Technical report H

Hydrology and flooding assessment report

Cleanaway & Macquarie Capital

Western Sydney Energy and Resource Recovery Centre

Hydrology and Flooding Assessment Report

WSERRC-ARU-SYD-WAEM-RPT-0001

Final | 21 September 2020

Job number 264039

Arup Pty Ltd ABN 18 000 966 165

Arup
Level 5
151 Clarence Street
Sydney NSW 2000
Australia
www.arup.com

ARUP

Executive summary

An energy from waste (EfW) facility is proposed at 339 Wallgrove Road, Eastern Creek. To support the Environmental Impact Statement submission an assessment of hydrology and flooding impacts associated with the proposal has been undertaken that considers both existing and post development conditions and mitigation measures.

Based on a review of available topographical and flood data an overland flow path was identified through the proposal site which runs from south to north adjacent to the eastern boundary. The assessment of existing conditions estimated 1% Average Exceedence Probability (AEP) peak flood levels along the overland flow path ranging from 55.5mAHD at the upstream (southern) site boundary to 53.1mAHD at the downstream (northern) boundary of the southern portion of the site.

As part of the proposal, the site will be re-graded and the existing overland flow path will be realigned as a trapezoidal channel running along the eastern site boundary. The proposed channel base width is 6m at the southern boundary, which allows flows from the Water NSW site to the south of the site to safely enter the site, before narrowing to 3m wide and continuing at this width to the northern boundary of the southern portion of the site. A 300mm deep meandering low flow channel is proposed to run along the base of the channel to maintain the characteristics of a natural channel and provide aquatic habitat.

An assessment of post development flood behaviour at the site has demonstrated that overland flow entering the site at the southern boundary can be conveyed by the overland flow channel. Flood modelling has demonstrated that this channel and proposed changes to the site topography will not result in an increase in flood levels at adjacent properties for events up to and including the 1% AEP, and will not increase flood hazard at adjacent properties for events up to and including the Probable Maximum Flood (PMF) level. Therefore, the proposal will not materially impact the flood risk at these properties. These results are consistent with the requirements of the State Environmental Planning Policy (Western Sydney Parklands 2009). Furthermore, adequate freeboard above 1% AEP flood levels is provided to the EfW main building and visitor centre with both also located above the flood planning level and PMF level.

In order to manage site stormwater runoff an interconnected bioretention and on-site detention (OSD) basin is proposed at the north-eastern corner of the southern portion of the site. This basin will improve the quality of stormwater discharged from the site as well as limiting the rate of discharge flows in accordance with Blacktown City Council requirements. Adherence with Blacktown City Council

water quality pollutant reduction targets has been demonstrated using MUSIC modelling.

A site water balance assessment has been completed for the proposal site. Rainwater falling on the main building is proposed to be collected and reused for the EfW process. The estimated residual potable water demand for the site is 281,000kL/year which would be supplied by mains water. The estimated sewer discharge is 9,000kL/year, with process water fully consumed on-site. The opportunity to utilise recycled water was considered but was not deemed feasible for the proposal.

A preliminary sediment and erosion control plan has been prepared to for the site with the aim to minimise environmental impacts on downstream waterways during construction. The contractor will be responsible for preparing and implementing a detailed, staged Soil and Water Management Plan during construction.

Through this assessment, compliance with proposal SEARs and relevant legislation relating to hydrology and flooding has been demonstrated.

Contents

Tables

Figures

Appendices

Environmental assessment requirements

The below table lists the Secretary's environmental assessment requirements (SEARs) relevant to hydrology and flooding and where they are addressed in this report.

Assessment Requirements	Reference in this technical paper
A description of existing baseline conditions including soil, water, groundwater resources, topography, hydrology, drainage lines, watercourses and riparian lands on or nearby to the site	Section 2 Groundwater resources are discussed in Technical Report F: Soil and water assessment report
An assessment of impacts on surface and groundwater sources (both quality and quantity), related infrastructure, watercourses and riparian land and measures proposed to reduce and mitigate these impacts	Section 4 Impacts on groundwater sources are discussed in Technical Report F: Soil and water assessment report
An assessment to demonstrate the development will have a Neutral or Beneficial Effect (NorBE) on water quality in the Sydney drinking water catchment.	Section 4.2.1
Proposed surface and groundwater monitoring activities and methodologies	Section 3.2.1 Groundwater monitoring is discussed in Technical Report F: Soil and water assessment report
Consideration of relevant NSW government guidelines and legislation, including the Water Act 1912 and Water Management Act 2000, NSW water quality and river flow objectives, guidelines for controlled activities on waterfront land (2018)	Section 4
A detailed site water balance, including identification of water requirements for the life of the project, measures that would be implemented to ensure an adequate and secure water supply is available for the proposal and a detailed description of the measures to minimise water use at the site	Section 4.2.2
A flood impact assessment, including an assessment of overland flow paths and flood risk associated with the development both on and off the site	Sections 2.7, 3.3.2 and 4.2.3. Detailed Site Flood Impact Assessment Report is included in Appendix A
A stormwater management strategy that provides details of stormwater and wastewater management systems including the capacity of onsite detention systems, details of water sensitive urban design measures, discharge locations, pathways and quality and measures to treat, reuse or dispose of water	Section 4.2 Details of wastewater management strategy is included in Technical Report P: Utilities and services assessment report
Details of construction works and spoil disposal, including a description of erosion and sediment controls, bulk earthworks, the management of acid sulfate soils and contingency plans for potential construction incidents	Section 4.1 Details of spoil disposal and management of soils is included in Technical

