infrastructure & development consulting

Badgerys Creek Industrial Park

85 Martin Road, Badgerys Creek

Integrated Water Management Plan

February 2025

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1 Introduction

Infrastructure & Development Consulting (IDC) have been engaged by ESR to prepare an Integrated Water Management Plan for the proposed SSDA for the Badgerys Creek Industry Park at 85 Martin Road, Badgerys Creek. The purpose of the study is to identify the opportunities, constraints and any risks associated with the proposal related to water management.

The following analyses have been undertaken to provide an overview of the engineering water management strategy for the site and to guide future detailed design through the implementation of appropriate authority controls and best management practices.

We note that the proposed water management measures are strategic in nature and further refinement may be required during the subsequent detailed design phases of the project, however, the underlying principles and objectives of this Report are to be maintained. Parts of this document will also be utilised for future discussions with external service authorities and other stakeholders to communicate the strategic vision of the project with respect to water management delivery.

2 The Site

The Badgerys Creek Industry Park project seeks to deliver a warehouse and distribution estate at 85 Martin Road, Badgerys Creek, situated within the Badgerys Creek Precinct in the Western Sydney Aerotropolis. The site covers Lots 30-35 DP3050 and is approximately 17 hectares in size. The site is bound by Martin Road to the east, Cuthel Road to the south, Lawson Road to the west and a rural property to the north.

The topography of the site is generally moderate, falling from south to north and naturally falls into two drainage catchments, separated by a ridge running in a north-south direction. The eastern catchment drains to Wianamatta South-Creek, located approximately 450m to the east of the site, while the western catchment drains to Badgerys Creek, located approximately 450m to the west.

Figure 1 – Site Boundary

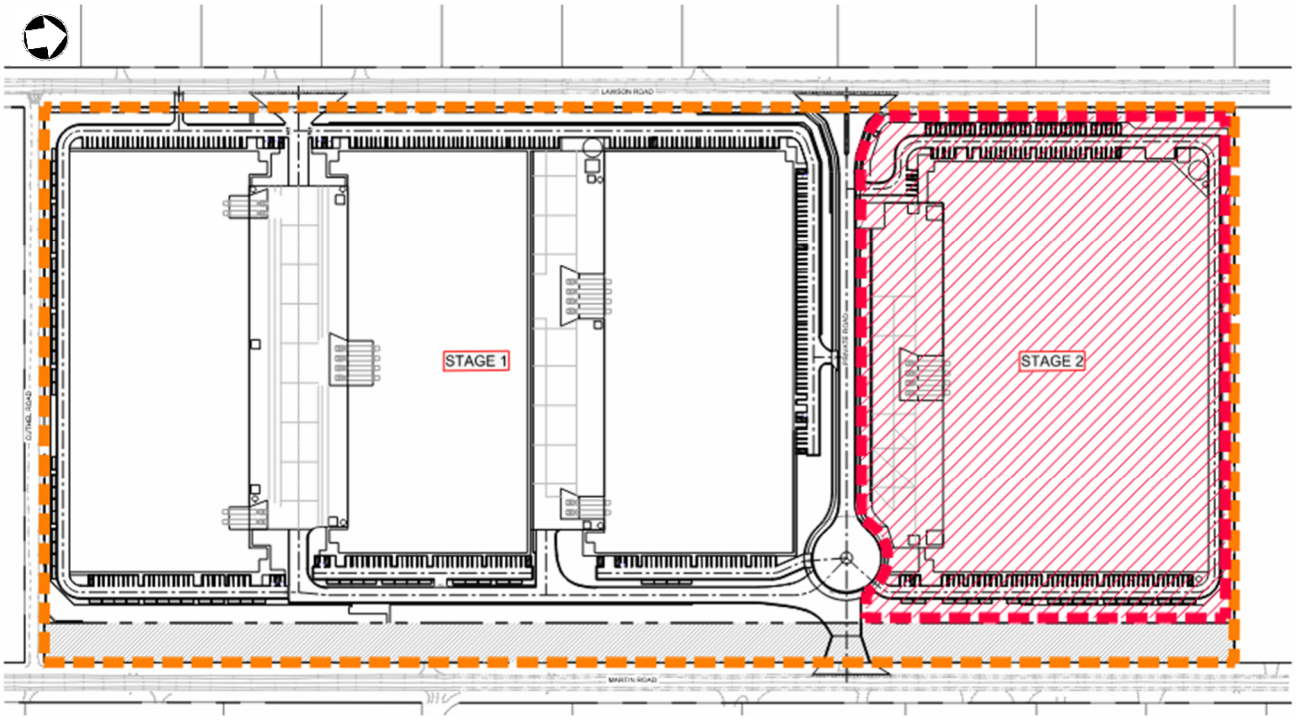
3 Proposed Development

The project seeks staged approval for the construction of 90,895m^2 of employment GLA across four (4) warehouse and distribution buildings and supporting ancillary office GFA. The project provides critical employment floorspace to generate economic activity to support the growth of the Aerotropolis.

The proposed development is to be delivered across two (2) separate stages as follows:

- Stage 1 = Torrens title subdivision to create three (3) lots including two (2) residue lots for future road dedication. This stage also includes the construction of Warehouses 1, 2, and 3 and associated private service road as well as the provision of temporary on-site stormwater management facilities on the northern portion of the lot.
- Stage 2 = Following completion of the future regional downstream stormwater infrastructure by Sydney Water, the temporary on-lot stormwater management facilities are to be decommissioned, and the final warehouse (Warehouse 4) constructed.

Figure 2 – Proposed Development and Staging



The current proposed development yield consists of the following:

- A total of 90,895m^2 of warehouse and ancillary office GLA, broken down as follows:
  - Warehouse 1 has a total GFA of 20,784m^2
    - Warehouse: 19,484m^2
    - Office: 1,300m^2
  - Warehouse 2 has a total FGA of 19,878m^2
    - Warehouse: 18,578m^2
    - Office: 1,350m^2
  - Warehouse 3 has a total GFA of 20,742m^2
    - Warehouse: 19,392m^2
    - Office: 1,350m^2
  - Warehouse 4 has a total GFA of 29,491m^2
    - Warehouse: 27,871m^2
    - Office: 1,620m^2
- Maximum building height of 24 metres.
- Construction of a 14.5m internal road and cul-de-sac to provide internal access from Lawson Road.
- On-site parking will be provided totalling 428 spaces across Stage 1 and 2.
- Provision of landscaping comprising of perimeter planting, vegetated communal areas and tree planting.
- Estate signage across the four warehouses; and
- Temporary stormwater infrastructure comprising of on-lot OSD basins and wetlands as part of the interim stormwater solution.

3.1 Site Context and Assumptions

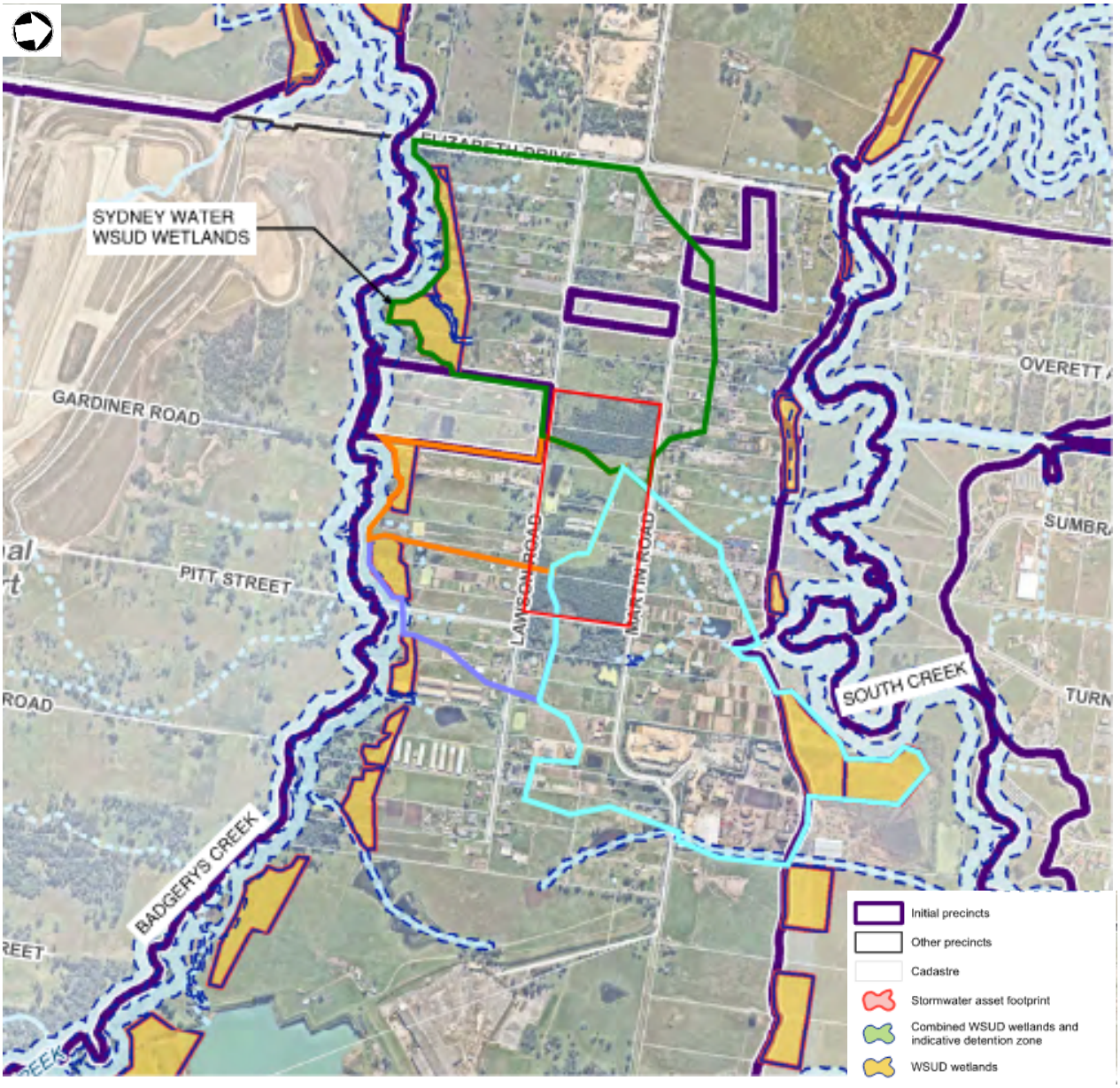
The proposed site is within the Badgerys Creek precinct of the Western Sydney Aerotropolis where Sydney Water is responsible for the water management for the precinct. Sydney Water has prepared the Stormwater and Water Cycle Management study which is a technical planning document that outlines how stormwater, water, wastewater, recycled water, trunk drainage and riparian zones should be managed to achieve the Western Parkland City vision within the Aerotropolis. As part of this, WSUD wetlands and stormwater detention basins have been proposed adjacent to Badgerys Creek and Wianamatta South Creek to treat and manage stormwater in the Badgerys Creek Precinct.

Recently, Sydney Water has changed/clarified their position on stormwater detention and floodplain management, stating that Councils will now be responsible for the implementation of this.

The below figure outlines the water management basins and their associated catchments in the vicinity of the subject site. We note that Sydney Water (based on their Western Sydney Aerotropolis Stormwater and Water Cycle Management Study, Sydney Water December 2021) has only proposed WSUD wetlands in the site's catchments, with no stormwater detention.

This is consistent with our own modelling and investigations and is discussed further in Section 10.2 below.

Figure 3 – Sydney Water Regional Basins – Badgerys Creek Precinct



Source: Western Sydney Aerotropolis Stormwater and Water Cycle Management Study, Sydney Water (December 2021)

The regional basins and the stormwater pit and pipe network connecting the precinct to the basins have yet to be constructed. As such, to meet the relevant water requirements in the interim, a temporary on-site water management system is proposed as part of the Stage 1 works (see Section 7 of this Report for details).

3.2 SEARs Requirements

This report provides a civil and stormwater assessment and responds to the Secretary's Environmental Assessment Requirements (SEARs) issued by DPHI on 27 August 2024. An outline of the SEARs relevant to this civil and stormwater assessment, and how they have been responded to is summarised below:

Table 1 – SEARs Requirements

	Issue and Assessment Requirements	Where Addressed
	Water Management – An integrated water management strategy, including • Details of the proposed stormwater/wastewater drainage design including the capacity of onsite detention system(s), onsite sewage management and measures to treat, reuse or dispose of water, consistent with the requirements of the Western Sydney Aerotropolis Development Control Plan – Phase 2 and the Blue Green Infrastructure framework of the Western Sydney Aerotropolis Precinct Plan. • A surface water discharge assessment in accordance with relevant EPA guidelines that provides characterisation of water quality at the point of discharge against the relevant water quality criteria using a MUSIC water quality model • Details of how the proposed stormwater drainage system will connect to Sydney Water's regional stormwater system, including details of any interim solution, consistent with the Department's Technical guidance for achieving Wianamatta–South Creek stormwater management targets (2022) for both construction and operational phases.	Sections 6 and 7 Sections 6 and 7 Section 7
	Flooding - A flood impact and risk assessment (FIRA) in accordance with the Flood risk management guideline LU01 - Flood impact and risk assessment (2023). The FIRA must: • Identify the flood planning level and any flood risk on-site (mainstream and overland) having regard to adopted flood studies, the potential effects of climate change, and any relevant provisions of the NSW Flood Risk Management Manual (2023) • Addresses the relevant provisions contained within the Aerotropolis Phase 2 DCP (Section 2.5.1 – Flood Management) • Assess the impacts of the development, including any changes to flood risk on-site or off-site, and detail design solutions and operational procedures to mitigate flood risk where required. • Detail an emergency management and response strategy for local catchment (and/or overland) and mainstream flooding, if required.	Section 12 Section 12 Section 12 Section 12
	Design Excellence • Demonstration of how the proposed development has been informed by the outcomes of the reviews carried out prior to lodgement by the State Design Review Panel (SDRP) required under section 4.31 of State Environmental Planning Policy (Western Parkland City) 2021	Section 8

4 Integrated Water Management Strategy

In order to address the requirements relating to stormwater and flooding outlined in the Secretary's Environmental Assessment Requirements (SEARS), IDC have prepared an Integrated Water Management Strategy to support the proposed Industrial Development.

This assessment includes water quality, water quantity and flooding aspects of the development and has been prepared in accordance with:

- Western Sydney Aerotropolis Development Control Plan 2022
- MUSIC modelling toolkit for Wianamatta South Creek
- Technical Guidance for achieving Wianamatta-South Creek stormwater management targets
- Western Sydney Aerotropolis (initial precincts) Stormwater and Water Cycle Management Study

The assessment includes a review of the following stormwater management principals:

1. Water Quality – which includes an analysis of Water Sensitive Urban Design (WSUD) including rainwater re-use, wetlands, re-use ponds, etc. based on MUSIC modelling.
2. Water Quantity – which includes an assessment of the pre and post development flows leaving the site to determine the on-site detention requirements using DRAINS software
3. Flooding Impact Risk Assessment – which includes an analysis of the pre and post development flows over the site and surrounds.

5 Stormwater, Water Sensitive Urban Design and Integrated Water Management

This section of the report identifies the Aerotropolis and Wianamatta-South Creek suite of stormwater, Water Sensitive Urban Design and Integrated Water Management requirements, including those identified in the Western Sydney Aerotropolis Development Control Plan 2022 objectives and performance outcomes (specifically Section 2.3.2, DPE WSA DCP, November 2022). The following section also demonstrates the Masterplan's compliance with the stormwater management and water sensitive urban design outcomes.

5.1 Objectives & Performance Outcomes

O1. Manage indirect and ongoing impacts of development on waterways to ensure that Wianamatta-South Creek Catchment water quality and flow objectives in the Aerotropolis Precinct Plan are achieved and maintained.

O2. Ensure development is integrated with water cycle management to meet the Wianamatta-South Creek Catchment stormwater management targets.

O3. Utilise stormwater for passive irrigation of street trees to promote healthy trees, optimise canopy cover and contribute to streetscape, urban cooling and amenity.

O4. Ensure overland flows are conveyed in a safe manner to the trunk drainage system.

O5. Protect, maintain and restore the ecological condition, hydrology and hydrogeology of aquatic ecosystems (including but not limited to wetlands and riparian lands).

Table 2 – Stormwater Management and Water Sensitive Urban Design Performance Outcomes

<table>
<tr><th colspan="2">Performance Outcome</th><th>Benchmark Solution</th></tr>
<tr><td>PO1</td><td>Development applications must demonstrate compliance with the stormwater quality targets at all times through interim stormwater management measures incorporated within the development, or by connection to the regional stormwater system once operational.</td><td>1. Compliance with the water quality targets below are satisfied where development applications demonstrate:
a. To the satisfaction of the Stormwater Management Authority and the consent authority that stormwater discharge from the development will flow into the regional stormwater system; and
b. The requirements of PO4 in Section 2.3.2 are met.

2. Where the Stormwater Management Authority indicates that the regional stormwater system will not be in place to service the development interim measures must be included to achieve the waterway health objectives of the Aerotropolis Precinct Plan. Interim stormwater management measures are to be designed to achieve the stormwater quality targets listed in the table below:

Note: A proponent may opt to undertake works-in-kind to deliver the regional stormwater system in accordance with the Stormwater Management Authority's requirements.

Parameter | Stormwater Quality Target – Operational Phase
Option 1: Annual Load Reduction</td></tr>
</table>

		Gross Pollutants (anthropogenic litter >5mm and coarse sediment >1mm)	90%
		Total Suspended Solids (TSS)	90%
		Total Phosphorus (TP)	80%
		Total Nitrogen (TN)	65%
		Option 2: Allowable Loads	
		Gross Pollutants (anthropogenic litter >5mm and coarse sediment >1mm)	< 16 kg/ha/y
		Total Suspended Solids (TSS)	< 80 kg/ha/y
		Total Phosphorus (TP)	< 0.3 kg/ha/y
		Total Nitrogen (TN)	< 3.5 kg/ha/y
PO2	Development applications must demonstrate compliance with the stormwater flow targets at all times through interim stormwater management measures incorporated within the development, or by connection to the regional stormwater system once operational.	**1.** Compliance with the stormwater flow targets below are satisfied where development applications demonstrate: a. To the satisfaction of the Stormwater Management Authority and the consent authority that stormwater discharge from the development will flow into the regional stormwater system, and b. The requirements of PO4 Section 2.3.2 are met. **2.** Where the Stormwater Management Authority indicates that the regional stormwater system will not be in place to service the development interim measures must be included to achieve the waterway health objectives of the Aerotropolis Precinct Plan. Interim stormwater management measures to be designed to achieve the following stormwater flow targets:	
		Parameter	**Stormwater Flow Target – Operational Phase**
		Option 1: Mean Annual Runoff	
		Mean Annual Runoff Volume (MARV)	≤ 2 ML/ha/year at the point of discharge to the local waterway
		90%ile flow	1,000 to 5,000 L/ha/day at the point of discharge to the local waterway
		50%ile flow	5 to 100 L/ha/day at the point of discharge to the local waterway
		10%ile flow	0 L/ha/day at the point of discharge to the local waterway
		Option 2: Flow Duration Curve Approach	
		95%ile flow	3,000 to 15,000 L/ha/day at the point of discharge to the local waterway
		90%ile flow	1,000 to 5,000 L/ha/day at the point of discharge to the local waterway
		75%ile flow	100 to 1,000 L/ha/day at the point of discharge to the local waterway
		50%ile flow	5 to 100 L/ha/day at the point of discharge to the local waterway
		Cease to flow	Cease to flow to be between 10% to 30% of the time
PO3	Development applications must include a Water Management Strategy (WMS)	**1.** The WMS is to provide details of: **a.** The approach to WSUD (including conceptual design details of the stormwater drainage, WSUD systems and on site detention) and how the approach will be implemented, including detail of ongoing management and maintenance responsibilities. This includes if the system is to be fenced, landscaped and maintained for the entirety of the operation of the system. **b.** Where required under PO1 and PO2, how the approach to WSUD complies with the water quality and flow objectives and targets consistent with the	

		technical guidance for achieving Wianamatta-South Creek stormwater management targets (DPE, 2022).
PO4	The regional stormwater system includes requirements for on lot as well as streetscape measures to ensure the Targets in PO1 and PO2 are met.	**1.** Development includes the following stormwater management measures within each lot created by the development: **a.** Minimum pervious areas to meet the requirements of PO8. **b.** Gross pollutant traps (GPTs) designed in accordance the Regional Stormwater Authority technical guidance. **c.** Passively irrigated street trees are provided in accordance with the provisions of clause 2.4.5 of this DCP.
PO6	Development must not increase existing urban salinity or result in increased salt loads in waterways, wetlands, drainage line or soils	**1.** A salinity and or sodicity hazard assessment is required to ensure no impacts to both the waterways and built infrastructure. **2.** All WSUD systems must incorporate an impervious liner, unless a detailed Salinity and Sodicity Assessment demonstrates infiltration of stormwater will not adversely impact the water table and soil salinity (or other soil conditions).
P07	Drainage is designed to safely convey overland flows	**1.** Designs shall ensure that flows are safely conveyed to avoid unsafe conditions for pedestrians and vehicles and to meet the requirements of Australian Rainfall & Runoff Guidelines 2019. **2.** Trunk drainage capable of conveying 1% AEP flow shall be designed as naturalised channels connecting to the existing stream system. **3.** Trunk drainage is to be located through natural creek lines or constructed natural drainage channels to help detain flows and contribute to biodiversity, public amenity and safety. **4.** Naturalised trunk drainage channels will commence when 15 ha of catchment contribute runoff flows.
PO8	Lots achieve minimum perviousness to meet stormwater drainage manager requirements and green and cooling objectives	**1.** Development is to demonstrate that the perviousness rates identified below are achieved. Development in the Mixed Use Zone: i. Mixed Use Centre (over 2:1 FSR) – 30% ii. Mixed Use Centre (up to 2:1 FSR) – 35% Development in the Enterprise and Agribusiness Zone: iii. Employment – business, commercial, light industrial (three storeys and above) – 30% iv. Employment – Large format industrial and light industrial (up to two storeys) – 15% ***Note 1:*** *If there is more than 1 building on a lot, the number of storeys for the purposes of this clause must be determined in accordance with the Business Zone Design Guide dated December 2021 and published on the NSW planning portal (see Figure 4).* ***Note 2:*** *Where an application includes the delivery of streets, streets are to be included in the pervious surface area calculations.* **2.** The site area pervious requirement is to be calculated in accordance with the following index: • Deep soil (one metre or more in depth, connected subsoil) – 100% • Shallow soil (less than one metre in depth, not connected to subsoil) – 75% • Permeable pavement – 50% Hardstand – 0% **Note:** as an example of application of the above ratios: i. Site area (comprising development lots and streets) is 1,000 square metres in a large format industrial area (up to 2 storeys) ii. 150 square metres of pervious area would be required if it is 100% deep soil iii. 300 square metres of pervious area would be required if it is 100% permeable pavement iv. areas of deep soil, shallow soil and permeable pavement can be used in combination to achieve the equivalent required pervious area.

The following sections of this report demonstrate compliance with the above requirements, noting that construction phase targets are to be addressed and demonstrated in a future detailed design phase with more detailed studies once the exact built form, staging, layout, etc. are known.

6 Stormwater Management & WSUD Performance Assessment

The Model for Urban Stormwater Conceptualisation (MUSIC) has been used in accordance with the technical guidance to demonstrate the achievement of the stormwater management targets (the guideline). As previously mentioned, the site will provide a temporary stormwater management treatment train to provide stormwater management until a time that the regional infrastructure has been constructed. This is discussed in detail below.

The MUSIC software was utilised to simulate the operation of the proposed urban stormwater management system for the site and to measure the removal rates expected when implementing the proposed WSUD measures to reduce the gross pollutant and nutrient load created by the proposed development and reduce the mean annual runoff volume from the site.

6.1 MUSIC Model Setup

The base MUSIC model was obtained from the *music-modelling-toolkit-wianamatta* suite of files that were released to industry by NSW EHG for the intended use of industry adopting them as the basis for studies of this type.

This suite of documents consists of:

- *Flow Duration Curve Development Scale – South Creek – locked.xlsx*
- *Frequently Asked Questions.pdf*
- *MUSIC Model for Mamre Circulation.sqz*
- *Music Modelling toolkit – Wianamatta.pdf*

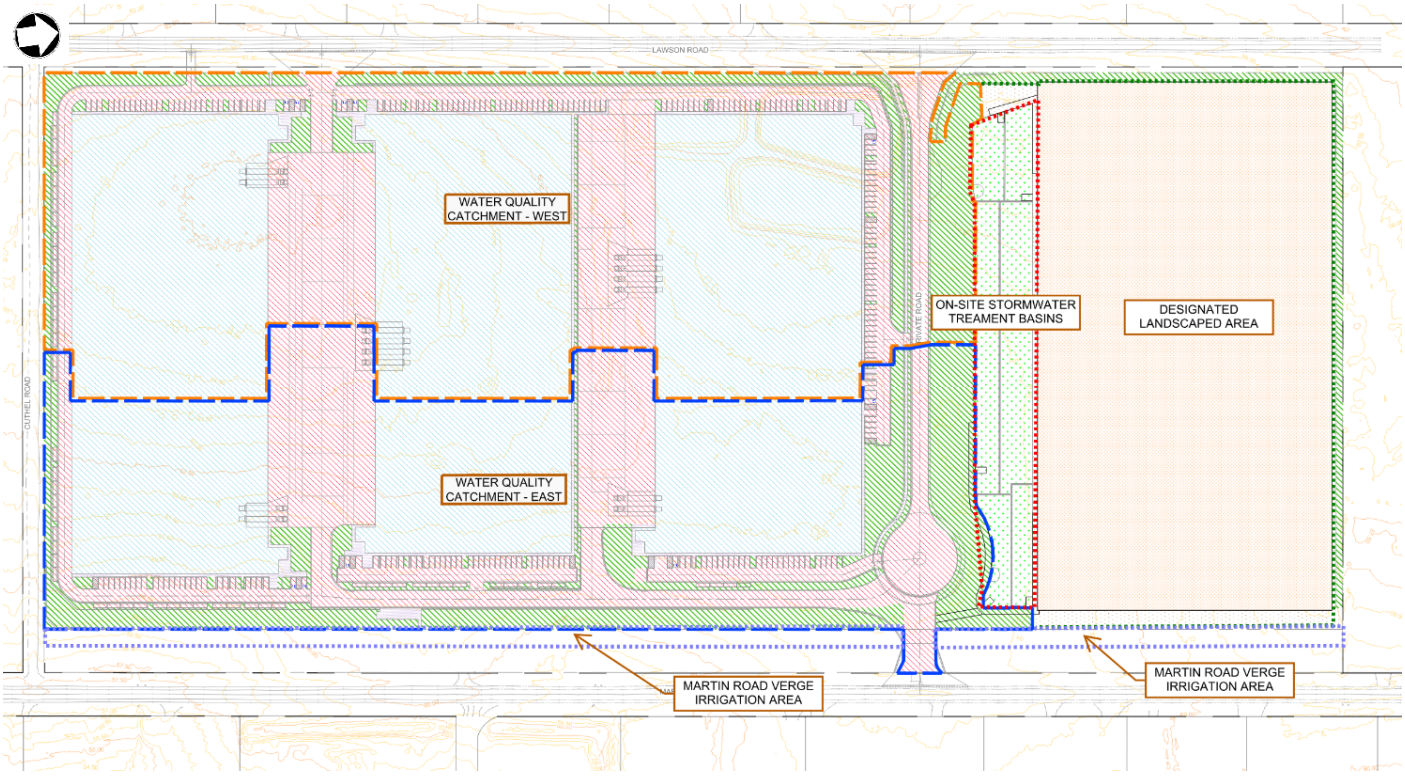
These files provided the basis of the modelling work including rainfall and evaporation data, pollution generation data, etc.

6.1.1 Proposed Treatment Train

The stormwater treatment train has been divided into four different treatment train sub-catchments shown in the Figure 4 below and is outlined as follows:

- Western Treatment Train collecting the western roadways and portions of Warehouse 1, 2 and 3 roofs and loading docks
- Eastern Treatment Train collecting the eastern roadways and portions of Warehouse 1, 2 and 3 roofs and loading docks
- Designated landscaped area located north of the stormwater management basin which will be left undeveloped to be used for temporary irrigation.
- Bypass catchments outlining catchments bypassing treatment.

Figure 4 – Stormwater Quality Treatment Train Sub-catchments

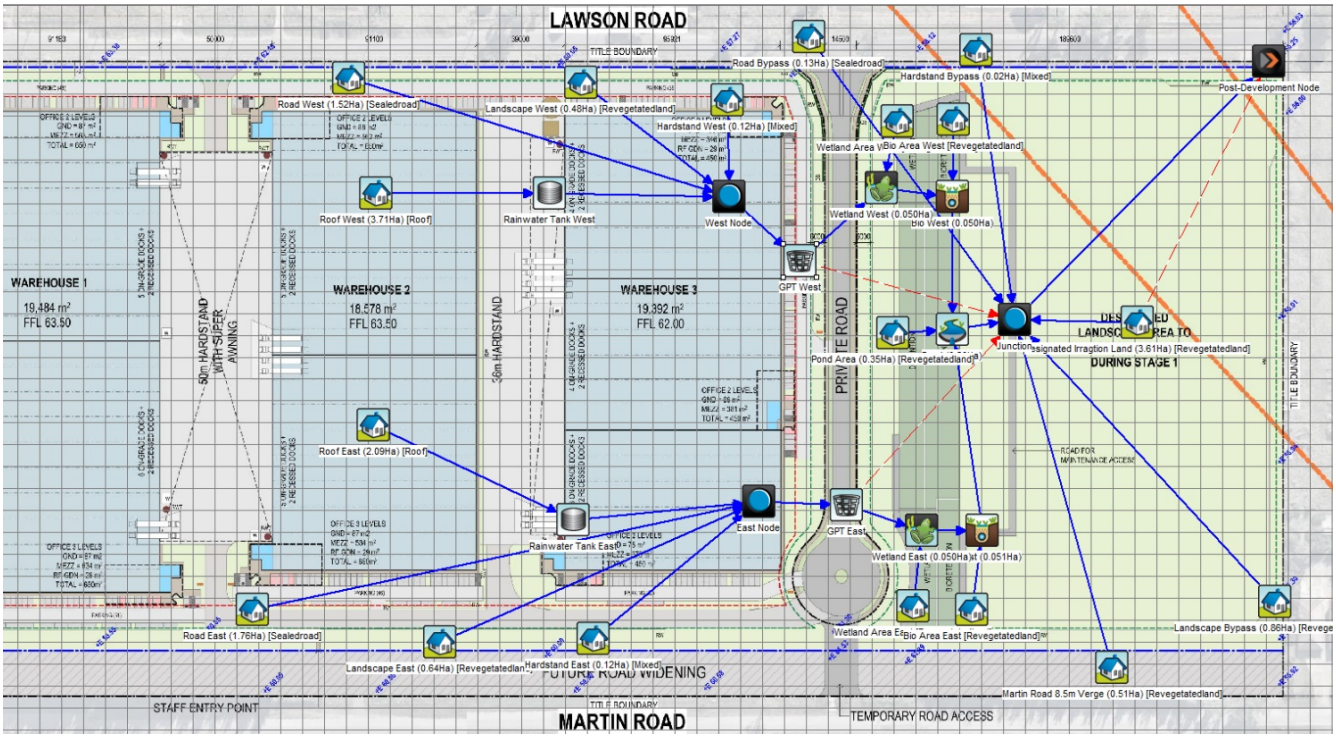


Each treatment train will consist of the following:

- A GPT to act as a primary treatment device.
- GPT flows to a wetland with a high-flow by-pass flows to be diverted directing to the stormwater detention basin.
- 2x 500m^2 wetlands each discharging into a 500m^2 bioretention basin to provide additional treatment.
- Treated water then discharges into a 2,000m^2 re-use pond. Pond water is to be used for landscaped irrigation.
- When the re-use pond reaches capacity, excess flows will overtop a weir to a detention basin
- 10kL Rainwater tanks will collect roof runoff to be used for toilet flushing
- The designated landscaped space is to be left undeveloped to be utilised for irrigation, helping remove stormwater from the site.
- As Martin Road will not be developed while Stage 1 of the proposed site is in operation, an additional landscaped strip (Martin Road verge) is proposed to be irrigated with treated water from the propose re-use pond.

The MUSIC model layout is shown in Figure 5 below.

Figure 5 – MUSIC Model Layout



Gross Pollutant Traps

The Gross Pollutant Trap treatment nodes were taken directly from the provided template files, with no nutrient removal. The high-flow bypass from the end of line GPT was set to the 1EY storm flow which was calculated using a simple DRAINS analysis. This was adopted to approximate the treatable flow and high-flow by-pass flow rates for these GPTs. Each GPT high flow bypass was set to $1m^3/s$.

Wetlands

In accordance with Table 46 of the technical guidance, the following parameters have been used for wetlands.

Table 3 – Wetland MUSIC Parameters

Wetlands	Acceptable parameter ranges
Inlet pond volume	Set to zero if upstream sediment basin is modelled separately or sized to target 95% removal of 125 µm particles for 4EY[1] flow events
Extended detention depth	Maximum of 350 mm (*300mm used)*
Permanent pool volume	0.3–0.4 m x wetland surface area *(0.4m used)*
Exfiltration	Maximum of 0.01mm/hour *(0mm/hr used)*
Evaporative loss	Maximum of 125% of PET (*125% Used)*
Outlet pipe	Adjust to ensure notional detention time is within ranges
Notional detention time	48–72 hours for detention depths of 100–350 mm No less than 48 hours for detention depths <100 mm
k & C* values	(MUSIC) Use default values

Bioretention

In accordance with Table 47 of the technical guidance, the following parameters have been used for the bioretention basins.

Table 4 – Bioretention MUSIC Parameters

Bioretention	Acceptable parameter ranges
Extended detention depth	Maximum of 300 mm (*300mm used)*
Unlined filter media perimeter	0.01m (i.e. the system is lined)
Saturated hydraulic conductivity	Maximum of 100mm/hour *(100mm/hour used)*
Filter media depth	0.4-0.7m *(0.6m used)*
TN content	800 mg/kg
Orthophosphate content	40mg/kg
Exfiltration rate	0
Lining	Yes – base is lined
Underdrain present	Yes
k & C* values	(MUSIC) Use default values

Ponds

Re-Use ponds were also implemented, immediately downstream of the wetlands as a means of capture for subsequent re-use and evaporation. In accordance with the technical guide, the following parameters were used.

Table 5 – Storage Pond MUSIC Parameters

Storage ponds	Acceptable parameter ranges
Water source	Only roof water or treated water into reuse storage ponds
Surface area	User defined
Permanent pool volume	Calculate with depth up to a maximum of 3.0 m *(2.5m used)*
Initial volume	Same as permanent pool volume
Exfiltration rate	0mm/hr
Evaporative loss	Maximum of 100% of PET
Reuse demands	Irrigation to be modelled as an annual demand Distribution* to be defined with a monthly pattern which is (Jan–Dec): 13%, 6%, 6%, 4%, 2%, 0%, 4%, 7%, 12%, 14%, 13%, 19% Indoor reuse to be modelled as a daily demand
Reuse rate	600mm/yr/m^2

The irrigation demand for the site has been calculated based on the following areas:

- A designated landscaped area north of the stormwater treatment basins. 100% of this area has been adopted for irrigation.
    - Area: 3.6Ha
- Remaining landscaped areas on site. 50% of this area has been adopted for irrigation
    - Area: 2.0Ha (1.0Ha for irrigation)
- Martin Road verge (landscape strip). IDC have assumed an 8.5m width of the 20m verge is to be used for irrigation. This provides a conservative value less than the 50% outlined in the technical guidance.
    - Area: 0.5Ha

Total landscaped area to be irrigated = 5.1Ha.

Therefore, at 600mm/yr/m^2, a total annual reuse for irrigation rate of 30,000kL/yr has been adopted for the site.

