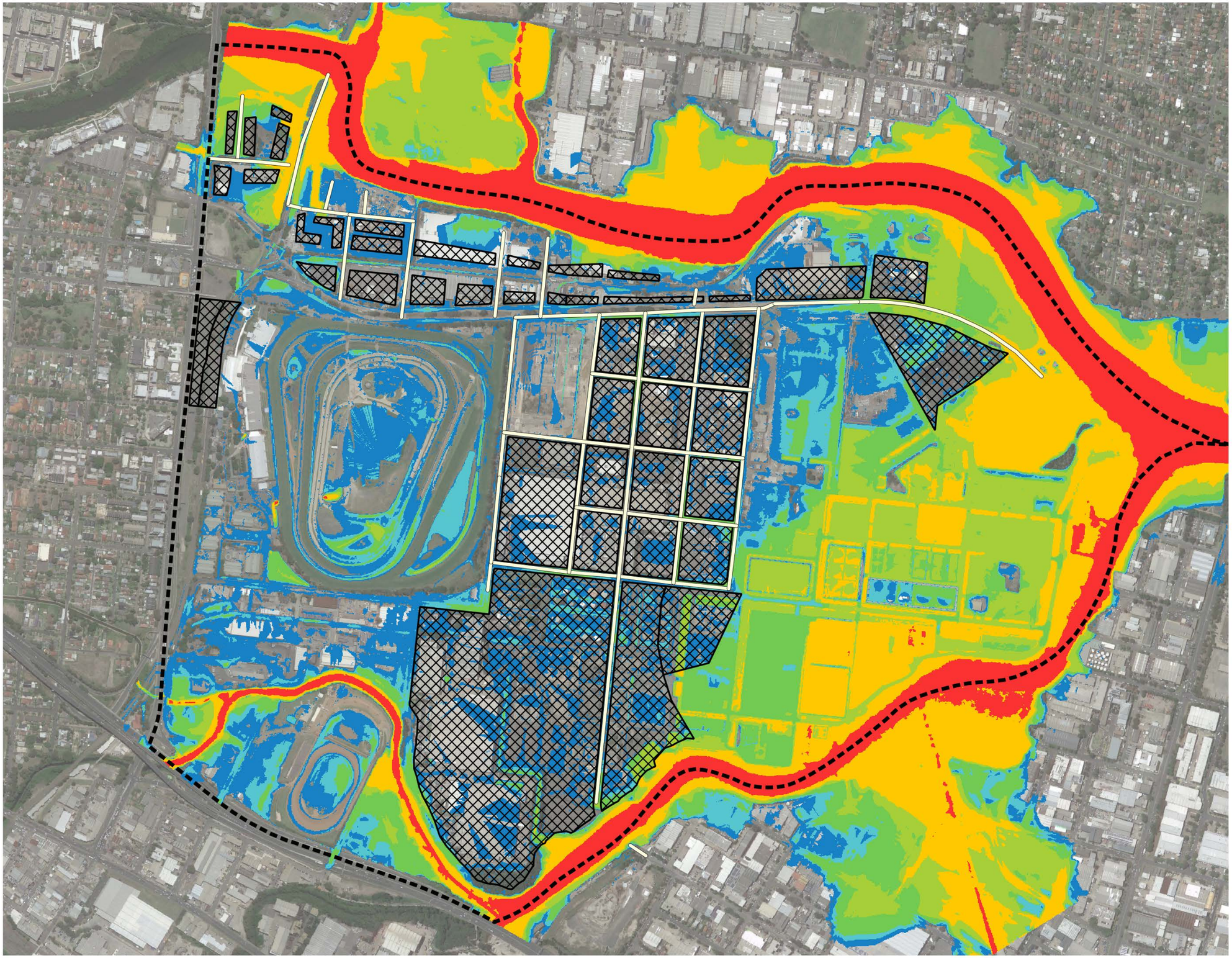
N

1% AEP Climate Change and 2m SLR Hazard

Camellia Rosehill Place Strategy

Pre-Development

Figure 23 Appendix A



LEGEND

- Camellia Rosehill Precinct Boundary
- Building Footprint
- Proposed Roads

Post-Development 100yr Climate Change ARI 2m SLR Hazard

- H1- Relatively benign flow conditions. No vulnerability constraints.
- H2- Unsafe for small vehicles.
- H3- Unsafe for all vehicles, children and the elderly.
- H4- Unsafe for all people and all vehicles.
- H5- Unsafe for all people and all vehicles. Buildings require special engineering design and construction.
- H6- Unconditionally dangerous. Not suitable for any type of developmen or evacuation access. All Building types considered vulnerable to failure.

REV	Description	Date	Approved
B	FINAL MASTERPLAN	2022-05-09	KB
A	ISSUED	2021-12-14	KB

Scale 1:10000

0 0.2 0.4 0.6 km

STATUS

Oringinal Size	A3	Drawn	QGIS
Coordinate System	MGA56	Designed	SL
Height Datum	AHD	Date Printed	09/05/2022

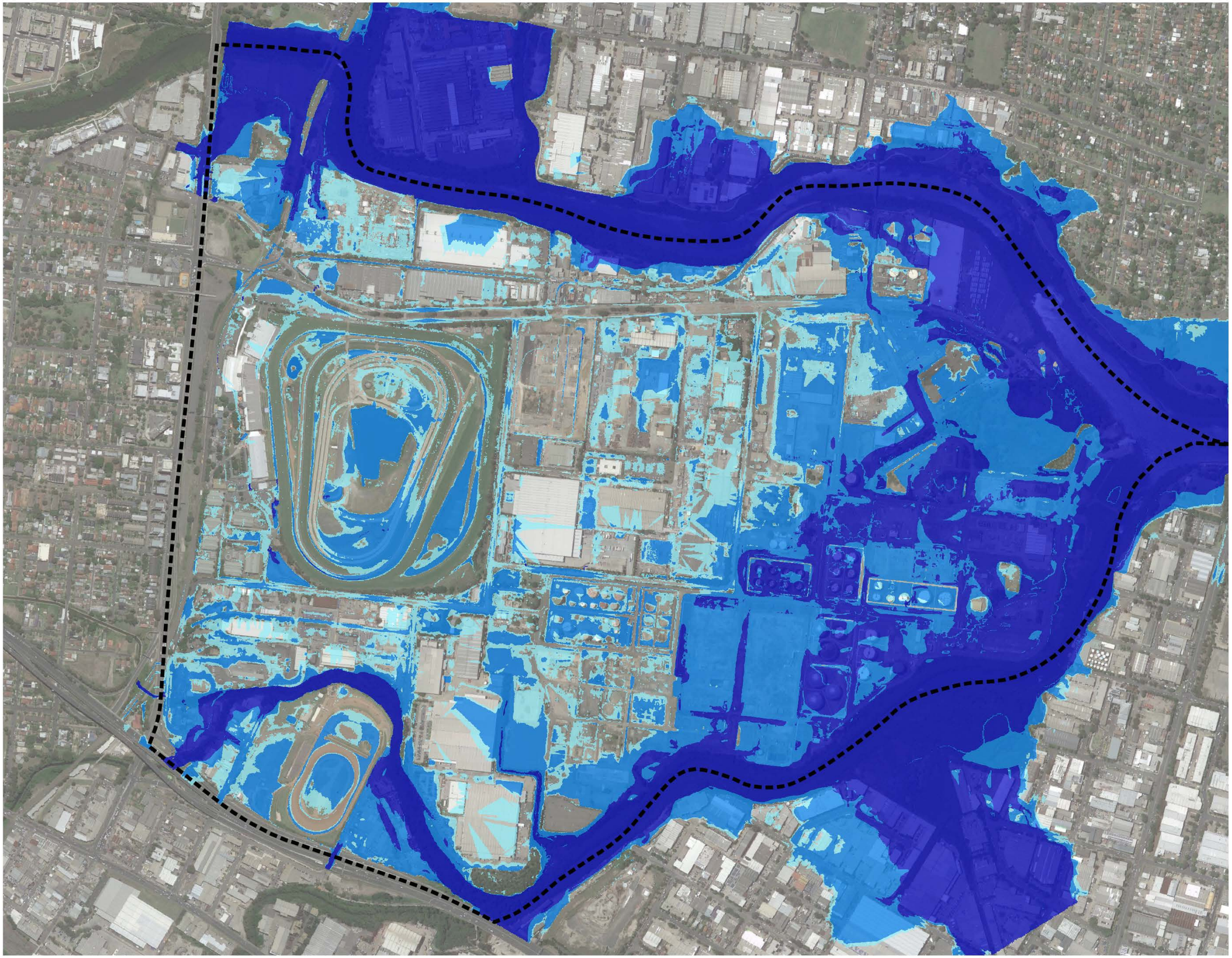
N

1% AEP Climate Change and 2m SLR Hazard

Camellia Rosehill Place Strategy

Post-Development

Figure 24 Appendix A



LEGEND

Camellia Rosehill Precinct Boundary

Pre-Development 100yr Climate Change ARI 2m SLR Hydraulic Categories

- Flood Fringe
- Flood Storage
- Flood Way

REV	Description	Date	Approved
B	FINAL MASTERPLAN	2022-05-09	KB
A	ISSUED	2021-12-14	KB

Scale 1:10000

0 0.2 0.4 0.6 km

STATUS

Oringinal Size	A3	Drawn	QGIS
Coordinate System	MGA56	Designed	SL
Height Datum	AHD	Date Printed	09/05/2022