	Report F: Soil and water assessment report
Agency SEARs relevant to Hydrology and Flooding – Blacktown City Council	
A detailed assessment of potential soil, surface and groundwater impacts	Section 4 Impacts on groundwater sources are discussed in Technical Report F: Soil and water assessment report
A Stormwater Management Strategy is to be provided for the site. The Strategy is to address detention for all storm events from 2 to 100 years ARI to pre-development discharges, stormwater quality using Part J of Council's DCP 2015, water conservation achieving a minimum of 80% of non-potable sources, and assessment and reduction of the stream erosion index.	Section 4.2
The SMS is to also consider flows from outside the immediate construction area of the proposed facility and how these flows (including road flows) are to be conveyed to the creek system and adverse impacts mitigated.	Section 4
A water balance assessment for the site, detailing water sources, water demand and consumption, water recycling, the quantity and quality of wastewater streams and the impact of any water and wastewater release from the site on surface and groundwater.	Section 4.2.2
Provided an Integrated Water Management Plan for the site.	Section 4.2
Detail spill containment and bunding.	Section 4.2.1
Agency SEARs relevant to Hydrology and Flooding – EPA	
Describe the catchment including proximity of the development to any waterways and provide an assessment of their sensitivity/significance from a public health, ecological, and/or economic perspective. The Water Quality and River Flow Objectives on the website: http://www.environment.nsw.gov.au/ieo/index.htm should be used to identify the agreed environmental values and human uses for any affected waterways.	Catchment area described in Section 2.6 Ecological assessment included in Technical Report Q: Biodiversity development assessment report
Identify all surface water features including water courses, wetlands and floodplains transacted by or adjacent to the proposed development.	Section 2.4 and Section 2.7
Provide details of the project that are necessary for predicting and assessing impacts to waters including: a. Outline site layout, demonstrating efforts to proximity to water resources (especially for activities with significant potential impacts e.g. effluent ponds) and showing potential areas of modification of contours, drainage works and associated infrastructure; land-forming and excavations; working capacity of structures; and water resource requirements of the proposal; b. Assessment of the potential impact of the development on all identified water features, tributaries and riparian areas; c. The quantity and physio-chemical properties of all potential water pollutants and the risks they pose to the environment and human health, including the risks they pose to Water Quality Objectives in the ambient waters	Section 4.2

(as defined on http://www.environment.nsw.gov.au/ieo/index.htm, using technical criteria derived from the Australian and New Zealand Guidelines for Fresh and Marine Water Quality, ANZECC 2000); d. Water management system including all potential sources of water pollution, proposals for re-use, treatment, etc., emission levels of any wastewater discharged, discharge points, summary of options to avoid a discharge, reduce its frequency or reduce its impacts, and rational for selection of option to discharge; e. Site diagram of the finished facility identifying the surface water flows and discharge pathways including the location of discharge monitoring points; f. Where a licensed discharge is proposed, provide the rationale as to why it cannot be avoided through application of a reasonable level of performance, using available technology, management practice and industry guidelines; and g. Where a licensed discharge is proposed, provide the rationale as to why it represents the best environmental outcome and what measures can be taken to reduce its environmental impact.	
Outline how total water cycle considerations are to be addressed showing total water balances for the development (with the objective of minimising demands and impacts on water resources). Include water requirements (quantity, quality and source(s)) and proposed storm and wastewater disposal, including type, volumes, proposed treatment and management methods and re-use options.	Section 4.2 Sewer disposal is addressed in Technical Report P: Utilities and services assessment report
Agency SEARs relevant to Hydrology and Flooding – DPIE Natural Resources Access Regulator	
A detailed and consolidated site water balance.	Section 4.2.2
Assessment of impacts on surface and ground water sources (both quality and quantity), related infrastructure, adjacent licensed water users, basic landholder rights, watercourses, riparian land, and groundwater dependent ecosystems, and measures proposed to reduce and mitigate these impacts.	Section 4.2
Proposed surface and groundwater monitoring activities and methodologies.	Section 3.2.1 Groundwater monitoring is described in Technical Report F: Soils and water assessment report
Consideration of relevant legislation, policies and guidelines, including the NSW Aquifer Interference Policy (2012), the Guidelines for Controlled Activities on Waterfront Land (2018) and the relevant Water Sharing Plans (available at https://www.industry.nsw.gov.au/water)	N/A – Site does not contain waterfront land, refer to Section 2.7
Agency SEARs relevant to Hydrology and Flooding – DPIE Environment, Energy and Science Group	
The EIS must describe background conditions for any water resource likely to be affected by the development, including: a. Existing surface and groundwater. b. Hydrology, including volume, frequency and quality of discharges at proposed intake and discharge locations.	Surface water including hydrology and water quality is described in Section 2