Rainwater Tanks

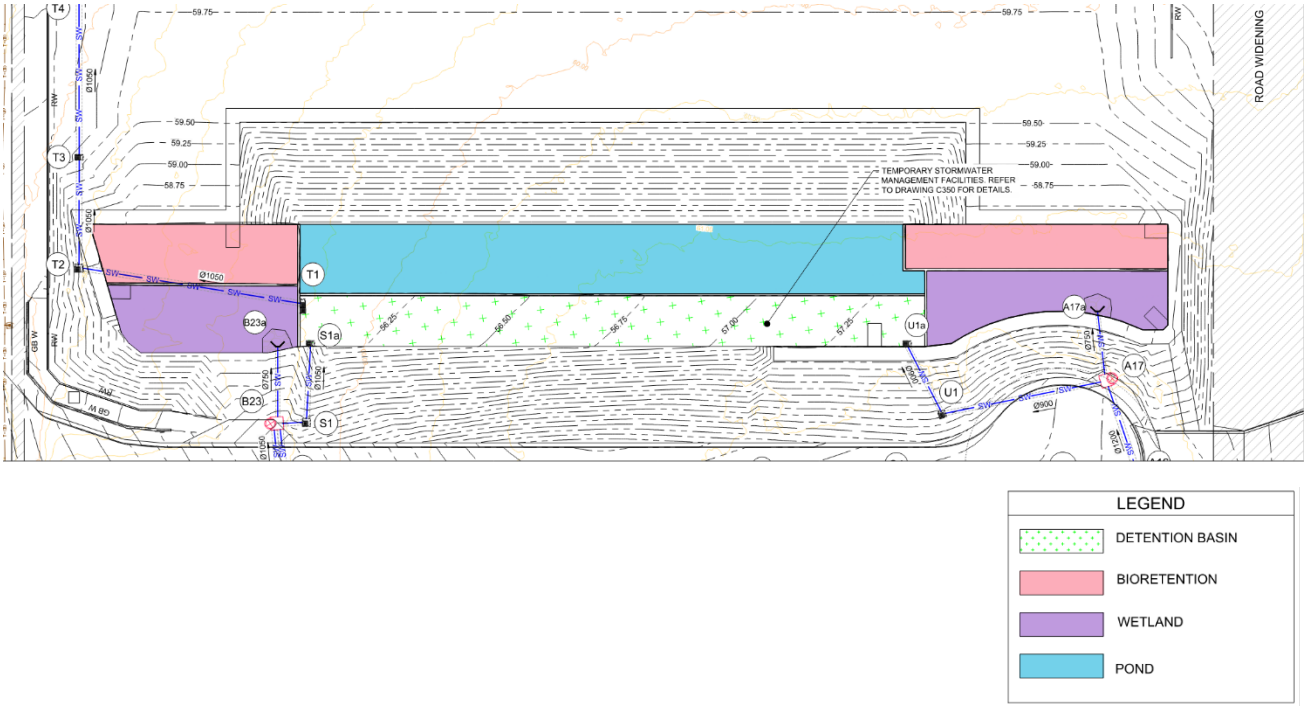
In accordance with Table 49 and Table 51 of the technical guidance, the following parameters have been used for the rainwater tanks.

Table 6 – Rainwater Tank MUSIC Parameters

Rainwater tanks	Acceptable parameter ranges
Water source	Only roof water into reuse tanks
Volume below overflow	User defined (10*kL Tanks used)*
Surface Area	Calculated with a maximum depth of 1.0-2.5m
Initial Volume	Same as volume below overflow
Rainwater tank demand (toilets)	15L/person/ha/day

The site will have an estimated 200 user during Stage 1. As such a reuse rate of 3kL/day has been adopted for the rainwater tanks.

Figure 6 – Proposed Water Quality Basin Layout



Proposed Site Modelling Results

The results of the MUSIC model are shown below and demonstrate compliance with both the stormwater quality and quantity targets.

Table 7 – Site Scenario - Stormwater Quality Targets - Option 2

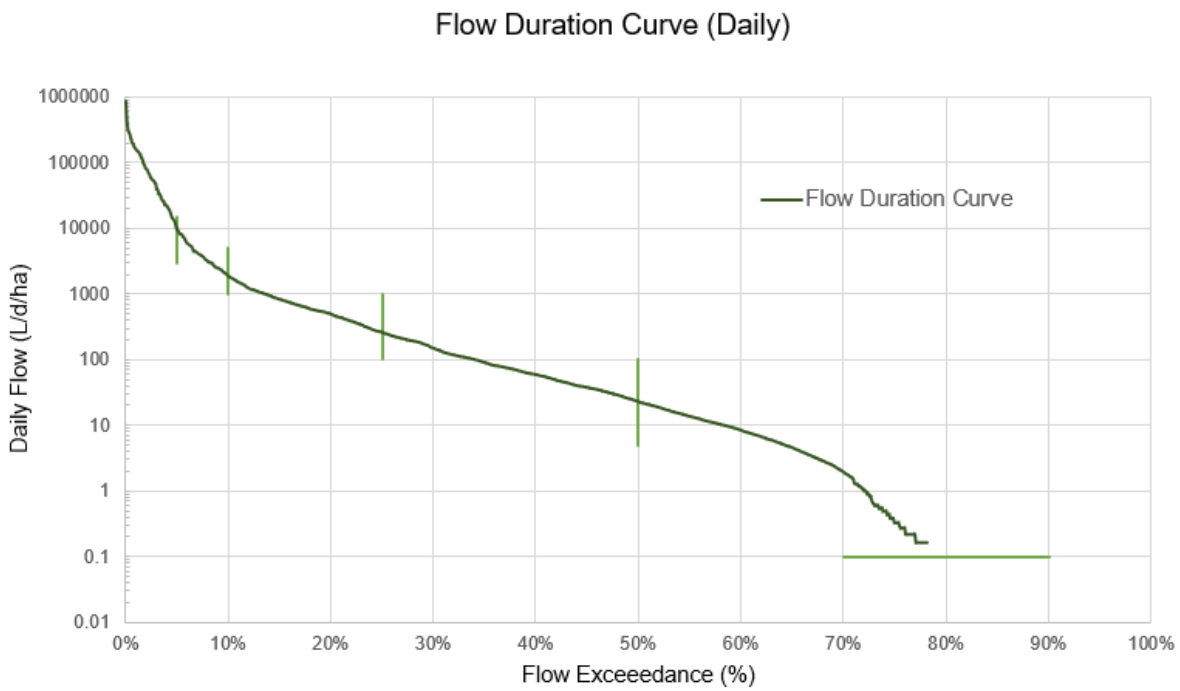
Pollutant	Sources (kg/year)	Residual Load (kg/year)	Pollution Reduction (kg/yr)	Stormwater Quality Targets (kg/ha/yr)	Complies?
Gross Pollutants	1,740	27.7	**1.77**	16	Yes
Total Suspended Solids	9,240	1,080	**68.99**	80	Yes
Total Phosphorus	19.7	3.99	**0.25**	0.3	Yes
Total Nitrogen	143	41.4	**2.64**	3.5	Yes

Note: Total site area = 15.7Ha

Table 8 – Site Scenario - Stormwater Quantity (flow) Targets Option 1 - MARV

Indices	Result	Complies?	Target
MARV (ML/ha/yr)	1.97	Yes	< 2
90%ile	1,869	Yes	1000 to 5000 L/ha/day
50%ile	23	Yes	5 to 100 L/ha/day
10%ile	0	Yes	0 L/ha/day

Figure 7 – Proposed Site - Daily Flow Duration Curve



6.1 Water Quality Conclusion

The above analysis shows that the proposed development has accommodated sufficient water management infrastructure to comply with the Wianamatta-South Creek stormwater management targets to the satisfaction of Sydney Water for the Stage 1 works. Once the Sydney Water regional basins are constructed, the basins will be decommissioned and removed as part of the ultimate site design.

Further, the water management infrastructure has been coordinated with the Connection to Country, Landscape architecture, Bushfire Management and Civil Engineering aspects of the project and can be taken forward with subsequent, more detailed investigations, modelling and design.

7 Stormwater Quantity Management

7.1 Stormwater Management & Quantity Performance Assessment

7.1.1 Ultimate Stormwater Management Methodology

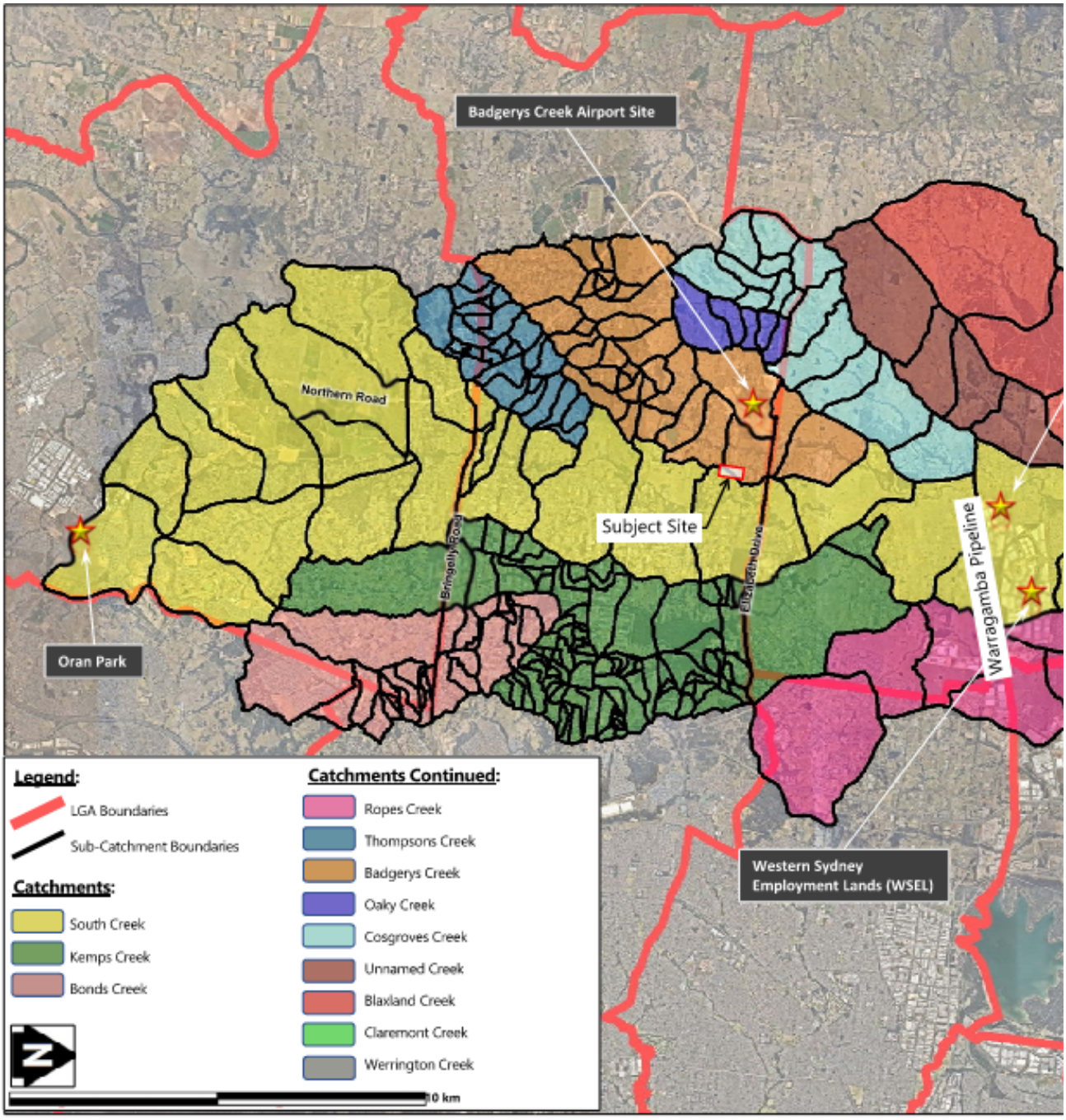
As mentioned previously in this report, Sydney Water has prepared a regional stormwater detention and water quality management plan for the Aerotropolis, providing WSUD wetlands along Badgerys Creek and Wianamatta South Creek. The proposed site is located on a crest that splits the site and diverts flows into four separate regional WSUD wetlands. We note Sydney Water has proposed no detention basins along South Creek or Badgerys Creek in any of the catchments where the proposed development is located. The ultimate design will maintain the existing catchments and provide 4 discharge points from the site to match each regional basin's catchment areas. For further details on the existing site catchments for the regional basins see Section 3.1 above.

In addition to Sydney Water's regional basin strategy, another pertinent study in the consideration of water management is Advisian's *Wianamatta South Creek Catchment Flood Study And Cumulative Impact Assessment* (issued January 2023). This analysis showed that efforts to attenuate flood discharges could serve to delay the arrival of the flood peak at the tributary confluences with South Creek, particularly upstream of the Warragamba Pipeline crossing. As a result, Recommendation 8 of the Report states:

> *No large scale stormwater detention for the purpose of attenuating flood flows of the magnitude of the 5% AEP event or rarer is required in the Thompsons Creek and Badgerys Creek (except at the Western Sydney Airport) catchments. The only caveat on this is where detention is afforded as part of measures proposed for the primary purpose of controlling surface water runoff.*

While the Advisian Cumulative Impact assessment has recommended that detention should not be provided in the Badgerys Creek catchments, we have undertaken a hydrological assessment to determine the necessity for detention on both the Badgerys Creek and Wianamatta South Creek catchments. Figure 8 below outlines the catchment delineation for the subject site between Badgerys Creek and South Creek. The pre and post development flows to each creek are further explained in Section 10.2 below.

Figure 8 – Wianamatta South Creek Sub Catchment Boundaries



Source: Wianamatta South Creek Catchment Flood Study – Cumulative Impact Assessment (January 2023)

7.1.2 Interim Stormwater Management Methodology

The regional WSUD wetlands and stormwater pit and pipe infrastructure connecting the site to the basins have not yet been constructed. As such, as part of the interim Stage 1 works for the development, stormwater flows are to be treated on-site prior to discharge until the regional stormwater infrastructure has been constructed in accordance with the DCP requirements.

While the proposed site is located on a crest contributing to 4 separate regional catchments, the stormwater management basins are to be consolidated into a single location. This was considered appropriate as the on-site stormwater basins were temporary in nature and provided a streamlined stormwater management approach.

However, the consolidated treatment basins will divert stormwater flows away from the 4 separate catchments to discharge site from a single location at the northern boundary. To ensure the northern catchment is not negatively impacted by the diversion of flows, an above ground detention basin has been proposed as part of the stormwater management plan. The detention basin has been sized to ensure that the peak post-development flow does not exceed the peak pre-development flows for all catchments.

7.2 DRAINS Modelling

A hydrological model of the proposed site catchment and external upstream catchments were formulated using the DRAINS software package and was analysed to assess the performance of the site stormwater network. The ILSAX hydrological model has been used in DRAINS program to perform design and analysis calculations for urban stormwater systems and model the flood behaviour on both rural and urban catchments.

The user data inputs required by the DRAINS ILSAX model include catchment areas, flow path lengths, time of concentration, pervious and impervious areas, IFD rainfall intensities and flow path roughness. Modelling is performed through the development of a network of pipes, pits and nodes to represent both the proposed and existing scenarios on site.

7.2.1 Design Storms

Minor Storm

The minor drainage system comprises the below ground pit and pipe network and is designed to safely collect and convey stormwater flows generated during minor storm events.

Liverpool Council's Stormwater Drainage Design D5 requires that the minor system be designed for the 10 Year ARI (10% AEP) Storm event for industrial sites.

Major Storm

The major drainage system incorporates overland flow routes through the circulation roadways for storm events up to and including the 100 Year ARI (1% AEP) storm event. The major system also allows safe conveyance of flows due to failure of the minor system.

Recessed loading docks across the site are proposed to be drained by gravity through the trunk drainage system. As these are localised sag areas they cannot be drained overland during the 1% AEP storm event. As such, the trunk drainage system for the site and all pipes conveying stormwater from the recessed loading docks have been sized to cater for the 1% AEP storm event. A maximum ponding depth of 250mm has been allowed for in the loading docks during the 1% AEP storm event to allow for safe evacuation from the recessed loading docks.

7.2.2 Intensity Frequency Duration (IFD)

Intensity-Frequency-Duration (IFD) data has been obtained from the Bureau of Meteorology, which follows the AR&R standard design rainfall events. The rainfall data has been adopted specifically for this site (see table below for details).

Table 9 – Rainfall Intensities

Duration	10% AEP	1% AEP	0.2% AEP
5 mins	152	240	294
10 mins	123	195	237
15 mins	103	163	199
20 mins	88.4	140	171
25 mins	77.5	123	150
30 mins	69.2	109	134
45 mins	52.7	83.4	102
60 mins	43.1	68.1	83.6
90 mins	32.2	50.9	62.5
120 mins	26.3	41.5	50.8
180 mins		31.4	38.3
360 mins		20.2	24.4
720 mins		13.7	16.6

Source: Bureau of Meteorology (BoM) 2021

7.2.3 DRAINS Parameters

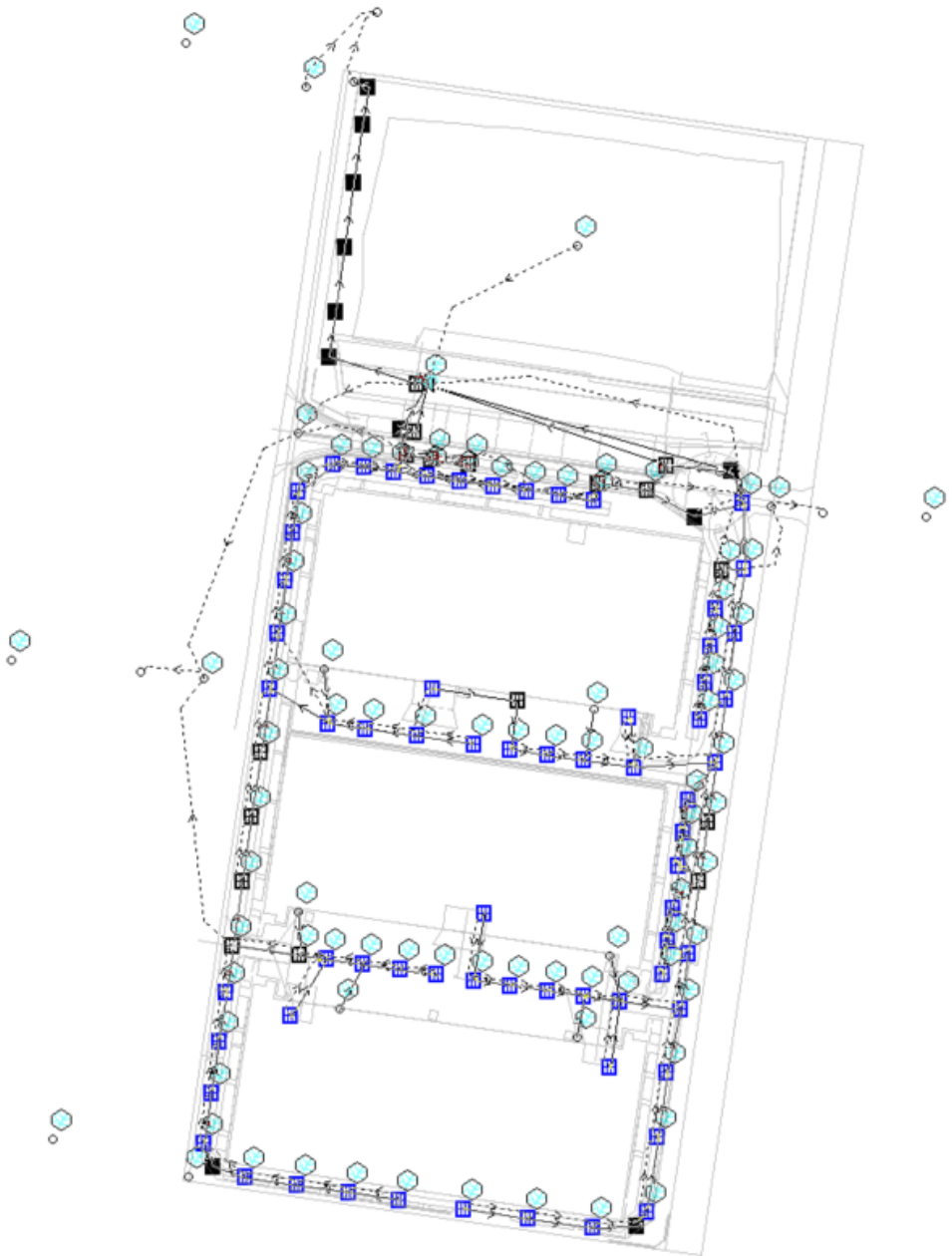
The DRAINS model of the proposed site was developed based on the following methodology:

- Impervious percentages for each catchment have been calculated based on the architectural landscape architectural plans.
- Existing catchment impervious percentages have been assumed as 0% impervious as a conservative assumption for the detention calculation.
- Catchments within the subject site have adopted a Time of Concentration (TOC) of 5 minutes for impervious surfaces and 5 minutes for pervious surfaces.
- Existing catchments have adopted a time of concentration based on kinematic wave calculations of the catchment characteristics. A minimum TOC of 5 minutes has been applied for all catchments.
- An above ground detention system was incorporated as part of the stormwater management basins to control the increased runoff to the northern boundary.
- The tailwater level at the site discharge pit (Pit T8) has been set to the surface level of the pit

7.3 Proposed Stage 1 Scenario Model

A DRAINS model of the proposed site stormwater system has been developed using the parameters specified above. The layout of the DRAINS model is shown in the Figure 9 below.

Figure 9 – Stage 1 DRAINS Model



Note: Pit, Pipe and Catchment details have not been shown for clarity

7.3.1 DRAINS Results

Results of the DRAINS assessment indicate that major and minor system requirements are satisfied at all proposed pits in the development area and that the piped system sufficiently conveys the minor and major system flows.

Detention Summary

Iterations were performed in the DRAINS model to determine the size of the stormwater detention basin needed to satisfy Council's pre-post requirements.

The proposed system has the following parameters:

- Total storage volume provided is approximately 4.950m^3 which is contained within the above ground stormwater treatment basins at the north of the site.
- Discharge is to be controlled via a 500mm orifice plate installed as the outlet of the discharge control pit to satisfy the pre-post conditions.
- The discharge control pit grate will perform as a secondary weir to allow additional flows to discharge the basin via a 1050mm diameter outlet pipe.
- A surcharge pit is proposed as the site discharge in the northwest corner of the site where flows will surcharge from this pit overland across Lawson Road. This is consistent with the existing site overland flow.
    - Minor flows will be conveyed via a 450mm diameter pipe to a culvert downstream of the site.
- In the event of the discharge control pit failing, an emergency overflow weir will convey flows to the private road, eventually discharging overland to Lawson Road.
- A 1 in 4 maintenance access path has been provided within the embankment of the stormwater management basins to allow safe egress in accordance with Council's requirements.
    - Additional access ramps have been provided for each stormwater management basin.
- Stubs are to be constructed across the site to divert the ultimate stormwater drainage away from the northern catchment and back towards their existing catchments.

Results of the DRAINS analysis are summarised in the following table:

Table 10 – DRAINS Pre-Post Comparison

Catchment	ARI	Pre-Development Peak Discharge (m^3/s)	Post Development Peak Discharge (m^3/s)
North	10% AEP	0.91	0.89
	1% AEP	2.06	1.82
West	10% AEP	1.00	0.10
	1% AEP	2.32	0.16
South West	10% AEP	0.26	0.04
	1% AEP	0.47	0.06
East	10% AEP	1.19	0.17
	1% AEP	2.33	0.25

Results of the DRAINS modelling indicate that the downstream peak discharges do not exceed those of the pre-developed scenario for the worst-case storm duration.

7.4 Ultimate Scenario

In the ultimate scenario, the regional stormwater infrastructure discussed in Section 7.1.1 has been constructed by Sydney Water, the on-site temporary stormwater management basins will be decommissioned and removed. The ultimate site stormwater network has been designed to match the existing catchment areas which have been used to size the regional WSUD wetlands downstream.

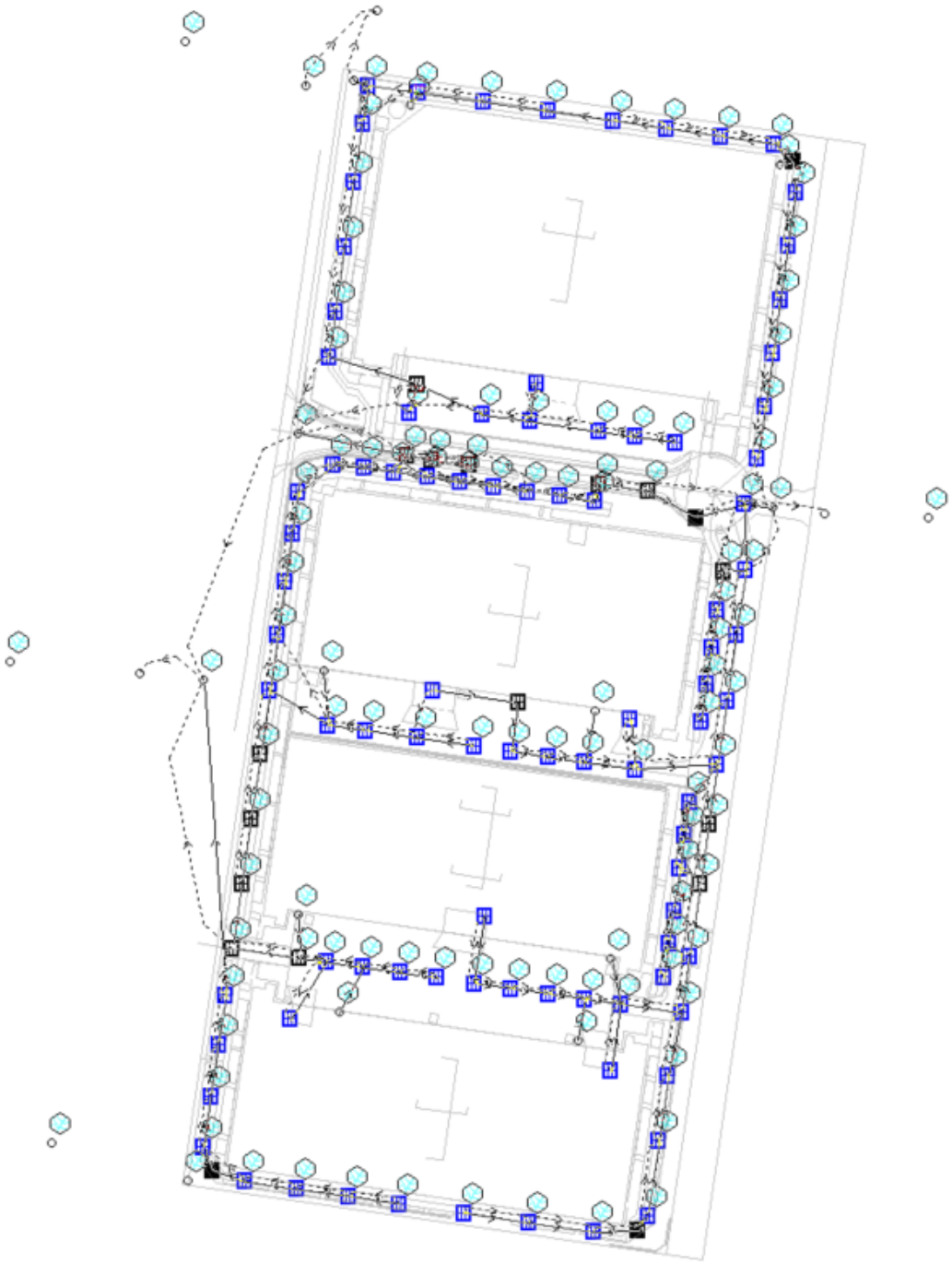
The temporary stormwater pipes diverting flow towards the stormwater management basins will be blocked off with flow being redirected to the stubs constructed as part of the Stage 1 works. The stubs will be connected to the regional trunk stormwater infrastructure within Lawson Road and Martin Road, which will be constructed prior to the decommissioning of the on-site stormwater basins.

The catchment areas are outlined in the table below:

Table 11 – Ultimate Scenario Catchment Areas

Catchment	Existing Area (Ha)	Ultimate Area (Ha)
North	0.92	0.36
West	5.37	5.55
South West	4.51	4.83
East	4.82	4.88
Total	**15.62**	**15.62**

Figure 10 – Ultimate DRAINS Model



Note: Pit, Pipe and Catchment details have not been shown for clarity

8 Asset Maintenance Requirements

In accordance with the Western Sydney Aerotropolis Development Control Plan 2022, all water management assets proposed are to be properly operated and maintained in order for the proposed stormwater treatment to function as designed.

As the water treatment basins will be temporary in nature and only service the proposed site, it will be the responsibility of the landowner to maintain the water treatment basins until such a time that the regional stormwater basins are constructed. The site will then be connected to the regional infrastructure and the temporary treatment decommissioned and removed.

Refer to Appendix B for an outline of the maintenance activities required for water management assets and the frequency of each activity.

9 State Design Review Panel (SDRP)

As part of the design process for this SSDA, the designs were presented to a State Design Review Panel (SDRP) who were able to provide comment on the proposed designs. The following comments were made through this process.

1. Implement a bulk earthworks strategy and benching strategy that balances cut and fill so this is no removal or importation of soil required:
2. It is acceptable to have some taller retaining walls to enable a balanced cut and fill
3. Review the design of the temporary OSD basin - it should be shallower and more naturally shaped and extend further to the north to reduce the extent of excavation, remove the need for the 5m retaining wall and provide better conditions for the ecological corridor to establish.

The SSDA civil designs have reviewed and adopted these comments with the following updates to the design.

1. To provide a more balanced cut and fill across the site, the Warehouse pads have been raised to reduce the overall cut. The ultimate cut and fill balance has intentionally been left in 50,000m^3 of fill to allow for any backfill required through construction.
2. Perimeter retaining walls have been raised to account for the raising of the warehouse platforms. Total retained height does not exceed 6m.
3. Stormwater management basin layout has been updated to remove any temporary perimeter retaining walls required around the basin. Basin perimeters batter to the surrounding at a maximum temporary batter of 1 in 4.

10 Regional Stormwater Modelling

A hydrological model of the regional catchments was formulated using the DRAINS software package through the RAFTS module for both South Creek and Badgerys Creek. The DRAINS program typically performs design and analysis calculations for urban stormwater systems and models the flood behaviour on both rural and urban catchments.

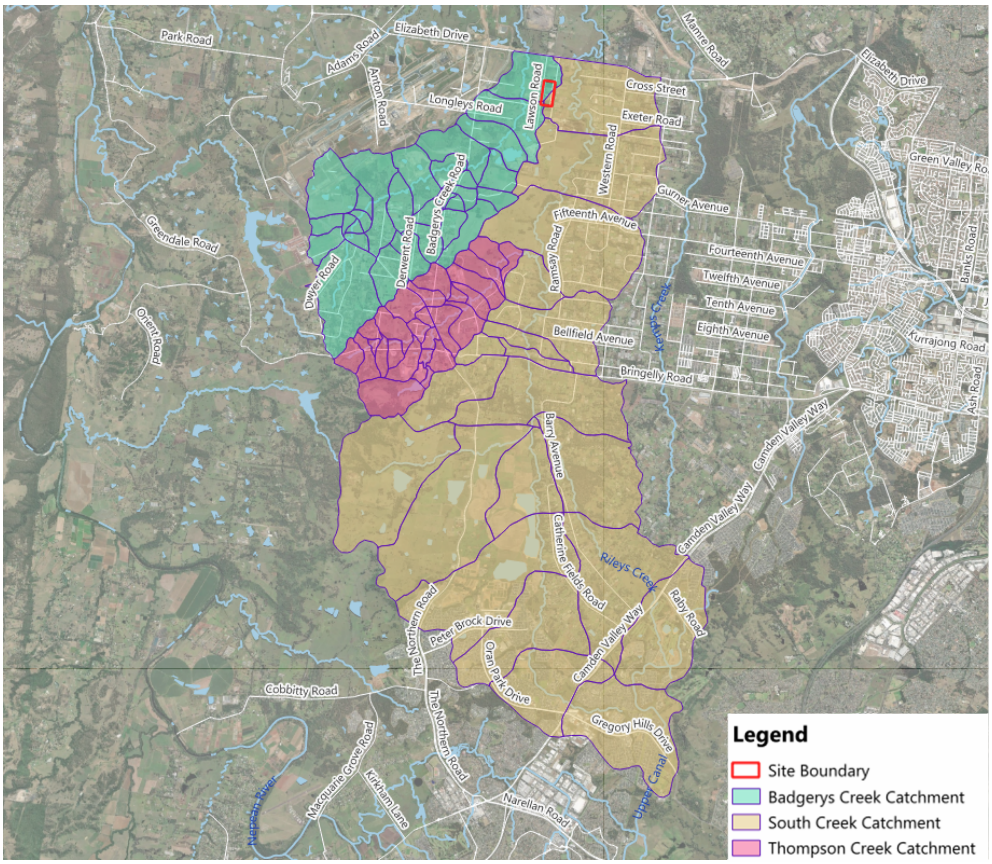
The user data inputs required by DRAINS include catchment areas, flow path lengths, time of concentration, pervious and impervious areas, IFD rainfall intensities and flow path roughness. Modelling is performed through the development of a network of catchments, nodes, flow paths, and basins to represent both the proposed and existing scenarios on site.

The purpose of this model was to prepare hydrographs to be used to accurately represent the existing stormwater inflows to the creeks for the mainstream flooding assessment.

10.1.1 Catchment Areas

The regional catchments generally fall into three main catchments; Badgerys Creek to the west of our proposed site, Wianamatta South Creek to the east of our site and Thompsons Creek to the south of our site and forms a junction with Wianamatta South Creek. Within each catchment, a number of sub-catchments were identified as shown in Figure 11 below.

Figure 11 – Existing Catchments



In order to calculate the hydrographs from the regional catchments, nodes were included in the DRAINS model to represent the current catchment scenario as described above. These nodes were then assigned a sub-catchment (including area, flow path length, slope, roughness, pervious and impervious areas and the like) which is representative of the total existing area which lies within the catchment boundary.

10.1.2 Impervious Fraction

The impervious fraction of the existing catchment was computed using a geospatial analysis of the existing land uses across the various sub-catchment areas. The existing terrain is primarily rural landholdings with substantial areas of riparian corridor and open space. The adopted fraction impervious for the existing scenario are within the range of 2-5% imperviousness for Badgerys Creek. We note that Wianamatta South Creek and Thompson Creek have some sub-catchments in urban areas with high impervious areas.

The sub-catchment area and impervious fraction details are summarised in Table 12 below.

10.1.1 Equal Area Slope

The Equal Area Slope method has been utilised in determining the equivalent linear slope of a drainage path that has a non-constant slope throughout the catchment. This methodology is widely adopted for rivers, creeks or similar with an Equal area slope being required to determine the applicable flows and velocities.

The equal area slope method was adopted to calculate the sub-catchment slopes for the RAFTS model using the DRAINS software. It is generally accepted that this methodology is more representative of a general stream slope than an average slope calculation and is more closely related to travel times of floods (McDermott, G. E. and Pilgrim, D. H. 1982) and thus adopted as the primary measure of stream slope in this study.

The flow paths for each sub-catchment were generated using GIS and draped to the existing DEM model to obtain a highly accurate representation of the sub-catchment streams and overland flow paths. The equal area slope method was applied to each flow path, and the results were adopted in the model. The flow paths for the sub-catchment are shown in Figure 12 below and tabulated in Table 12.