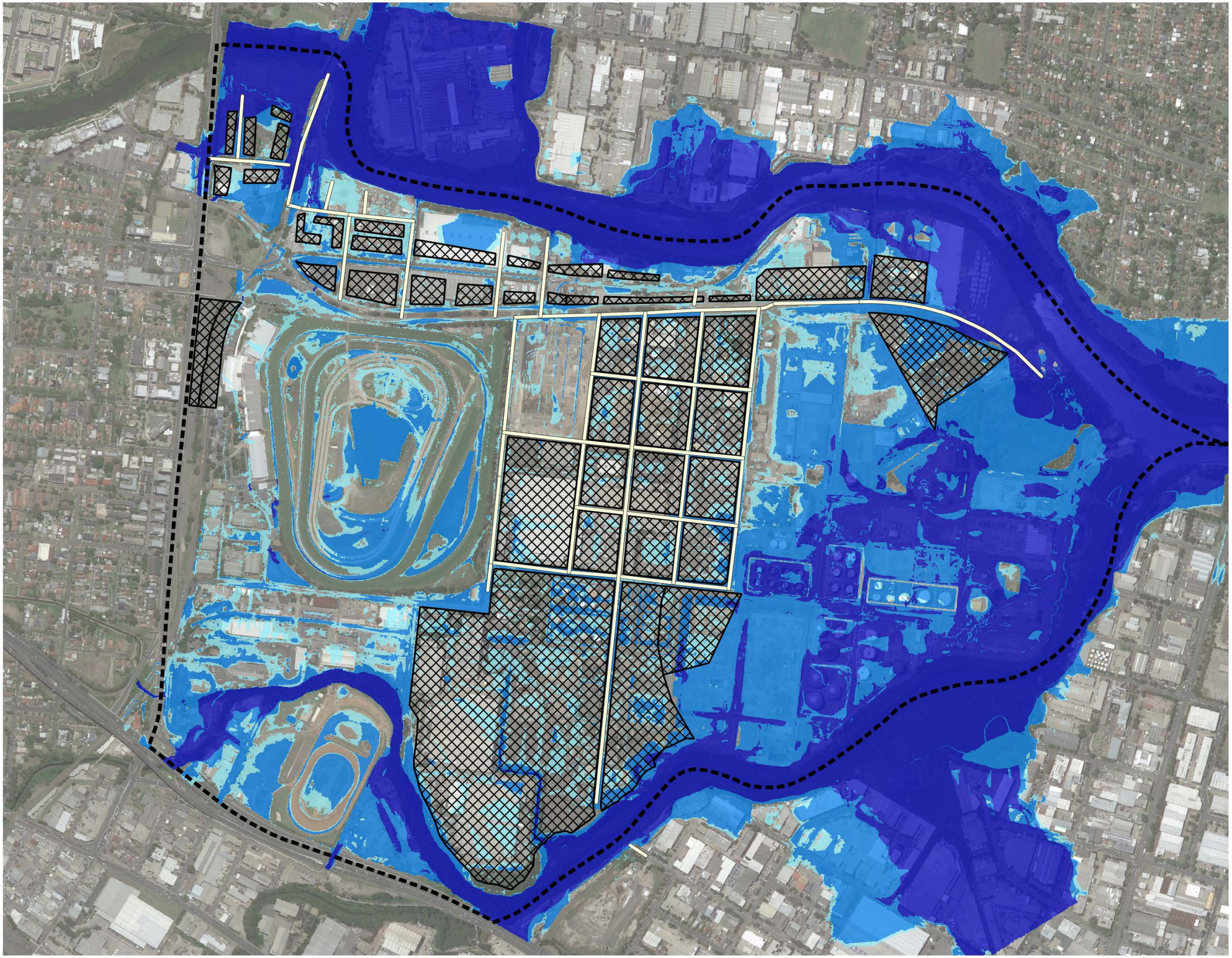
N

1% AEP Climate Change and 2m SLR Hydraulic Categories

Camellia Rosehill Place Strategy

Pre-Development

Figure 25 Appendix A



LEGEND

- Camellia Rosehill Precinct Boundary
- Building Footprint
- Proposed Roads

Post-Development 100yr Climate Change ARI 2m SLR Hydraulic Categories

- Flood Fringe
- Flood Storage
- Flood Way

REV	Description	Date	Approved
B	FINAL MASTERPLAN	2022-05-09	KB
A	ISSUED	2021-12-14	KB

Scale 1:10000

0 0.2 0.4 0.6 km

STATUS

Oringinal Size	A3	Drawn	QGIS
Coordinate System	MGA56	Designed	SL
Height Datum	AHD	Date Printed	09/05/2022

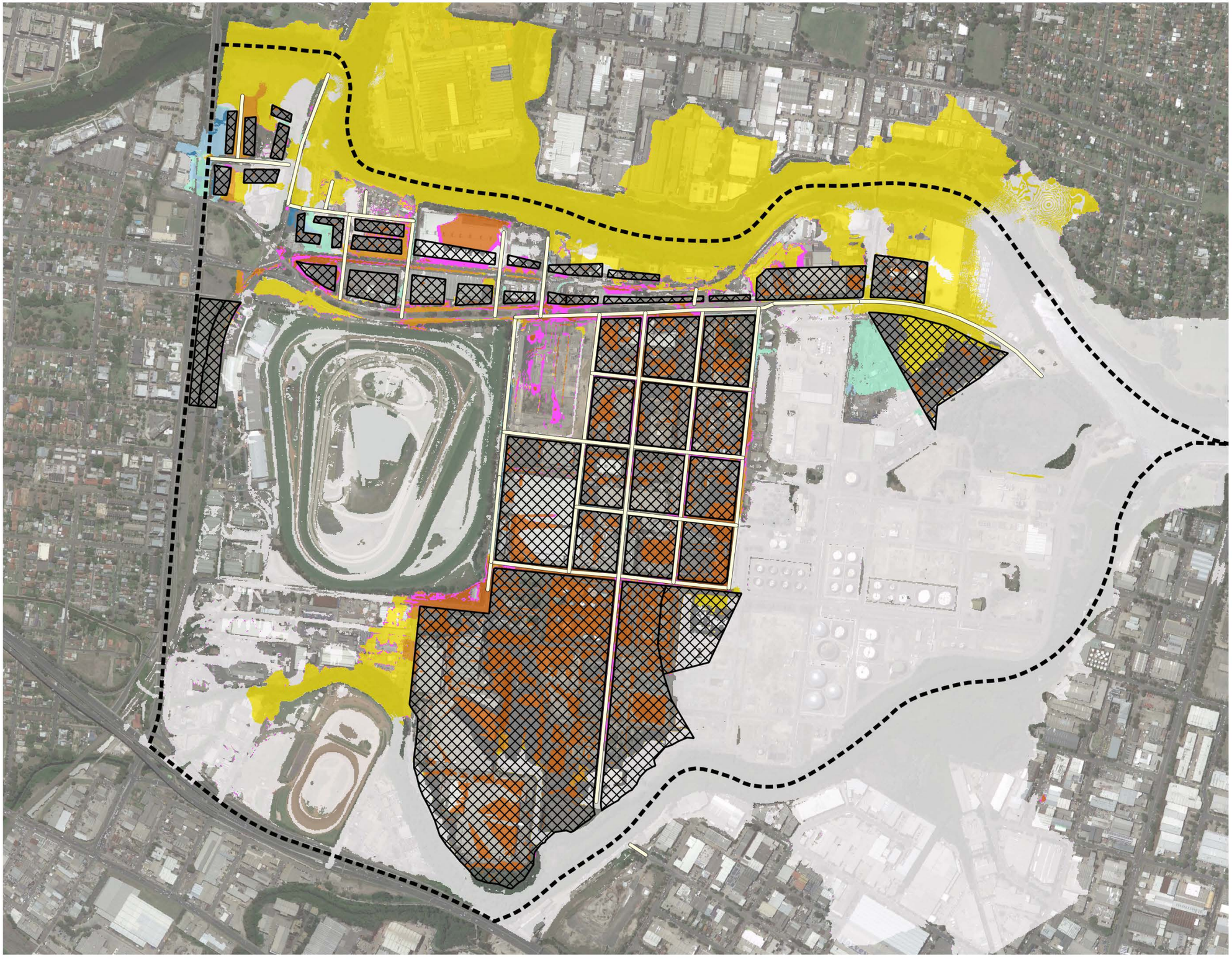
N

1% AEP Climate Change and 2m SLR Hydraulic Categories

Camellia Rosehill Place Strategy

Post-Development

Figure 26 Appendix A



LEGEND

- Camellia Rosehill Precinct Boundary
- Building Footprint
- Proposed Roads

100yr Climate Change, 2m SLR Afflux (m)

- <= -0.1m
- > -0.1 - <= -0.03m
- > -0.03 - <= -0.01m
- > -0.01 - <= +0.01m
- > +0.01 - <= +0.03m
- > +0.03 - <= +0.1m
- > +0.1m
- Was Wet Now Dry
- Was Dry Now Wet

REV	Description	Date	Approved
B	FINAL MASTERPLAN	2022-05-09	KB
A	ISSUED	2021-12-14	KB

Scale 1:10000

0 0.2 0.4 0.6 km

STATUS

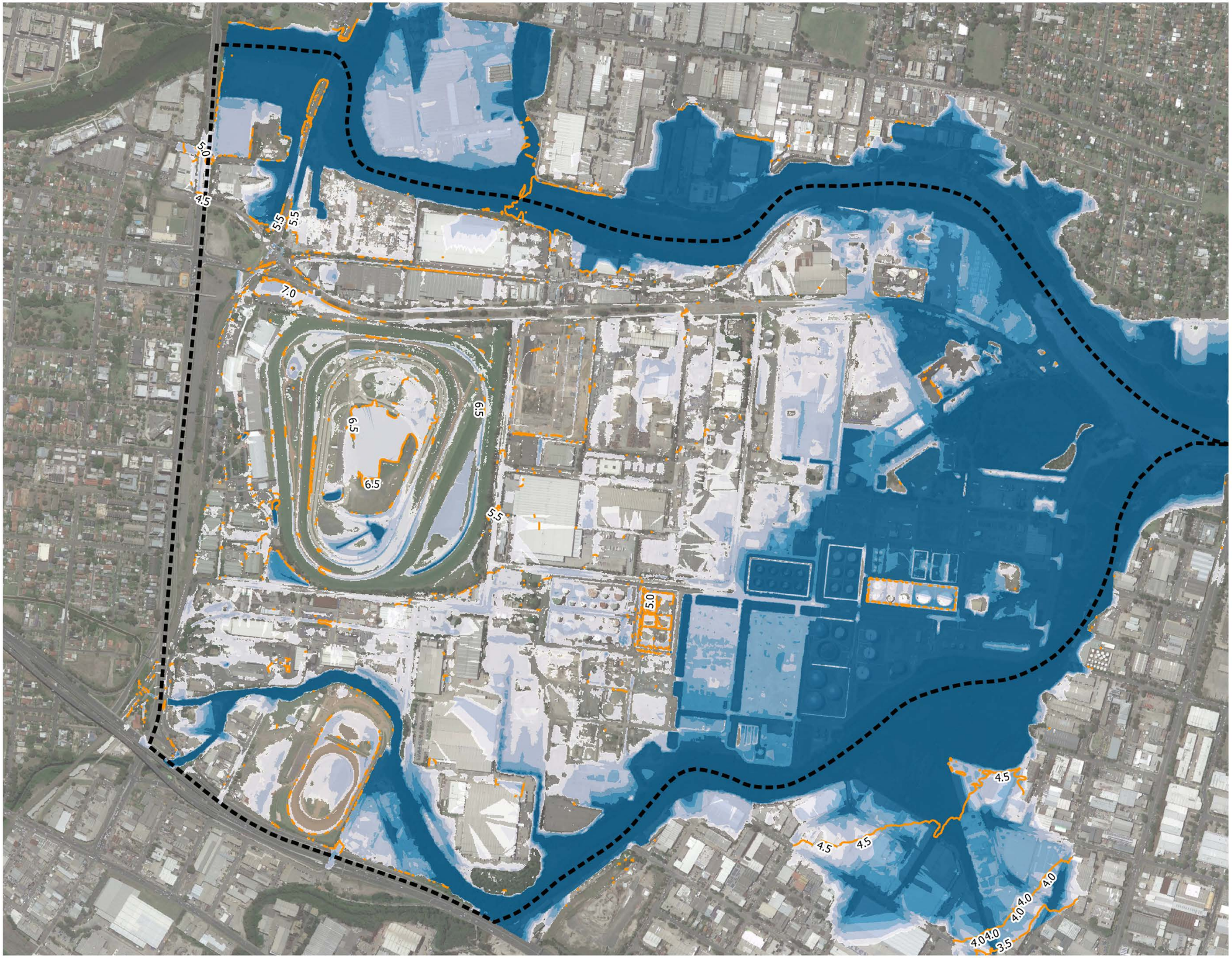
Oringinal Size	A3	Drawn	QGIS
Coordinate System	MGA56	Designed	SL
Height Datum	AHD	Date Printed	09/05/2022

N

1% AEP Climate Change and 2m SLR Water Level Difference

Camellia Rosehill Place Strategy

Figure 27 Appendix A



LEGEND

Camellia Rosehill Precinct Boundary

200yrSLR Pre-Dev 0.5m Water Level Contour

Pre-Development 200yr ARI 2m SLR Depth (m)

- <= 0.1
- 0.1 - 0.3
- 0.3 - 0.6
- 0.6 - 0.9
- 0.9 - 1.2
- > 1.2

REV	Description	Date	Approved
B	FINAL MASTERPLAN	2022-05-09	KB
A	ISSUED	2021-12-14	KB

Scale 1:10000

0 0.2 0.4 0.6 km

STATUS

Oringinal Size	A3	Drawn	QGIS
Coordinate System	MGA56	Designed	SL
Height Datum	AHD	Date Printed	09/05/2022