c. Water Quality Objectives (as endorsed by the NSW Government http://www.environment.nsw.ciov.au/ieo/index.htm) including groundwater as appropriate that represent the community's uses and values for the receiving waters. d. Indicators and trigger values/criteria for the environmental values identified at (c) in accordance with the ANZECC (2000) Guidelines for Fresh and Marine Water Quality and/or local objectives, criteria or targets endorsed by the NSW Government. e. Risk-based Framework for Considering Waterway Health Outcomes in Strategic Land-use Planning Decisions http://www.environment.nsw.gov.au/research-and-publications/publications-search/risk-based-framework-for-considering-waterway-health-outcomes-in-strategic-land-use-planning	Groundwater conditions are described in Technical Report F: Soils and water assessment report
The EIS must assess the impacts of the development on water quality, including: a. The nature and degree of impact on receiving waters for both surface and groundwater, demonstrating how the development protects the Water Quality Objectives where they are currently being achieved, and contributes towards achievement of the Water Quality Objectives over time where they are currently not being achieved. This should include an assessment of the mitigating effects of proposed stormwater and wastewater management during and after construction. b. Identification of proposed monitoring of water quality. c. Consistency with any relevant certified Coastal Management Program (or Coastal Zone Management Plan).	Surface water impacts are assessed in Section 4.2.1 Groundwater impacts are assessed in Technical Report F: Soils and water assessment report
The EIS must assess the impact of the development on hydrology, including: a. Water balance including quantity, quality and source. b. Effects to downstream rivers, wetlands, estuaries, marine waters and floodplain areas. c. Effects to downstream water-dependent fauna and flora including groundwater dependent ecosystems. d. Impacts to natural processes and functions within rivers, wetlands, estuaries and floodplains that affect river system and landscape health such as nutrient flow, aquatic connectivity and access to habitat for spawning and refuge (e.g. river benches). e. Changes to environmental water availability, both regulated/licensed and unregulated/rules-based sources of such water. f. Mitigating effects of proposed stormwater and wastewater management during and **a**fter construction on hydrological attributes such as volumes, flow rates, management methods and re-use options. g. Identification of proposed monitoring of hydrological attributes.	Section 4
The EIS must map the following features relevant to flooding as described in the Floodplain Development Manual 2005 (NSW Government 2005) including:	Section 2.8, Section 4.2.4 and Appendix A

a. Flood prone land. b. Flood planning area, the area below the flood planning level. c. Hydraulic categorisation (floodways and flood storage areas) d. Flood Hazard.	
The EIS must describe flood assessment and modelling undertaken in determining the design flood levels for events, including a minimum of the 5% Annual Exceedance Probability (AEP), 1 % AEP, flood levels and the probable maximum flood, or an equivalent extreme event.	Section 2.8, Section 4.2.4 and Appendix A
The EIS must model the effect of the proposed development (including fill) on the flood behaviour under the following scenarios: a. Current flood behaviour for a range of design events as identified in 14 above. This includes the 0.5% and 0.2% AEP year flood events as proxies for assessing sensitivity to an increase in rainfall intensity of flood producing rainfall events due to climate change.	As described in Section 3.2.2, sensitivity to climate change has been assessed by simulating the 1% AEP event with rainfall adjustment according to RCP8.5 (high) as per AR&R 2019. Results are discussed in Section 4.2.4 and Appendix A
Modelling in the EIS must consider and document: a. Existing council flood studies in the area and examine consistency to the flood behaviour documented in these studies. b. The impact on existing flood behaviour for a full range of flood events including up to the probable maximum flood, or an equivalent extreme flood. c. Impacts of the development on flood behaviour resulting in detrimental changes in potential flood affection of other developments or land. This may include redirection of flow, flow velocities, flood levels, hazard categories and hydraulic categories d. Relevant provisions of the NSW Floodplain Development Manual 2005.	Section 2.8, Section 4.2.4 and Appendix A
The EIS must assess the impacts on the proposed development on flood behaviour, including: a. Whether there will be detrimental increases in the potential flood affectation of other properties, assets and infrastructure. b. Consistency with Council floodplain risk management plans. c. Consistency with any Rural Floodplain Management Plans. d. Compatibility with the flood hazard of the land. e. Compatibility with the hydraulic functions of flow conveyance in floodways and storage in flood storage areas of the land. f. Whether there will be adverse effect to beneficial inundation of the floodplain environment, on, adjacent to or downstream of the site.	Section 2.8, Section 4.2.4 and Appendix A NSW SES was not consulted as no impacts on any flood evacuation plans are anticipated

g. Whether there will be direct or indirect increase in erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses. h. Any impacts the development may have upon existing community emergency management arrangements for flooding. These matters are to be discussed with the NSW SES and Council. i. Whether the proposal incorporates specific measures to manage risk to life from flood. These matters are to be discussed with the NSW SES and Council. j. Emergency management, evacuation and access, and contingency measures for the development considering the full range or flood risk (based upon the probable maximum flood or an equivalent extreme flood event). These matters are to be discussed with and have the support of Council and the NSW SES. k. Any impacts the development may have on the social and economic costs to the community as consequence of flooding.	
Agency SEARs relevant to Hydrology and Flooding – Water NSW	
An assessment of the impacts of the proposed development on drainage paths and on the Pipelines corridor. The EIS should model pre and post-development flows that enter or are conveyed across the pipelines corridor. WaterNSW require that post-development flows be equal or less than the pre-development flows for each event up to and including 1% AEP. Additional surface and groundwater entering the Pipeline corridor should be prevented.	Section 4.2.3