Figure 12 – Flow Path / Equal Area Slope Map

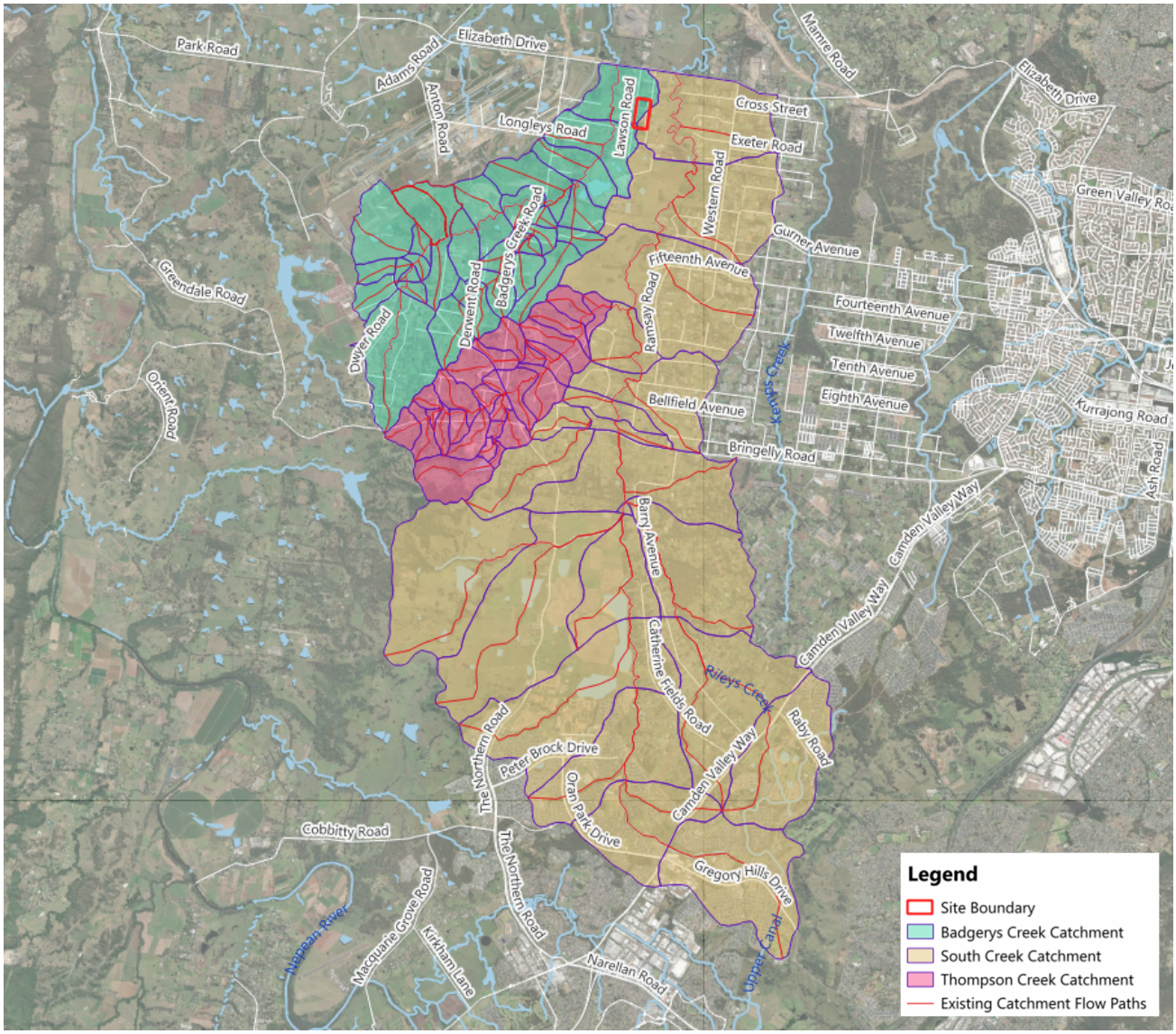


Table 12 – Existing Badgerys Creek Catchment Parameters

Name	Total Area (Ha)	Impervious Percentage (%)	Average Slope (%)	Manning's n
1.00	519.3	49	0.73	0.055
1.01	351.2	60	0.74	0.055
1.02	460.4	65	0.69	0.055
1.03	685.9	32	0.7	0.045
1.04	289.4	0	0.95	0.045
1.06	5.2	5	0.31	0.025
1.08	495.5	10	0.64	0.045

1.09	305.7	9	1.08	0.045
1.09.1	233.8	4	0.93	0.045
1.09.2	55.6	5	1.9	0.045
1.09.3	45.4	4	1.36	0.045
1.09.4	73.4	4	1.95	0.045
1.10	138.6	6	0.31	0.045
1.12	637.48	17	0.55	0.045
1.13	422.1	20	0.41	0.045
1.13.1	564	23	0.5	0.045
2.00	642.1	2	1.06	0.045
2.01	756.1	5	0.71	0.045
3.00	453.4	10	0.79	0.045
3.01	575.2	9	0.69	0.045
3.02	465.8	10	1	0.045
4.00	13	8	3.34	0.045
4.00.1.00	36.7	1	3.3	0.045
4.00.1.01	40.3	1	3.44	0.045
4.00.1.02	6.79	5	2.75	0.045
4.00.1.03	19.9	3	3.01	0.045
4.00.1.04	24.2	2	3.31	0.045
4.00.1.05	23.4	7	3.71	0.045
4.00.1.06	53.9	3	1.42	0.045
4.00.1.07	46.6	11	2.67	0.045
4.00.1.08	19.1	5	2.52	0.045
4.00.2.00	118.5	0	2.8	0.045
4.00.2.01	8	5	1.19	0.045
4.00.2.02	10.7	5	1.09	0.045
4.00.2.03	16.1	5	1.34	0.045
4.00.3.00	34.2	7	2.3	0.045
4.00.4.00	11.1	31	1.5	0.045
4.01	63.1	2	1.21	0.045
4.01.1.0	54.3	3	1.22	0.045
4.01.1.1	60	5	1.43	0.045
4.01.1.2	33.8	3	1.22	0.045
4.01.2.0	51.5	3	2.05	0.045
4.01.2.1	27.9	6	2.34	0.045

4.01.2.2	46.4	8	1.99	0.045
4.01.2.3	12.7	0	0.35	0.045
4.02	28.7	3	1.63	0.045
4.02.1	50	3	0.99	0.045
4.02.2	43.9	1	1.71	0.045
5.00	46.45	5	0.69	0.045
5.00.1.0	306.9	5	0.87	0.055
5.00.1.1	17.9	4	1.47	0.045
5.00.1.2	9.5	3	2.11	0.045
5.00.1.3	15.9	3	1.2	0.045
5.00.1.4	22.2	2	0.46	0.045
5.00.1.5	169.3	3	1.06	0.055
5.00.1.6	70	5	1.73	0.045
5.00.1.7	109.1	2	1.62	0.045
5.00.2.0	47.1	5	1.36	0.045
5.00.2.1	10.4	5	0.89	0.045
5.00.3	30.5	5	1.88	0.045
5.00.4	154.7	5	1.31	0.045
5.01	107	3	1.31	0.055
5.01.1.0	91.3	5	1.28	0.055
5.01.1.1	17.2	5	1.87	0.055
5.01.1.2	46.2	5	1.39	0.045
5.01.1.3	50.3	5	1.21	0.045
5.01.1.4	34.9	5	0.88	0.045
5.01.1.5	13.2	5	0.73	0.045
5.01.1.6	25.4	5	1.39	0.045
5.01.1.7	19.9	4	2.03	0.045
5.01.1.8	120.4	2	1.2	0.045
5.01.2.0	42.5	5	1.23	0.045
5.01.2.1	13	5	1.45	0.045
5.01.3.0	81.5	5	0.78	0.045
5.01.3.1	34.3	5	1.63	0.045
5.01.3.2	61.2	5	2.14	0.045
5.02	149.12	4	0.61	0.055
5.02.1	155.8	4	0.8	0.055

10.1.2 Design Storms

Design storms using IFD data obtained from the Australian Bureau of Meteorology were entered into DRAINS for the following durations for the 1% AEP storm event for the 2, 9, 12, 24 and 36-hour storm durations to remain consistent with the Advisian Report. Additionally, the PMF storm event for the 1, 1.5, 2, 3 and 6-storm durations have also been included.

10.1.3 DRAINS – XP-RAFTS Hydrological Model

In order to prepare the regional hydrographs, a DRAINS (XP-RAFTS module) base model was established. The hydrological model for the existing conditions scenario was adjusted as necessary and validated against the Advisian peak flow rates by using the published existing and continuing loss parameters and adjusting the Bx multiplier. This provided a reasonable validation between the base case model setup for this assessment and the results of the existing studies which have been adopted in the region. Based on this, the variable model parameters were.

Table 13 – DRAINS Model Initial and Continuing Losses

	Badgerys Creek	Thompson Creek	Wianamatta-South Creek
Impervious Area Initial Loss (mm)	1	1	1
Impervious Area Continuing Loss (mm/h)	0	0	0
Pervious Area Initial Loss (mm)	37.1	17.2	35.7
Pervious Area Continuing Loss (mm/h)	0.94	0.94	0.94
Bx Multiplier	1.3	1.3	1.2

10.1.4 Regional Hydrograph Results

The results of this model, as well as the TUFLOW model were compared against the existing Advisian study to validate our work to establish the existing scenario for the mainstream flooding.

Table 14 below shows the existing case peak 1% AEP discharge rates from the hydrologic model at key locations in the regional catchment. This data was relied upon for the validation of the existing scenario hydrologic model prepared as part of this study.

Table 14 – Advisian Existing Hydrology Results at Key Calibration Points

Tributary/Location (1% AEP)	RAFTS Node	Peak Flows (m^3/s) Predicted for a Range of Storm Durations (hrs)			
		9	**12**	**24**	**36**
Badgerys Creek	5.02	**127**	113	120	120
Thompsons Creek	4.02	**85.2**	72.5	72.0	64.6
Wianamatta South Creek	1.08	289	280	286	**305**
Wianamatta South Creek	1.13	477	422	466	**492**

Table 15 – IDC Regional Hydrology Results

Tributary/Location (1% AEP)	RAFTS Node	Peak Flows (m^3/s) Predicted for a Range of Storm Durations (hrs)			
		9	**12**	**24**	**36**
Badgerys Creek	5.02	126	109	129	**130**
Thompsons Creek	4.02	**84.6**	76.4	75.9	70.4
Wianamatta South Creek	1.08	309	292	328	**345**
Wianamatta South Creek	1.13	394	419	438	**513**

Table 16 – Comparisons of Hydrology Calibration (% difference in flow rates)

Tributary/Location (1% AEP)	RAFTS Node	Peak Flows (m^3/s) Predicted for a Range of Storm Durations (hrs)			
		9	**12**	**24**	**36**
Badgerys Creek	5.02	0.8%	3.5%	7.5%	**8.3%**
Thompsons Creek	4.02	**0.7%**	5.4%	5.4%	9.0%
Wianamatta South Creek	1.08	6.9%	4.3%	14.7%	**13.1%**
Wianamatta South Creek	1.13	17.4%	0.7%	6.0%	**4.3%**

Noting that the IDC calculated flow rates are within an acceptable order of magnitude of error (and generally more conservative) to the Advisian modelling we believe that this represents a satisfactory verification of the hydrology for the purposes of the mainstream flooding assessment.

10.2 Proposed Regional Stormwater Model

To review the impact of the proposed site in the ultimate scenario on the receiving waterways, a "proposed case" hydrological model was created. This model took the respective outflow hydrographs from the "site" DRAINS model/s and inserted them into the regional RAFTS model for both the Badgerys Creek and Wianamatta South Creek catchments. This model considers the site to be fully developed, with Warehouse 4 constructed and the temporary on-site stormwater treatment basins decommissioned.

10.2.1 Catchment Areas

To avoid "double counting" of catchment areas, the existing catchments were updated to excise the site from their area with the ultimate site area considered with the insertion of the hydrographs from the proposed site model. Table 17 below outline the updated regional catchment areas for the model.

Table 17 – Proposed Reginal Stormwater Catchments

Tributary/Location	Catchment	Existing Model Areas (Ha)	Proposed Model Areas (Ha)
Badgerys Creek	5.02	149.1	138.4
	Subject Site - North	-	0.4
	Subject Site – West	-	5.5
	Subject Site – Southwest	-	4.8
Total		**149.1**	**149.1**
Wianamatta South Creek	1.13	422.1	417.2
	Subject Site – East	-	4.9
Total		**422.1**	**422.1**

10.2.2 Impervious Fraction and Equal Area Slope

The impervious fractions and equal area slopes from the existing regional stormwater model were maintained in the proposed model as the proposed model still assumes the regional site is undeveloped.

10.2.3 Proposed Regional Hydrograph Results

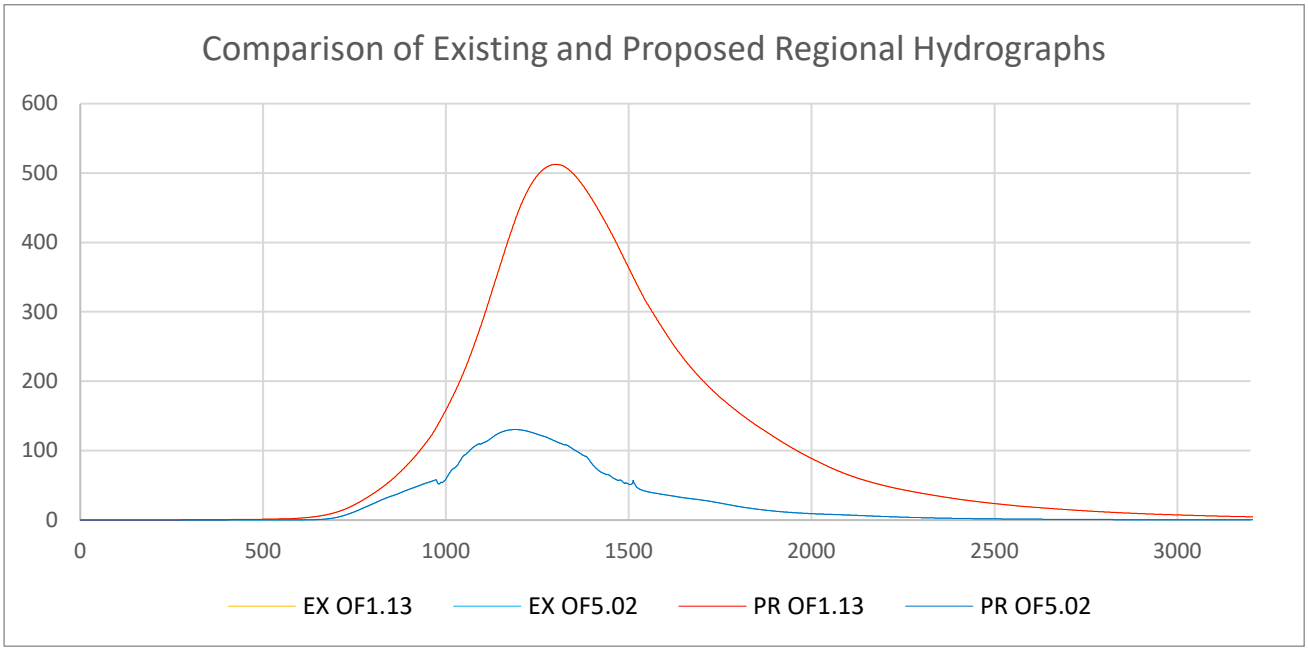
The results of the proposed regional stormwater model were compared against the existing model to assess if the post developed flows are less than the predevelopment flow at each receiving waterway. Table 18 below shows the proposed peak 1% AEP discharge rates from both catchment's hydrological model at the receiving waterway at key locations in the catchment.

Table 18 – Existing and Proposed Hydrology Results

Tributary/Location (1% AEP)	RAFTS Node	Scenario	Peak Flows (m^3/s) Predicted for a Range of Storm Duration (hrs)			
			9	**12**	**24**	**36**
Badgerys Creek	5.02	Existing	126	109	129	**130**
		Ultimate	126	109	129	**130**
Wianamatta South Creek	1.13	Existing	394	419	438	**513**
		Ultimate	394	419	438	**512**

Figure 13 below compares the existing and proposed hydrographs for the 36-hour storm duration and show the critical duration for the site. The 36-hour storm duration is shown as it is the critical storm duration for both creek systems.

Figure 13 – Comparison of Existing and Proposed Regional Hydrographs



In the ultimate scenario, the proposed development has a minor positive (reduced peak flow) impact on the peak flow rates at both Wianamatta South Creek and Badgerys Creek. This is expected, as the peak flow at Wianamatta South Creek from the proposed site occurs at 1,050 minutes while the South Creek peak flow occurs over 4 hours later at 1,300 minutes.

Similarly in Badgerys Creek, the peak flow from the proposed site occurs at 1,050 minutes while the main creek peak flow occurs at 1,200 minutes. As such, no detention has been proposed on site in the ultimate scenario.

11 Flooding and Environmental Resilience Management

This section of the report identifies the Aerotropolis and Wianamatta-South Creek suite of flooding and environmental resilience management requirements, including those identified in the Western Sydney Aerotropolis Development Control Plan 2022 objectives and performance outcomes (specifically Section 2.5.1, DPE WSA DCP, November 2022). The following sections of flood reporting also demonstrate the Masterplan's compliance with the floodplain management and flood protection outcomes.

11.1 Objectives & Performance Outcomes

O1. Ensure development in the floodplain is consistent with the NSW Flood Prone Land Policy and the principles of the NSW Floodplain Development Manual.

O2. Embed Aboriginal cultural knowledge and caring for Country practices to minimise the impact of development on flood behaviour and function of the floodplain and avoid adverse impacts to the existing flora, fauna and community.

O3. Minimise the flood risk to life and property, including to uses downstream, associated with the use of land considering the full range of flooding.

O4. Enable key community services and infrastructure that respond to flood threats to function during flooding.

O5. Allow development on land that is compatible with the flood function and behaviour on the land, taking into account projected changes as a result of climate change.

O6. Consider areas within the floodplain for amenity and recreation use where compatible with flood function and flood risk.

O7. Development is not intensified in a floodway or flood storage area.

O8. Avoid adverse or cumulative impacts on flood behaviour and the environment.

O9. Enable the safe occupation and efficient evacuation of people in the event of a flood.

Table 19 – Stormwater Management and Water Sensitive Urban Design Performance Outcomes

Performance Outcome		**1% AEP Floodway and Critical flood Storage Areas (defined in Appendix A)** ***Unsuitable for urban land uses***
PO1	Conveyance and storage of floodwaters through the floodplain is managed.	**1.** Except for concessional development, development is not permissible in this area – refer to clause 4.24 of the Parkland City SEPP.
	The siting and layout of development considers flood constraints, including risks to personal safety during the full range of floods.	**2.** For concessional development, the applicant is to demonstrate that the structure can be undertaken in accordance with a Flood Impact and Risk Assessment (FIRA).
	The site layout and built form of the development is compatible with flood constraints and potential risk.	**3.** The FIRA is undertaken by a suitably qualified professional engineer and considers the impacts of:
		a. Flooding on the development;
		b. The development on flooding;
		c. Flooding and the development on property and the existing and future community; and
		d. Climate change consistent with the objectives of this DCP.
		4. The FIRA has considered the impacts on flooding due to encroachment of structures and the associated collection of debris and potential for blockage.
		5. The FIRA assesses flood constraints for both pre and post development cases to ensure there are no significant detrimental impacts on flood behaviour or the community within and outside the development site.
PO2	Development has minimal impact on flood behaviour.	**1.** In addition to concessional development, the only structures to be considered in this area are for the purposes of creek crossings (pedestrian bridges and road bridges).
		2. The FIRA demonstrates that the structure will not increase flood affectation to existing and proposed development within and outside the development site.
		3. The FIRA considers the cumulative impact of potential future development from the upstream hydraulic control to the downstream hydraulic control.

		4. The FIRA demonstrates that the peak flow at the downstream hydraulic control is maintained with development and that the shape of the flood hydrograph is generally maintained for events up to and including the 1% AEP flood event.
PO3	Structures are designed and constructed so that they remain structurally sound for the life of the development considering flood and debris forces.	**1.** In addition to concessional development, the only structures to be considered in this area are for the purposes of creek crossings (pedestrian bridges and road bridges).
		2. In addition to concessional development, the only structures to be considered in this area are for the purposes of creek crossings (pedestrian bridges and road bridges).
		3. All structures are of flood-compatible building components below or at the flood planning level.
		4. An engineer's report is submitted to certify that the structure can withstand the forces of floodwater including debris and buoyancy up to and including the **flood planning level (based on the 1% AEP flood plus 500mm freeboard).**
PO4	All fill ensures the long-term stability of the development site and is not affected by erosion.	**1.** The FIRA demonstrates that any fill as a result of the development will not be impacted by erosion and will have long term stability.
PO5	The safety of users of developed areas located on the floodplain for the full range of flooding is ensured.	**1.** Applicant demonstrates that evacuation of the proposed development can be undertaken in accordance with the Local Flood Plan or SES flood emergency management strategy for the area.
		2. The FIRA demonstrates that evacuation can be undertaken consistent with the Local Flood Plan or SES flood emergency strategy for the area.
PO6	Public safety and the environment are not adversely affected by the detrimental impacts of floodwater on hazardous materials manufactured or stored in bulk.	**1.** No external storage of materials which may cause pollution or be potentially hazardous during any flood.
PO7	Fencing is designed and constructed so that it does not impede and/or direct the flow of floodwaters, add debris to floodwaters or increase flood affectation on surrounding land.	**1.** Use open type fencing.
		2. Fencing is not permissible unless it can be shown, through a FIRA, not to impact on flood conveyance or behaviour.
PO8	Earthworks including cut and fill do not impact flood storage areas.	**1.** The FIRA demonstrates earthworks will not affect flood storage capacity or flood behaviour for the full range of flood events.

Performance Outcome		Between 1% AEP Floodway / Critical Flood Storage and Flood Planning Area (defined in Appendix A)
		Unsuitable for Critical and Sensitive Land Uses
PO1	Conveyance and storage of floodwaters through the floodplain is managed.	**1.** Applicant to demonstrate that development as a consequence of a subdivision or development proposal, can be undertaken in accordance with a FIRA.
	The siting and layout of development considers flood constraints, including risks to personal safety during the full range of floods.	**2.** The FIRA is undertaken by a suitably qualified professional engineer and considers the impacts of:
	The site layout and built form of the development is compatible with flood constraints and potential risk.	**a.** Flooding on the development;
		b. The development on flooding;
		c. Flooding and the development on property and the existing and future community; and
		d. Climate change consistent with the objectives of this DCP.
		3. The FIRA assesses flood constraints for both pre and post development cases with and without climate change to ensure there are no significant detrimental impacts on flood behaviour or to the community upstream, downstream, or adjacent to the site.
		4. The FIRA considers:
		a. Car parks;
		b. The type of car park;
		c. For open car parks, the restraints used to secure and prevent floating vehicles from leaving the car park; and
		d. For enclosed carparks, how floodwaters will be stopped from entering the enclosed car park.
		5. For all zones, any development that includes a residential component has Habitable Floor Levels equal to or greater than the 1% AEP flood level plus 500mm freeboard.

		6. Building Floor Levels are equal to or greater than the 1% AEP flood level plus 500mm freeboard in the following areas:
		a. Enterprise Zone;
		b. Agribusiness Zone; and
		c. Mixed Use Zone.
PO2	Development has minimal impact on flood behaviour.	**1.** The FIRA demonstrates that development will not increase flood affectation to existing and proposed development within and outside the development site.
		2. The FIRA demonstrates the cumulative impact of potential future development from the upstream hydraulic control to the downstream hydraulic control.
		3. The FIRA demonstrates that the peak flow at the downstream hydraulic control is maintained with development and that the shape of the flood hydrograph is generally maintained for events up to and including the 1% AEP flood event.
PO3	Structures are designed and constructed so that they remain structurally sound for the life of the development considering flood and debris forces.	**1.** All structures are of flood-compatible building components below or at the flood planning level.
		2. An engineer's report is submitted to certify that the structure can withstand the forces of floodwater including debris, immersion, and buoyancy up to and including the flood planning level.
		3. The FIRA demonstrates that all new electrical equipment, power points, wiring, fuel lines, sewerage systems or any other service pipes and connections can be waterproofed and/or located above the flood planning level.
PO4	All fill ensures the long-term stability of the development site and is not affected by erosion.	**1.** The FIRA demonstrates that any fill as a result of the development will not be impacted by erosion and will have long term stability.
PO5	The safety of users of developed areas located on the floodplain for the full range of flooding is ensured.	**1.** Vehicular and pedestrian access ensures access /egress is provided to above the predicted peak level of the PMF.
		2. The FIRA demonstrates that evacuation can be undertaken consistent with the Local Flood Plan or SES flood emergency strategy for the area.
PO6	Public safety and the environment are not adversely affected by the detrimental impacts of floodwater on hazardous materials manufactured or stored in bulk.	**1.** No external storage of materials which may cause pollution or be potentially hazardous during any flood.

PO7	Fencing is designed and constructed so that it does not impede and/or direct the flow of floodwaters, add debris to floodwaters or increase flood affectation on surrounding land.	**1.** Fencing is constructed in a manner that does not obstruct the flow of floodwaters.
		2. Fencing of flow paths is limited to permeable open type fences.
PO8	Earthworks including cut and fill do not impact flood storage areas.	**1.** The FIRA demonstrates that earthworks will not affect flood storage capacity or flood behaviour for the full range of flood events.

Performance Outcome		**Outside Flood Planning Area to Probable Maximum Flood (defined in Appendix A)**
		Unsuitable for Critical Land Uses
PO1	Conveyance and storage of floodwaters through the floodplain is managed.	**1.** Applicant to demonstrate that development as a consequence of a subdivision or development proposal, can be undertaken in accordance with a FIRA.
	The siting and layout of development considers flood constraints, including risks to personal safety during the full range of floods.	**2.** The FIRA is undertaken by a suitably qualified professional engineer and considers the impacts of:
	The site layout and built form of the development is compatible with flood constraints and potential risk.	**a.** Flooding on the development;
		b. The development on flooding;
		c. Flooding and the development on property and the existing and future community; and
		d. Climate change consistent with the objectives of this DCP.
		3. The FIRA assesses flood constraints for both pre and post development cases with and without climate change to ensure there are no detrimental impacts on flood behaviour or to the community upstream, downstream, or adjacent to the site.
		4. Critical and sensitive land uses are to have floor levels equal to or greater than the PMF level, where intended to be utilised during flooding.
PO2	Development has minimal impact on flood behaviour.	**1.** The FIRA demonstrates that development will not increase flood affectation to existing and proposed development within and outside the development site.

		2. Except for single detached dwellings and alterations and additions to existing dwellings, an engineer's report is required to certify that the development will not increase flood affectation to existing and proposed development.
PO3	Structures are designed and constructed so that they remain structurally sound for the life of the development considering flood and debris forces.	**1.** Critical and sensitive land uses are of flood -compatible building components below or at the PMF level, where intended to be utilised during flooding.
		2. An engineer's report is submitted to certify that the structure can withstand the forces of floodwater including debris and buoyancy up to and including the PMF level for sensitive development or essential community facilities intended to be utilised during flooding.
PO4	All fill ensures the long-term stability of the development site and is not affected by erosion.	**1.** The FIRA demonstrates that any fill as a result of the development will not be impacted by erosion and will have long term stability.
PO5	The safety of users of developed areas located on the floodplain for the full range of flooding is ensured.	**1.** Vehicular access to precincts is designed to ensure rising road access/egress is provided to above the predicted peak level of the PMF.
		2. FIRA for sensitive and critical development demonstrates that evacuation can be undertaken consistent with the Local Flood Plan or SES flood emergency strategy for the area.
PO6	Public safety and the environment are not adversely affected by the detrimental impacts of floodwater on hazardous materials manufactured or stored in bulk.	**1.** No external storage of materials which may cause pollution or be potentially hazardous during any flood.
PO7	Fencing is designed and constructed so that it does not impede and/or direct the flow of floodwaters, add debris to floodwaters or increase flood affectation on surrounding land.	N/A
		N/A
PO8	Earthworks including cut and fill do not impact flood storage areas.	**1.** The FIRA demonstrates that earthworks will not affect flood storage capacity or flood behaviour for the full range of flood events.
		2. Any fill platform associated with development does not create a local site-specific flood island isolating the user from safety during flooding

11.2 Western Sydney Aerotropolis Development Control Plan 2022 Requirements

To fulfill the above requirements, we have undertaken two separate flooding assessments, a local overland flood assessment and a mainstream flood assessment. The local flooding assessment will consist of 'pre to post' hydrologic assessment of the site and its environs. The mainstream flood assessment is to assess the impact of the proposed site on the adjacent Badgerys Creek and South Creek while the overland flow study will assess the impacts of the proposed site on the neighbouring properties.

The proposed site meets all the performance outcomes of the Western Sydney Aerotropolis Development Control Plan 2022 flooding and environmental resilience requirements, as no development is proposed in the 1% AEP or PMF flood extents. The analysis detailed in the subsequent sections of the Flood Impact and Risk Assessment confirm these outcomes are met.

12 Flood Impact & Risk Assessment (FIRA)

12.1 Flood Modelling

12.1.1 Objective

The key requirements for undertaking flood modelling for this Flood Risk & Impact Assessment are to provide a clear representation of flooding associated with the proposed development of the site and its surroundings. This report will demonstrate the flooding impact on the development site, as well as the impact the site has on the wider floodplain within the catchment, as well as existing properties and the community.

This will be addressed by:

- assessing the impacts of contributing catchments to the existing development site.
- assessing piped systems, overland flow paths and downstream system constraints.
- assessing the likely impact the proposed development has on flooding on adjacent sites; and
- identifying flood hazard/flood risk for the proposed development.
- assess the impact of the proposed development on the adjacent Badgerys Creek and South Creek.
- Review the potential impacts of climate change on the proposed site.

This report will demonstrate that there are no significant detrimental impacts on flood behaviour or on the community upstream, downstream, or adjacent to the site. It will also establish that the proposed earthworks will not affect flood storage capacity or flood behaviour for the full range of flood events.

The flood modelling and results presented in the following sections of this report have been prepared based on the Stage 1 scenario for the site when the on-site basin is still in operation. Refer to Section 10.2, for review of the impact of the proposed ultimate site on the adjacent Wianamatta South Creek and Badgerys Creek.

12.1.2 Introduction

Flood modelling has been undertaken over the site utilising TUFLOW, a two-dimensional (2D) hydraulic modelling program that has been used to assess the existing (pre-development) and proposed (post-development) flooding scenario for a range of storm events including the critical 1% AEP flood event within the subject site. Hydrological modelling has been undertaken using DRAINS (as detailed in Section 7 above), and hydraulic terrain flood modelling (2-dimensional) was undertaken for the subject site using TUFLOW. A detailed description of the hydrological and hydraulic modelling assessment is provided in the following sections of this report.

Two separate TUFLOW models have been created to assess the mainstream flooding and local flooding separately. The mainstream model will assess the flood behaviour of the two adjacent creeks, Badgerys Creek and Wianamatta South Creek, and will assess the potential impact the proposed site will have on the creeks. This model will utilise the hydrographs prepared as outlined in Section 4 of this report.

The overland flow assessment will focus on the potential impact of the proposed site on the neighbouring properties. This model will apply direct rainfall onto the neighbouring areas with flows from our site extracted from the DRAINS model to assess how the local flood waters external to our site will behave when considering the designed outlet flows from our site.

12.1.3 TUFLOW Software Package

The subject site and the surrounding catchment areas were modelled using the TUFLOW program.

TUFLOW computes flow paths by dividing the floodplain into a grid of individual cells. The flow of water between cells is then computed repeatedly at regular timesteps by solving two-dimensional shallow water equations to estimate the flood spread and flow. As each cell contains information on water levels, flows are routed in the direction that will naturally follow the modelled topography.

The flood assessment was modelled using TUFLOW build 2023_03_AA_64.

12.2 Mainstream Flooding

A mainstream flood model was compiled to represent the natural flows through the study catchment. Flows arrive at the subject site from the south, following two main creek tributaries each conveying flows to the north and the confluence of Badgerys Creek, Thompsons Creek and Wianamatta South Creek. The existing terrain consists of large rural landholdings with a rural road network throughout.

12.2.1 Model Build

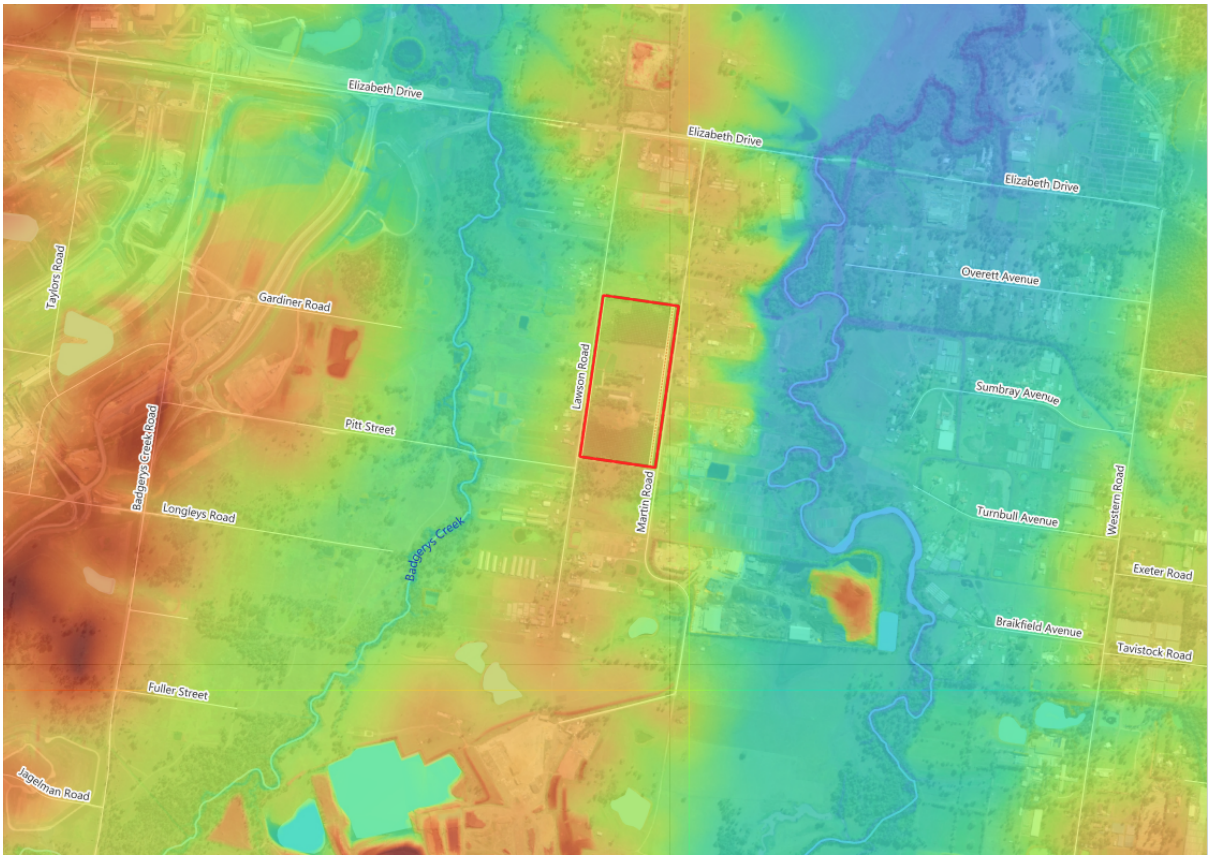
In order to simulate the flood event across the site, inflow boundary conditions in the form of hydrographs (m^3/s versus time) were inserted at key locations within the model extents. These locations were selected at key points in the existing catchment that intersected with our TUFLOW model extents. The hydrographs (extracted from the hydrological DRAINS model) were applied to the 2d network as overland flows to simulate the floodwaters entering the model network.

12.2.2 Digital Elevation Model

A digital elevation model (DEM) was generated using LiDAR (Light Detection and Ranging) aerial survey obtained from the NSW Government Spatial Services for the site and surrounding catchment area.

Figure 14 below shows the LiDAR survey DEM as a representation of the base elevations used in the model. This image was generated using QGIS Software.

Figure 14 – Pre-Development Scenario Digital Elevation Model



12.2.3 Model Extent and Grid Generation

A TUFLOW modelling grid was generated for the model extents. The finite element grid forms the basis for TUFLOW modelling and creates a readable network where each grid cell has applied characteristics such as elevation, slope, roughness etc. The model extents have extended upstream for both Badgerys Creek and Wianamatta South Creek to show the flood behaviour within the creeks.

A 4m x 4m grid size was selected for the model and is considered appropriate for the scale of the development site with urbanised and industrial catchments. This grid size allows a finer and more accurate representation of the flows than a more conventional larger grid size often utilised in regional scale flood studies.

The model extent is shown in Figure 15 below.

Figure 15 – Model Extent

12.2.4 Roughness Coefficients

Manning's 'n' roughness coefficients were applied within the TUFLOW model to regions created in a TUFLOW Materials file. This file bounds regions within the model area and applies a bed resistance value, in this case, a Manning's 'n' value. TUFLOW adopts these values for each 4m x 4m cells within the specified regions. A plan of the TUFLOW Materials file regions can be found in Figure 16 below. Each of these regions has adopted the Manning's values set out below in Table 20.