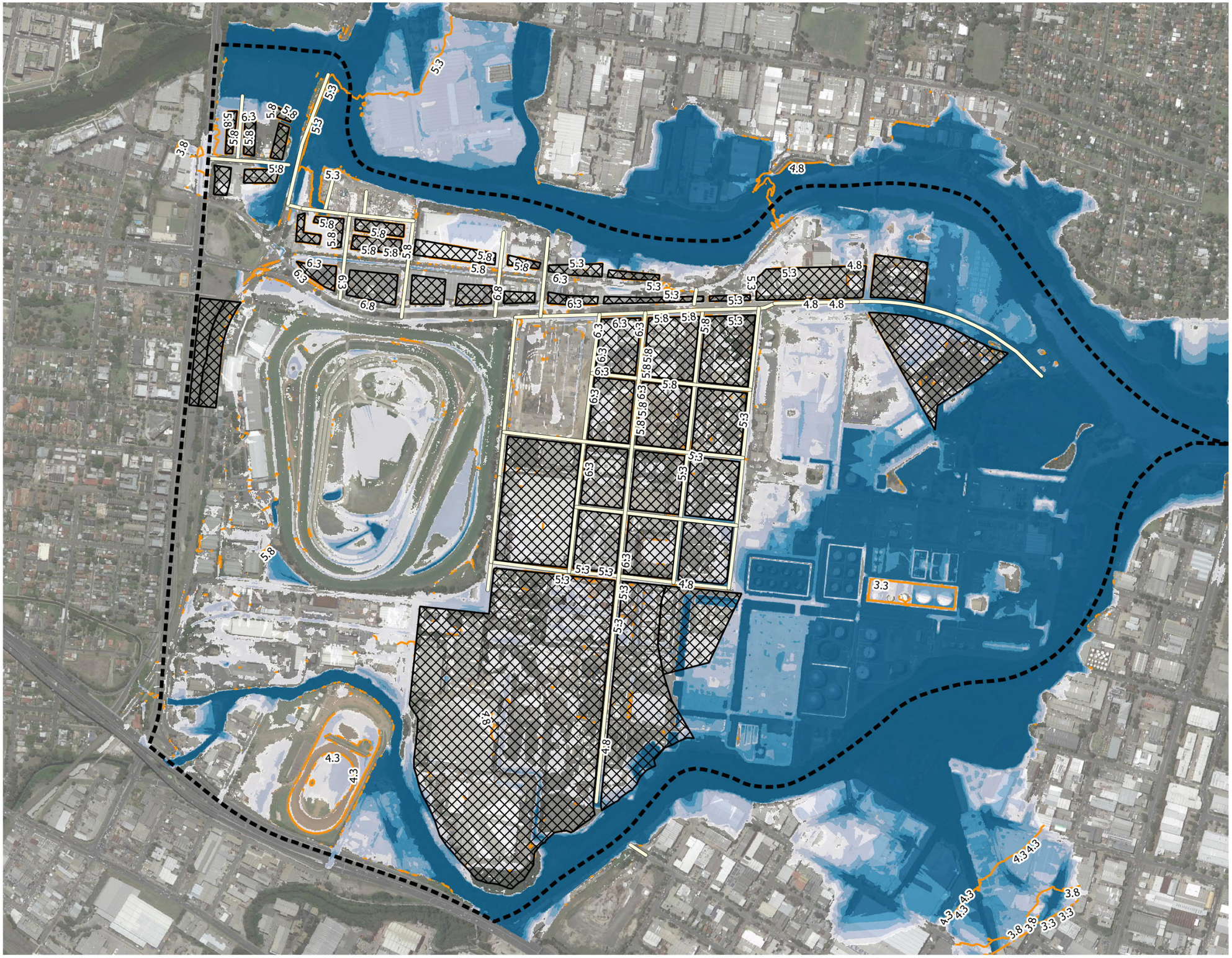
N

0.5% AEP and 2m SLR Depths and Water Level Contours

Camellia Rosehill Place Strategy

Pre-Development

Figure 28 Appendix A



LEGEND

- Camellia Rosehill Precinct Boundary
- Building Footprint
- Proposed Roads
- 200yrSLR Post-Dev 0.5m Water Level Contour

Post-Development 200yr ARI 2m SLR Depth (m)

- <= 0.1
- 0.1 - 0.3
- 0.3 - 0.6
- 0.6 - 0.9
- 0.9 - 1.2
- > 1.2

REV	Description	Date	Approved
B	FINAL MASTERPLAN	2022-05-09	KB
A	ISSUED	2021-12-14	KB

Scale 1:10000

0 0.2 0.4 0.6 km

STATUS

Oringinal Size	A3	Drawn	QGIS
Coordinate System	MGA56	Designed	SL
Height Datum	AHD	Date Printed	09/05/2022

N

0.5% AEP and 2m SLR Depths and Water Level Contours

Camellia Rosehill Place Strategy

Post-Development

Figure 29 Appendix A

LEGEND

Camellia Rosehill Precinct Boundary

Pre-Development 200yr ARI 2m SLR
Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

REV	Description	Date	Approved
B	FINAL MASTERPLAN	2022-05-09	KB
A	ISSUED	2021-12-14	KB

Scale 1:10000

0 0.2 0.4 0.6 km

STATUS

Oringinal Size	A3	Drawn	QGIS
Coordinate System	MGA56	Designed	SL
Height Datum	AHD	Date Printed	09/05/2022

N

0.5% AEP and 2m SLR Velocity

Camellia Rosehill Place Strategy

Pre-Development

Figure 30 Appendix A

LEGEND

- Camellia Rosehill Precinct Boundary
- Building Footprint
- Proposed Roads

Post-Development 200yr ARI 2m SLR Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

REV	Description	Date	Approved
B	FINAL MASTERPLAN	2022-05-09	KB
A	ISSUED	2021-12-14	KB

Scale 1:10000

0 0.2 0.4 0.6 km

STATUS

Oringinal Size	A3	Drawn	QGIS
Coordinate System	MGA56	Designed	SL
Height Datum	AHD	Date Printed	09/05/2022

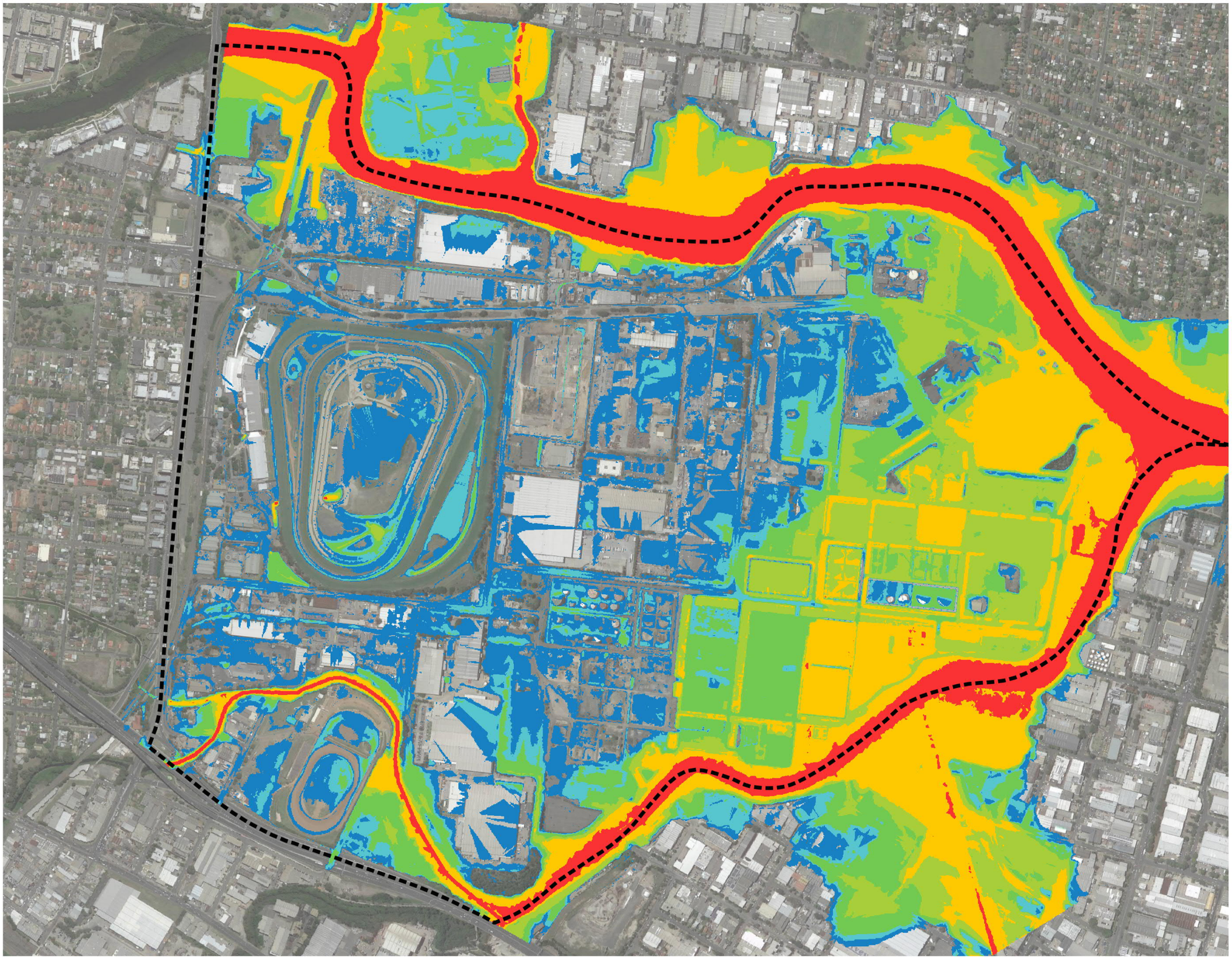
N

0.5% AEP and 2m SLR Velocity

Camellia Rosehill Place Strategy

Post-Development

Figure 31 Appendix A



LEGEND

Camellia Rosehill Precinct Boundary

Pre-Development 200yr ARI 2m SLR

Hazard

- H1- Relatively benign flow conditions. No vulnerability constraints.
- H2- Unsafe for small vehicles.
- H3- Unsafe for all vehicles, children and the elderly.
- H4- Unsafe for all people and all vehicles.
- H5- Unsafe for all people and all vehicles. Buildings require special engineering design and construction.
- H6- Unconditionally dangerous. Not suitable for any type of developmen or evacuation access. All Building types considered vulnerable to failure.