Abbreviations and glossary

Abbreviations	
AEP	Annual Exceedence Probability (AEP) refers to the probability of a flood event occurring in any year
AR&R	Australian Rainfall and Runoff (AR&R) is a national guideline document, data and software suite that can be used for the estimation of design flood characteristics in Australia
BoM	Bureau of Meteorology
OSD	On-site detention
PMP	Probable Maximum Precipitation (PMP) is the greatest depth of precipitation for a given duration meteorologically possible for a given size storm area at a particular location at a particular time of year
PMF	The Probable Maximum Flood (PMF) is the flood that may be expected from the most severe combination of critical meteorological and hydrologic conditions that are reasonably possible in a particular drainage area
IPCC	United Nations International Panel for Climate Change (IPCC)
RCP	A Representative Concentration Pathway (RCP) is a greenhouse gas concentration trajectory adopted by the IPCC
Proposal (the)	The purpose of the proposal is to build an energy-from-waste (EfW) facility that can generate up to 55 megawatts (MW) of power by thermally treating up to 500,000 tonnes per year of residual municipal solid waste (MSW) and residual commercial and industrial (C&I) waste streams that would otherwise be sent to landfill.

1 Introduction

Cleanaway and Macquarie Capital are jointly developing an energy-from-waste (EfW) facility known as the Western Sydney Energy and Resource Recovery Centre (WSERRC) (the proposal).

The proposal will be designed to thermally treat up to 500,000 tonnes per year of residual Municipal Solid Waste (MSW) and residual Commercial and Industrial (C&I) waste streams that would otherwise be sent to landfill. This process would generate up to 58 megawatts (MW) of base load electricity some of which would be used to power the facility itself with the remaining 55MW exported to the grid. The proposal involves the building of all onsite infrastructure needed to support the facility including site utilities, internal roads, weighbridges, parking and hardstand areas, storm water infrastructure, fencing and landscaping.

The proposal site is located at 339 Wallgrove Road in Eastern Creek, NSW (Lot 1 DP 1059698) which is in the Blacktown local government area (LGA). The site is in the Wallgrove Precinct of the Western Sydney Parklands (WSP) Plan of Management.

The 8.23ha site is divided by a small strip of land not part of the proposal site, resulting in a 2.04ha northern section and a 6.19ha southern section. This dividing strip is part of the adjacent lot and includes a right of carriageway benefitting the proposal site allowing vehicles to move between the two parts of the site. The proposal area will be fully contained in the 6.19ha portion of the site. Works to occur on the 2.04 ha northern section of the site include the clearing of weeds and exotic vegetation within the existing overland flow channel which is confined to the eastern section of this parcel of land. The northern section will also be used temporarily to support construction works. It is not currently expected that any other works will occur on the 2.04 ha northern section of the site as part of this proposal.

This report provides information relevant to the existing site hydrology and flood risk broadly across the study area and assesses potential impacts associated with the proposal.

2 Existing environment

This Section describes hydrological conditions and flood risk at the existing site.

2.1 Site location

The proposal site is located at 339 Wallgrove Road, Eastern Creek. The site is bounded by the M7 Motorway to the west, the Water NSW Warragamba Pipelines to the south and the Global Renewables Limited (GRL) alternative waste treatment facility to the east and the SUEZ Eastern Creek Waste Management Centre to the north. Site access from Wallgrove Road is via the Austral Bricks access road which passes under the M7 Motorway, with a specific site access road over the Warragamba Pipelines. The proposed development will be contained within the southern section of the site.

A stormwater overland flow path passes through the site from south the north adjacent to the eastern boundary. This overland flow path eventually discharges to Reedy Creek approximately 400m north of the site. The site location is shown in Figure 1.