Figure 16 – TUFLOW Materials File Regions – Pre-Development Conditions

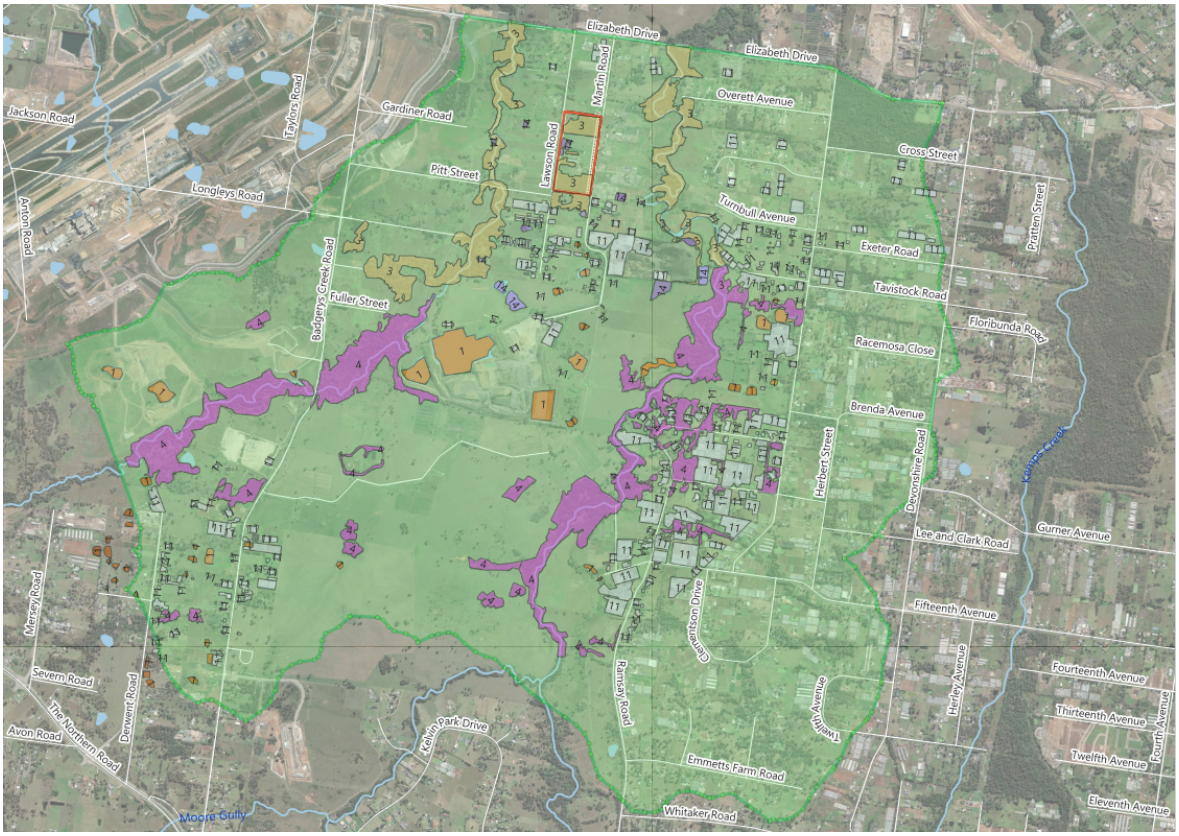


Table 20 – Materials File Parameters

Material ID	Manning's n	Description
1	0.035	Clear creek channel or watercourse
2	0.055	Lightly vegetated creek channel
3	0.10	Moderately vegetated creek channel
4	0.12	Heavily vegetated creek channel
5	0.05	Grassed floodplain and sparse trees
6	0.08	Floodplain with moderate coverage of trees
7	0.12	Floodplain with dense trees
8	0.04	Urban floodplain
9	0.09	Industrial floodplain
10	0.015	Roadways
11	0.50	Industrial/commercial buildings (ARR2019)
12	0.011	Hardstand
13	0.012	Pathways
14	0.03	Wetlands/Ponds/Basins

12.2.5 Boundary Conditions

In order to simulate the flood events across the site, boundary conditions (or inflow conditions) in the form of hydrographs are inserted within the model extents. The hydrographs (extracted from *DRAINS*) are applied at the low points within the respective catchments to simulate the floodwaters entering the site.

The inflow boundary condition polygons are represented in Figure 17 below utilise a flow versus time relationship applied over an area.

Regions are created within the model (known as SA boundaries, shown in orange in Figure 17) and flows are applied directly onto the cells within as an inflow source. Flows are directed to the lowest cell-based elevations and are then distributed according to the topography. The inflow hydrographs assigned to these regions are shown in Figure 18 and Figure 19 below. The boundary condition distributes flow in quantity and direction across the cells based on their topography, bed roughness and whether upstream or downstream conditions control the flow. These inflows were extracted from the DRAINS modelling as detailed in Section 7 of this report.

Figure 17 – Model SA Boundary Conditions – Pre-Development Conditions

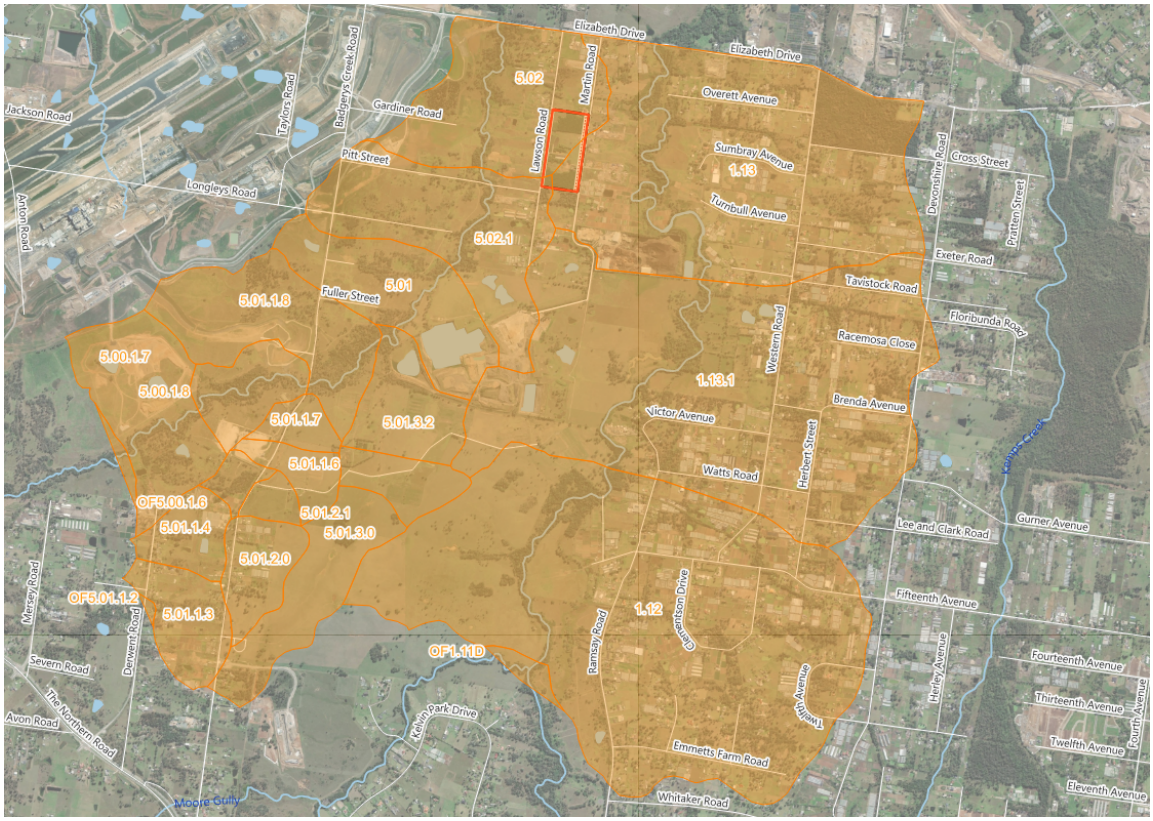


Figure 18 and Figure 19 below shows hydrographs for each of the inflow SA boundary locations utilised in the TUFLOW model for the 1% AEP 36-hour storm event. The hydrographs were applied as inflows at these locations over a period of just over 36 hours.

Figure 18 – 2D Boundary Inflow Hydrographs – Badgerys Creek

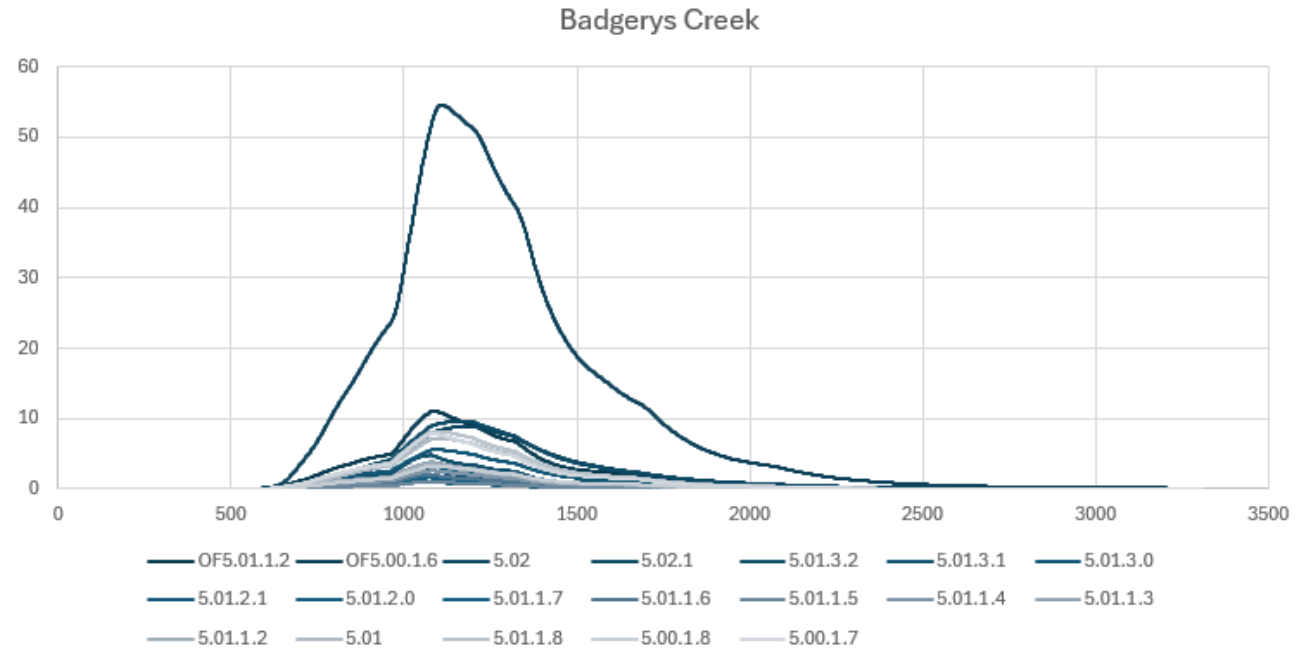
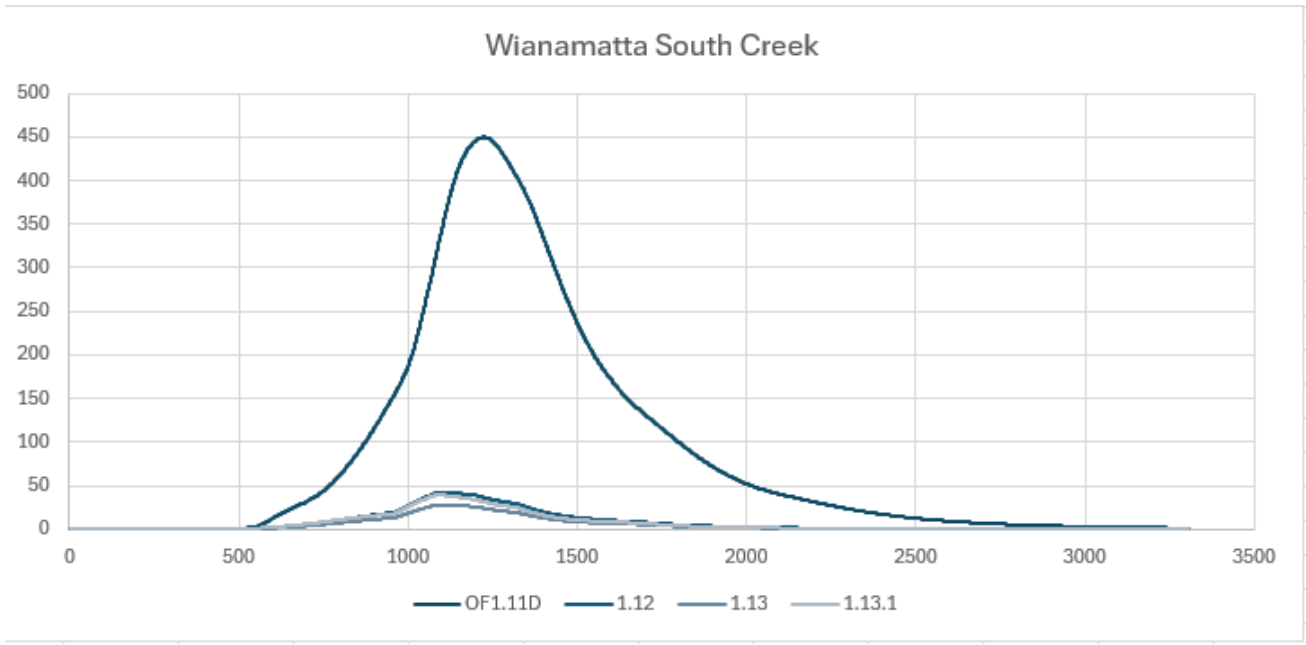


Figure 19 – 2D Boundary Inflow Hydrographs – Wianamatta South Creek



Downstream boundary conditions were placed at the outlet of the TUFLOW model boundary extents (BC_Out and SC_Out) as shown in blue in Figure 20 at the northern limits of the model boundary.

The model assigns a water level to the cells across these boundaries based on a water level verses flow curve (stage discharge, HQ). A slope is specified in the model data, and the TUFLOW program generates the HQ curve, allowing flows to leave the model at the boundary extents without creating a dam like effect. The downstream boundary conditions adopted a slope of 0.01% based on the existing LIDAR data.

Figure 20 – Downstream Boundary Conditions (Outflow)

12.2.6 Floodplain

The underlying digital elevation model (DEM) for the 2D model was created from the latest LiDAR data with a 0.5m resolution. However, the 2D model covering the floodplain is based on a fixed grid with a cell size of 4m. Each grid cell is assigned attributes including ground elevation which determines the topographic base for the 2D model. The 4m grid is generally accepted as a reasonable grid size to adopt when modelling urban and industrial catchments. It was considered that such a model grid size would give a reasonable balance between the accuracy of the model and model run time.

12.2.7 Additional Assumptions

The following assumption has been made in the development of the existing scenario TUFLOW model.

- Initial and Continuing Losses are accounted for in the hydrological model (DRAINS model). They have not been applied to the two-dimensional (2D) model to avoid doubling up on the infiltration losses.
- An existing pit and pipe (minor) network has not been modelled as part of this study. The flood analysis considered only overland flows over the catchment terrain and conservatively assumes all existing minor systems are blocked/full during the modelled storm events.

The above assumptions have been considered based on engineering design principles and industry standards. They are considered reasonable assumptions for the model development.

12.2.8 Model Controls

Within a TUFLOW model, simulation time commands are entered to control all time dependant data. For 2D models these controls include a Start Time, End Time and a Timestep. The starting time and finishing times specify the period in hours for which calculations are made. The timestep is the calculation interval in seconds, which is dependent on various conditions such as grid size and hydrograph inputs.

For the 1% AEP storm event, a peak duration of 36 hours was deemed the critical or worst-case storm event for the Badgerys Creek catchment area. However, for completeness, a more extensive suite of storm durations was modelled to determine the maximum extent of flood affection within and adjacent to the site. The ensemble included the 9 hour, 12 hour, 24 hour and 36 hour durations for the 1% AEP storm event. The results were compiled through post-processing to achieve a peak output for all durations. An additional map has been included in the appendices to indicate where these maximum storm durations impacted various locations across the site. It is noted that for the 1% AEP event, the 36 hour duration was deemed the most critical storm in both Badgerys Creek and Wianamatta South Creek.

The same approach was undertaken for the PMF event with the 1 hour, 1.5 hour, 2 hour, 3 hour and 6 hour storm duration compiled to produce the peak event results.

The TUFLOW model controls have been set to run for a variable period (depending on storm duration) at a timestep of 1 second. This variable time period was deemed suitable for each storm to allow the flows to reach a maximum extent of inundation before receding. The catchment area was run for a 40-hour period to ensure the peak storm event (critical 36-hour storm duration) is captured.

12.2.9 Model Validation

The TUFLOW model was run utilising the hydrographs extracted from DRAINS modelling undertaken for the catchment. The hydrograph outputs from DRAINS were directly compared with the known results from the Advisian flood modelling results. The reported flow rates for the Badgerys Creek system were generally within +/-3% of the measured Advisian peak flow rate (for the 1% AEP peak ensemble storm event) and similarly for the Wianamatta South Creek system and were therefore considered acceptable for use.

Flood planning levels and extents were extracted from the TUFLOW model and compared with the water surface level results in the Advisian report. Water levels at key locations around the subject site exhibited differences of generally between 0-100mm (with IDC's levels being higher and thus more conservative). We note the IDC model has been created using a more recent LIDAR file which is more refined. This would account for the differences in flood levels between the two models. Based on the available data the correlation between water levels, the flood extents were considered appropriate.

12.2.10 Mainstream Flood Results

The existing scenario TUFLOW model was run for the 1% AEP and PMF event utilising peak flows extracted from the *DRAINS* model. The peak flows from the ensemble of storms was combined to assess the peak flows across the catchment and is outlined in Figure 21 and Figure 22 for the 1% and PMF flood event. The peak duration for the 1% and 0.2% AEP events was the 36-hour storm for both creek catchments. The peak duration for the PMF event was the 2 hour storm for Badgerys Creek and the 6 hour storm event was the peak duration for Wianamatta South Creek adjacent to the site (note, peak ensembles were utilised for the 1% AEP and PMF events).

Figure 21 – Pre-development 1% AEP Peak Storm Duration

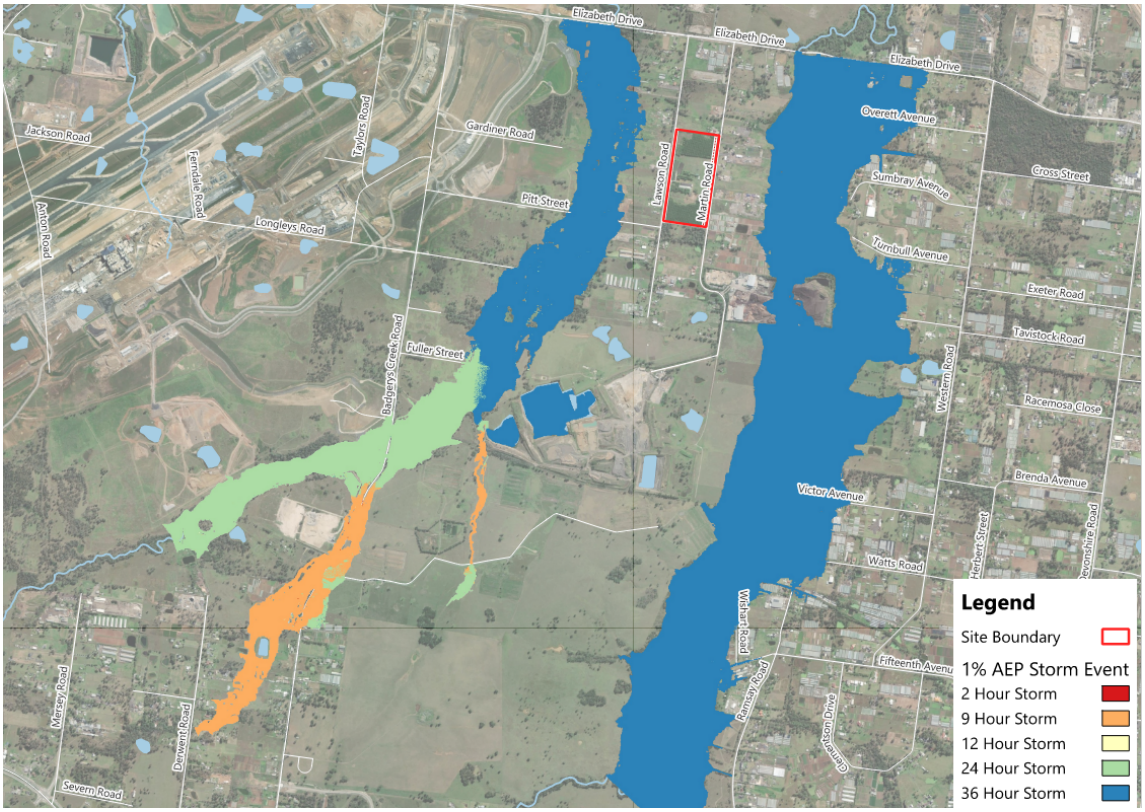
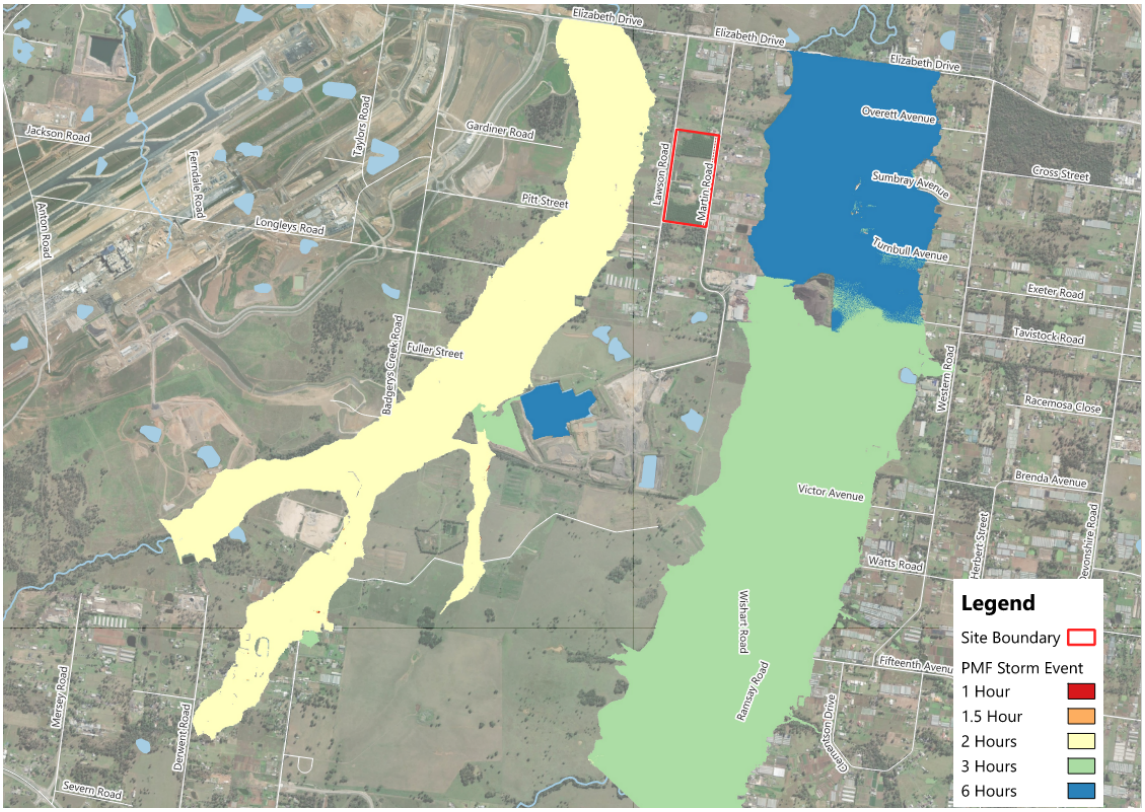


Figure 22 – Pre-development PMF Peak Storm Duration



The TUFLOW model was run for a variable event length, typically twice the duration of the storm event, to allow the flows to 'fill' the model and settle out before the peak extents were determined.

The TUFLOW output results for the pre-developed or existing 1% AEP and PMFs scenario have been shown in the following figures.

Figure 23 – Pre-development 1% AEP Flood Extents and Depth (m)

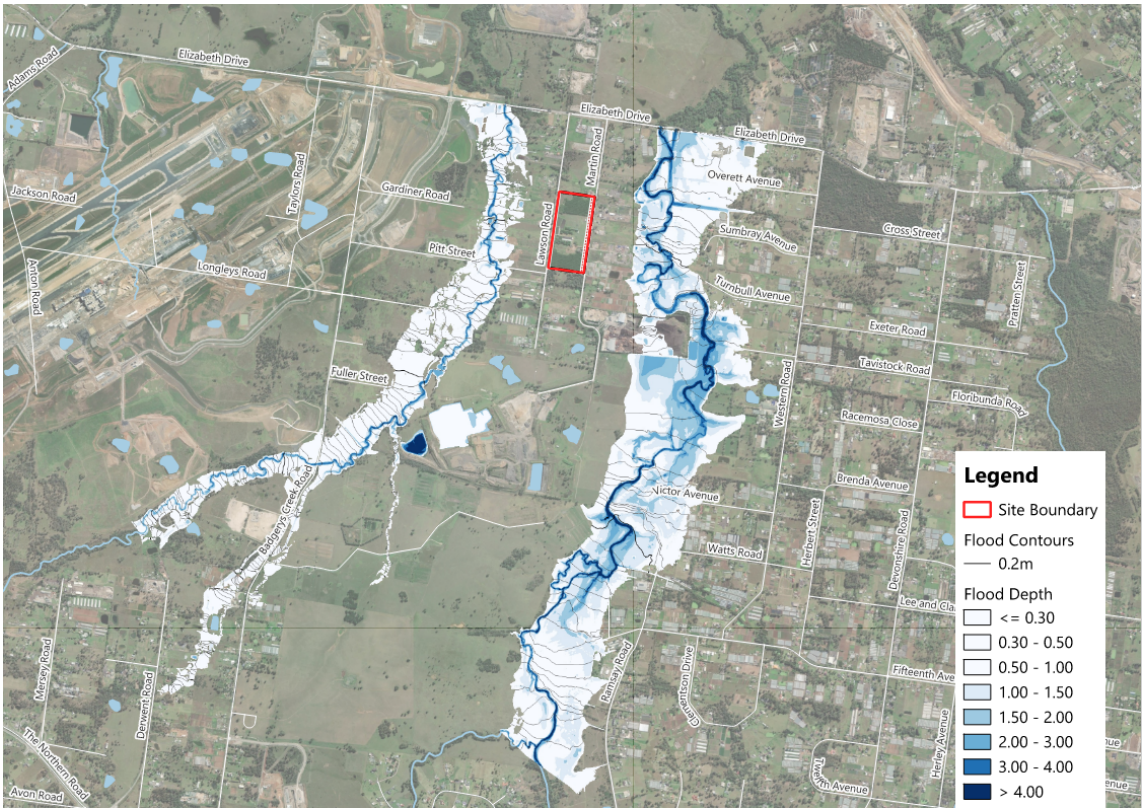


Figure 24 – Pre-Development 1% AEP Flood Levels (m AHD)

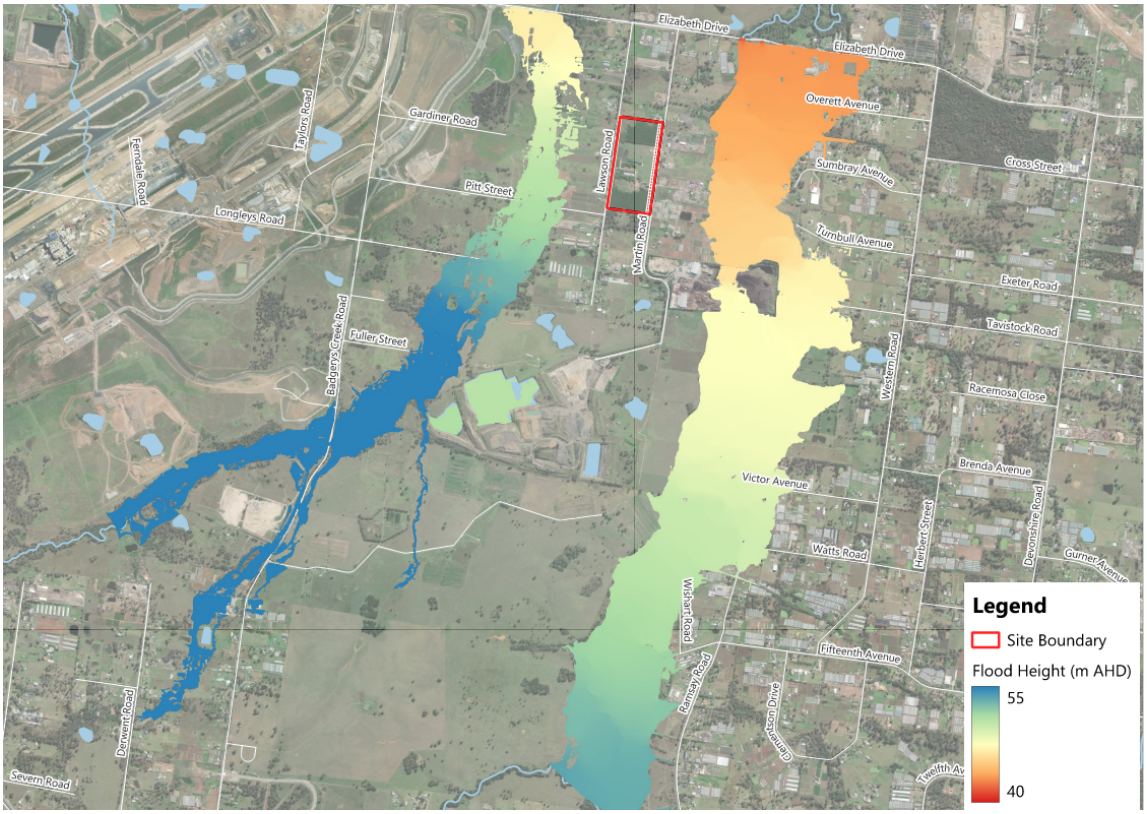


Figure 25 – Pre-development PMF Flood Extents and Depth (m)

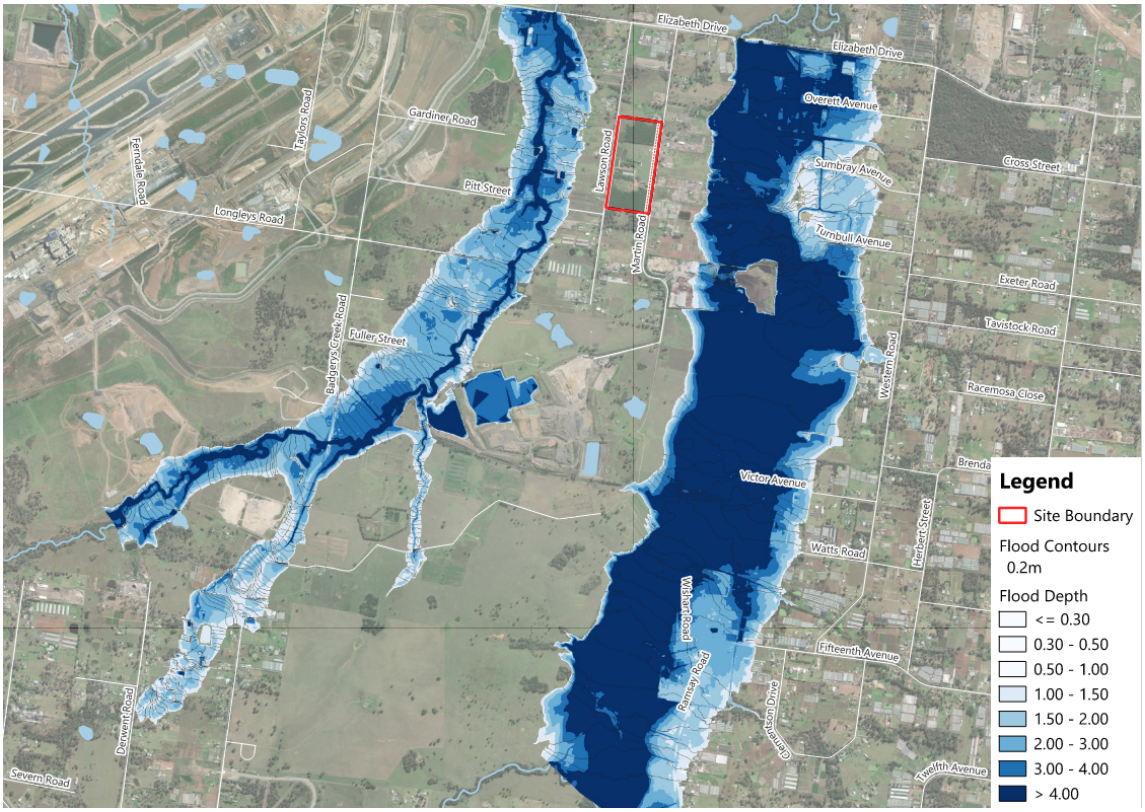
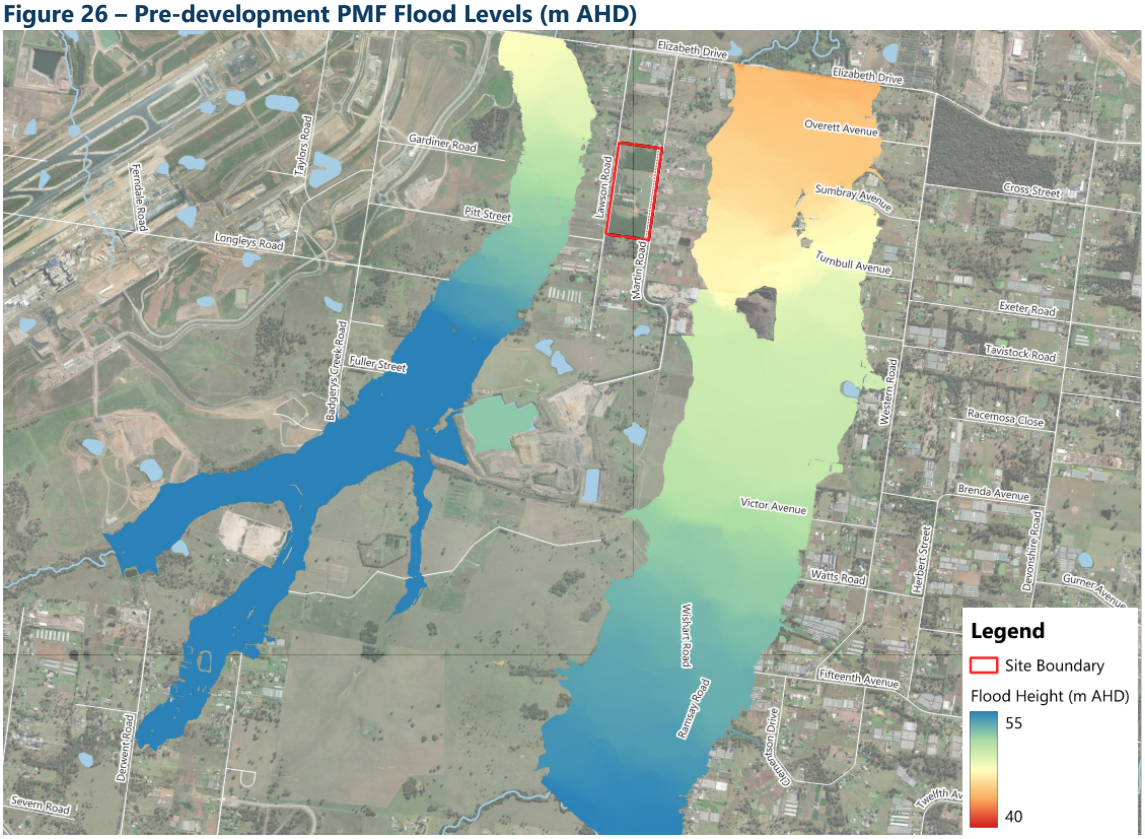


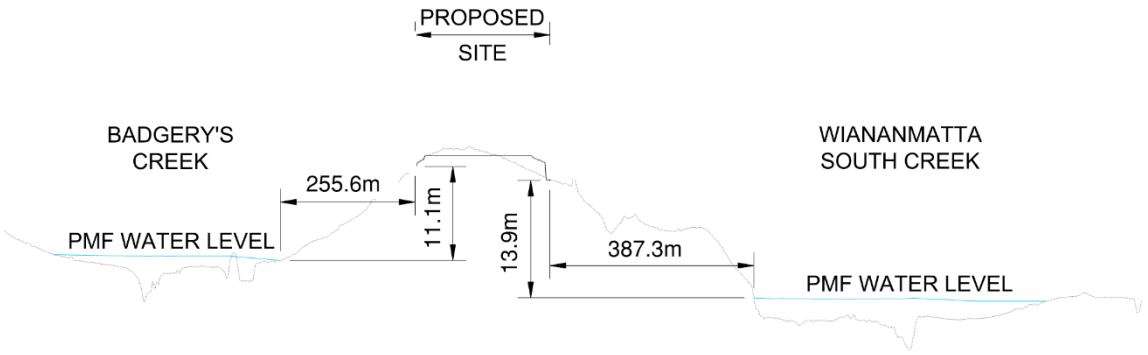
Figure 26 – Pre-development PMF Flood Levels (m AHD)



12.2.11 Mainstream Flood Result Commentary

The pre-development flood mapping results indicate that the flows generally follow the natural creeks and are mostly contained within the creek channels. The below profile outlines the levels of Badgerys Creek and Wianamatta South Creek and the PMF flood levels in comparison to the proposed site. The proposed site is noted to be approximately 11-13m higher than the PMF flood levels of the adjacent creeks. As the proposed site is outside the PMF flood extent is noticeably higher than the PMF flood levels, the site does not impact the adjacent creeks and no further mainstream flood analysis has been undertaken.

Figure 27 – Creek PMF water levels and Proposed Site



Further mapping for the Mainstream Flood 1% AEP, 0.2% AEP & PMF events are contained in Appendix A.

12.3 Local Overland Flooding

An overland flow analysis was undertaken to assess the effectiveness of the proposed Stage 1 stormwater management facilities during the 100 year ARI (1% AEP) Storm event and to identify any adverse impacts to the downstream properties. As such, two (2) scenarios were evaluated as follows:

- **Existing Scenario –** Adopts the existing catchment characteristics for the surrounding area, i.e. represents the existing overland flows in the rural catchment prior to any development activities which allows a comprehensive evaluation of pre-development and post-development flows.
- **Proposed Scenario –** Adopts the Stage 1 scenario of the site where Warehouses 1-3 have been constructed and the stormwater management facilities are treating and detaining flows from the site to the required pre-existing conditions. The neighbouring area is assumed to remain as existing. This allows for evaluation of the development's potential impact on adjoining properties.