REV	Description	Date	Approved
B	FINAL MASTERPLAN	2022-05-09	KB
A	ISSUED	2021-12-14	KB

Scale 1:10000

0 0.2 0.4 0.6 km

STATUS

Oringinal Size	A3	Drawn	QGIS
Coordinate System	MGA56	Designed	SL
Height Datum	AHD	Date Printed	09/05/2022

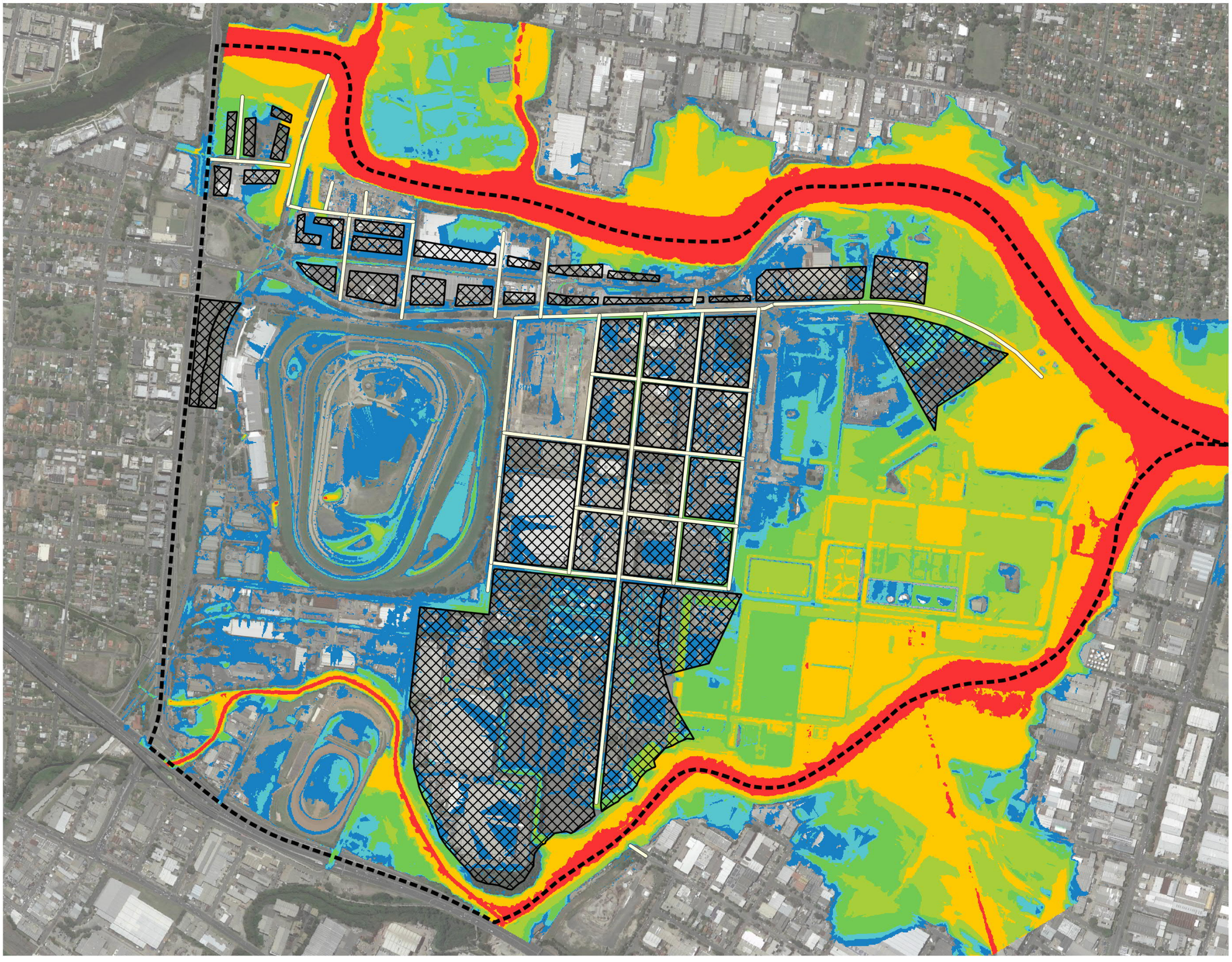
N

0.5% AEP and 2m SLR Hazard

Camellia Rosehill Place Strategy

Pre-Development

Figure 32 Appendix A



wsp

LEGEND

- Camellia Rosehill Precinct Boundary
- Building Footprint
- Proposed Roads

Post-Development 200yr ARI 2m SLR Hazard

- H1- Relatively benign flow conditions. No vulnerability constraints.
- H2- Unsafe for small vehicles.
- H3- Unsafe for all vehicles, children and the elderly.
- H4- Unsafe for all people and all vehicles.
- H5- Unsafe for all people and all vehicles. Buildings require special engineering design and construction.
- H6- Unconditionally dangerous. Not suitable for any type of developmen or evacuation access. All Building types considered vulnerable to failure.

REV	Description	Date	Approved
B	FINAL MASTERPLAN	2022-05-09	KB
A	ISSUED	2021-12-14	KB

Scale 1:10000

0 0.2 0.4 0.6 km

STATUS

Oringinal Size	A3	Drawn	QGIS
Coordinate System	MGA56	Designed	SL
Height Datum	AHD	Date Printed	09/05/2022

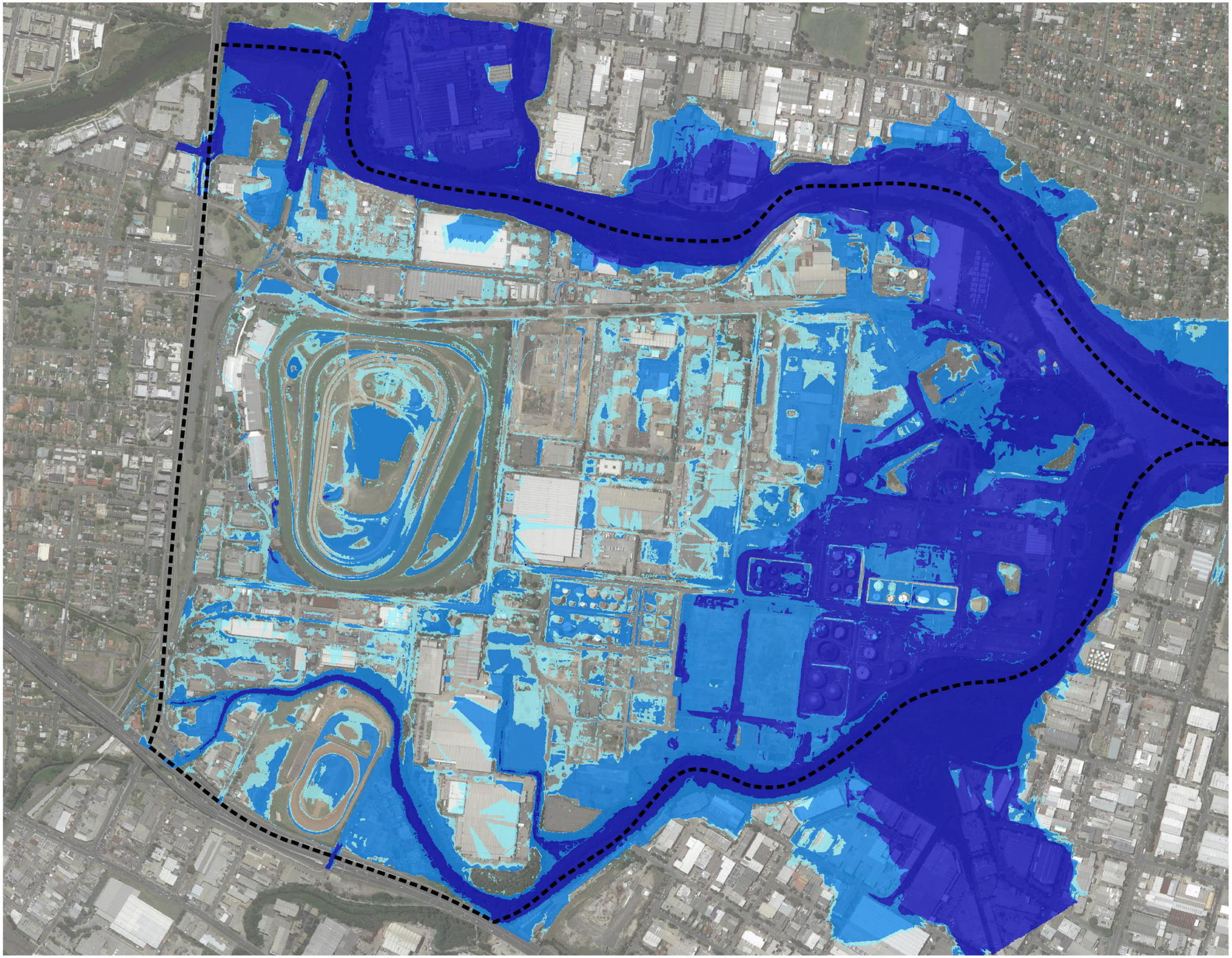
N

0.5% AEP and 2m SLR Hazard

Camellia Rosehill Place Strategy

Post-Development

Figure 33 Appendix A



LEGEND

Camellia Rosehill Precinct Boundary

Pre-Development 200yr ARI 2m SLR
Hydraulic Categories

- Flood Fringe
- Flood Storage
- Flood Way

REV	Description	Date	Approved
B	FINAL MASTERPLAN	2022-05-04	KB
A	ISSUED	2021-12-14	KB

Scale 1:10000

0 0.2 0.4 0.6 km

STATUS

Oringinal Size	A3	Drawn	QGIS
Coordinate System	MGA56	Designed	SL
Height Datum	AHD	Date Printed	04/05/2022

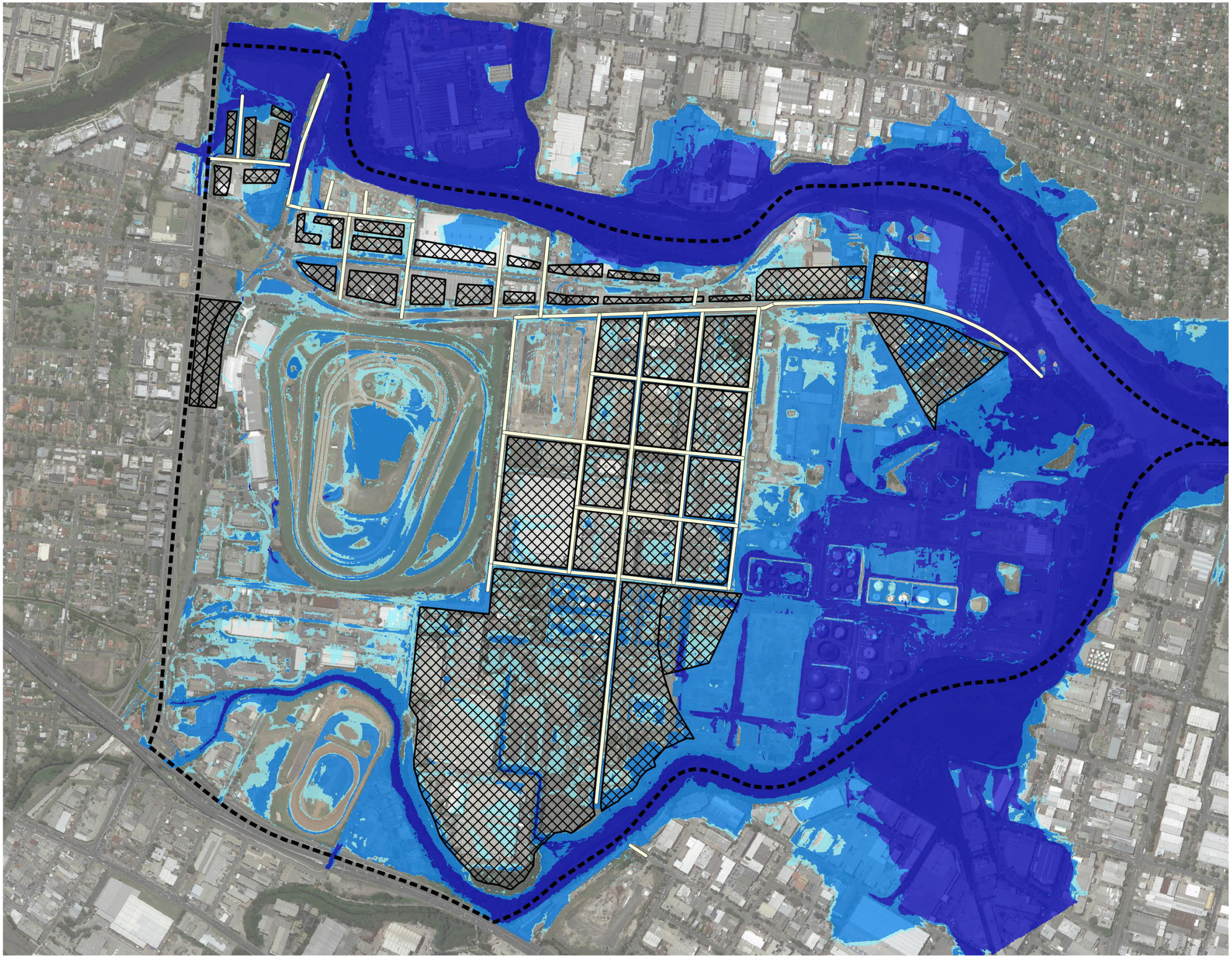
N

0.5% AEP and 2m SLR Hydraulic Categories

Camellia Rosehill Place Strategy

Pre-Development

Figure 34 Appendix A



LEGEND

- Camellia Rosehill Precinct Boundary
- Building Footprint
- Proposed Roads

Post-Development 200yr ARI 2m SLR Hydraulic Categories

- Flood Fringe
- Flood Storage
- Flood Way

REV	Description	Date	Approved
B	FINAL MASTERPLAN	2022-05-09	KB
A	ISSUED	2021-12-14	KB