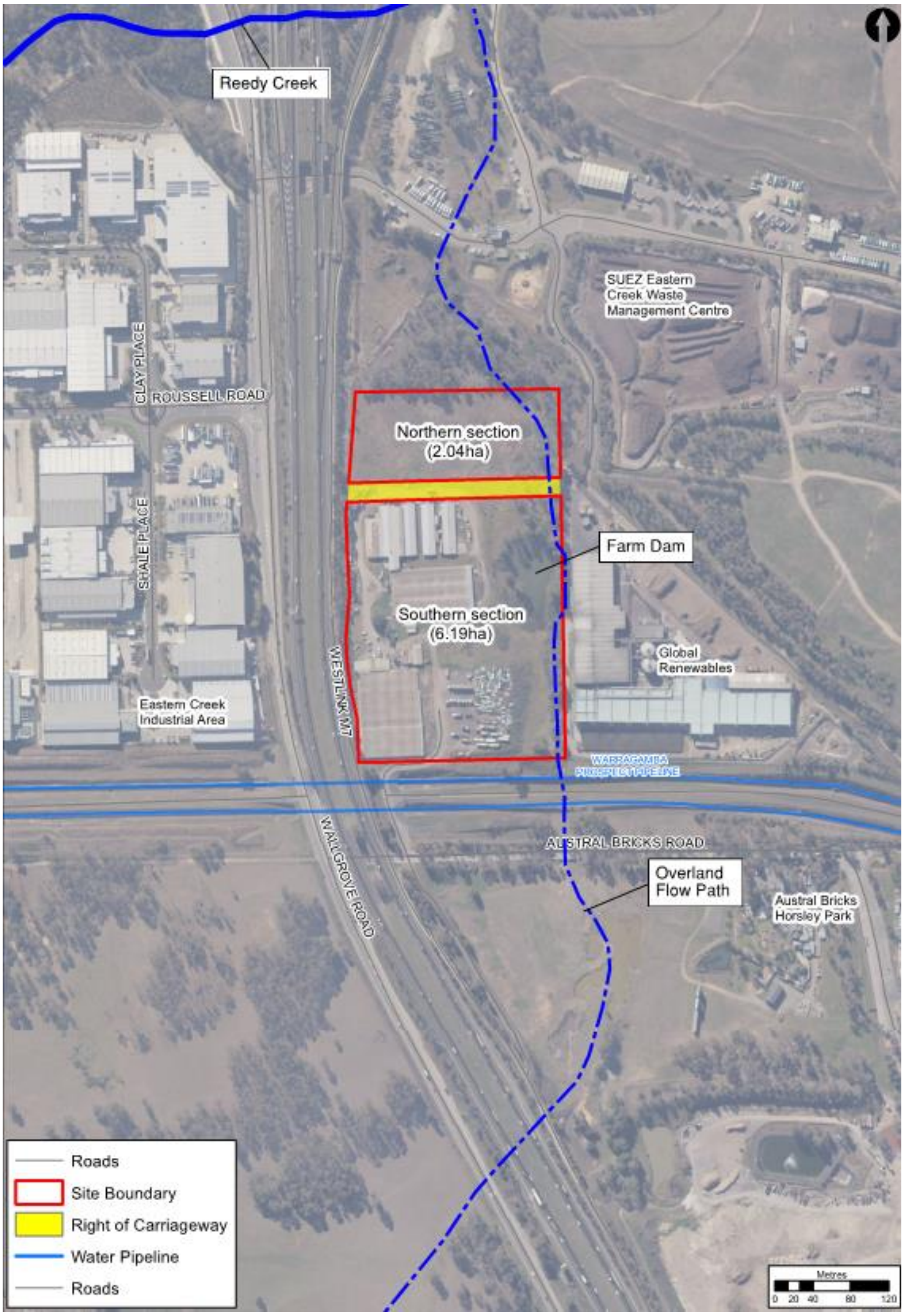


Figure 1 Site locality plan

2.2 Rainfall and climate

Rainfall and evaporation data for the site has been sourced from the Bureau of Meteorology using data from meteorological station 067019 at Prospect Reservoir. This station is located approximately 5km east of the proposal site. Data is available from this station from 1887 to present day.

A summary of average rainfall and evaporation statistics is included in Table 1. Mean annual rainfall at the site is 874mm, while median annual rainfall is 858mm. On average 84 days per year have rainfall of greater than 1mm. Rainfall at the site is highest during January, February and March and lowest during winter and early spring. Evaporation is highest in December and lowest in June.

Table 1 Summary of climate statistics at Prospect Reservoir

Month	Mean rainfall (mm)	Mean number of days of rain >= 1 mm	Mean daily evaporation (mm)
January	95.1	8	5.5
February	98.8	8.2	4.7
March	98.7	8.4	3.9
April	75.7	7	2.9
May	69	6.3	2
June	77	7	1.6
July	55.4	5.6	1.7
August	50.2	5.7	2.5
September	46.5	6.1	3.6
October	58.8	6.8	4.4
November	72.6	7.3	5
December	75.5	7.5	5.6
Annual	873.7	83.9	3.6

20 years of daily rainfall data from 2000 to 2019 has been used for the water balance. The MUSIC water quality model requires rainfall data for a continuous period at a 6-minute time step. The model has been developed using Blacktown City Council MUSIC Link, which fixes the rainfall data to meteorological station 067020 at Liverpool for the data period of 1967 to 1976 which is considered representative of typical rainfall for the area. MUSIC Link also fixes potential evapotranspiration data in the model and uses average monthly data for Sydney.

As part of the Site Flood Impact Assessment three design flood events were modelled; 5% Annual Exceedance Probability (AEP), 1% AEP and Probable Maximum Precipitation (PMP). Rainfall data for the 5% and 1% AEP events were extracted from the Bureau of Meteorology (BoM, 2020). A 1% AEP climate change scenario was also modelled. The Australian Rainfall and Runoff (2019) method was followed whereby the median of 10 temporal patterns is selected for each design event. PMP data was determined for the site using the Generalised Short Duration Method (BoM, 2003).

2.3 Site topography

Existing levels at the southern section of the site range from approximately 62mAHD at the south-west of the site to approximately 52mAHD at the north of the site. The south-west of the site is the highest portion of the site. The area occupied by existing buildings in the western portion of the site is raised in comparison to the eastern portion of the site where the farm dam is situated, and the overland flow path runs through the site from south to north.

The car park at the southeast of the site sits at approximately 60mAHD with a 5m high embankment down to the vegetated area and overland flow path. This embankment reduces in height to approximately 2m immediately north-east of the farm dam.

The M7 Motorway adjacent to the site is elevated several metres above the ground level of the site. The level difference is typically overcome with an embankment however, there is a 30m long retaining wall located at the south-western corner of the site, outside of the site boundary.

2.4 Stormwater drainage

Site drainage

The existing site stormwater network includes a series of ill-defined open drains, the farm dam and the overland flow path. There is minimal piped stormwater drainage within the site with building downpipes discharging to the adjacent surface. The farm dam can be seen in the aerial photograph in Figure 2.