12.3.1 Existing Scenario

12.3.2 Model Build

While the Mainstream flood model utilised hydrographs (m^3/s) to represent the flows through the catchment, the overland flow study has been constructed using a rainfall on grid model.

A rainfall on grid model is a simplistic calculation method comparable to the loss methods included in traditional hydrology models (e.g. RORB, URBS, WBNM). The calculation utilises rainfall hyetographs (time vs depth) as a boundary condition input, continuing and initial loss values depending on site materials and applies the excess rainfall to the model 2D cells. TUFLOW then applies the excess rainfall across the cell area to convert the rainfall depth to a volume. By focusing on a smaller area and evenly distributing rainfall across every cell, a rainfall on grid model allows us to better assess the local flooding when compared to the mainstream flood model.

12.3.3 Digital Elevation Model

The digital elevation model used for the mainstream flood modelling has also been utilised for the overland flow model. Refer to Section 12.2.2 for details on the digital elevation model.

12.3.4 Model Extent and Grid Generation

A TUFLOW modelling grid was generated for the model extents. The finite element grid forms the basis for TUFLOW modelling and creates a readable network where each grid cell has applied characteristics such as elevation, slope, roughness etc. The model extents have extended upstream for both Badgerys Creek and Wianamatta South Creek to show the flood behaviour within the creeks. The model extent has been reduced to the local catchment from the proposed site to each of the adjacent creeks.

A 2m x 2m grid cell size was selected for the model and is considered appropriate for the scale of the development and reduced model extent. The reduced grid size allows for a finer and more accurate representation of the flows when compared to the 4m x 4m cell size used in the mainstream flood model.

Figure 28 – Model Extent

12.3.5 Initial and Continuous Losses and Roughness Coefficients

Manning's 'n' roughness coefficients were applied within the TUFLOW model to regions created in a TUFLOW materials file. The materials file used for the overland flow flood model mimics the mainstream flood model however initial and continuous losses have been included in the materials file. The mainstream flood model applied the loss factors as part of the SA boundary condition hydrographs exported from the DRAINS model. As the overland flow flood model applies the rainfall directly to the flood model, the loss factors need to be included in the TUFLOW model.

The initial and continuous losses have been adopted using the published loss parameters from the Advisian model outlined in Section 10.1.3 of this report. As mentioned in the previous section, the Badgerys Creek and Wianamatta South Creek catchments have different loss factors applied to them. As such, the material file has been separated by Creek catchments. A plan of the TUFLOW Material file regions can be found in Figure 29 below. Each of these regions has adopted the Manning's value and loss factors outlined below in Table 21.

Figure 29 – TUFLOW Materials File Regions – Pre-Development Conditions

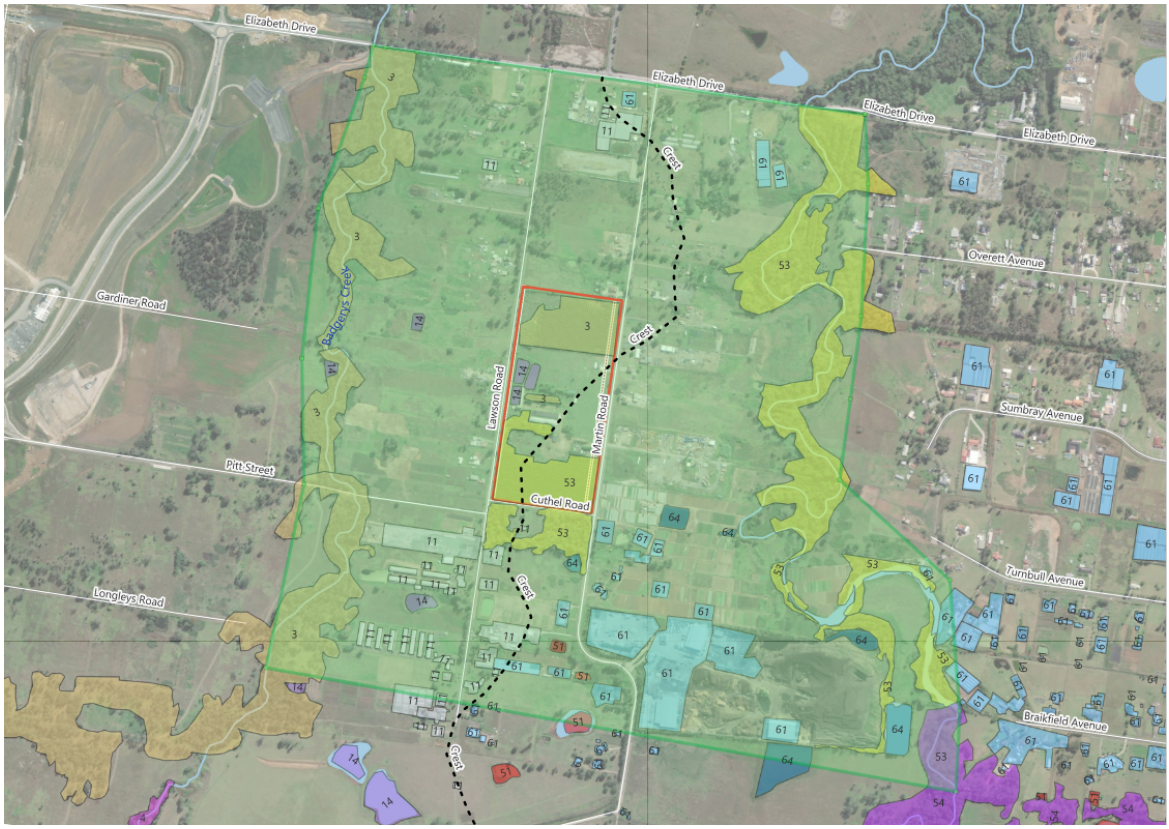


Table 21 – Materials File Parameters

Material ID	Manning's n	Catchment	Initial Losses	Continuing Losses	Description
1	0.035	Badgerys Creek	37.1	0.94	Clear creek channel or watercourse
2	0.055	Badgerys Creek	37.1	0.94	Lightly vegetated creek channel
3	0.10	Badgerys Creek	37.1	0.94	Moderately vegetated creek channel
4	0.12	Badgerys Creek	37.1	0.94	Heavily vegetated creek channel
5	0.05	Badgerys Creek	37.1	0.94	Grassed floodplain and sparse trees
6	0.08	Badgerys Creek	37.1	0.94	Floodplain with moderate coverage of trees
7	0.12	Badgerys Creek	37.1	0.94	Floodplain with dense trees
8	0.04	Badgerys Creek	37.1	0.94	Urban floodplain
9	0.09	Badgerys Creek	37.1	0.94	Industrial floodplain
10	0.015	Badgerys Creek	37.1	0.94	Roadways
11	0.50	Badgerys Creek	37.1	0.94	Industrial/commercial buildings (ARR2019)

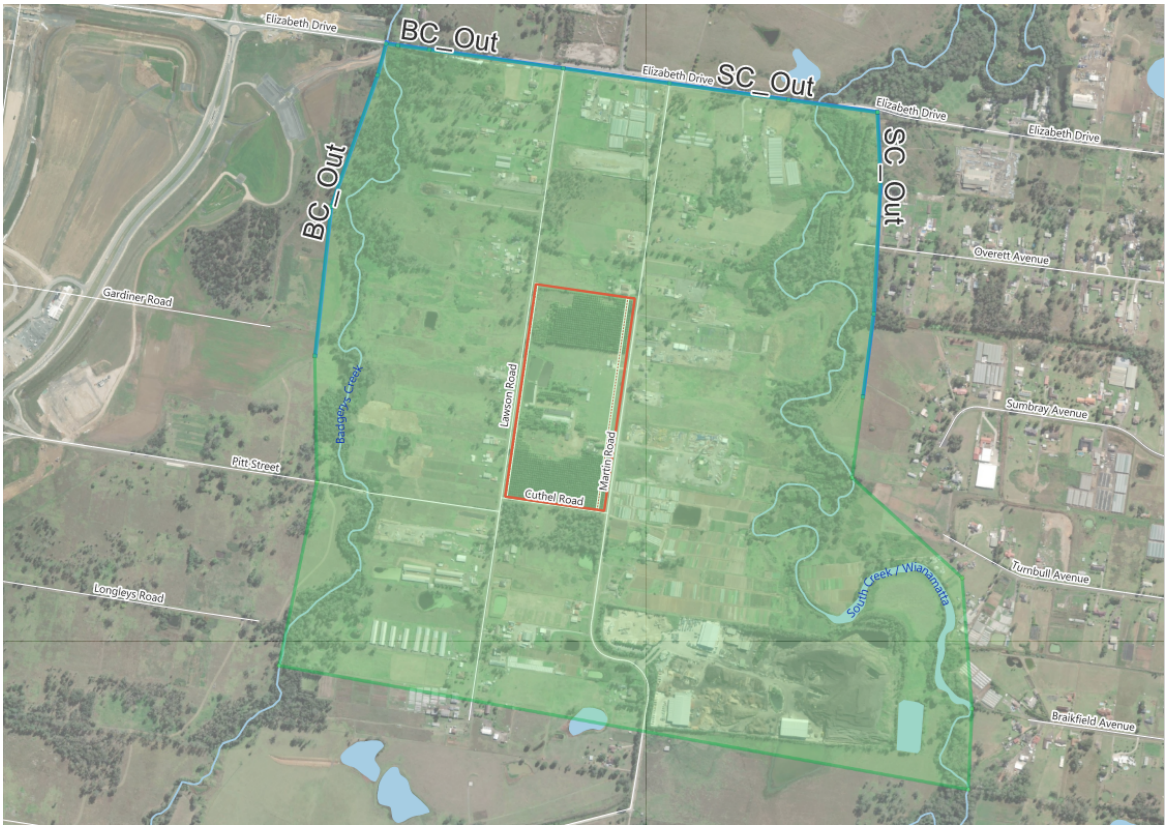
12	0.011	Badgerys Creek	37.1	0.94	Hardstand
13	0.012	Badgerys Creek	37.1	0.94	Pathways
14	0.03	Badgerys Creek	37.1	0.94	Wetlands/Ponds/Basins
51	0.035	Wianamatta South Creek	35.7	0.94	Clear creek channel or watercourse
52	0.055	Wianamatta South Creek	35.7	0.94	Lightly vegetated creek channel
53	0.10	Wianamatta South Creek	35.7	0.94	Moderately vegetated creek channel
54	0.12	Wianamatta South Creek	35.7	0.94	Heavily vegetated creek channel
55	0.05	Wianamatta South Creek	35.7	0.94	Grassed floodplain and sparse trees
56	0.08	Wianamatta South Creek	35.7	0.94	Floodplain with moderate coverage of trees
57	0.12	Wianamatta South Creek	35.7	0.94	Floodplain with dense trees
58	0.04	Wianamatta South Creek	35.7	0.94	Urban floodplain
59	0.09	Wianamatta South Creek	35.7	0.94	Industrial floodplain
60	0.015	Wianamatta South Creek	35.7	0.94	Roadways
61	0.50	Wianamatta South Creek	35.7	0.94	Industrial/commercial buildings (ARR2019)
62	0.011	Wianamatta South Creek	35.7	0.94	Hardstand
63	0.012	Wianamatta South Creek	35.7	0.94	Pathways
64	0.03	Wianamatta South Creek	35.7	0.94	Wetlands/Ponds/Basins

12.3.6 Boundary Conditions

To simulate the flood events across the site, boundary conditions (or inflow conditions) in the form of hyetographs (depth over time) have been applied to all cells within the model extent. The hyetographs for the overland flood study have been adopted from the IFD data outlined in Section 7.2.2 of this report. The boundary condition then distributes flow in quantity and direction across the cells of the model based on their topography, roughness, and whether upstream or downstream conditions control the flow.

Downstream boundary conditions were placed at the outlet of the TUFLOW model as shown in blue in Figure 30 at the northern limits of the model boundary and along the edge of Badgerys Creek and Wianamatta South Creek.

Figure 30 – Model Extent



12.3.7 Additional Assumptions

The following assumption has been made in the development of the existing scenario TUFLOW model.

- An existing pit and pipe (minor) network has not been modelled as part of this study. The flood analysis considered only overland flows over the catchment terrain and conservatively assumes all existing minor systems are blocked/full during the modelled storm events.

The above assumptions have been considered based on engineering design principles and industry standards. They are considered reasonable assumptions for the model development.

12.3.8 Model Controls

Within a TUFLOW model, simulation time commands are entered to control all time dependant data. For 2D models, these controls include a Start Time, End Time and a Timestep. The starting time and finishing times specify the period in hours for which calculations are made. The timestep is the calculation interval in seconds, which is dependent on various conditions such as grid size and hydrograph inputs.

For the 1% AEP storm event, a suite of storm durations was modelled to determine the maximum extent of flood affection within and adjacent to the site. The ensemble included the 20, 25, 30, 45, 60, 90, 120, 180 and 720-minute durations for the 1% AEP storm event. The results were compiled through post-

processing to achieve a peak output for all durations. An additional map has been included in the appendices to indicate where these maximum storm durations impacted various locations across the site. It is noted that the 120-minute duration storm was deemed the most critical storm for the local site.

The TUFLOW model controls have been set to run for a variable period (depending on storm duration) at a timestep of 1 second. This variable time period was deemed suitable for each storm to allow the flows to reach a maximum extent of inundation before receding. The catchment area was run for a 14-hour period to ensure all storm events (including the 720-minute storm duration) were captured.

12.3.9 Existing Flood Results

The overland flow flood model was run for the 1% AEP storm event using hyetographs in a rainfall-on-grid TUFLOW model. The peak flow from the ensemble of storms was combined to create a peak of peaks flood extents to assess the peak flows across the catchment. The peak duration primarily was the 120-minute storm duration and the 720-minute storm event for the key overland flow path.

The TUFLOW model was run for a variable event length, typically twice the duration of the storm event to allow the flows to 'fill' the model and settle out before the peak extents were determined. The TUFLOW output results for the existing 1% AEP scenario have been shown in the following figures.

Figure 31 – Pre-development Overland Flow 1% AEP Flood Extents and Depth (m)

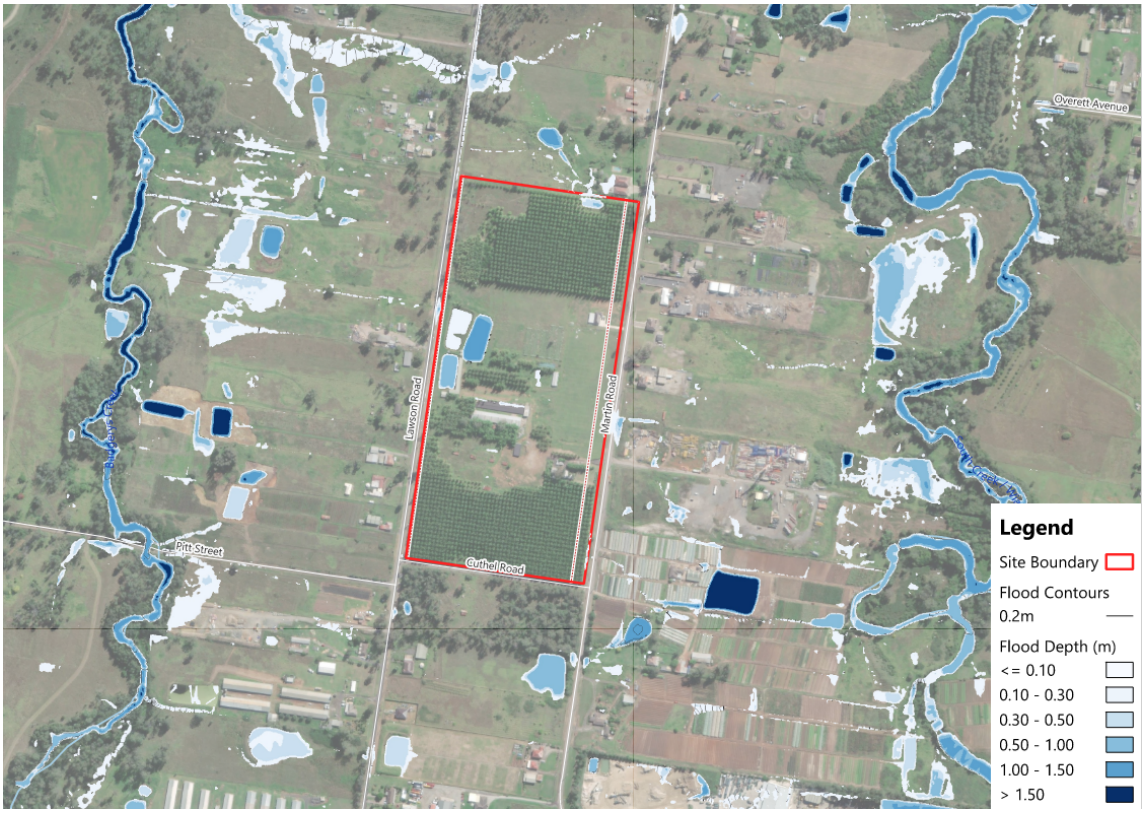


Figure 32 – Pre-development Overland Flow1% AEP Flood Levels (m AHD)

12.3.10 Existing Flood Commentary

The pre-development flood mapping results for the overland flow flood study indicate that stormwater runoff from the site generally follows the Sydney Water existing catchments, with runoff discharging the site in 3 locations.

- Minor flooding is observed at the north of the site at the boundary with the adjacent property.
- The existing farm ponds on site.
- Flooding was observed at the Martin Road sag point. Flooding is contained outside of the proposed scope of works and within the future road widening area.
- Minor flooding was observed in Lawson Road however this is outside the proposed property boundary.
- The key overland flow route for Lawson Road is observed to the north of the subject site discharging to Badgerys Creek.
- There is a minor overland flow route from the centre of the site along Martin Road discharging to Wianamatta South Creek.

Each of the above locations where flooding was observed is within localised sag points within the existing surface topography. The modelling results have indicated that there are isolated areas of shallow flood depth with no key overland flow route observed within or directly adjacent to the subject site.

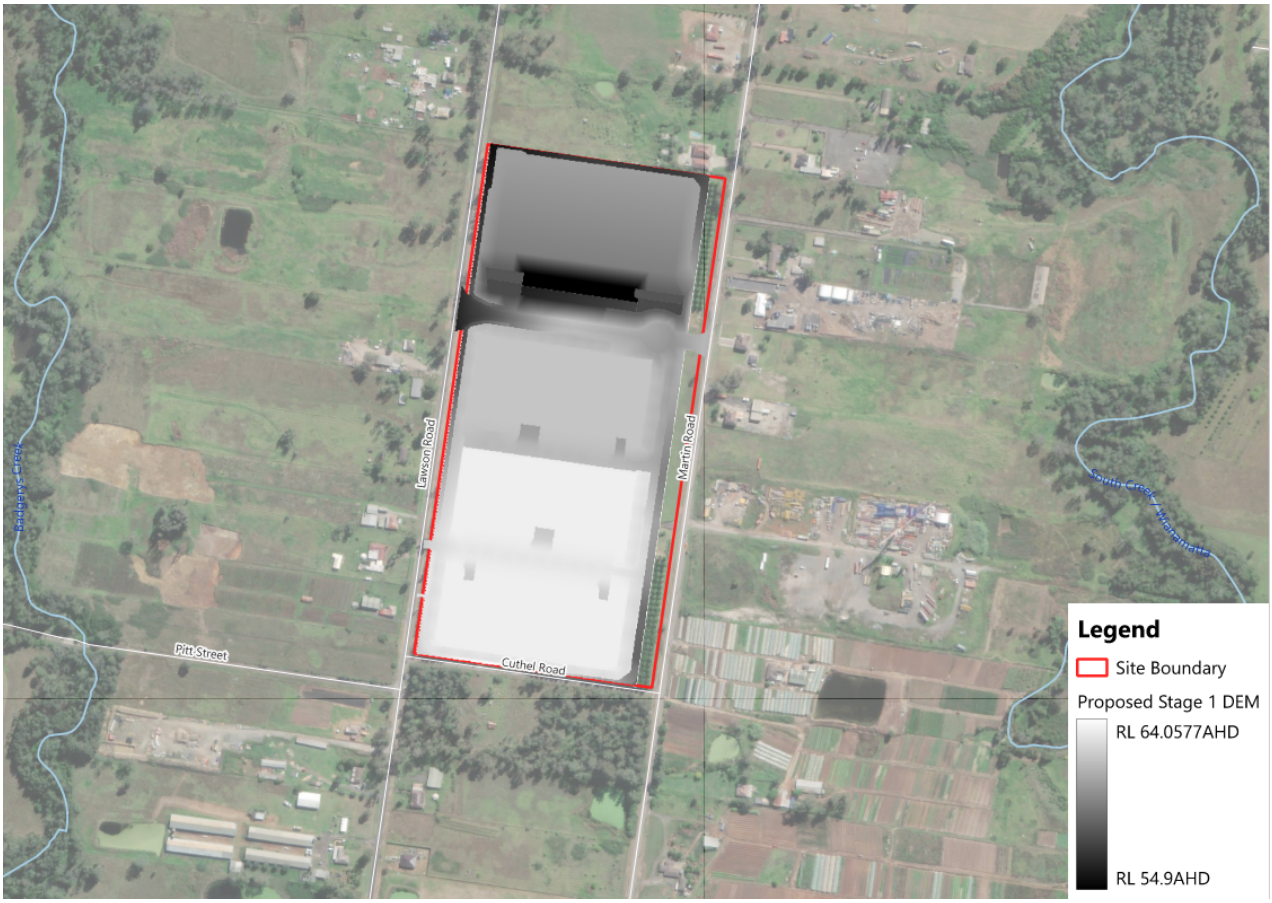
12.3.11 Proposed Scenario

12.3.12 Model Build

The post-development Stage 1 overland flow flood model builds on the pre-development model that has been outlined in Section 12.3.1 above. An additional DEM for the proposed scenario was developed (refer to Figure 33 below). This incorporated the proposed stage development including Warehouses 1-3 (including the associated loading docks and circulation road), the private road, all perimeter retaining walls and the stormwater management basins that make up the Stage 1 development.

The DEM was superimposed onto the existing LiDAR data to establish a comprehensive representation of the intended Stage 1 development scenario, while also accounting for the existing surroundings. This approach facilitates the quantitative evaluation of the potential effects the proposed development might exert on neighbouring properties and local settings.

Figure 33 - Proposed Scenario Digital Elevation Model (DEM)

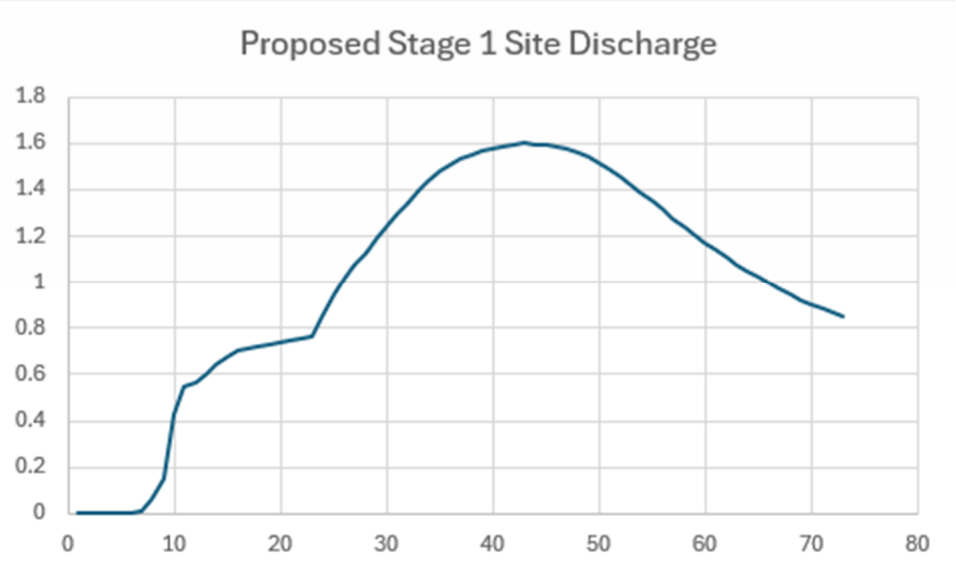


12.3.13 Boundary Conditions

To include flows generated by the developed area, a boundary condition in the form of a hydrograph is inserted within the model extents. The hydrograph (extracted from DRAINS) has been applied to the proposed discharge point from the stormwater management basins at Lawson Road to simulate the design discharge flows exiting the site. The Proposed DRAINS model and discharge flow rates have been outlined in Section 7 of this report.

The hydrograph was preferred to a rainfall on grid approach for the proposed site as the inground stormwater infrastructure on site has not been modelled in the overland flow TUFLOW model and water will pond at the recessed loading docks and stormwater management basins providing an incorrect flood behaviour in the model. An additional boundary condition was included in the model to remove the proposed site from the rainfall on grid extents. This blocked any rainfall falling on the proposed site in the model, avoiding a double-up of outflows created from the site. Figure 34 below outlines the hydrograph applied to the model for the proposed site discharge.

Figure 34 – 2D Boundary Inflow Hydrograph – Proposed Site Discharge



12.3.14 Post Development Results

The overland flow flood model was run for the 1% AEP storm event using hyetographs in a rainfall on grid TUFLOW model. The peak flow from the ensemble of storms was combined to create a peak of peaks flood extents to assess the peak flows across the catchment. Similarly to the pre development model, the peak duration primarily was the 120 minute storm duration and the 720 minute storm event for the key overland flow path.

The TUFLOW model was run for a variable event length, typically twice the duration of the storm event to allow the flows to 'fill' the model and settle out before the peak extents were determined. The TUFLOW output results for the existing 1% AEP scenario have been shown in the following figures.

Figure 35 – Post-development Overland Flow 1% AEP Flood Extents and Depth (m)

Figure 36 – Pre-development Overland Flow1% AEP Flood Levels (m AHD)

12.3.15 Post Development Flood Commentary

The following is a summary of key results from the modelling.

1. The proposed works have removed the localised sag point at the north of the site however minor flooding is still observed in the adjacent property.
2. Flooding at the Martin Road and Lawson Road sag points has reduced when compared to the pre-development model.
3. Discharge flows from site travel north within the Lawson Road verge to the key overland flow path towards Badgerys Creek.
4. We note that no flooding is shown within the site boundary in the post development model as we have applied the site discharge boundary condition external to the site at the north west corner of the site. The detention basin has been accounted for in the discharge rate applied
5. All proposed building pads are suitably set above the adjacent 1% AEP flood level + 500mm freeboard.

12.3.16 Pre-to-Post Development Comparison and Flood Affectation Analysis (Afflux)

A direct comparison of the existing and post developed 1% AEP scenario flood depths was undertaken to assess flood affectation adjacent to the site. Increases in the water surface level were separated from decreases and are identified in Figure 37 below.

Figure 37 - Afflux Results (Existing to Proposed)

12.3.17 Summary of Results

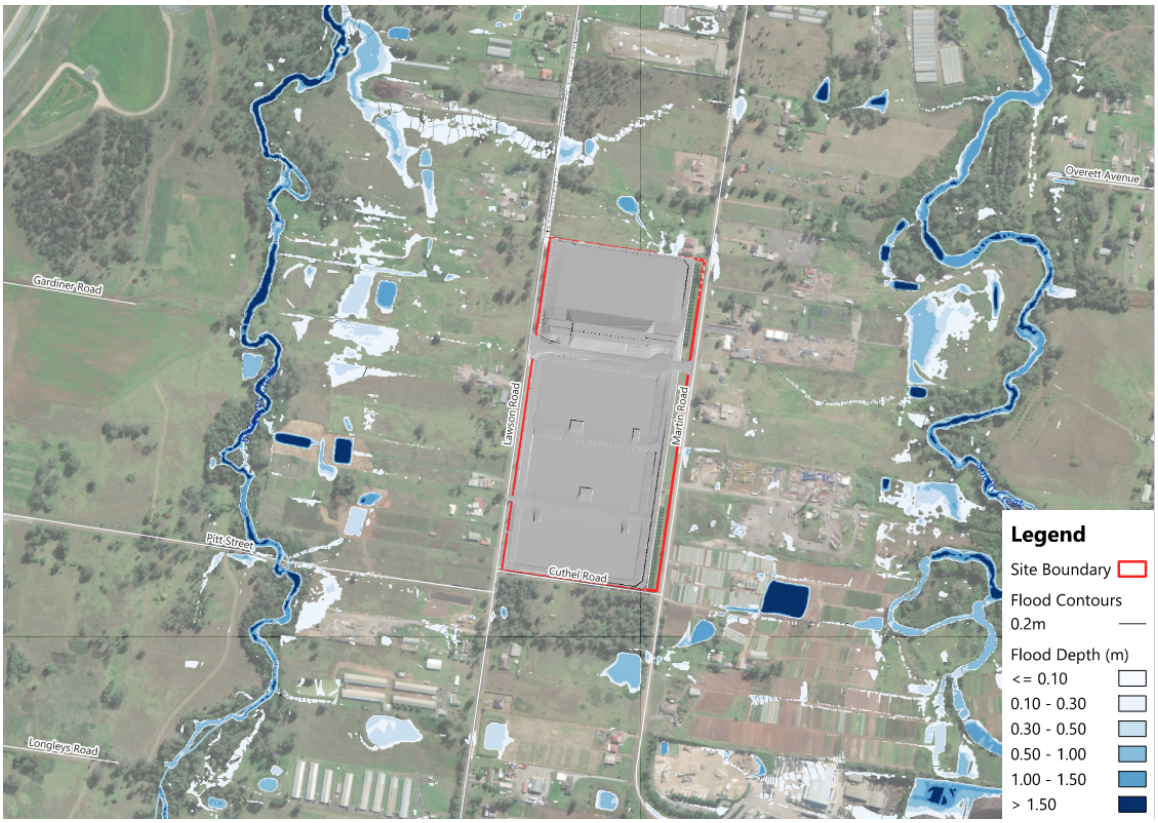
- Results of the flood comparison showed generally no increase in flood levels around the site. The grey areas shown above indicate no water level changes greater than 20mm.
- Flood levels from the Martin Road sag point are reduced by 150mm directly adjacent to the site. This reduction continues to Wianamatta South Creek. This indicates that the flows to the Wianamatta South Creek catchment are reduced from the proposed development.
- Similarly, flood levels in Badgerys Creek are either showing no change or a reduction in flood levels. This indicates that the flows to Badgerys Creek catchment are reduced from the proposed development.
- A 40mm increase in flood depth is observed at the neighbouring property to the north of the site. This is due to water ponding towards our site.
    - The proposed development will need to enter into a neighbouring work agreement to allow for minor grading along the boundary to resolve the minor afflux water in this location.
- A 50-100mm increase in flood depth is observed at the proposed site discharge point at the northwest of the site in Lawson Road. Discharge flows meet the site's pre-development flow rate and are contained within the road verge. While flows are concentrated due to the site discharge the increase in water is localised to the Lawson Road verge and dissipates by the time the flows reach the culvert under Lawson Road which key overland flow route towards Badgerys Creek. This is considered acceptable for the interim works.

12.4 Flood Function Practical Consideration of Climate Change

An allowance for Climate change has been included in line with the recommendations of Section D.22 of the Western Sydney Aerotropolis Development Control Plan 2022 – Appendix 2 and the SEARs requirements for this site. The DCP recommends that the site-specific Flood Risk Assessment (FIRA) as a minimum should address the impacts of climate change on design flood modelling comparing the 0.2% AEP as a proxy for assessing sensitivity to an increase in rainfall intensity due to climate change. The impacts of climate change have been assessed in the overland flow flood model.

This event has been run as a sensitivity on the final development outcome. Figure 38 below shows the depths and extent of the 0.2% AEP storm event and the impact on the proposed site design landform.

Figure 38 - 0.2% AEP Flood extent for Climate Change Consideration



As can be seen from the above mapping, the climate change scenario closely resembles the 1% AEP flood extents and does not affect the proposed development. It is noted there is approximately 20-50mm difference in peak flood level between the 1% AEP and the 0.2% AEP (climate change sensitivity check) results across the flood model. It is acknowledged that the finished floor levels of the proposed development all meet the required freeboard from the climate change sensitivity analysis (i.e., 0.2% AEP + 500m freeboard). Additional maps have been provided in the appendices of this report to demonstrate this.

12.4.1 Pre-to-Post Development Comparison and Flood Affectation Analysis (Afflux)

A direct comparison of the existing and post developed 0.2% AEP scenario flood depths was undertaken to assess flood affectation adjacent to the site. Increases in the water surface level were separated from decreases and are identified in Figure 39 below.

Figure 39 - Afflux Results for Climate Change Increase (0.2% AEP Storm)

12.4.2 Summary of Results

- Results of the 0.2% AEP flood comparison were similar to the 1% AEP and showed generally no increase in the flood level across the site and its surrounds.
- Increases in flood depth were still observed at the proposed site discharge and northern boundary of the site however these were in line with the 1% AEP storm event.
- The proposed development has shown no substantial increase in flood levels upstream or downstream of the site.

Further mapping for the 1% AEP, 0.2% AEP & PMF events are contained in Appendix A.

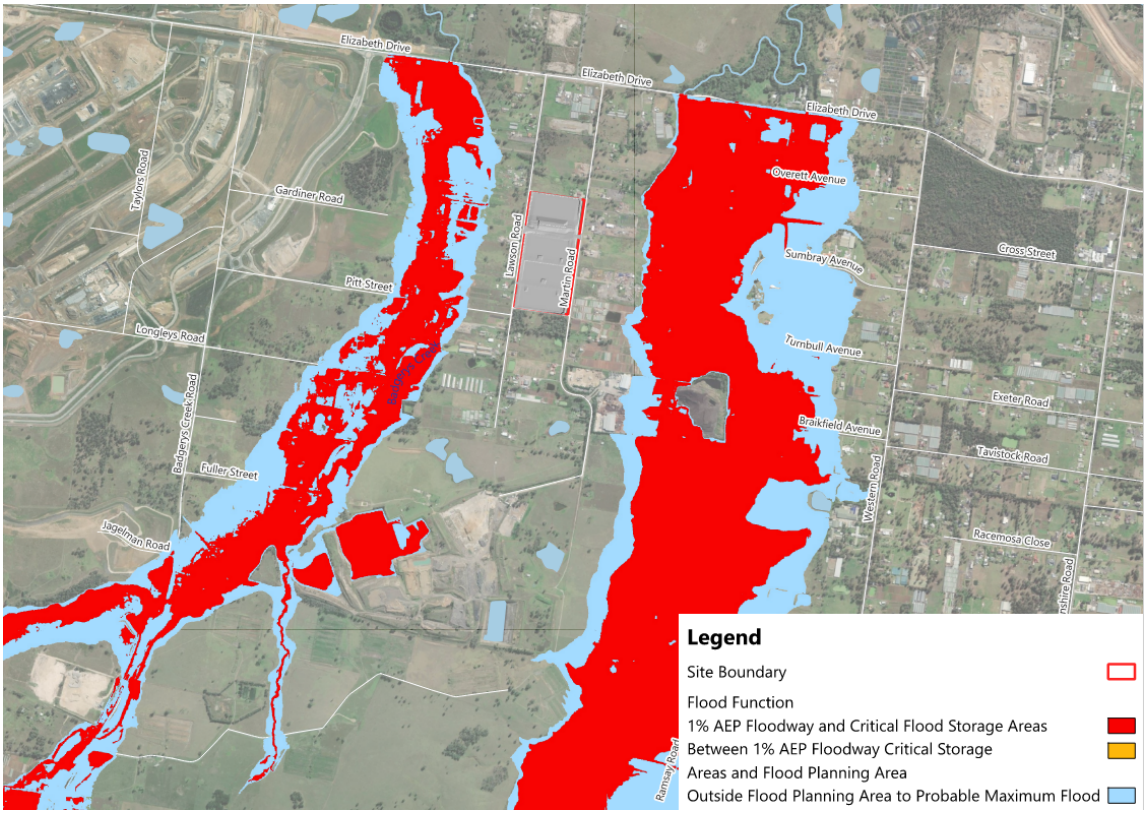
12.5 DCP Objectives and Performance Outcomes Summary

The performance outcomes identified in the Aerotropolis and Wianamatta-South Creek suite of flooding and environmental resilience management requirements identify 3 distinct zones relevant to flood controls for urban land uses. These include the;

- 1% AEP Floodway and Critical flood Storage Areas (red)
- Between 1% AEP Floodway / Critical Flood Storage and Flood Planning Area (orange)
- Outside Flood Planning Area to Probable Maximum Flood (blue)

These zones have been mapped utilising the flood results of the mainstream flood assessment to identify where performance outcome requirements are relevant to the masterplan design. See Figure 40 below which identifies the relevant flood categories related to DCP benchmarks.

Figure 40 – Post-Development Flood Function



12.5.1 Commentary

The proposed site is located outside of the red mapped areas in accordance with the benchmark requirements. The results of the FIRA have assessed flooding in these red mapped areas and confirms that there is in impact on flood behaviour due to our development site.