Scale 1:10000

0 0.2 0.4 0.6 km

STATUS

Oringinal Size	A3	Drawn	QGIS
Coordinate System	MGA56	Designed	SL
Height Datum	AHD	Date Printed	09/05/2022

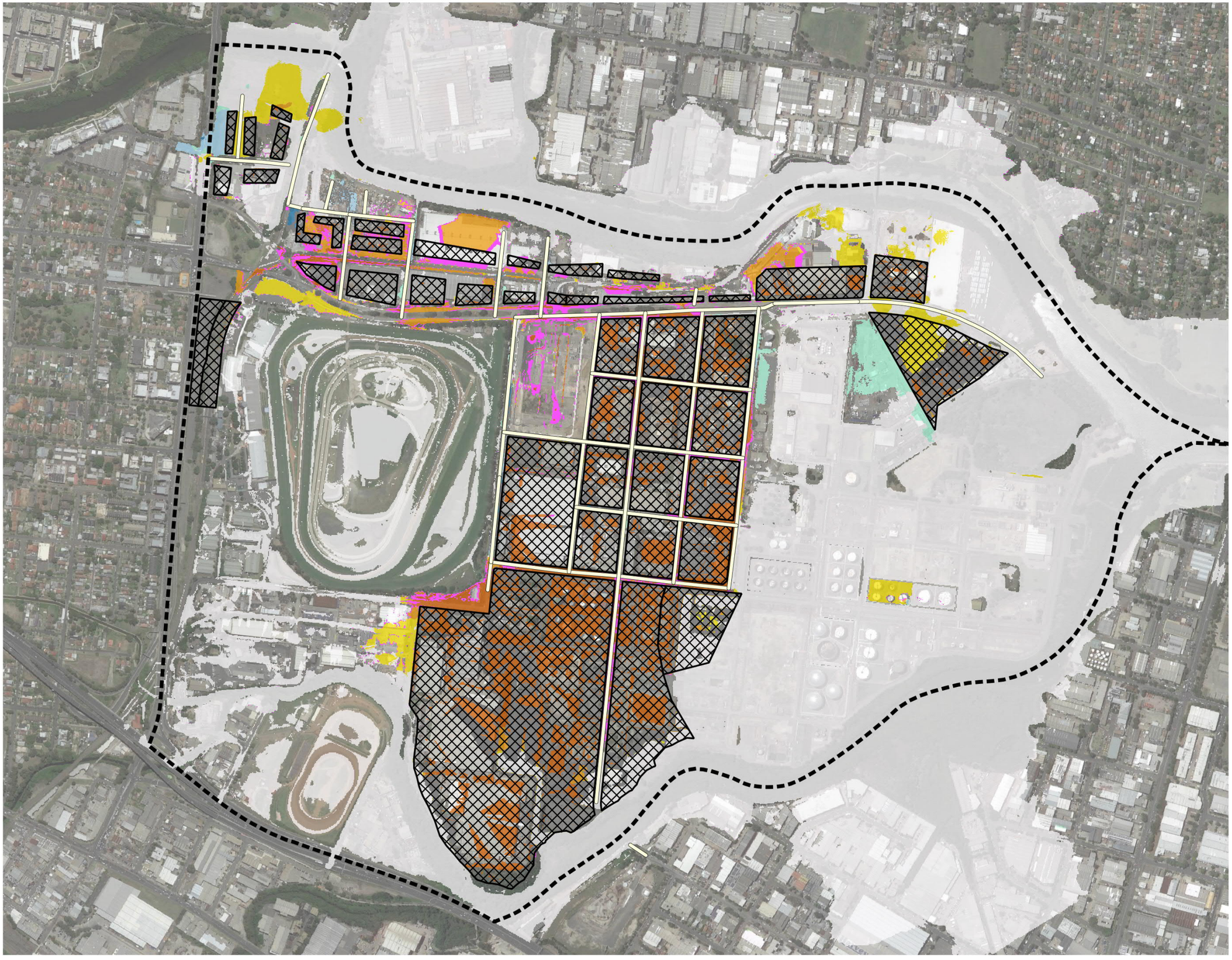
N

0.5% AEP and 2m SLR Hydraulic Categories

Camellia Rosehill Place Strategy

Post-Development

Figure 35 Appendix A



LEGEND

- Camellia Rosehill Precinct Boundary
- Building Footprint
- Proposed Roads

200yr, 2m SLR Afflux (m)

- <= -0.1m
- > -0.1 - <= -0.03m
- > -0.03 - <= -0.01m
- > -0.01 - <= +0.01m
- > +0.01 - <= +0.03m
- > +0.03 - <= +0.1m
- > +0.1m
- Was Wet Now Dry
- Was Dry Now Wet

REV	Description	Date	Approved
B	FINAL MASTERPLAN	2022-05-09	KB
A	ISSUED	2021-12-14	KB

Scale 1:10000

0 0.2 0.4 0.6 km

STATUS

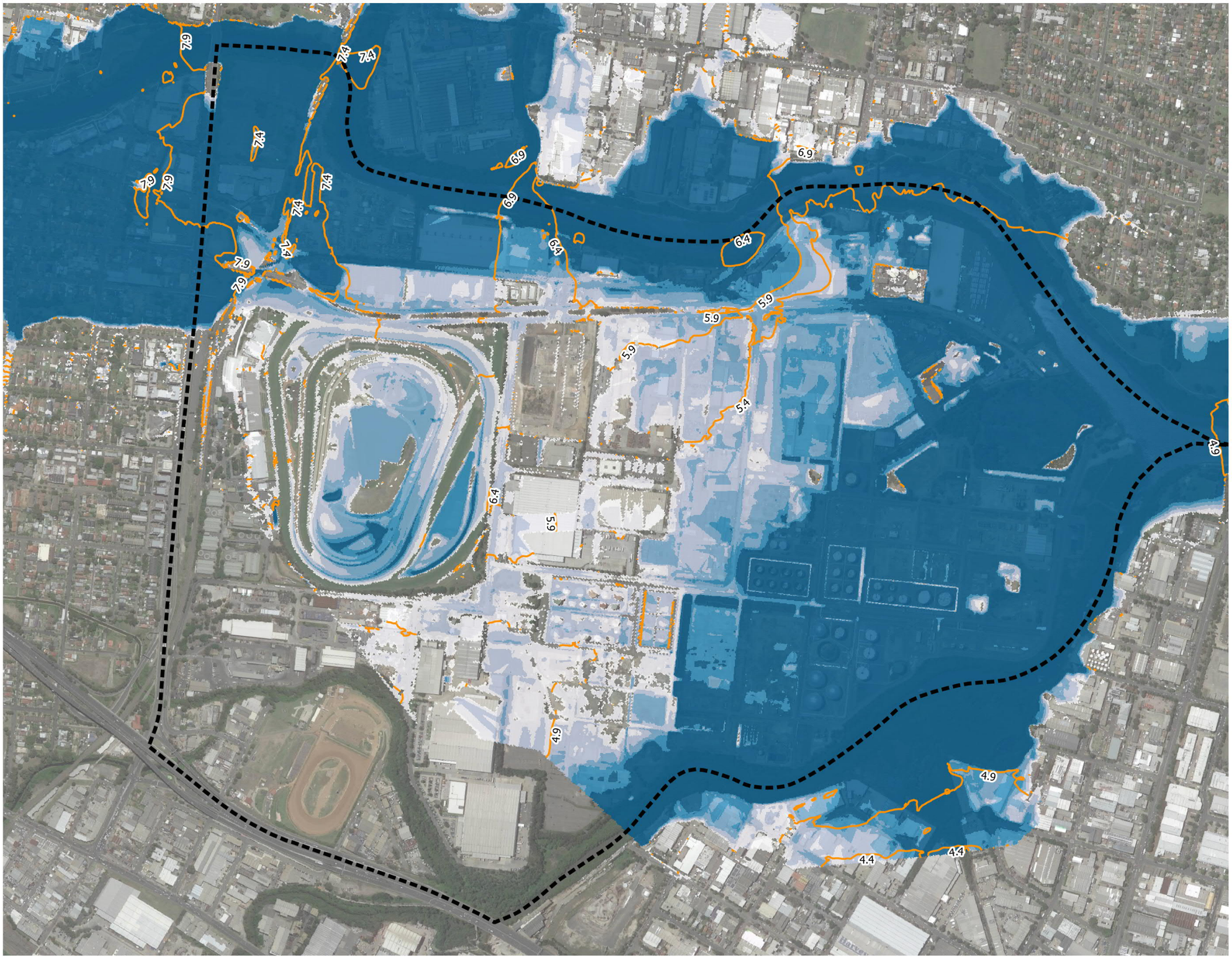
Oringinal Size	A3	Drawn	QGIS
Coordinate System	MGA56	Designed	SL
Height Datum	AHD	Date Printed	09/05/2022

N

0.5% AEP and 2m SLR Water Level Difference

Camellia Rosehill Place Strategy

Figure 36 Appendix A



LEGEND

- Camellia Rosehill Precinct Boundary
- PMF Pre-Dev 0.5m Water Level Contour

Pre-Development PMF Depth (m)

- <= 0.1
- 0.1 - 0.3
- 0.3 - 0.6
- 0.6 - 0.9
- 0.9 - 1.2
- > 1.2

REV	Description	Date	Approved
B	FINAL MASTERPLAN	2022-05-05	KB
A	ISSUED	2021-12-14	KB

Scale 1:10000

0 0.2 0.4 0.6 km

STATUS

Oringinal Size	A3	Drawn	QGIS
Coordinate System	MGA56	Designed	SL
Height Datum	AHD	Date Printed	05/05/2022