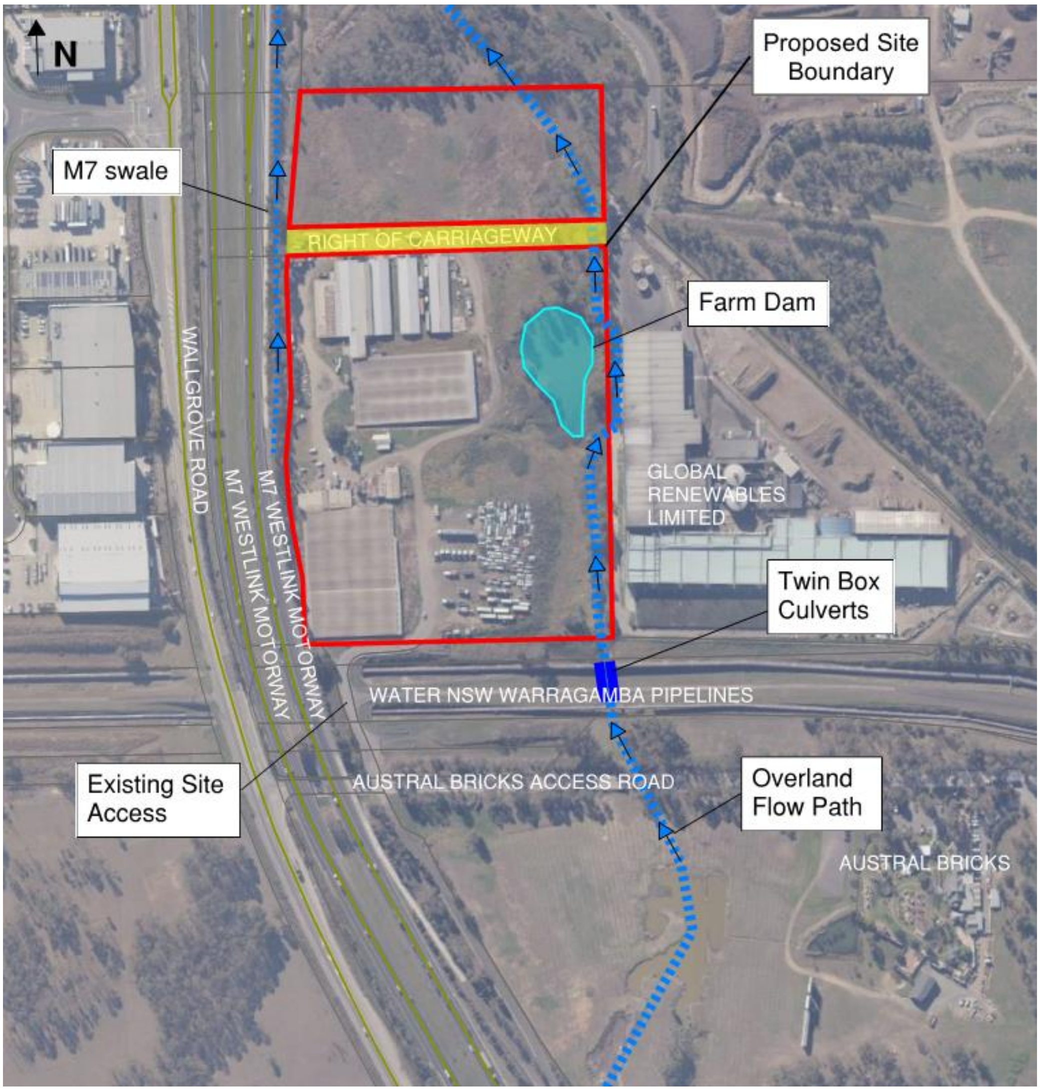


Figure 2 Key stormwater features at proposal site and surrounding area

Overland flow path

An overland flow path runs from south to north along the eastern boundary of the site. This flow path enters the site via twin culverts from the Water NSW land to the south. The flow path enters the GRL site for approximately 50m before flowing back into the proposal site. Based on a site inspection, the overland flow path appears to be separate from the farm dam, however, there is likely to be some mixing of flows during significant rainfall events. The overland flow path eventually discharges to Reedy Creek approximately 400m north of the site.

Levels along the overland flow path through the southern section of the site range from approximately 54.5mAHD at the south-eastern corner of the site to 52.5mAHD at the north-eastern corner of site. The overland flow path is overgrown with invasive vegetation.

The approximate alignment of the overland flow path along with key stormwater features at the GRL site is shown in Figure 2 and Figure 3.