The footprint of flood impact outside of the flood planning area to the Probable Maximum flood extent, shown mapped in blue, also demonstrates the proposed site has no impact on the flood behaviour on the neighbouring properties. The FIRA also has subsequently demonstrated that the proposed works will not affect the storage capacity or flood behaviour for the full range of events.

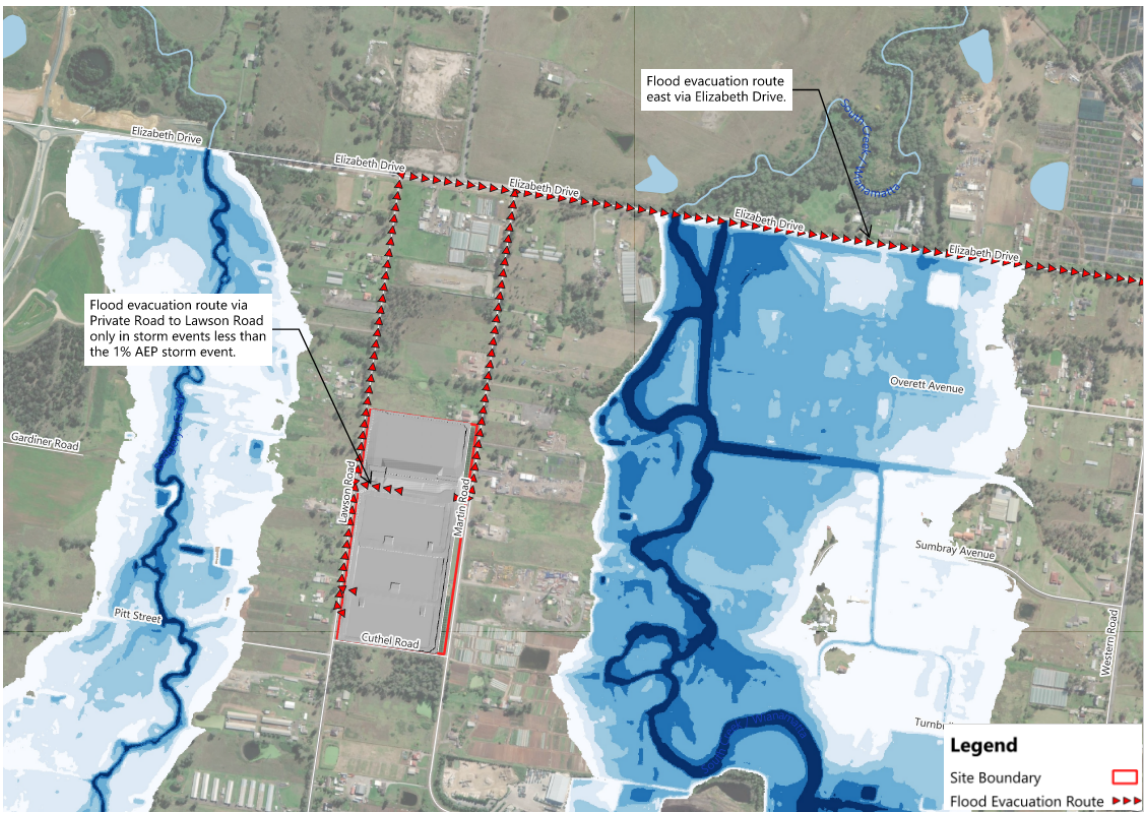
12.6 Flood Evacuation Route

In the event of a storm requiring flood evacuation, flood egress from the proposed site from:

- The internal Private Road either via the permanent access to Lawson Road or the temporary driveway to Martin Road,
- The Warehouse 1 and 2 loading dock exit driveway to Lawson Road, or
- The Warehouse 1 access driveway to Lawson Road.

The evacuation route from site via both Lawson Road and Martin Road will travel north to Elizabeth Drive before turning east to higher ground. It should be noted that in the event of a storm event greater than the 1% AEP storm, stormwater will overtop the stormwater management basin discharge control weir and direct stormwater onto the internal private and towards the permanent driveway to Lawson Road. As such, this route will not be suitable for flood evacuation and one of the other routes should be used.

Figure 41 – Flood Evacuation Route – PMF Flood Levels



It is noted that the flood evacuation route via Elizabeth Drive travels over South Creek and is prone to flooding. An assessment of flood inundation of Elizabeth Drive has been completed to understand at what storm durations Elizabeth Drive will flood and the time it takes for the road to flood, blocking egress from the proposed site.

In the 1% AEP storm event, the Elizabeth Drive low point (RL42.90) will flood in the 24hr and 36hr storm events at a maximum depth of 350mm. The 24 hour storm will flood Elizabeth Drive 14 hours into the storm which represents the shortest time for Elizabeth Drive to flood in the 1% AEP storm event. This will mean that the proposed site has 14 hours to evacuate the site prior to South Creek flooding Elizabeth Drive.

Similarly, in the PMF storm event, the Elizabeth Drive low point will flood in the 1.5hr, 2hr, 3hr and 6hr storm events at a maximum depth of 1.2m. The 1.5 hour storm will flood Elizabeth Drive in 2 hours into the storm which represents the shortest time for Elizabeth Drive to flood in the PMF storm event. This will mean that the proposed site has 2 hours to evacuate the site prior to South Creek flooding Elizabeth Drive. See Figure 42 and Figure 43 below for the water level over time graphs over Elizabeth Drive for 1% AEP and PMF storm events respectively.

Figure 42 – Water Level over Elizabeth Drive – 1% AEP Storm Event

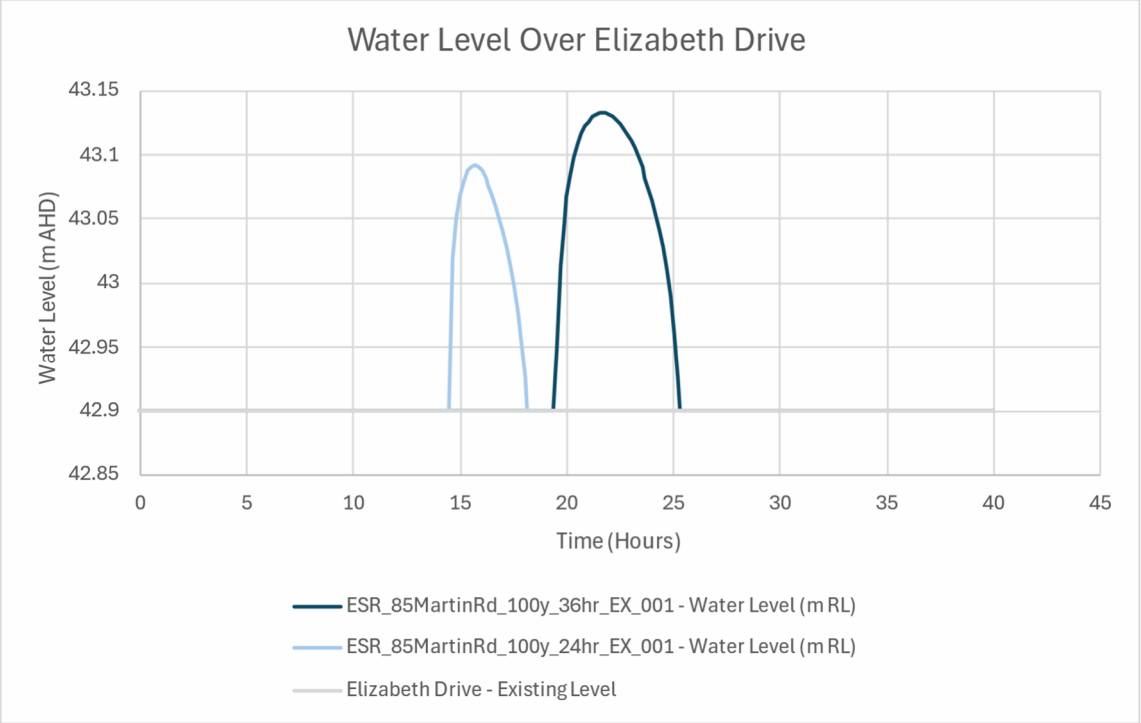
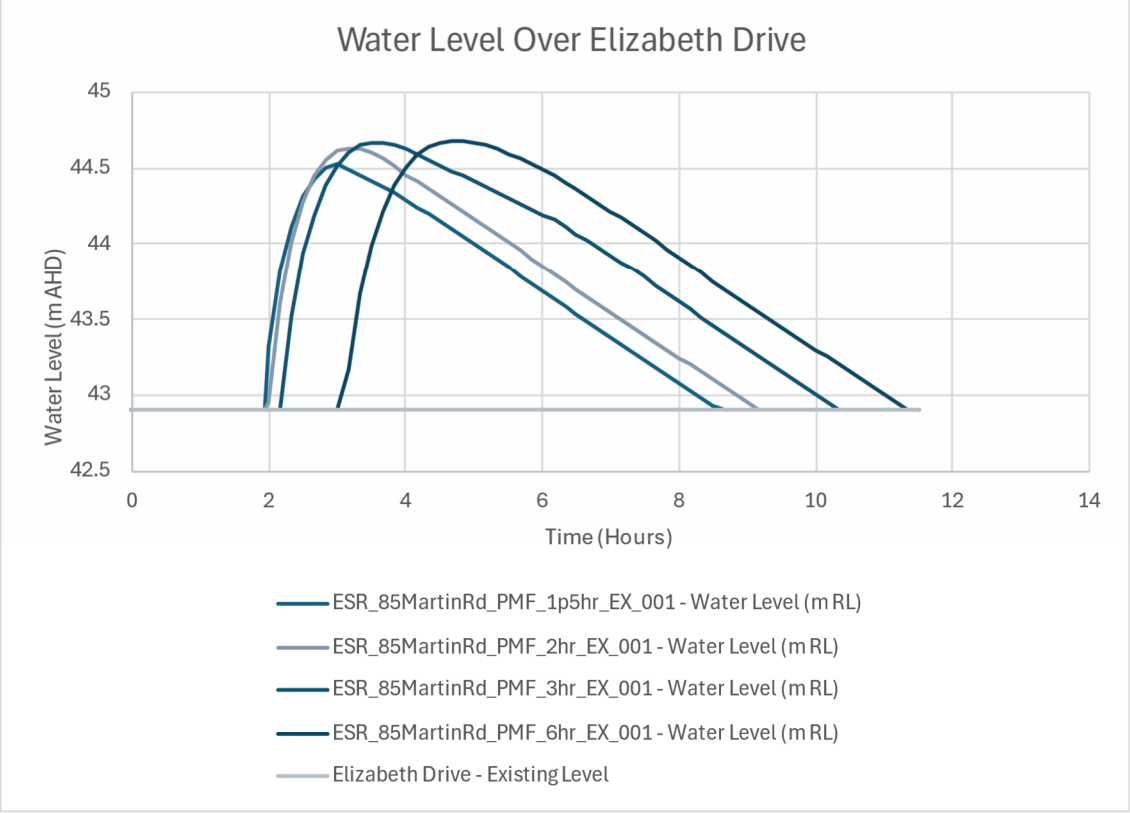


Figure 43 – Water Level over Elizabeth Drive – PMF Storm Event



To ensure a safe flood evacuation from site, all staff on site are to be inducted and trained in the flood evacuation routes and procedures including the timing of inundation of Elizabeth Drive. Each company on site is to have a staff member who has access to the Bureau of Meteorology and SES flood information and warnings and is responsible for relaying the relevant information to all people on site. This will include instructions on when to evacuate, to ensure safe evacuation prior to Elizabeth Road becoming flooded.

12.7 Summary and Recommendations

The following key results and recommendations were determined for the site based on a pre-development to post-development comparison of flood levels.

- All works are above the PMF flood levels in the Wianamatta South Creek and Badgerys creek catchments and therefore no further analysis was required for the mainstream flooding
- The site's interim integrated water cycle management plan has made sufficient allocations for the required water management infrastructure to not impact both neighbouring properties and the downstream creek systems.
- The proposed development is above both the 1% AEP + 0.5m freeboard and the 0.2% AEP flood levels.
- There are negligible adverse impacts to downstream flood levels due to the proposed development.
- The proposed development will need to enter into a neighbouring work agreement with the northern neighbour to allow for minor grading along the boundary to resolve the minor afflux water in this location.

Appendices

A. Flood Maps 86

B. Maintenance Schedule 87

A. Flood Maps

Title:
Mainstream Existing 1% AEP Flood Depth

Figure:
M-100E-1

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Project Name **Badgerys Creek Industrial Park**

Client **ESR Australia**

0 200 400 600 800 1,000 m

Project ID **24-109**

Date **29/11/24**

Revision **A**

Prepared by **JK**

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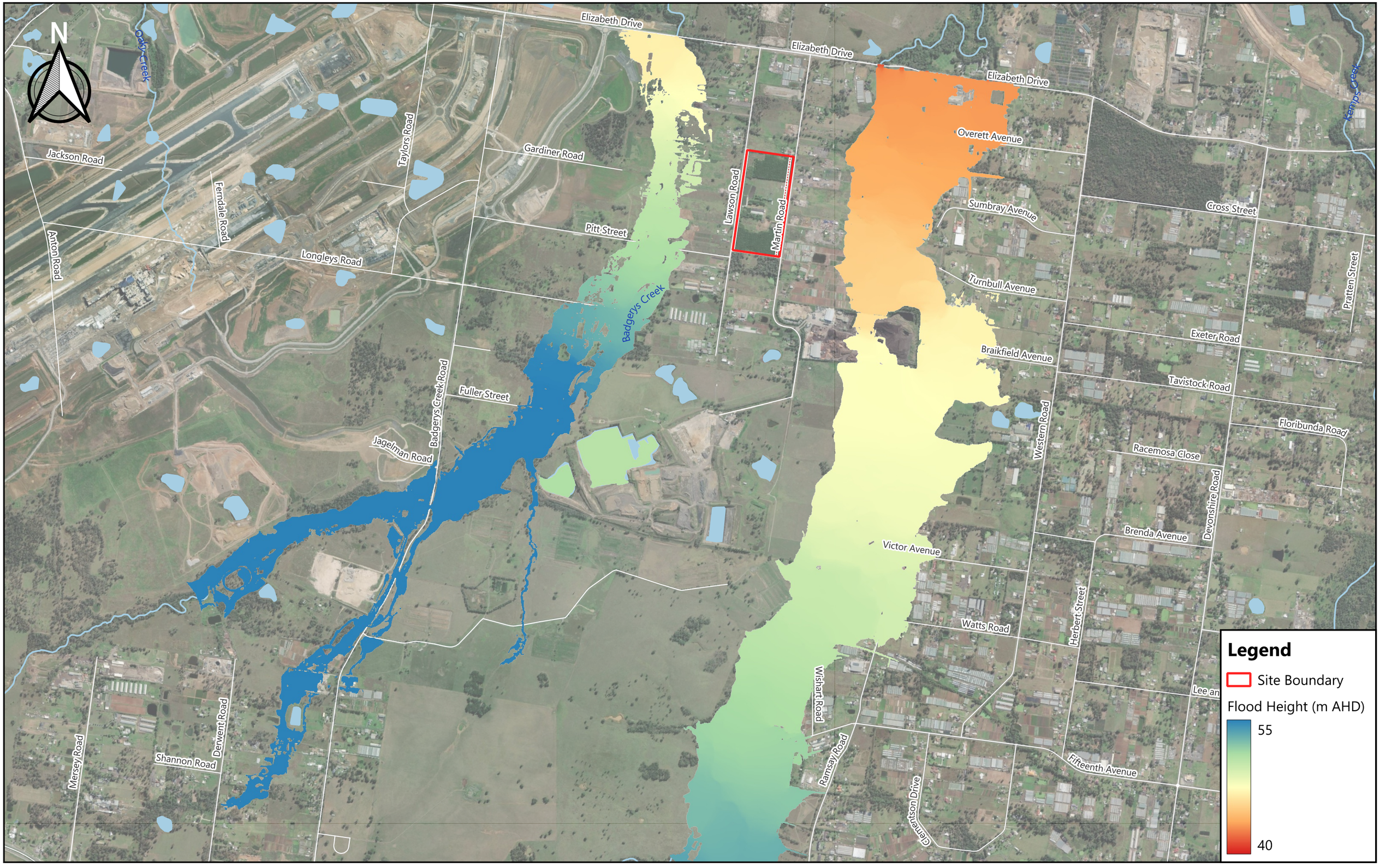
infrastructure & development consulting



Title:
Mainstream Existing 1% AEP Flood Height

Figure:
M-100E-2

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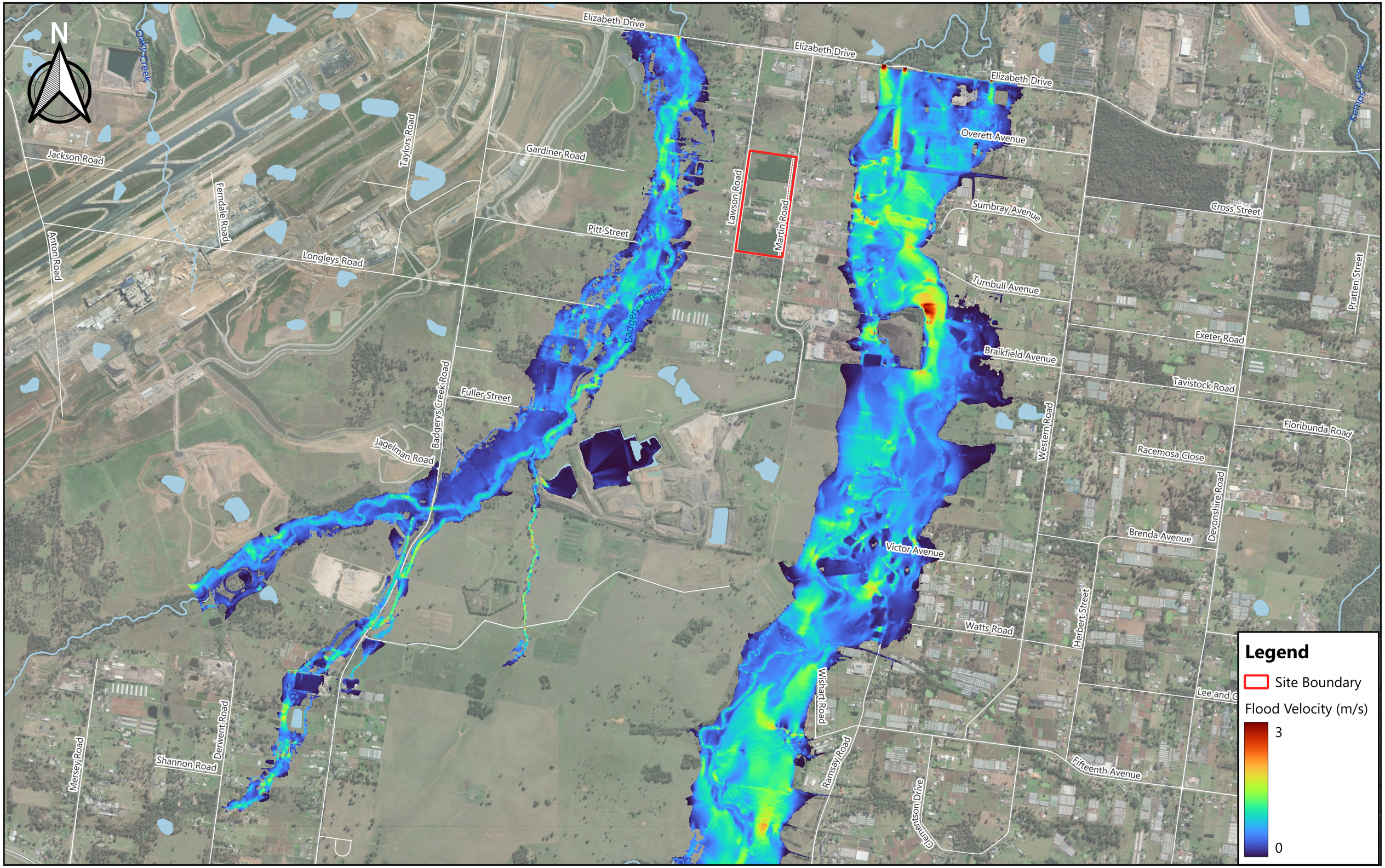

Title:
Mainstream Existing 1% AEP Flood Velocity

Figure:
M-100E-3

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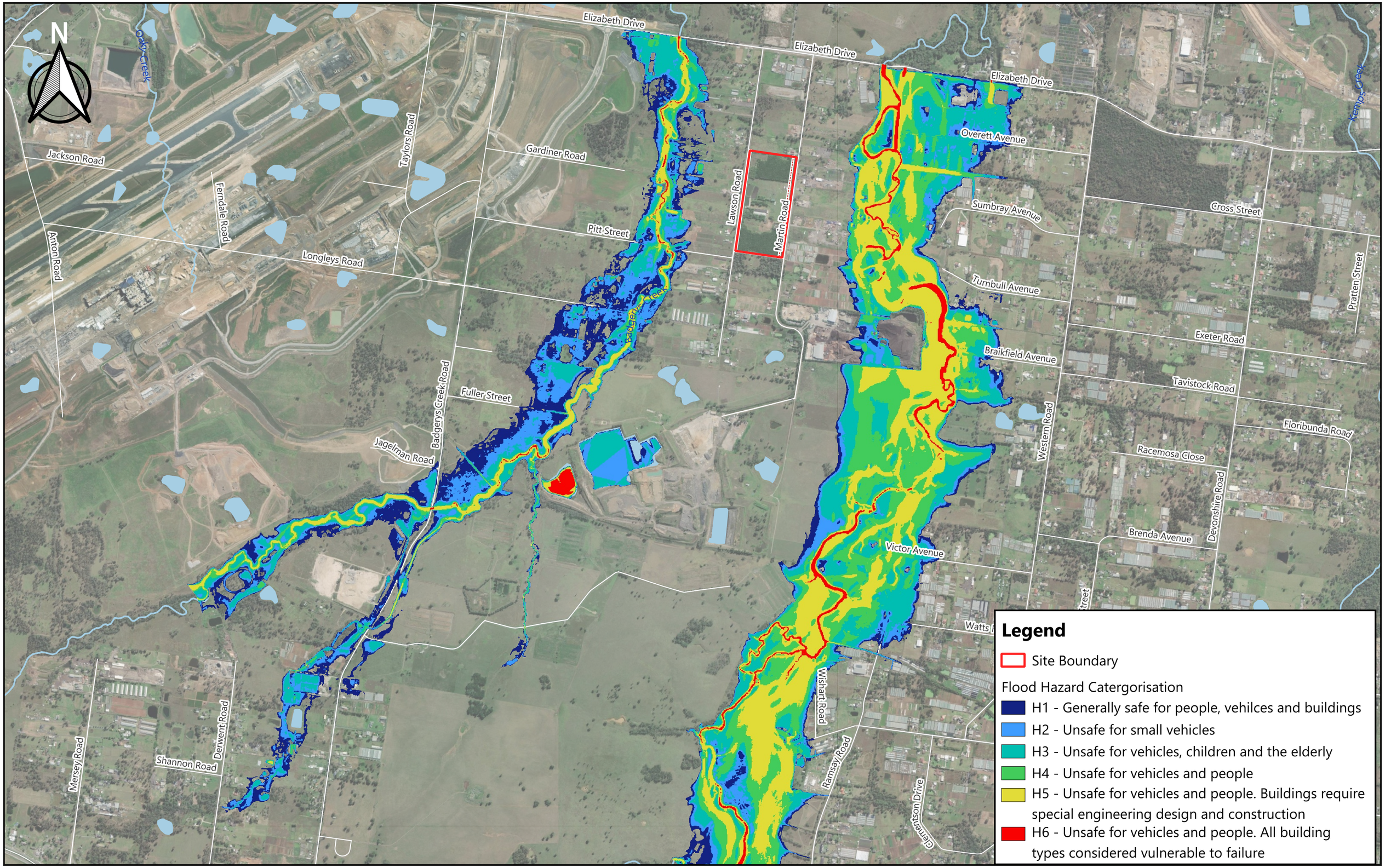

Title:
Mainstream Existing 1% AEP Flood Hazard

Figure:
M-100E-4

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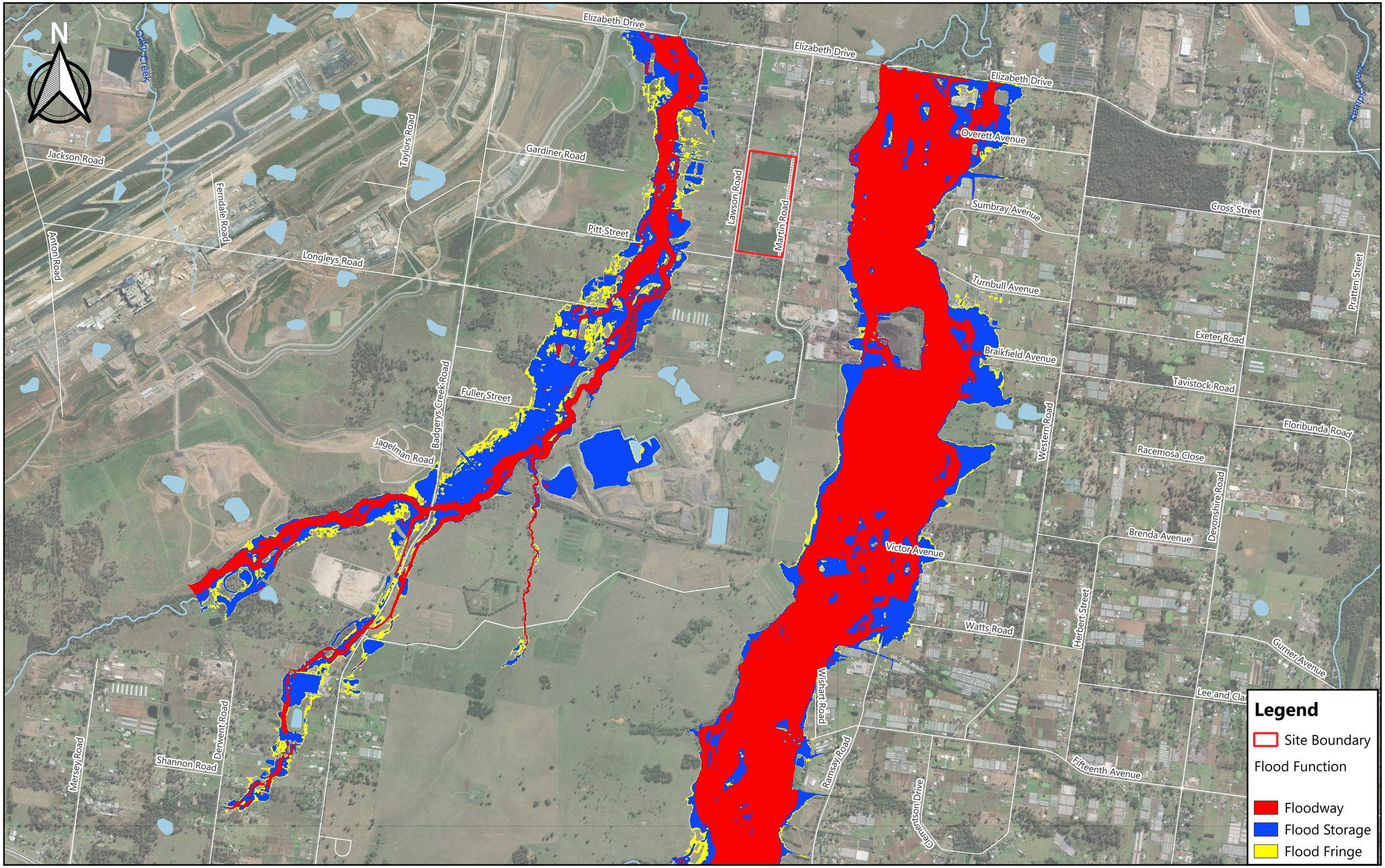

Title:

Mainstream Existing 1% AEP Flood Function

Figure:

M-100E-5

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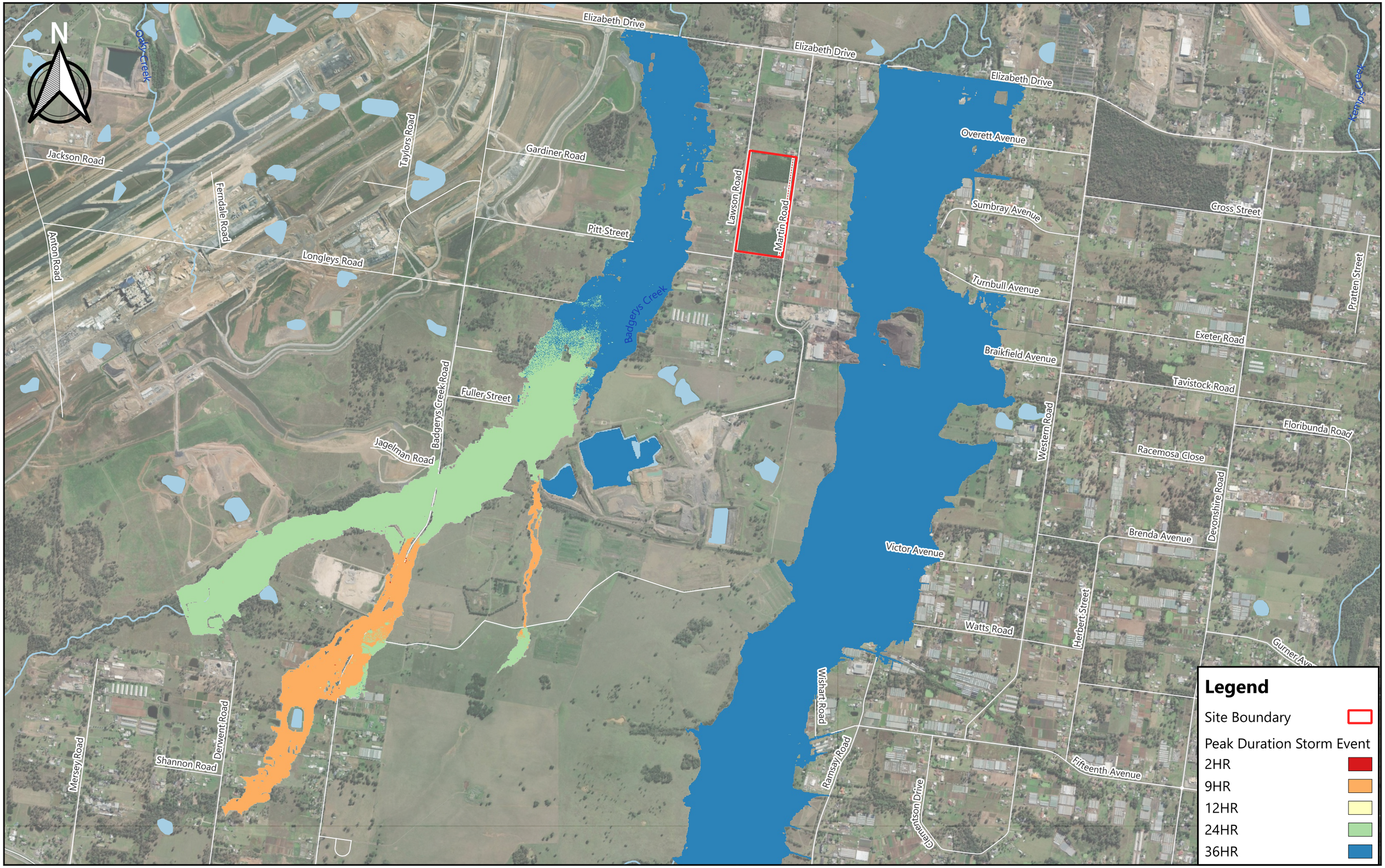

Title:
Mainstream 1% AEP Flood Duration

Figure:
M-100E-6

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Date **29/11/24**

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Title:

Mainstream Existing 0.2% AEP Flood Depth

Figure:

M-500E-1

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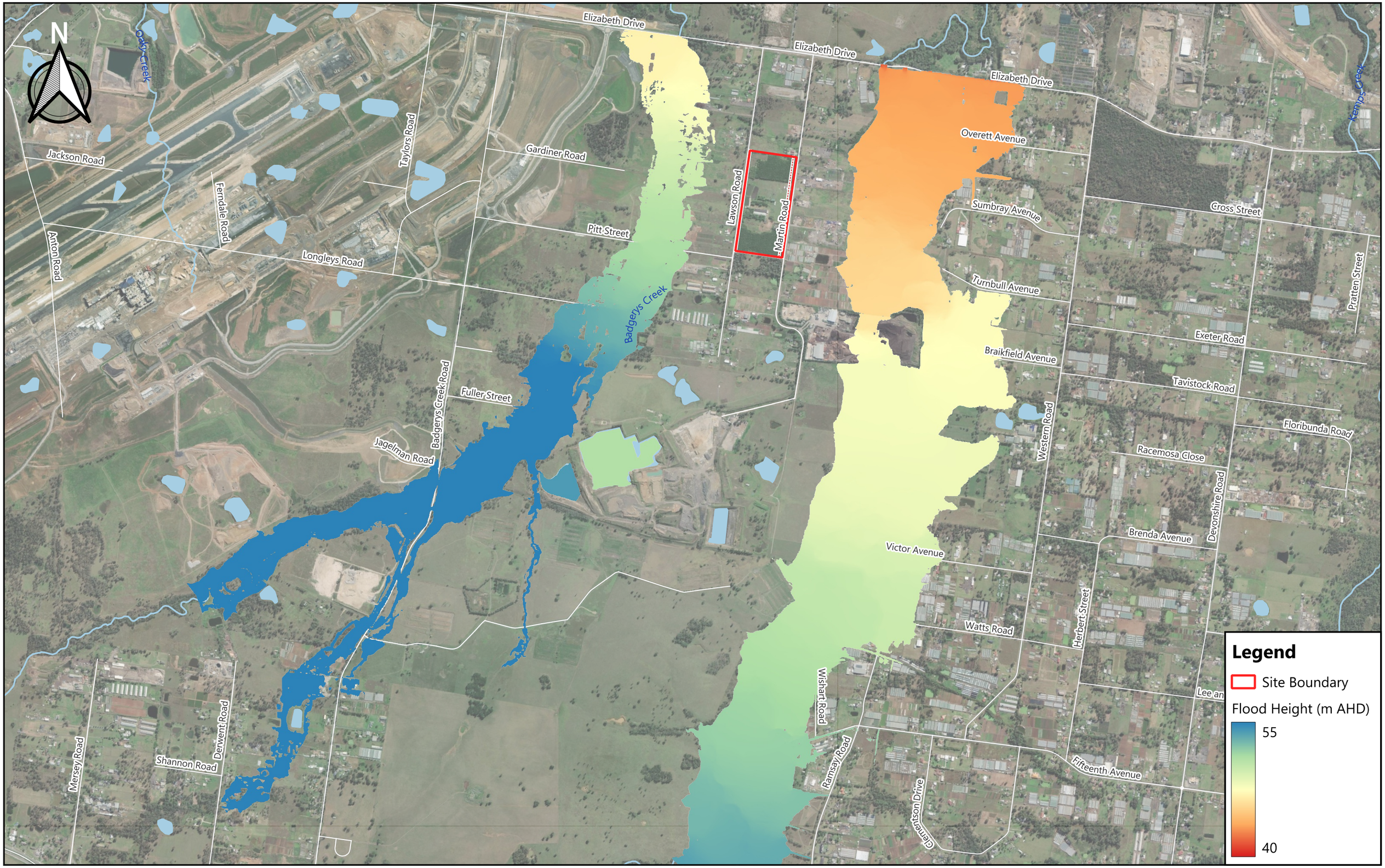

Title:

Mainstream Existing 0.2% AEP Flood Height

Figure:

M-500E-2

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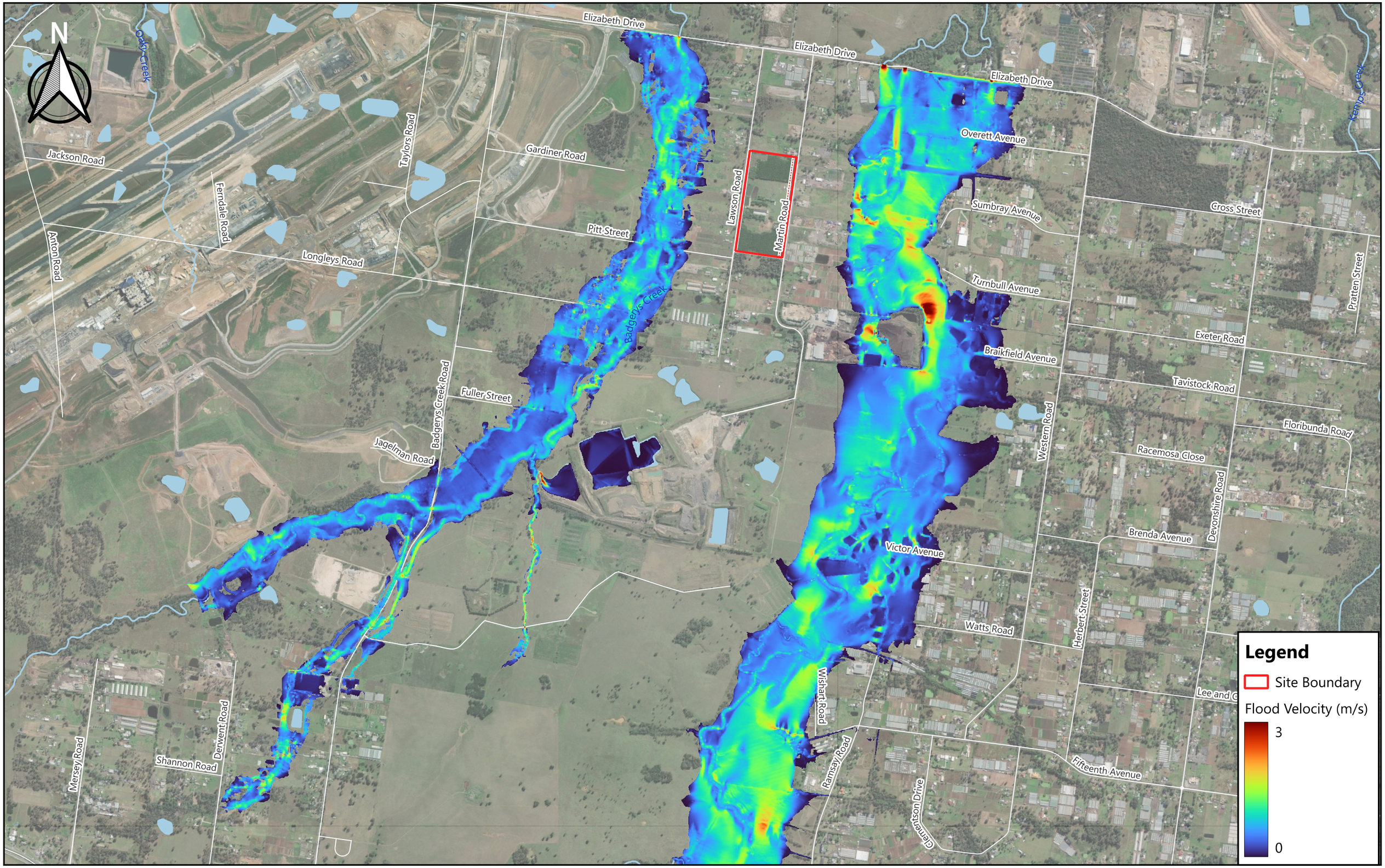

Title:
Mainstream Existing 0.2% AEP Flood Velocity

Figure:
M-500E-3

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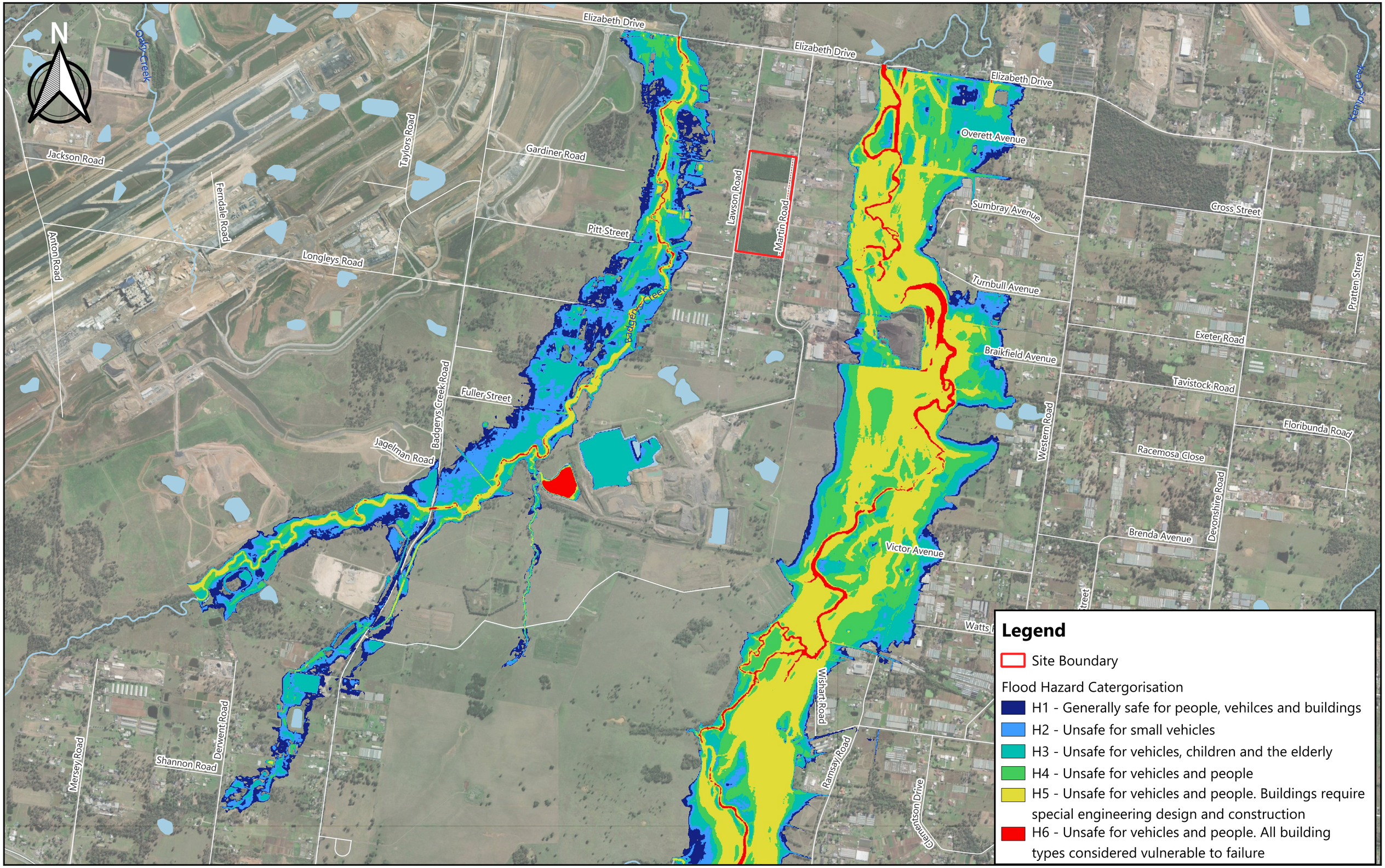

Title:
Mainstream Existing 0.2% AEP Flood Hazard

Figure:
M-500E-4

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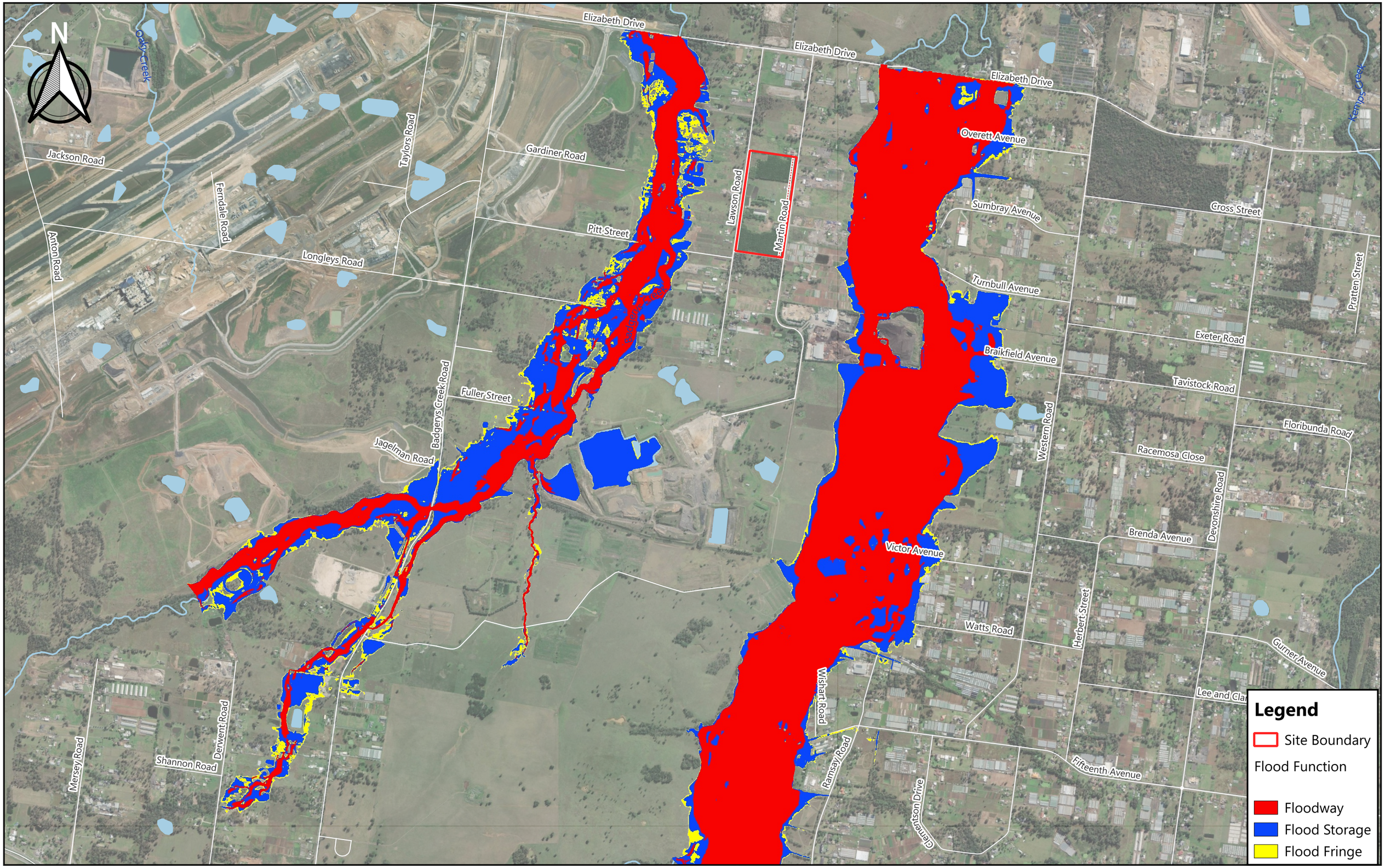

Title:

Mainstream Existing 0.2% AEP Flood Function

Figure:

M-500E-5

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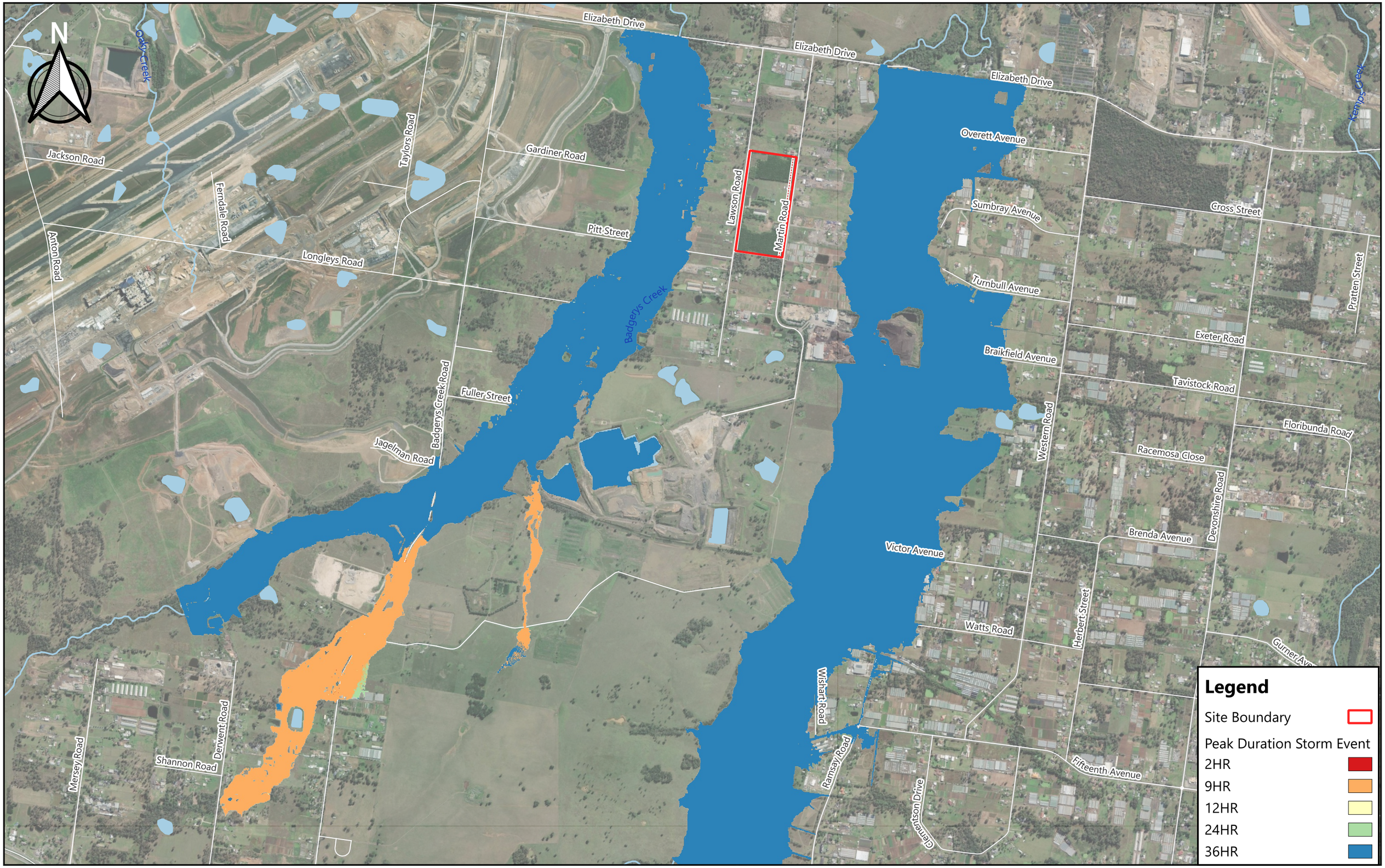

Title:
Mainstream 0.2% AEP Flood Duration

Figure:
M-500E-6

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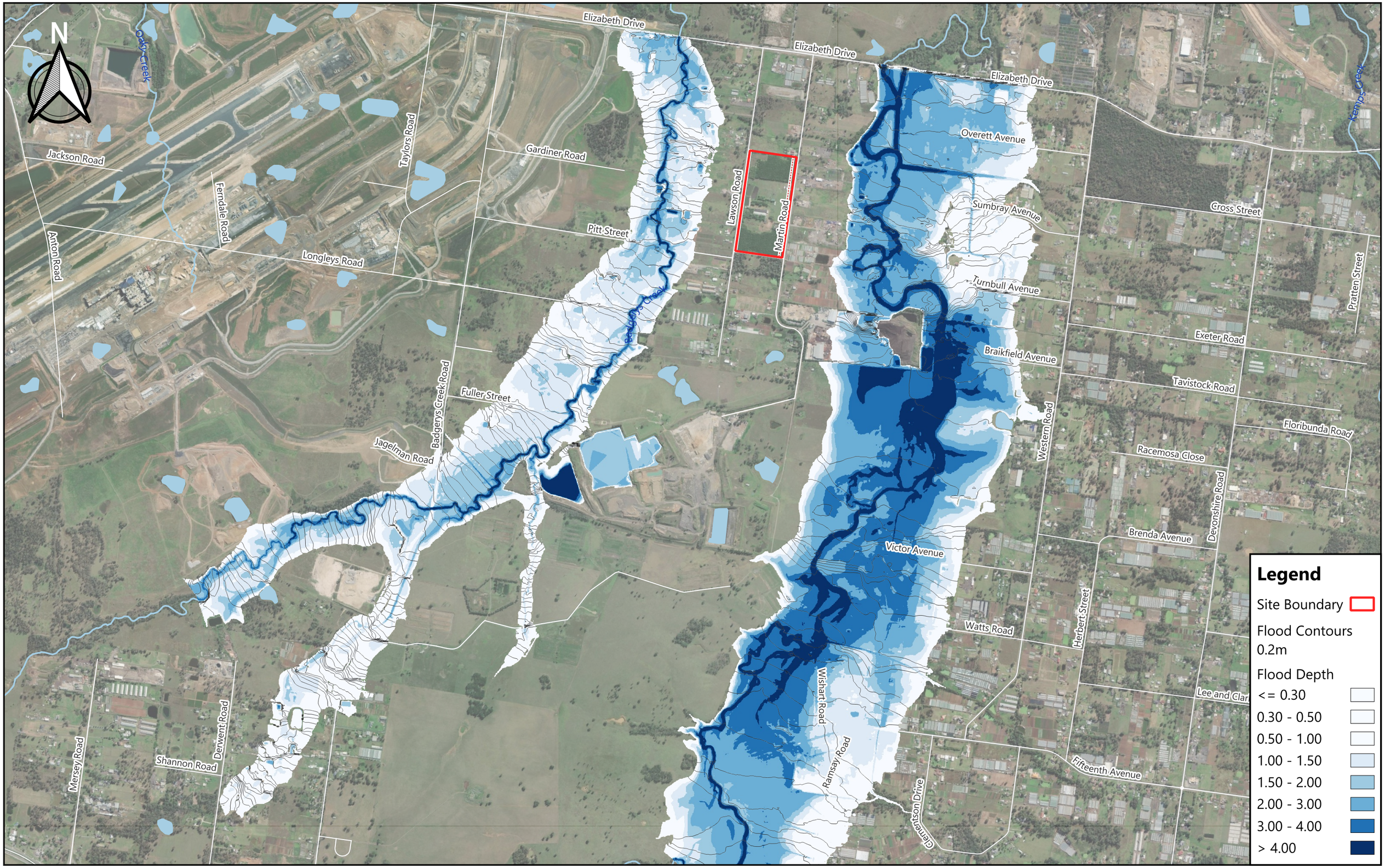

Title:
Mainstream Existing PMF Flood Depth

Figure:
M-PMF-E-1

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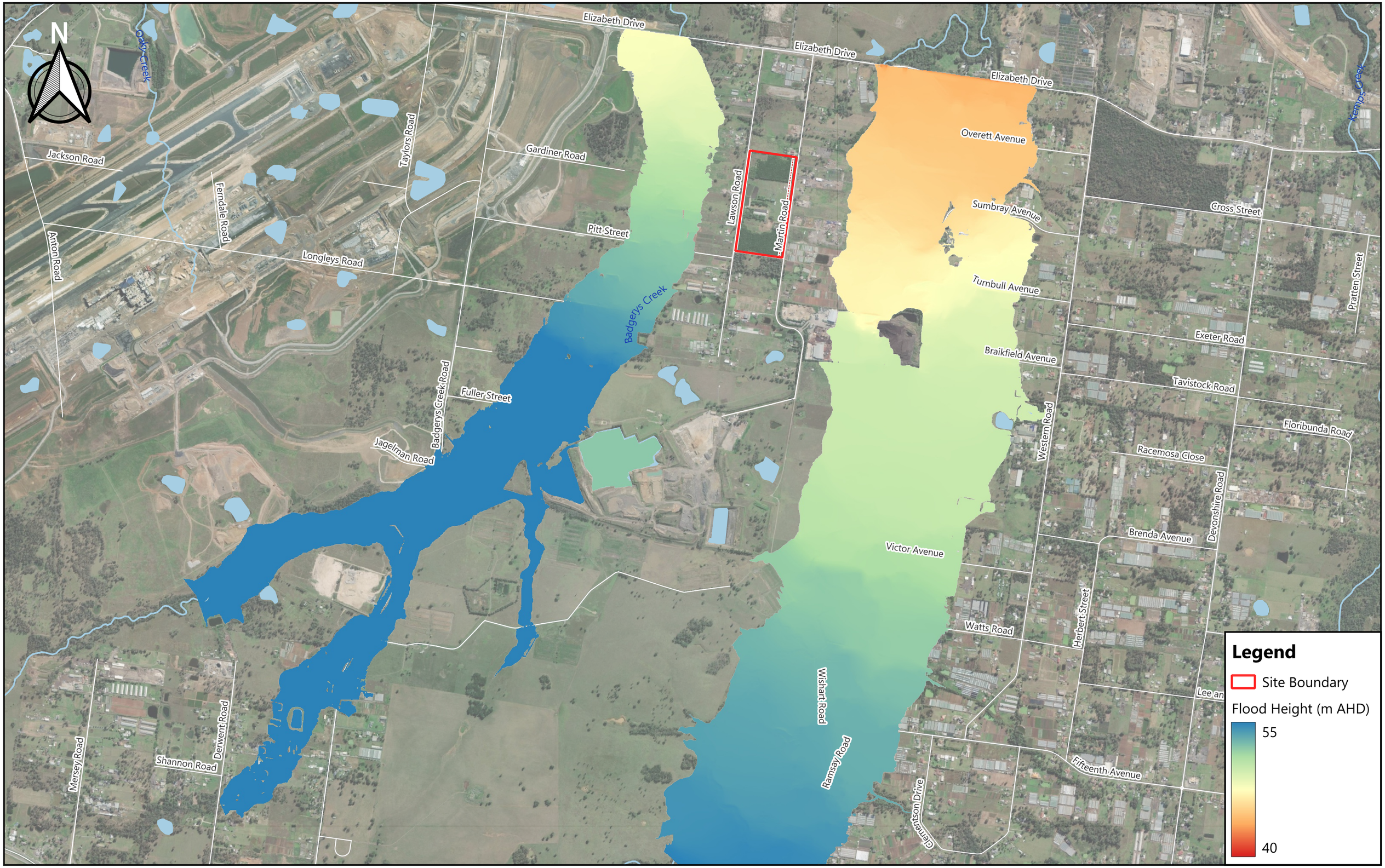

Title:
Mainstream Existing PMF Flood Height

Figure:
M-PMF-E-2

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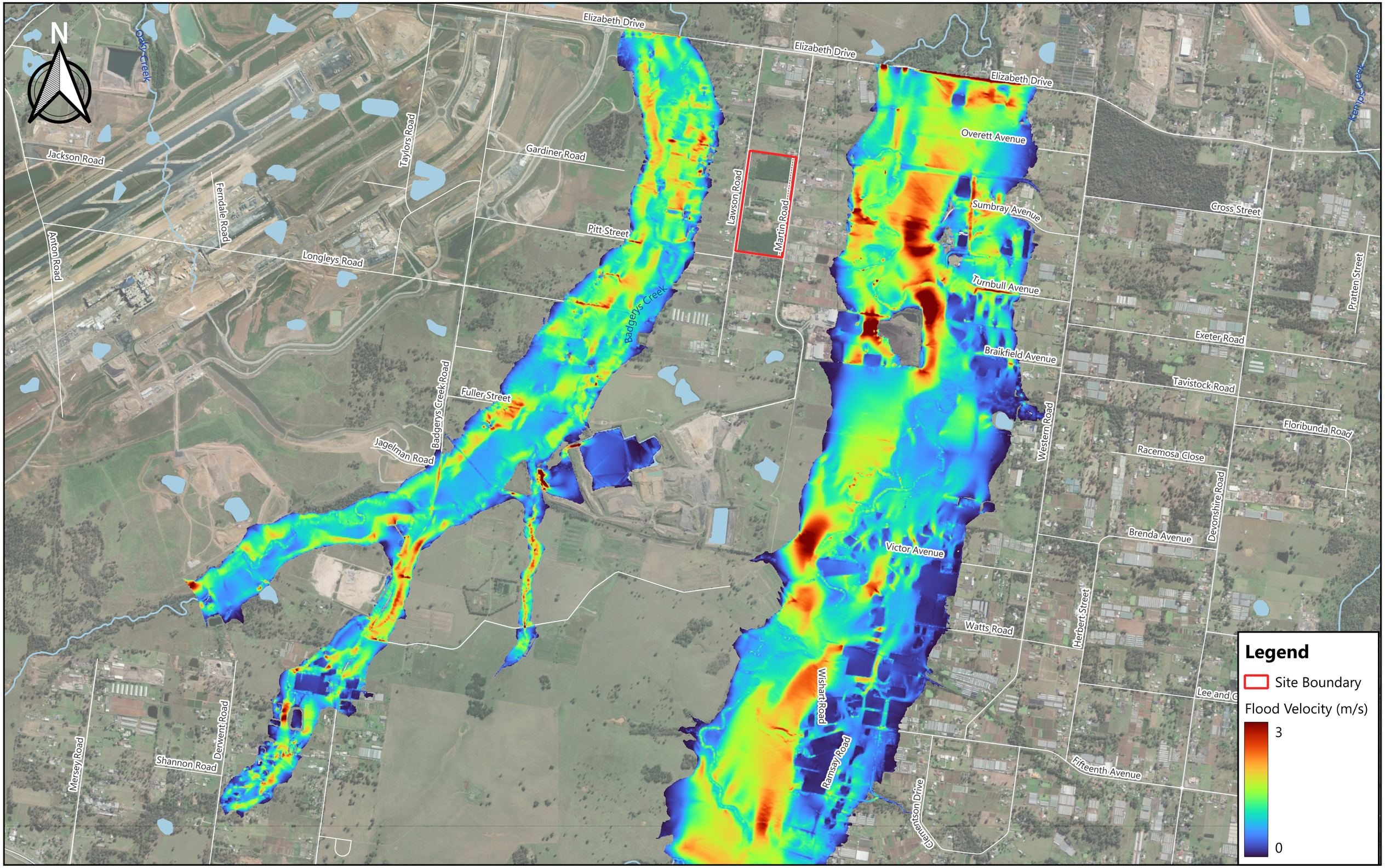

Title:
Mainstream Existing PMF Flood Velocity

Figure:
M-PMF-E-3

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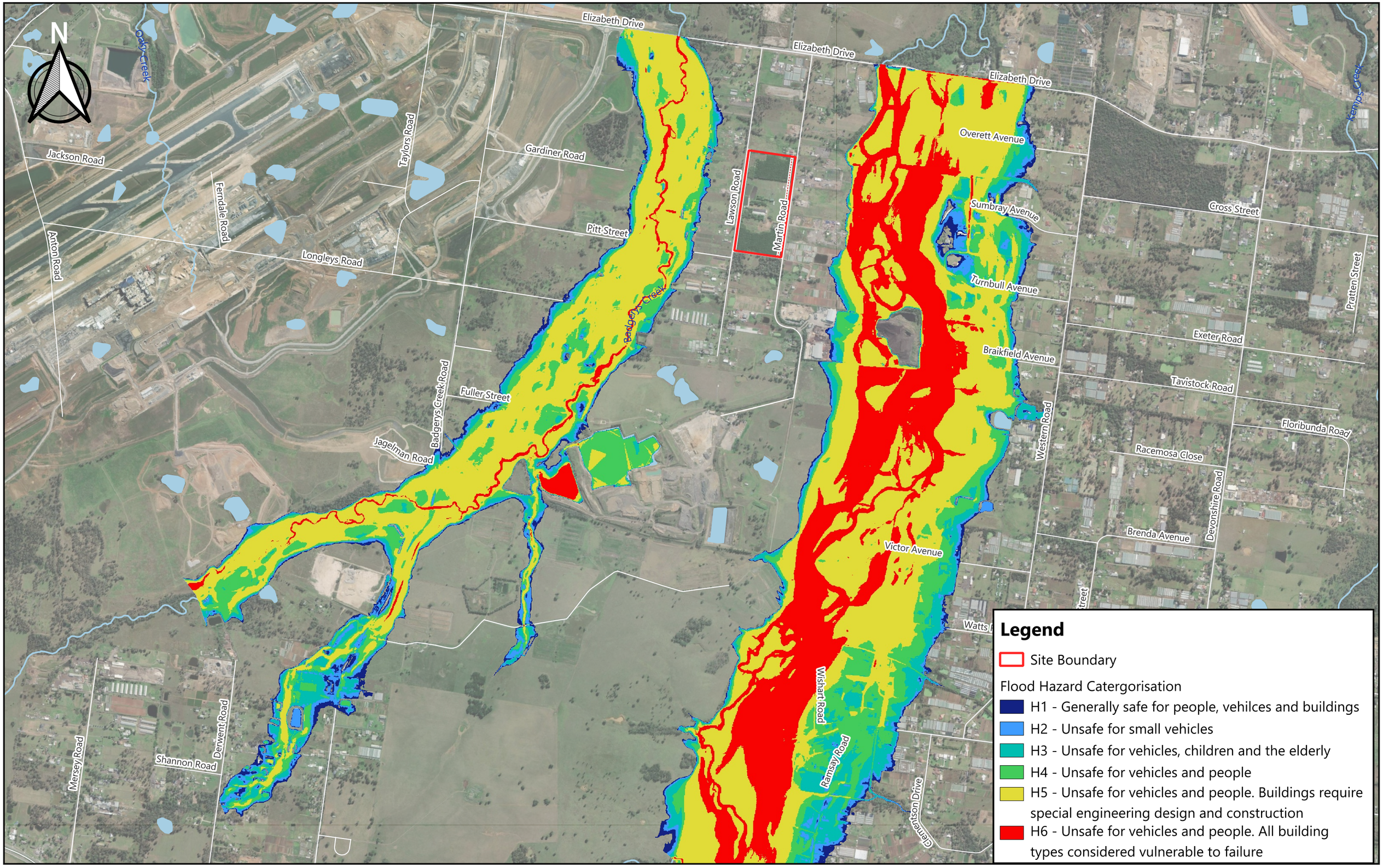

Title:
Mainstream Existing PMF Flood Hazard

Figure:
M-PMF-E-4

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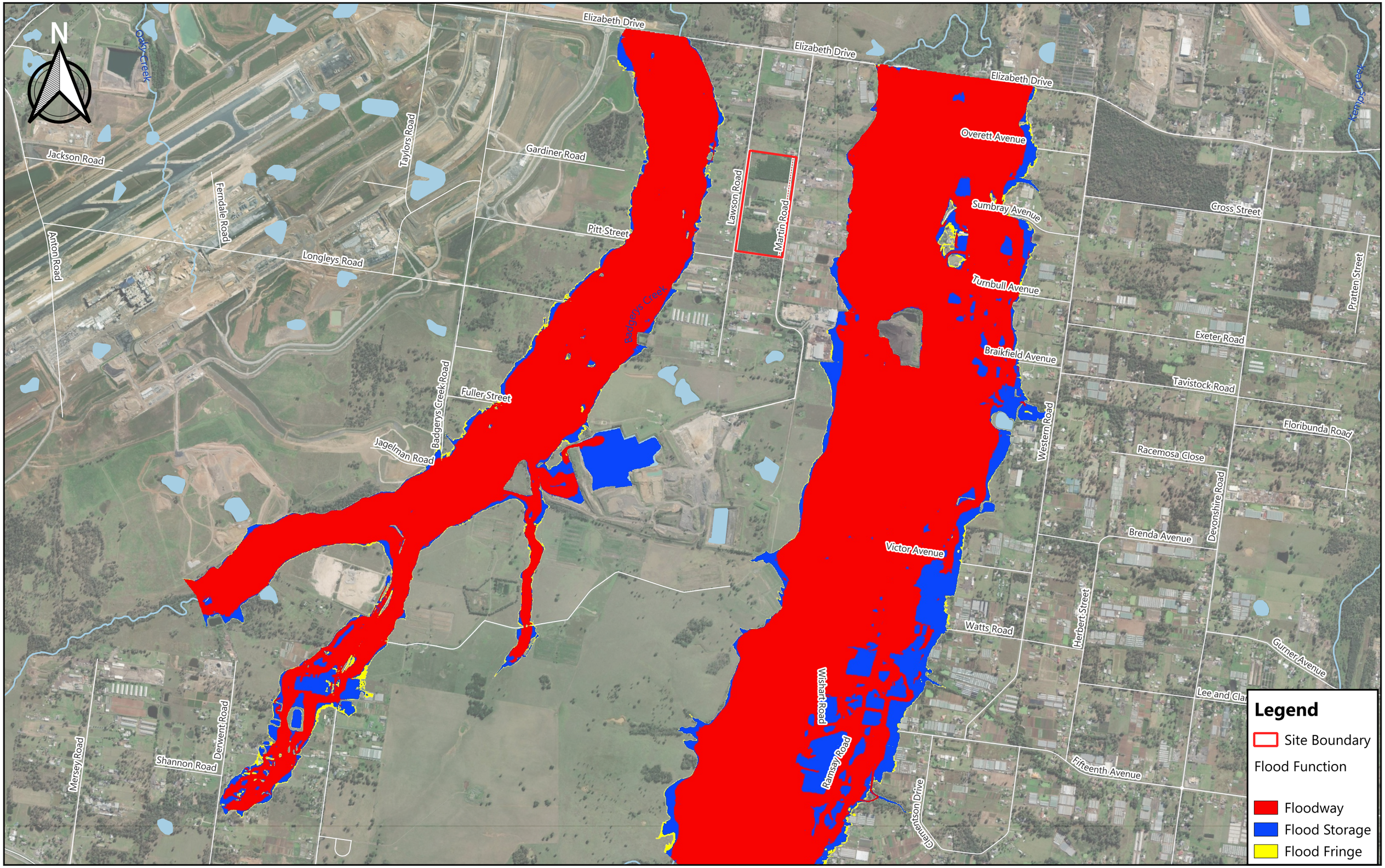

Title:
Mainstream Existing PMF Flood Function

Figure:
M-PMF-E-5

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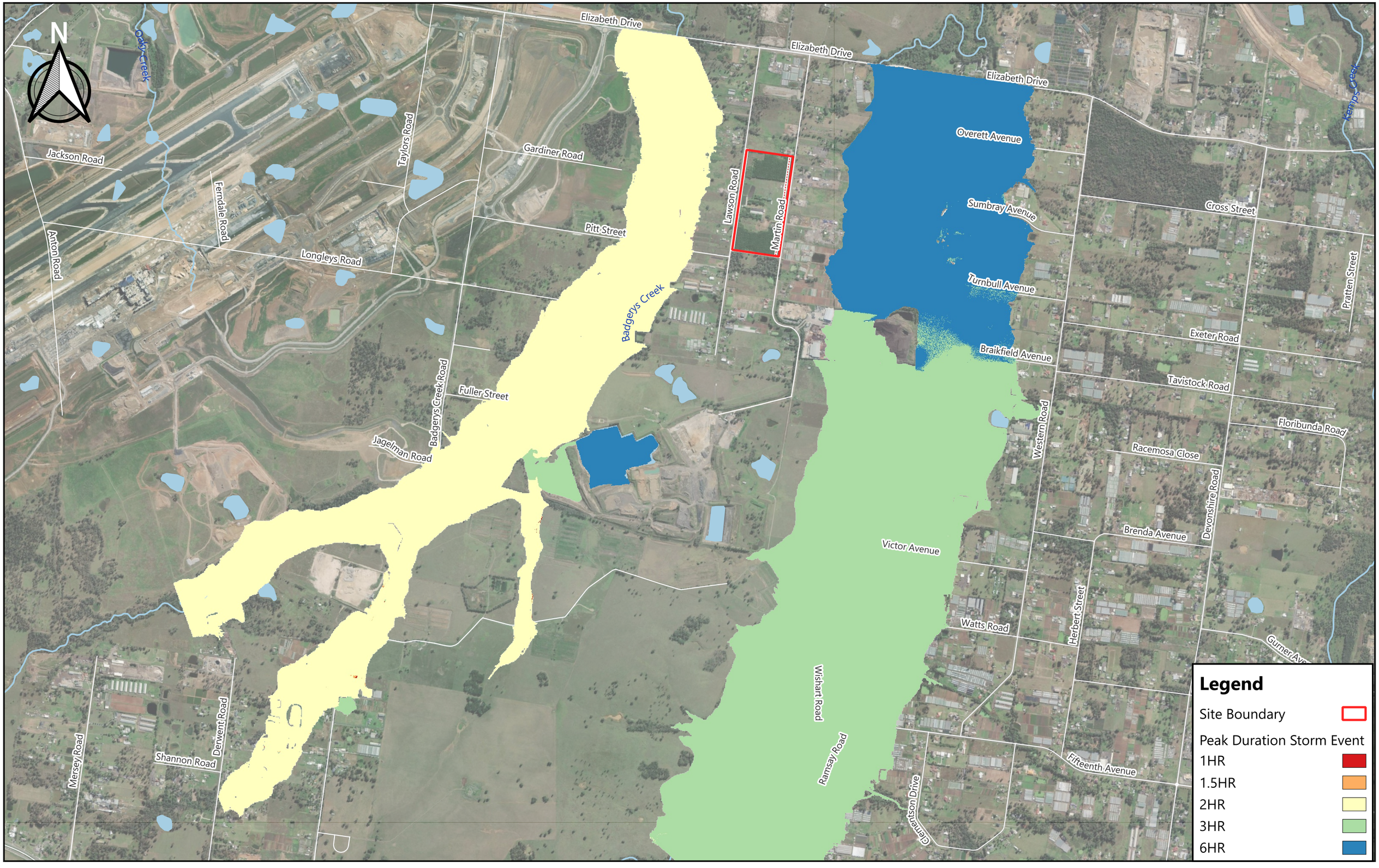