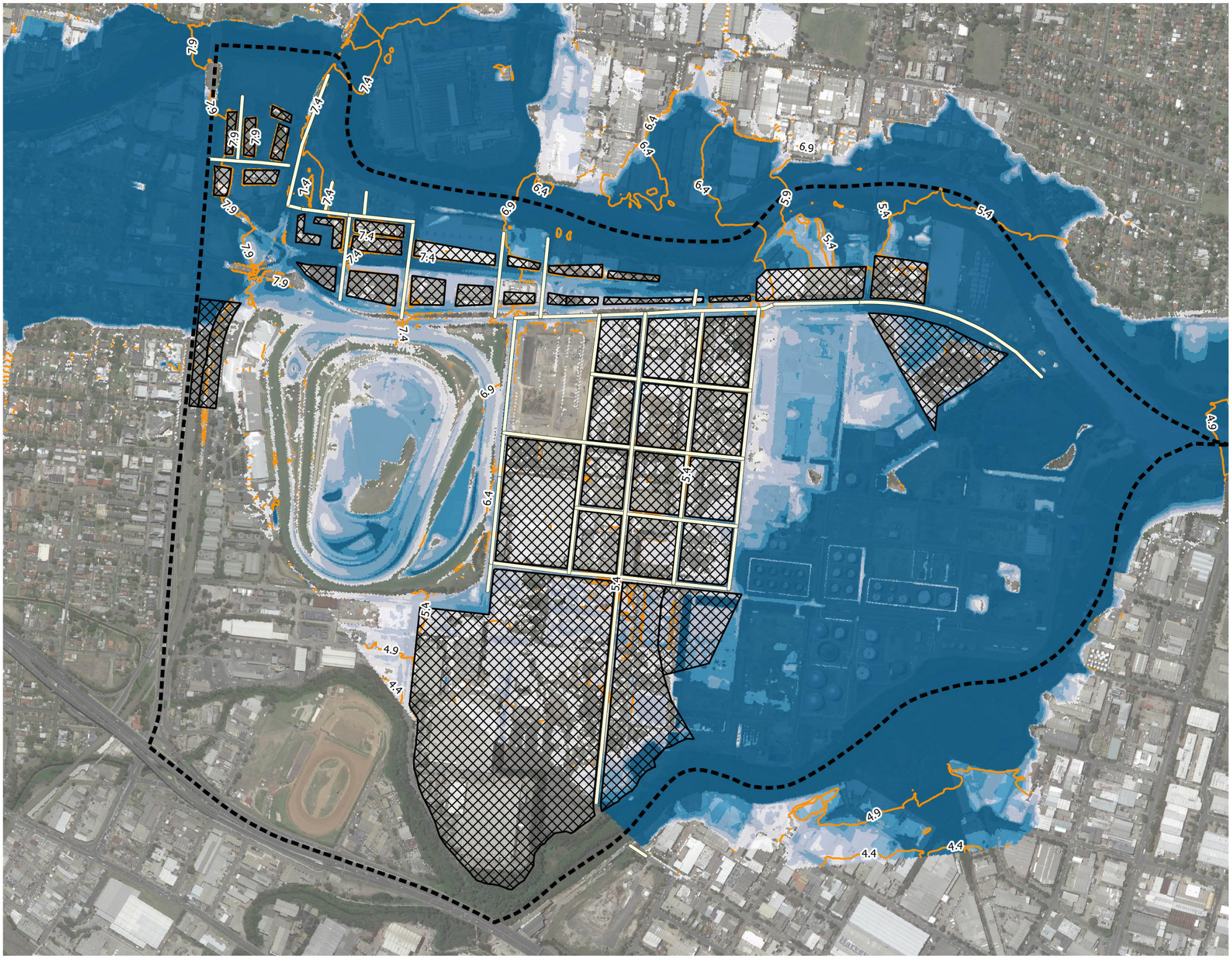
N

PMF Depths and Water Level Contours

Camellia Rosehill Place Strategy

Pre-Development

Figure 37 Appendix A



LEGEND

- Camellia Rosehill Precinct Boundary
- Building Footprint
- Proposed Roads
- PMF Post-Dev 0.5m Water Level Contour

Post-Development PMF Depth (m)

- <= 0.1
- 0.1 - 0.3
- 0.3 - 0.6
- 0.6 - 0.9
- 0.9 - 1.2
- > 1.2

REV	Description	Date	Approved
B	FINAL MASTERPLAN	2022-05-09	KB
A	ISSUED	2021-12-14	KB

Scale 1:10000

0 0.2 0.4 0.6 km

STATUS

Oringinal Size	A3	Drawn	QGIS
Coordinate System	MGA56	Designed	SL
Height Datum	AHD	Date Printed	09/05/2022

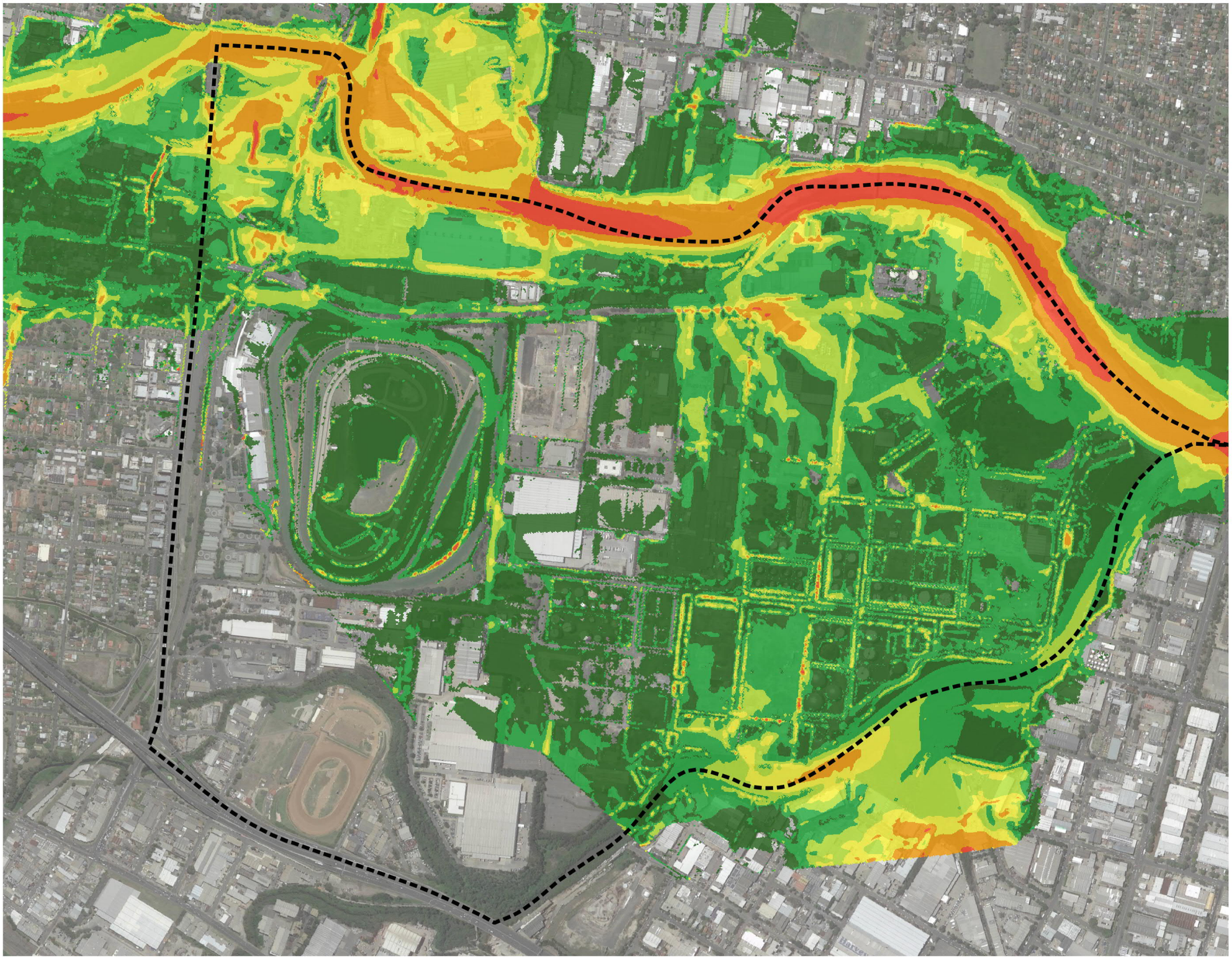
N

PMF Depths and Water Level Contours

Camellia Rosehill Place Strategy

Post-Development

Figure 38 Appendix A



LEGEND

Camellia Rosehill Precinct Boundary

Pre-Development PMF

Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

REV	Description	Date	Approved
B	FINAL MASTERPLAN	2022-05-04	KB
A	ISSUED	2021-12-14	KB

Scale 1:10000

0 0.2 0.4 0.6 km

STATUS

Oringinal Size	A3	Drawn	QGIS
Coordinate System	MGA56	Designed	SL
Height Datum	AHD	Date Printed	04/05/2022

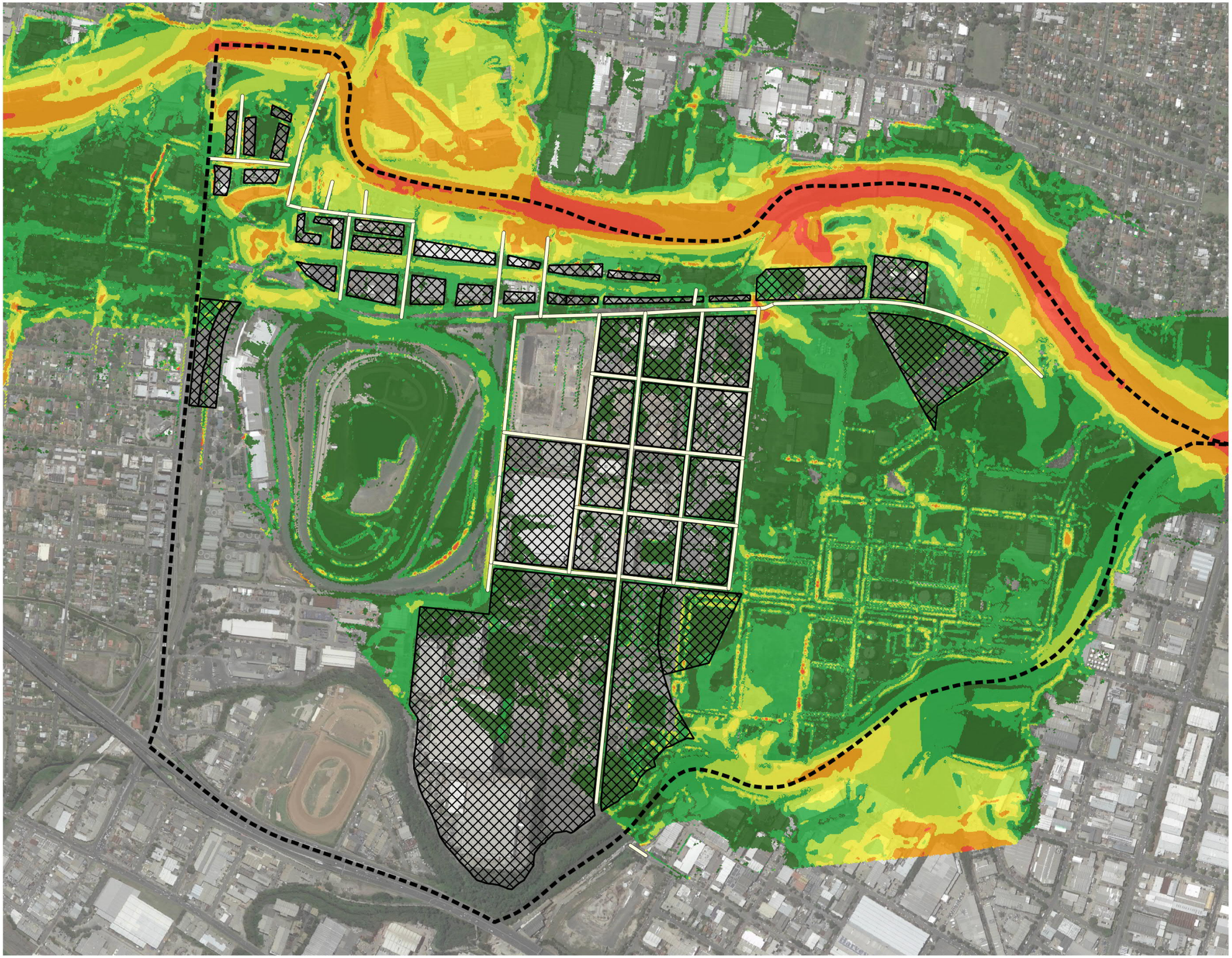
N

PMF Velocity

Camellia Rosehill Place Strategy

Pre-Development

Figure 39 Appendix A



LEGEND

- Camellia Rosehill Precinct Boundary
- Building Footprint
- Proposed Roads

Post-Development PMF Velocity (m/s)

- 0.00 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- 2.00 to 3.00
- > 3.00

REV	Description	Date	Approved
B	FINAL MASTERPLAN	2022-05-09	KB
A	ISSUED	2021-12-14	KB

Scale 1:10000

0 0.2 0.4 0.6 km

STATUS

Oringinal Size	A3	Drawn	QGIS
Coordinate System	MGA56	Designed	SL
Height Datum	AHD	Date Printed	09/05/2022