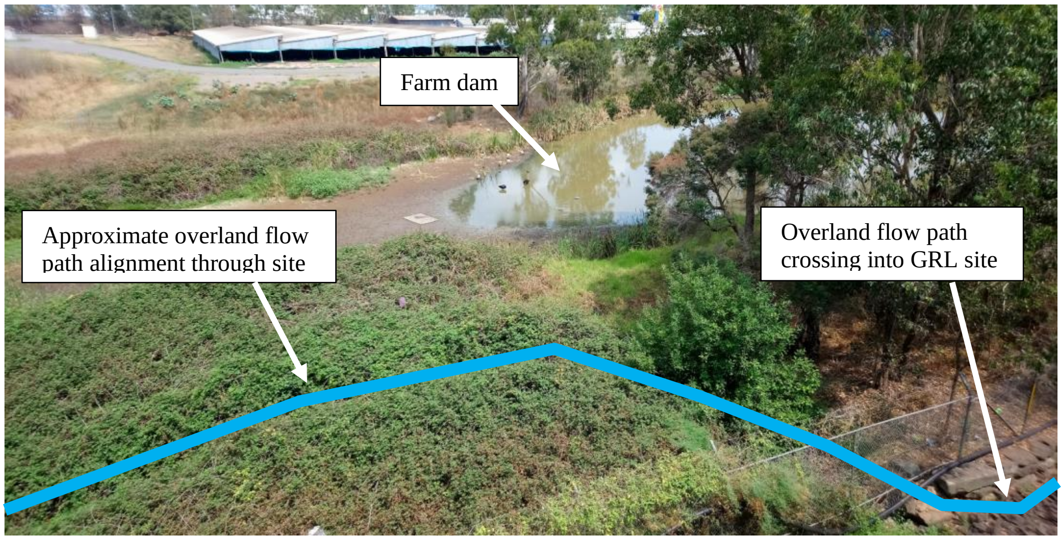


Figure 3 Photograph looking west towards proposal site from GRL site

A separate open stormwater drain is located within the M7 Motorway property boundary which collects and conveys stormwater from the section of the M7 Motorway adjacent to the proposal site. This drain has been designed such that stormwater from the M7 Motorway does not discharge to the proposal site. Stormwater runoff from a small portion of the proposal site adjacent to the western boundary, comprising approximately 5% of the site, currently flow overland into the M7 Motorway drain.

2.5 Water quality

2.5.1 Council monitoring records

Blacktown City Council (BCC) conducted water quality monitoring in Reedy Creek over a 6-month period in 2008 and 2009. The sampling location was immediately downstream of the M7 cycle path, about 400m north of the proposal site. Despite not being recent, these results provide an indication of the typical water quality in Reedy Creek downstream of the proposal site. Results from this testing are summarised in Table 2 and show various values outside of the Australia and New Zealand Environment and Conservation Council (ANZECC) guidelines for each test. This indicates relatively poor water quality in Reedy Creek during the testing period.

Table 2 Reedy Creek water quality results supplied by BCC ^

Date	Electroconductivity (mS/cm)	Turbidity (NTU)	Dissolved oxygen (% saturation)	pH	Chlorophyll *a* (ug/L)
ANZECC water quality guideline trigger value^	0.125 – 2.2	6 - 50	85 - 110	6.5 – 8.0	3
25-Sep-08	1.962	215.4	40.8	7.41	18.8
07-Oct-08	0.671	326.8	41.8	7.39	559.7
13-Nov-08	4.42	18.6	124	6.6	14.9
04-Dec-08	0.011	324.8	38.3	5.8	6.4
08-Jan-09	0.08	19.2	101.1	4.77	63.1
20-Feb-09	0.923	1426.2	82.5	6.8	74.6

^ ANZECC Guidelines for Fresh and Marine Water Quality (2000) water quality trigger values for lowland rivers in south east Australia are also shown and where values are outside these ranges they are shown in red

2.5.2 Site specific water quality testing

As part of the site environmental investigations undertaken by Douglas Partners summarised in Technical Report G, water quality testing was undertaken at the site. These tests primarily focused on the overland flow path and farm dam. Test locations are shown in Figure 4. A summary of these results is included in Table 3. These results show electroconductivity and pH values consistent with ANZECC guidelines for lowland rivers in south east Australia (ANZECC Guidelines for Fresh and Marine Water Quality (2000). Results for dissolved oxygen and total phosphorus are outside of the ANZECC guidelines range for all samples, while electroconductivity and pH. These results indicate relatively high nutrient content in the water.

Figure 4 Site water quality test locations

Table 3 Site water quality test results^

Sample	Date	Electroconductivity (mS/cm)	Dissolved oxygen (% saturation)*	pH	Total phosphorus (mg/L)
ANZECC water quality guideline trigger value^		0.125 – 2.2	85 - 110	6.5 – 8.0	0.025
SW01	28-02-20	0.98	79	7.9	0.2
SW02	28-02-20	0.42	77	7.5	0.4
SW03	28-02-20	1.2	77	7.8	0.2
SW04	28-02-20	0.42	73	7.6	0.3
SW05	28-02-20	0.46	80	7.4	0.4

^ ANZECC Guidelines for Fresh and Marine Water Quality (2000) water quality trigger values for lowland rivers in south east Australia are also shown and where values are outside these ranges they are shown in red
* Dissolved oxygen % saturation values calculated based on sample results and an estimated temperature of 20°C

2.6 Stormwater catchment areas

Internal Catchment

The internal site catchment generally drains from south to north and west to east. Existing buildings have downpipes that discharge to the surrounding ground with flows conveying overland flow to the east. Scoured flow paths are evident in the gravel and grassed areas. These flows eventually make their way to the overland flow channel and farm dam located at the lower, eastern part of the site.

Small areas of hard standing at the west of the southern portion of the site are graded to the west, conveying overland flows into the open drain serving the M7 Motorway. This open drain flows north and ultimately discharges into Reedy Creek north of the site.

Existing hard standing and the large parking/laydown area fall to the east conveying overland flows to the overland flow channel and farm dam at the east of the site. The farm dam appears to be bunded thereby controlling flows leaving the site. From the farm dam spillway, the densely vegetated overland flow path conveys flows northwards then north-west. This flow path merges with another channel prior to passing through a culvert under the main entrance road of Eastern Creek Waste Management Centre. After the culvert crossing, another man-made channel directs flows northwards before discharging into Reedy Creek.