Title:

Mainstream PMF Flood Duration

Figure:

M-PMF-E-6

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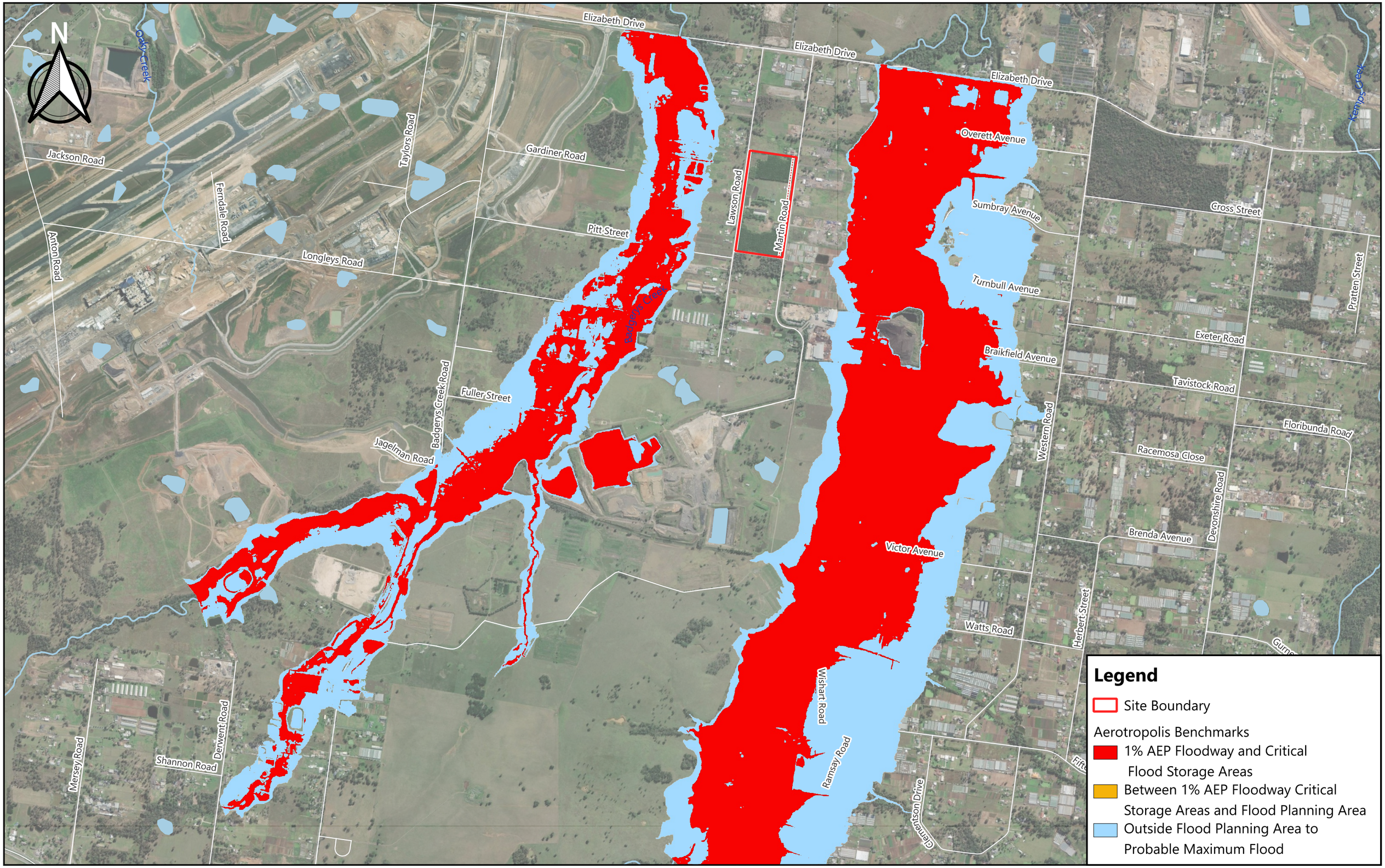

Title:
Aerotropolis Phase 2 DCP Benchmarks

Figure:
M-DCP-1

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0 200 400 600 800 1,000 m

Project ID **24-109**

Date **29/11/24**

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Title:
Overland Flow Existing 1% AEP Flood Depth

Figure:
O-100E-1

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Project Name **Badgerys Creek Industrial Park**

Client **ESR Australia**

0 50 100 150 200 250 m

Project ID **24-109**

Date **29/11/24**

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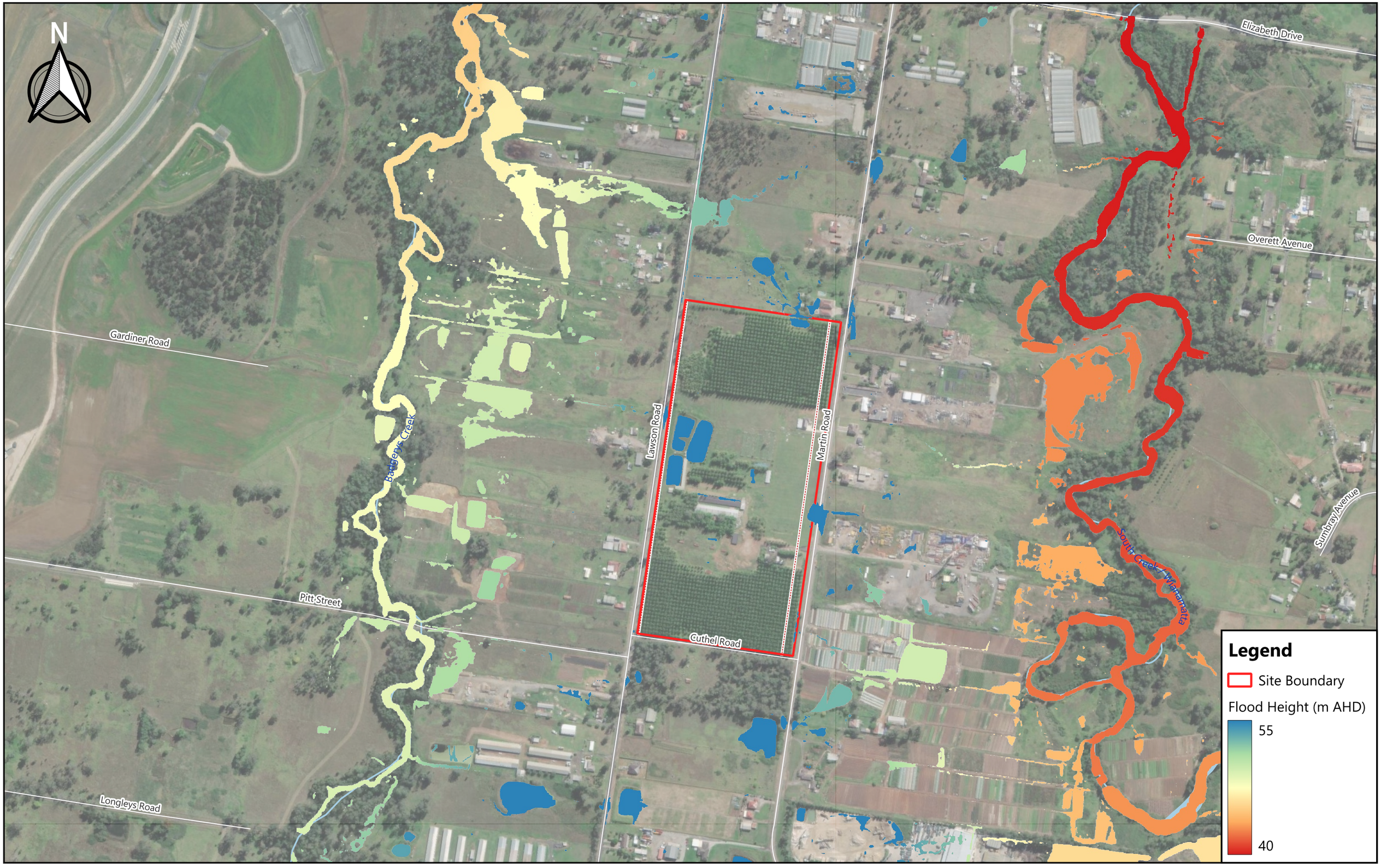

Title:

Overland Flow Existing 1% AEP Flood Height

Figure:

O-100E-2

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Project Name **Badgerys Creek Industrial Park**

Client **ESR Australia**

0 50 100 150 200 250 m

Project ID **24-109**

Date **29/11/24**

Revision **A**

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Title:
Overland Flow Existing 1% AEP Flood Velocity

Figure:
O-100E-3

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Client **ESR Australia**

0 50 100 150 200 250 m

Project ID **24-109**

Date **29/11/24**

Revision **A**

Prepared by **JK**

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N

Gardiner Road

Lawson Road

Martin Road

Elizabeth Drive

Overett Avenue

Sumbray Avenue

Pitt Street

Cuthel Road

Longleys Road

Legend

- Site Boundary

Flood Hazard Catergorisation

- H1 - Generally safe for people, vehilces and buildings
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles, children and the elderly
- H4 - Unsafe for vehicles and people
- H5 - Unsafe for vehicles and people. Buildings require special engineering design and construction
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure

Title:

Overland Flow Existing 1% AEP Flood Hazard

Figure:

O-100E-4

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Client **ESR Australia**

0 50 100 150 200 250 m

Project ID **24-109**

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N

Gardiner Road

Lawson Road

Martin Road

Elizabeth Drive

Overett Avenue

Sumbray Avenue

Pitt Street

Cuthel Road

Longleys Road

Legend

- Site Boundary

Flood Function

- Floodway
- Flood Storage
- Flood Fringe

Title:

Overland Flow Existing 1% AEP Flood Function

Figure:

O-100E-5

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Client **ESR Australia**

0 50 100 150 200 250 m

Project ID **24-109**

Date **29/11/24**

Revision **A**

Prepared by **JK**

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Title:
Overland Flow Existing 0.2% AEP Flood Depth

Figure:
O-500E-1

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Client **ESR Australia**

0 50 100 150 200 250 m

Project ID **24-109**

Date **29/11/24**

Revision **A**

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N

Gardiner Road

Badgerys Creek

Lawson Road

Martin Road

Elizabeth Drive

Overett Avenue

Sumbray Avenue

South Creek / Wianamatta

Pitt Street

Cuthel Road

Longleys Road

Legend

Site Boundary

Flood Height (m AHD)

55

40

Title:

Overland Flow Existing 0.2% AEP Flood Height

Figure:

O-500E-2

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Client **ESR Australia**

0 50 100 150 200 250 m

Project ID **24-109**

Date **29/11/24**

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N

Gardiner Road

Lawson Road

Martin Road

Elizabeth Drive

Overett Avenue

Sumbray Avenue

Pitt Street

Cuthel Road

Longleys Road

Legend

Site Boundary

Flood Velocity (m/s)

3

0

Title:

Overland Flow Existing 0.2% AEP Flood Velocity

Figure:

O-500E-3

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Martin Road

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Overett Avenue

Sumbray Avenue

Pitt Street

Cuthel Road

Longleys Road

Legend

- Site Boundary

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- H1 - Generally safe for people, vehilces and buildings
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles, children and the elderly
- H4 - Unsafe for vehicles and people
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- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure

Title:

Overland Flow Existing 0.2% AEP Flood Hazard

Figure:

O-500E-4

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Project Name **Badgerys Creek Industrial Park**

Client **ESR Australia**

0 50 100 150 200 250 m

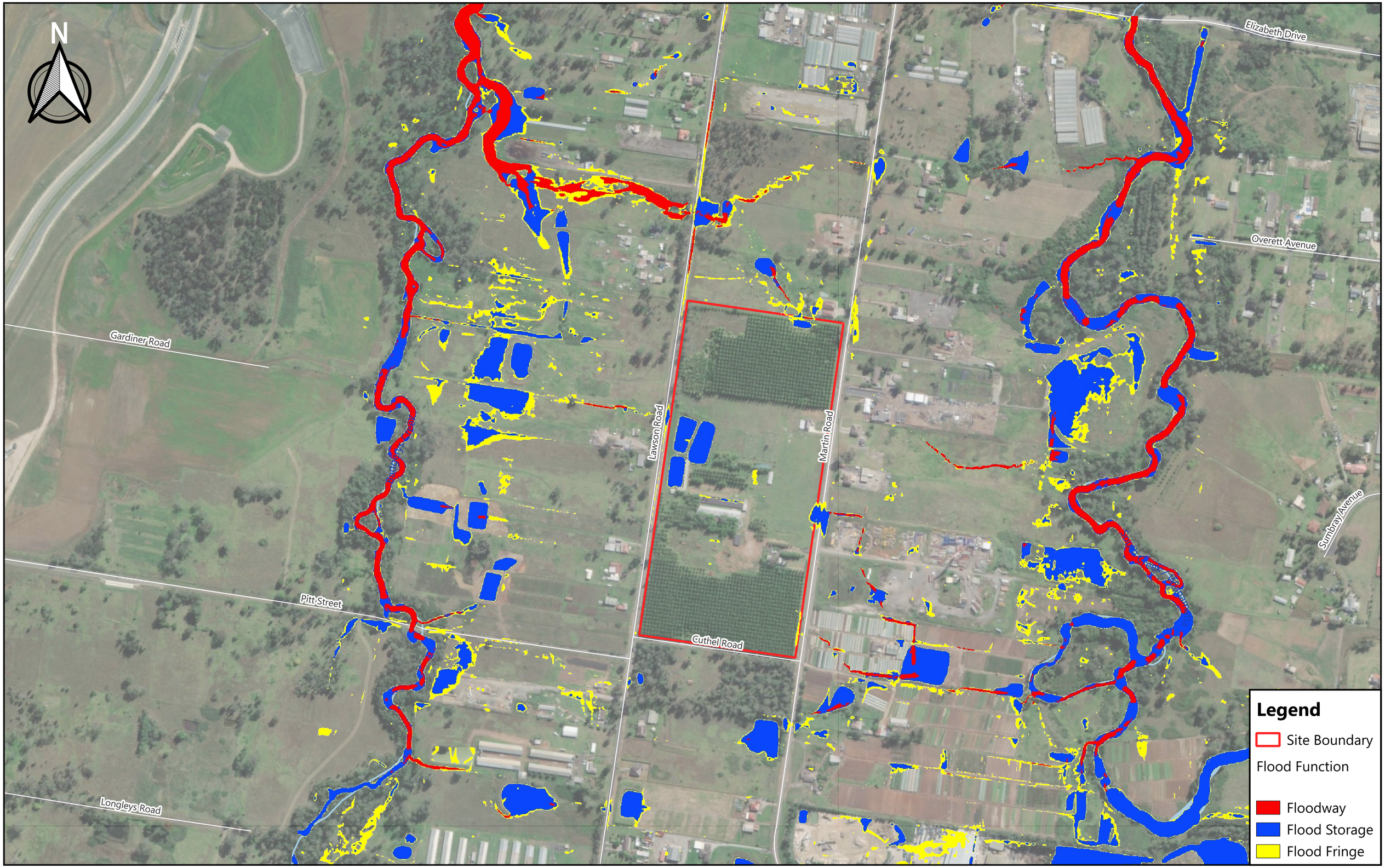
Project ID **24-109**

Date **29/11/24**

Revision **A**

Prepared by **JK**

idc infrastructure & development consulting



Title:
Overland Flow Existing 0.2% AEP Flood Function

Figure:
O-500E-5

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idc
infrastructure & development consulting

N

Gardiner Road

Lawson Road

Martin Road

Elizabeth Drive

Overett Avenue

Sumbray Avenue

Pitt Street

Cuthel Road

Longleys Road

South Creek / Wianamatta

Legend

Site Boundary

Flood Contours 0.2m

Flood Depth

<= 0.10	
0.10 - 0.30	
0.30 - 0.50	
0.50 - 1.00	
1.00 - 1.50	
> 1.50	

Title:

Overland Flow Proposed 1% AEP Flood Depth

Figure:

O-100P-1

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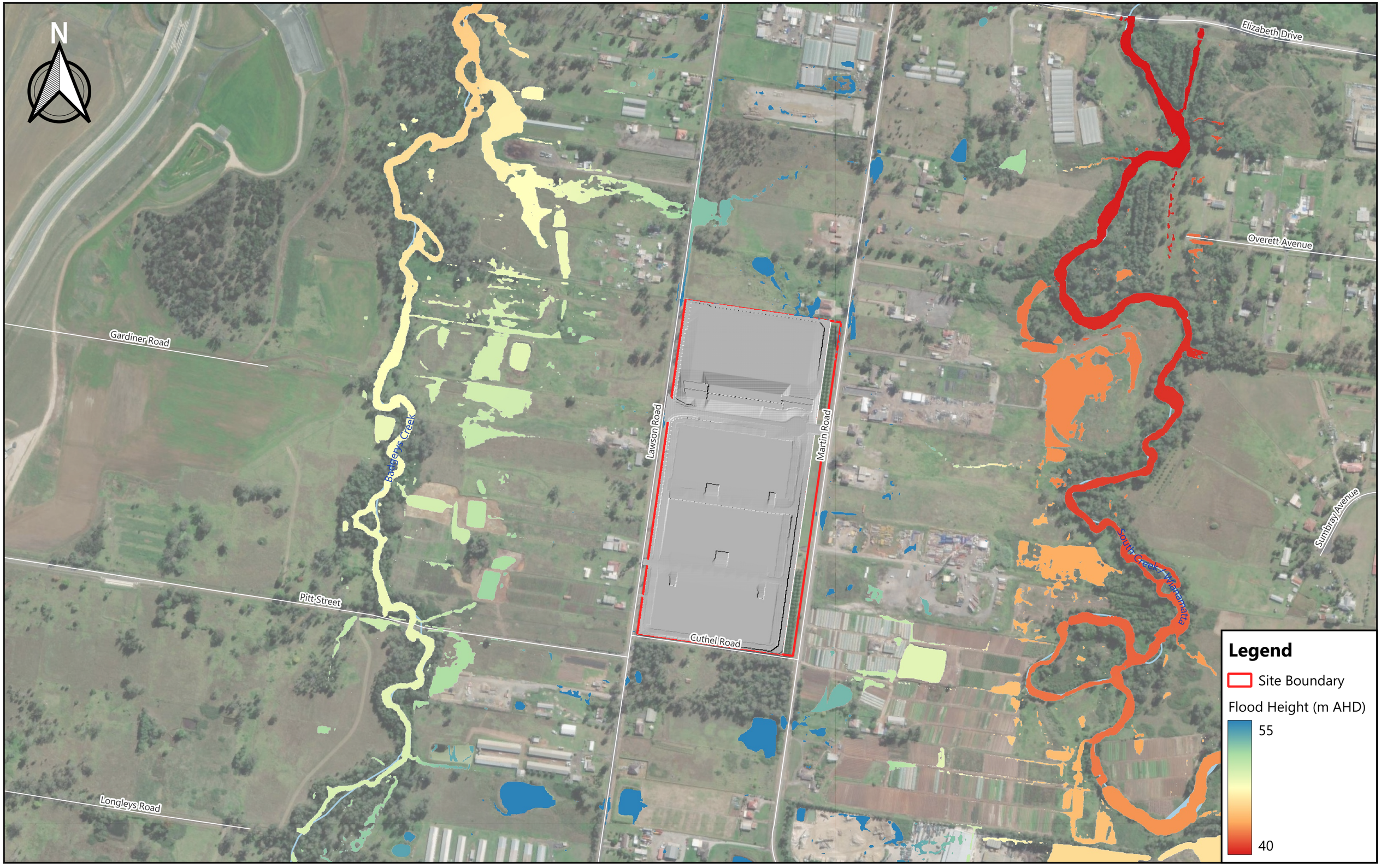

Title:

Overland Flow Proposed 1% AEP Flood Height

Figure:

O-100P-2

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Sumbray Avenue

Pitt Street

Cuthel Road

Longleys Road

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Site Boundary

Flood Velocity (m/s)

3

0

Title:

Overland Flow Proposed 1% AEP Flood Velocity

Figure:

O-100P-3

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Pitt Street

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Legend

- Site Boundary

Flood Hazard Catergorisation

- H1 - Generally safe for people, vehilces and buildings
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles, children and the elderly
- H4 - Unsafe for vehicles and people
- H5 - Unsafe for vehicles and people. Buildings require special engineering design and construction
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure

Title:

Overland Flow Proposed 1% AEP Flood Hazard

Figure:

O-100P-4

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Site Boundary

Flood Function

Floodway

Flood Storage

Flood Fringe

Title:

Overland Flow Proposed 1% AEP Flood Function

Figure:

O-100P-5

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Lawson Road

Martin Road

Badgerys Creek

South Creek / Wianamatta

Pitt Street

Cuthel Road

Legend

- Site Boundary

Flood Afflux

- <= -0.50
- -0.50 - -0.20
- -0.20 - -0.03
- -0.03 - -0.02
- -0.02 - 0.02
- 0.02 - 0.03
- 0.03 - 0.20
- 0.20 - 0.50
- > 0.50
- Was wet now dry
- Was dry now wet

Title:

Overland Flow Proposed 1% AEP Flood Afflux

Figure:

O-100P-6

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Legend

Site Boundary

Flood Contours 0.2m

Flood Depth

- <= 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- > 1.50

Title:

Overland Flow Proposed 0.2% AEP Flood Depth

Figure: **O-500P-1**

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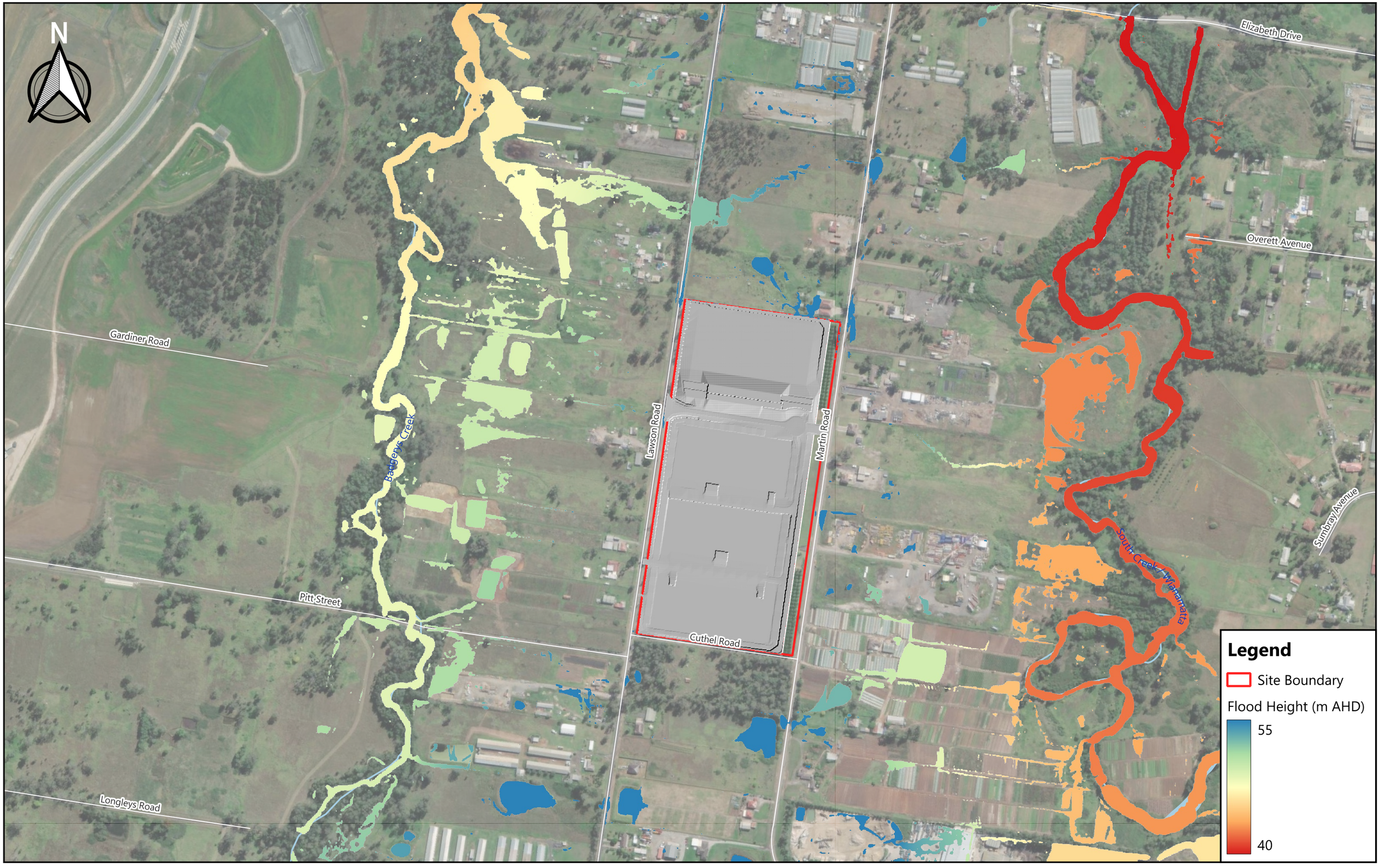

Title:

Overland Flow Proposed 0.2% AEP Flood Height

Figure:

O-500P-2

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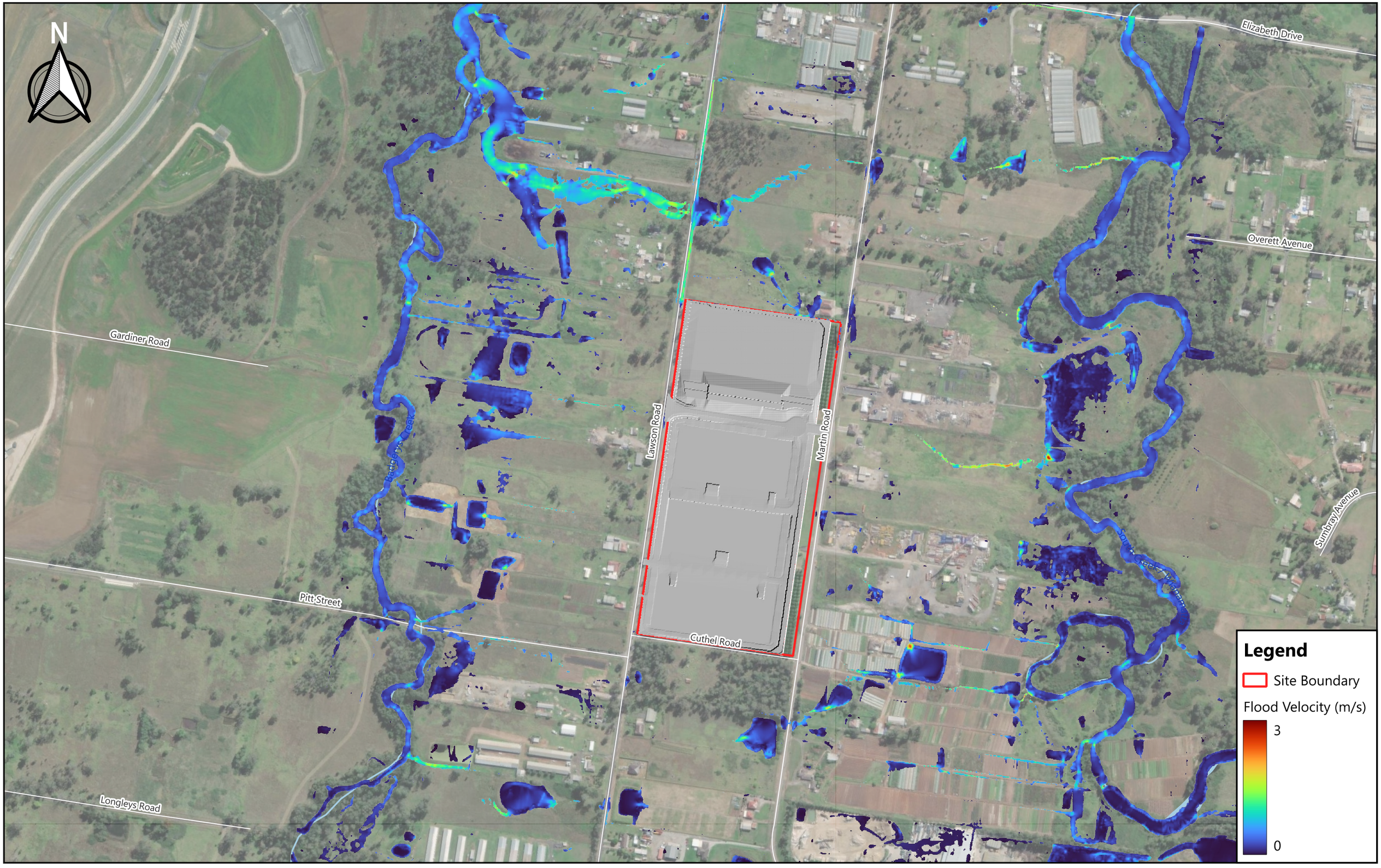

Title:

Overland Flow Proposed 0.2% AEP Flood Velocity

Figure:

O-500P-3

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Title:

Overland Flow Proposed 0.2% AEP Flood Hazard

Figure:

O-500P-4

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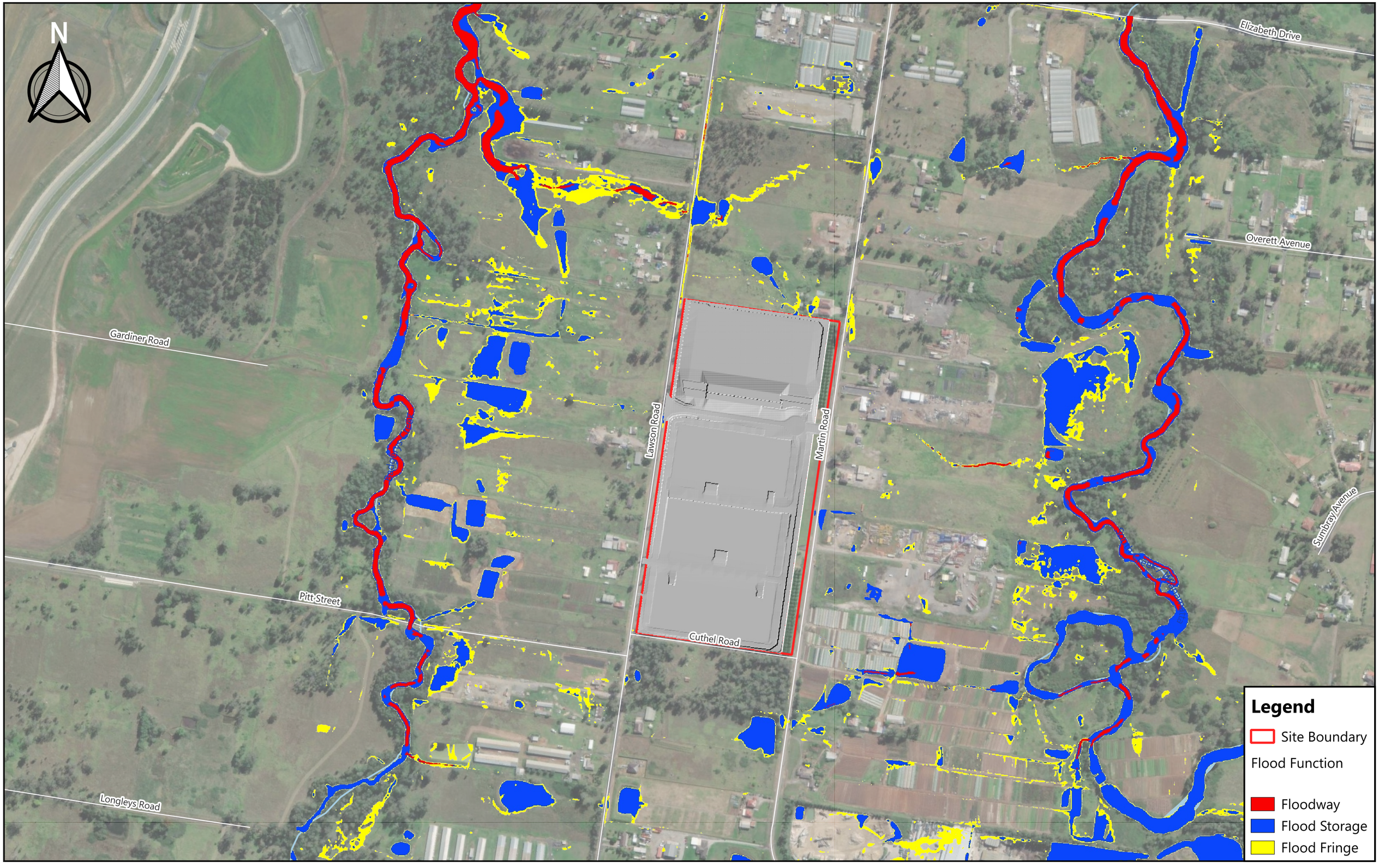

Title:

Overland Flow Proposed 0.2% AEP Flood Function

Figure:

O-500P-5

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Pitt Street

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Legend

- Site Boundary

Flood Afflux

- <= -0.50
- -0.50 - -0.20
- -0.20 - -0.03
- -0.03 - -0.02
- -0.02 - 0.02
- 0.02 - 0.03
- 0.03 - 0.20
- 0.20 - 0.50
- > 0.50
- Was wet now dry
- Was dry now wet

Title:

Overland Flow Proposed 0.2% AEP Flood Afflux

Figure:

O-500P-6

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B. Maintenance Schedule

PERIODIC MAINTENANCE PROCEDURES – BIORETENTION "RAINGARDENS", WETLANDS, PONDS & STORMWATER BASIN

PROJECT: ESR – 85 Martin Road, Badgerys Creek

ELEMENT	POTENTIAL CONCERN	INSPECTION	FREQUENCY	MAINTENANCE REQUIRED	COMPLETED (Y / N)
FILTER MEDIA					
Filter Media	Holes / scour	Check for holes, erosion and scour	6-monthly and after all major storm events	Infill any holes in the filter media. Provide energy dissipation (e.g. rocks and pebbles at inlet) if necessary	
Filter Media	Sediment deposits	Check for accumulation of sediments near inlets	6-monthly and after all major storm events	Remove Sediment build-up from inlet areas	
Filter Media	Filter media surface porosity	Inspect for the accumulation of an impermeable layer (such as oily or clayey sediment) that may have formed on the surface of the filter media. A symptom may be that water remains ponded in the Bio-retention for more than a few hours after a rain event	6-monthly and after all major storm events	Repair minor accumulations by raking away any mulch on the surface and scarifying the surface of the filter media plants. If required, replace filter media if basin function is impaired and cannot be rectified by normal maintenance procedures.	
Filter Media	Litter control	Check for litter including organic litter (e.g. mulching, decaying leaves) in and around treatment areas.	6-monthly and after all major storm events	Remove both organic and anthropogenic litter to ensure flow paths and infiltration through the filter media are not hindered	
VEGETATION					
Turf / grass	Pests and diseases	Assess plants for disease, pest infection, stunted growth or senescent (i.e. ageing) gross	6-monthly and after all major storm events	Look for signs of disease, pest infection and stunted growth. Remove affected plants or treat as necessary. Undertake remediation to any areas exhibiting erosion or scour. Carry out infill planting if required using original planting schedules	
Turf / grass	Mowing of the bioretention grass	Reduced gross density	6-monthly and after all major storm events	If mowing occurs during wet periods the clippings should be collected to prevent mobilisation by subsequent rain events. Care should be taken to prevent rutting when mowing the Bioretention	

Bioretention Surface Layer	Weeds	It is important to identify the presence of any rapidly spreading weeds as they occur. The presence of weeds can diminish aesthetics and also compromise the systems long term performance	3-monthly and after all major storm events	Remove weeds and dispose of suitably. Carry out infill planting if required using original planting schedules	
Bioretention Surface Layer	Lack of water	Check for turf plant condition (e.g. stunted growth, unhealthy appearance). Filter media could also reveal flaking or cracks	3-monthly and during dry periods	Irrigate if required following extended dry periods.	
DRAINAGE					
Subsoil Drainage	Blockage	Ensure that perforated pipes are not blocked to prevent filter media and plants from becoming waterlogged. A small steady clear flow of water may be observed discharging from the perforated pipe at its connection into the outlet pit some hours after rainfall. Note that smaller rainfall events after dry weather may be completely absorbed by the filter media and not result in flow. CCTV inspection of pipelines for blockages and structural integrity may be useful	6-monthly and after all major storm events	Rod and flush drainage lines to prevent build-up of sediment	
Outlet / Discharge Control Pit	Accumulation of sediments in the Pit. Evidence of cracking or spalling of concrete structures. Evidence of erosion downstream of overflow weir	Check for build-up of sediments and litter inside pit. Check condition of pit walls, base and lid	6-monthly and after all major storm events	Remove any blockages / sediments. Any cracks in concrete structures to be reviewed by an appropriately qualified Structural Engineer. Review scour protection in overflow weir and provide additional energy dissipation (e.g. rocks and pebbles) if necessary	