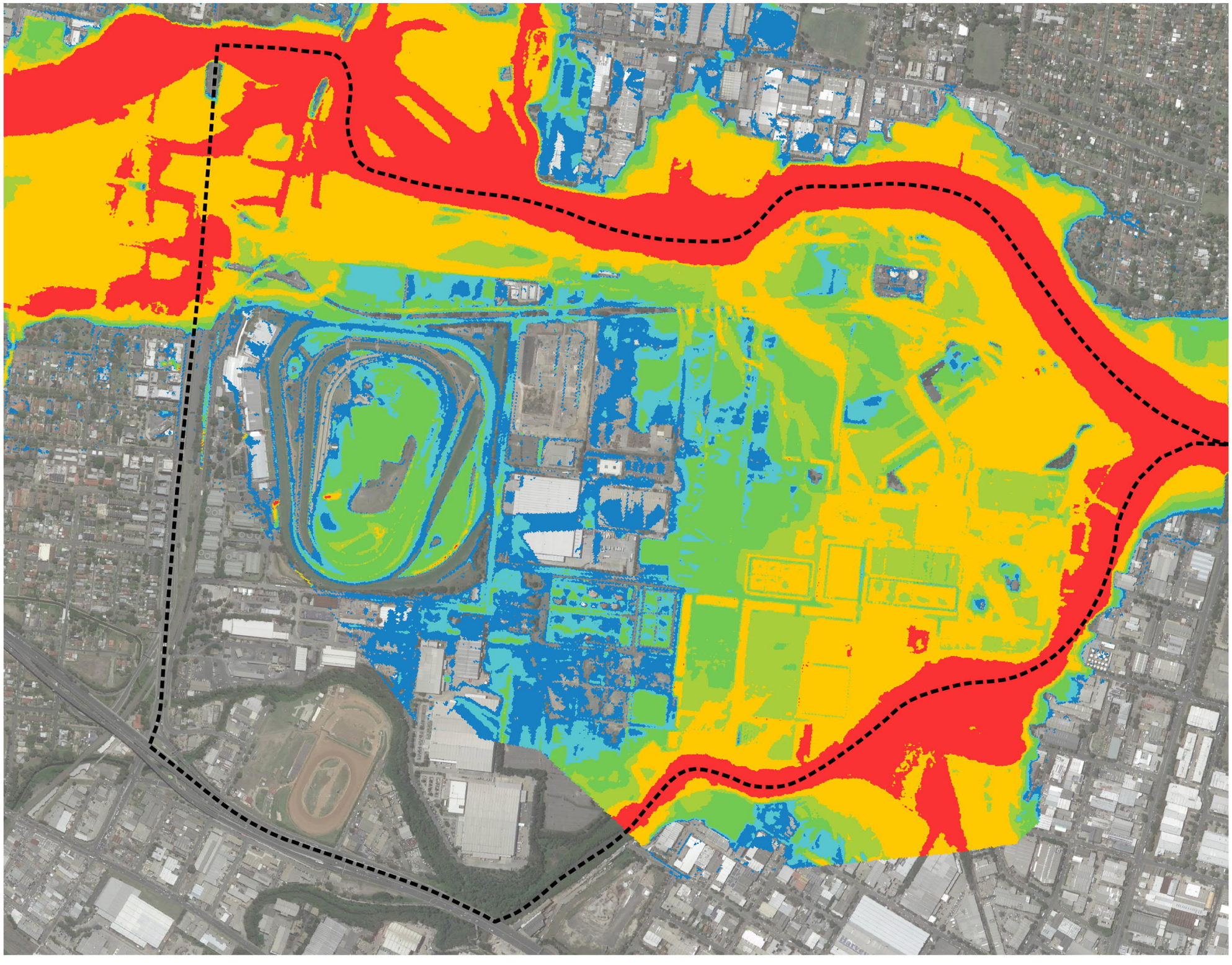
N

PMF Velocity

Camellia Rosehill Place Strategy

Post-Development

Figure 40 Appendix A



LEGEND

Camellia Rosehill Precinct Boundary

Pre-Development PMF

Hazard

- H1- Relatively benign flow conditions. No vulnerability constraints.
- H2- Unsafe for small vehicles.
- H3- Unsafe for all vehicles, children and the elderly.
- H4- Unsafe for all people and all vehicles.
- H5- Unsafe for all people and all vehicles. Buildings require special engineering design and construction.
- H6- Unconditionally dangerous. Not suitable for any type of developmen or evacuation access. All Building types considered vulnerable to failure.

REV	Description	Date	Approved
B	FINAL MASTERPLAN	2022-05-04	KB
A	ISSUED	2021-12-14	KB

Scale 1:10000

0 0.2 0.4 0.6 km

STATUS

Oringinal Size	A3	Drawn	QGIS
Coordinate System	MGA56	Designed	SL
Height Datum	AHD	Date Printed	04/05/2022

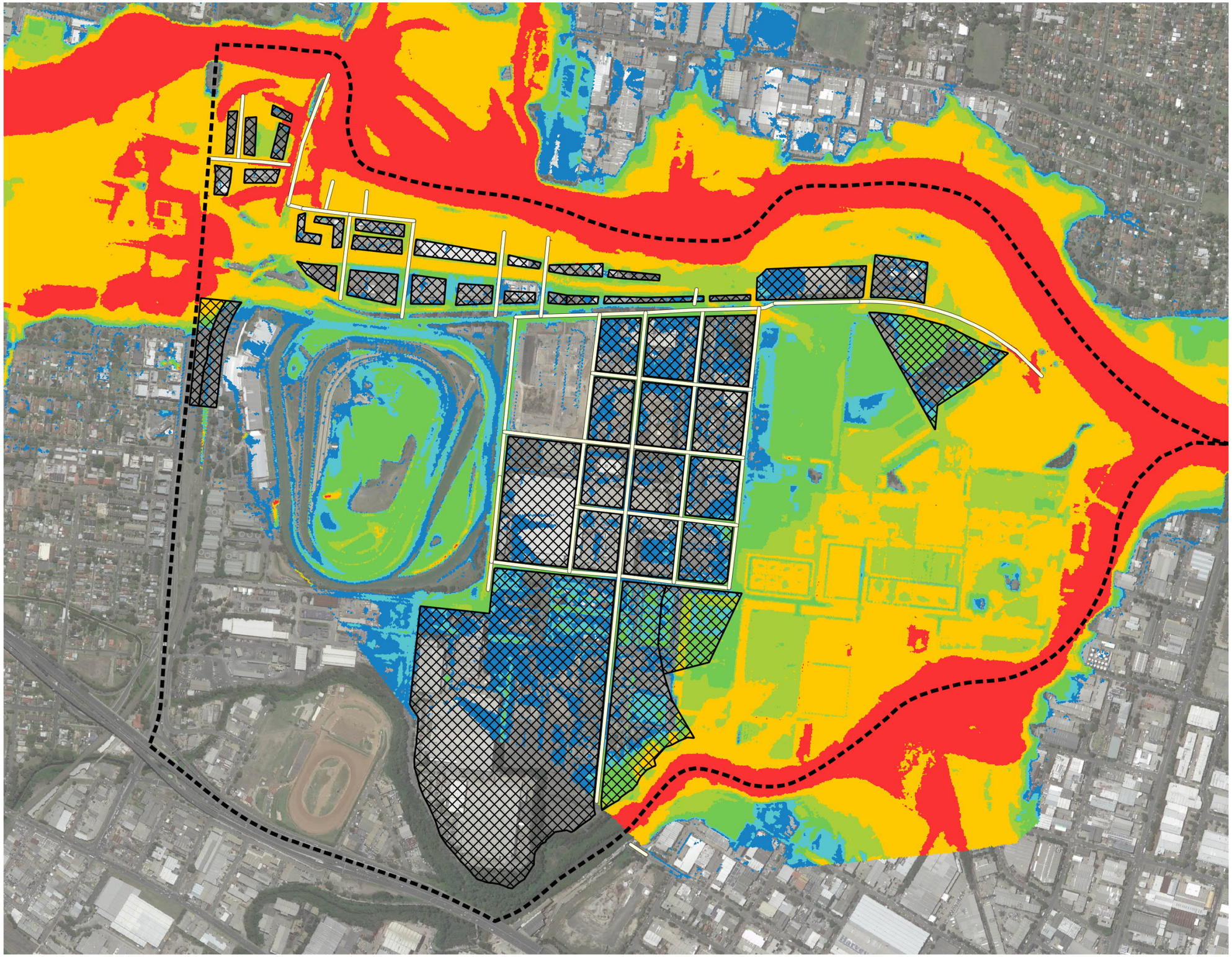
N

PMF Hazard

Camellia Rosehill Place Strategy

Pre-Development

Figure 41 Appendix A



LEGEND

- Camellia Rosehill Precinct Boundary
- Building Footprint
- Proposed Roads

Post-Development PMF

Hazard

- H1- Relatively benign flow conditions. No vulnerability constraints.
- H2- Unsafe for small vehicles.
- H3- Unsafe for all vehicles, children and the elderly.
- H4- Unsafe for all people and all vehicles.
- H5- Unsafe for all people and all vehicles. Buildings require special engineering design and construction.
- H6- Unconditionally dangerous. Not suitable for any type of developmen or evacuation access. All Building types considered vulnerable to failure.

REV	Description	Date	Approved
B	FINAL MASTERPLAN	2022-05-09	KB
A	ISSUED	2021-12-14	KB

Scale 1:10000

0 0.2 0.4 0.6 km

STATUS

Oringinal Size	A3	Drawn	QGIS
Coordinate System	MGA56	Designed	SL
Height Datum	AHD	Date Printed	09/05/2022

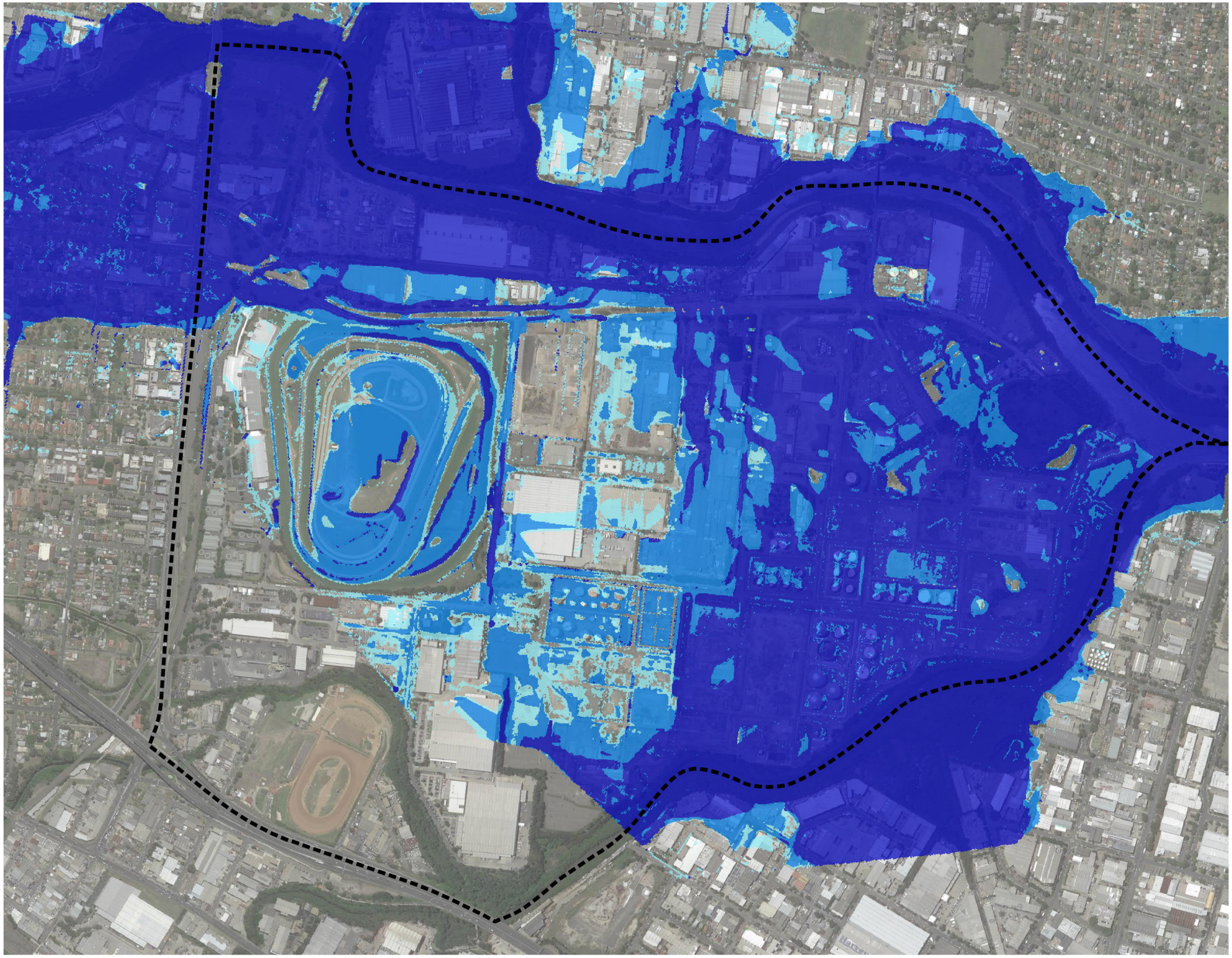
N

PMF Hazard

Camellia Rosehill Place Strategy

Post-Development

Figure 42 Appendix A



LEGEND

Camellia Rosehill Precinct Boundary

Pre-Development PMF

Hydraulic Categories

- Flood Fringe
- Flood Storage
- Flood Way

REV	Description	Date	Approved
B	FINAL MASTERPLAN	2022-05-04	KB
A	ISSUED	2021-12-14	KB

Scale 1:10000

0 0.2 0.4 0.6 km

STATUS

Oringinal Size	A3	Drawn	QGIS
Coordinate System	MGA56	Designed	SL
Height Datum	AHD	Date Printed	04/05/2022

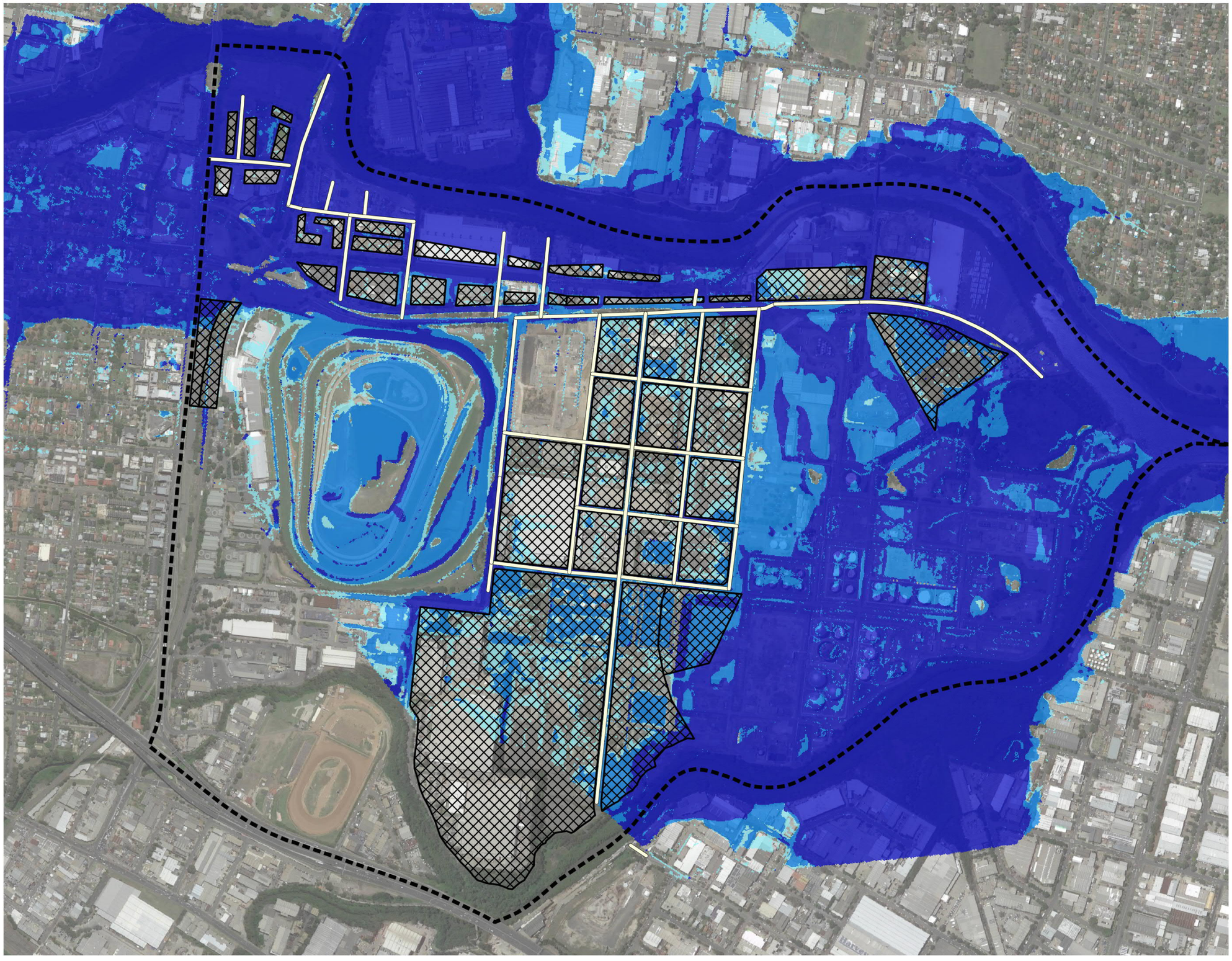
N

PMF Hydraulic Categories

Camellia Rosehill Place Strategy

Pre-Development

Figure 43 Appendix A



LEGEND

- Camellia Rosehill Precinct Boundary
- Building Footprint
- Proposed Roads

Post-Development PMF Hydraulic Categories

- Flood Fringe
- Flood Storage
- Flood Way

REV	Description	Date	Approved
B	FINAL MASTERPLAN	2022-05-09	KB
A	ISSUED	2021-12-14	KB

Scale 1:10000

0 0.2 0.4 0.6 km

STATUS

Oringinal Size	A3	Drawn	QGIS
Coordinate System	MGA56	Designed	SL
Height Datum	AHD	Date Printed	09/05/2022

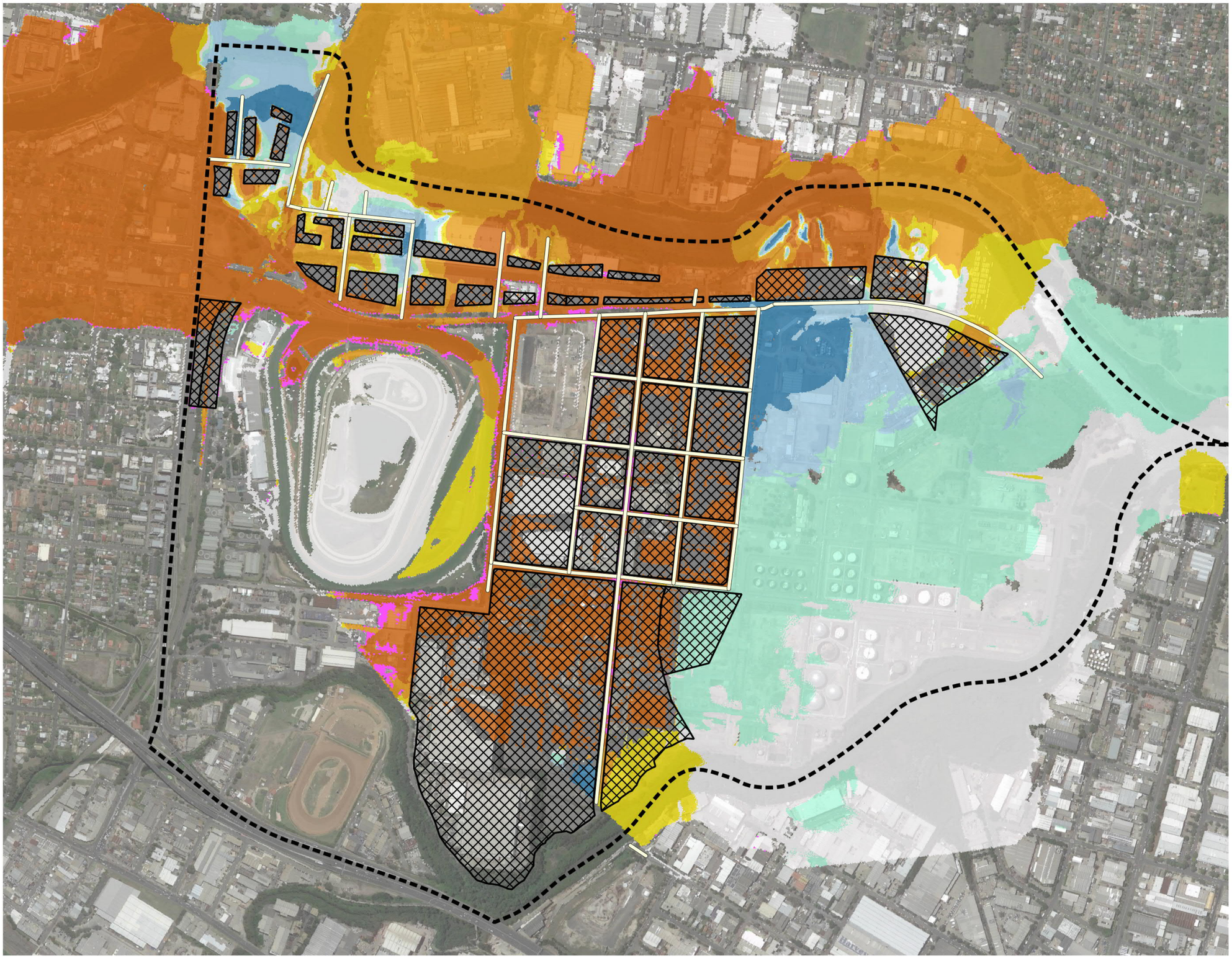
N

PMF Hydraulic Categories

Camellia Rosehill Place Strategy

Post-Development

Figure 44 Appendix A



LEGEND

- Camellia Rosehill Precinct Boundary
- Building Footprint
- Proposed Roads

PMF Afflux (m)

- <= -0.1m
- > -0.1 - <= -0.03m
- > -0.03 - <= -0.01m
- > -0.01 - <= +0.01m
- > +0.01 - <= +0.03m
- > +0.03 - <= +0.1m
- > +0.1m
- Was Wet Now Dry
- Was Dry Now Wet

REV	Description	Date	Approved
B	FINAL MASTERPLAN	2022-05-09	KB
A	ISSUED	2021-12-14	KB

Scale 1:10000

0 0.2 0.4 0.6 km

STATUS

Oringinal Size	A3	Drawn	QGIS
Coordinate System	MGA56	Designed	SL
Height Datum	AHD	Date Printed	09/05/2022

N

PMF Water Level Difference

Camellia Rosehill Place Strategy

Figure 45 Appendix A

About Us

WSP is one of the world's leading professional services consulting firms. We are dedicated to our local communities and propelled by international brainpower. We are technical experts and strategic advisors including engineers, technicians, scientists, planners, surveyors and environmental specialists, as well as other design, program and construction management professionals. We design lasting solutions in the Transport & Water, Property & Buildings, Earth & Environment, and Mining & Power sector as well as offering strategic Advisory, Engagement & Digital services. With approximately 6,100 talented people in more than 50 offices in Australia and New Zealand, we engineer future ready projects that will help societies grow for lifetimes to come. www.wsp.com/en-au/.