External Catchments

A review of aerial photography and LiDAR data for the area upstream of the proposal site was undertaken to identify any possible upstream catchments draining to the site. Based on this review, a catchment area of approximately 1.2km^2 was identified that drains to the proposal site, this area is shown in Figure 5. The flow path from this catchment area crosses Wallgrove Road, the M7 Motorway and the Warragamba Pipelines before entering the proposal site. The upstream catchment is generally flat. There is the potential for online storage and flow attenuation upstream of Wallgrove Road and the M7 Motorway, at the farm dams at the Austral Bricks site and within the Water NSW land to the south of the proposal site.

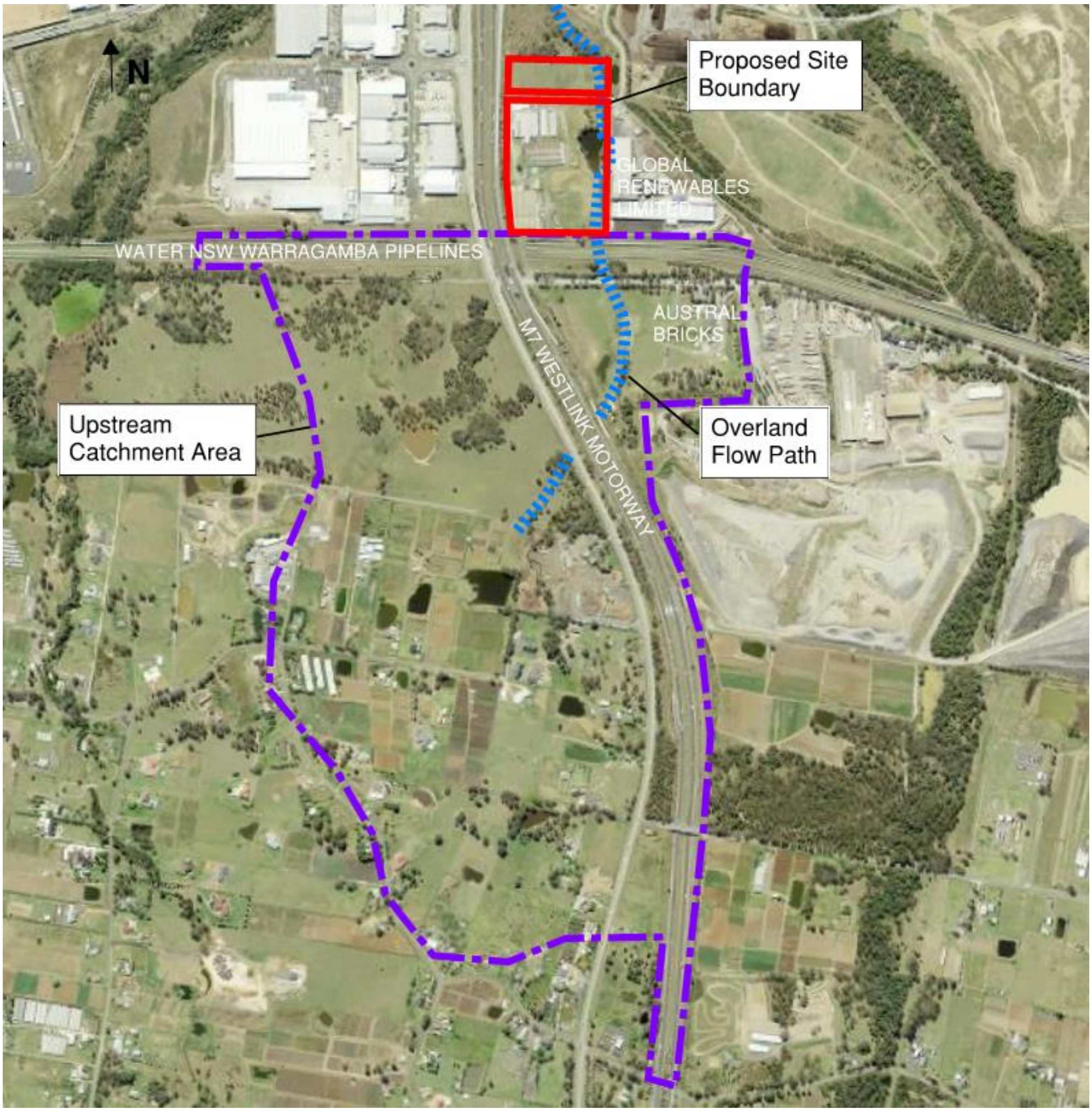


Figure 5 Upstream stormwater catchment area and overland flow path

2.7 Riparian corridors

NSW Map data (Six Maps) has been reviewed in order to assess the stream order of any watercourses at or adjacent to the development site and identify their associated riparian corridors. Based on a review of this data as shown in Figure 6, the overland flow path through the site is not a defined water course. Therefore, the preservation of a riparian corridor at the site is not required.

Based on the Strahler System classification, both Reedy Creek and Eastern Creek would be defined as third order watercourses. In accordance with the NSW Office of Water Guidelines for Riparian Corridors on Waterfront Land, riparian corridor widths of 60m plus channel width are recommended. These indicative riparian corridors are shown in Figure 6. As can be seen, these riparian corridors are at least 400m from the proposal site and so do not impact on the proposed development.

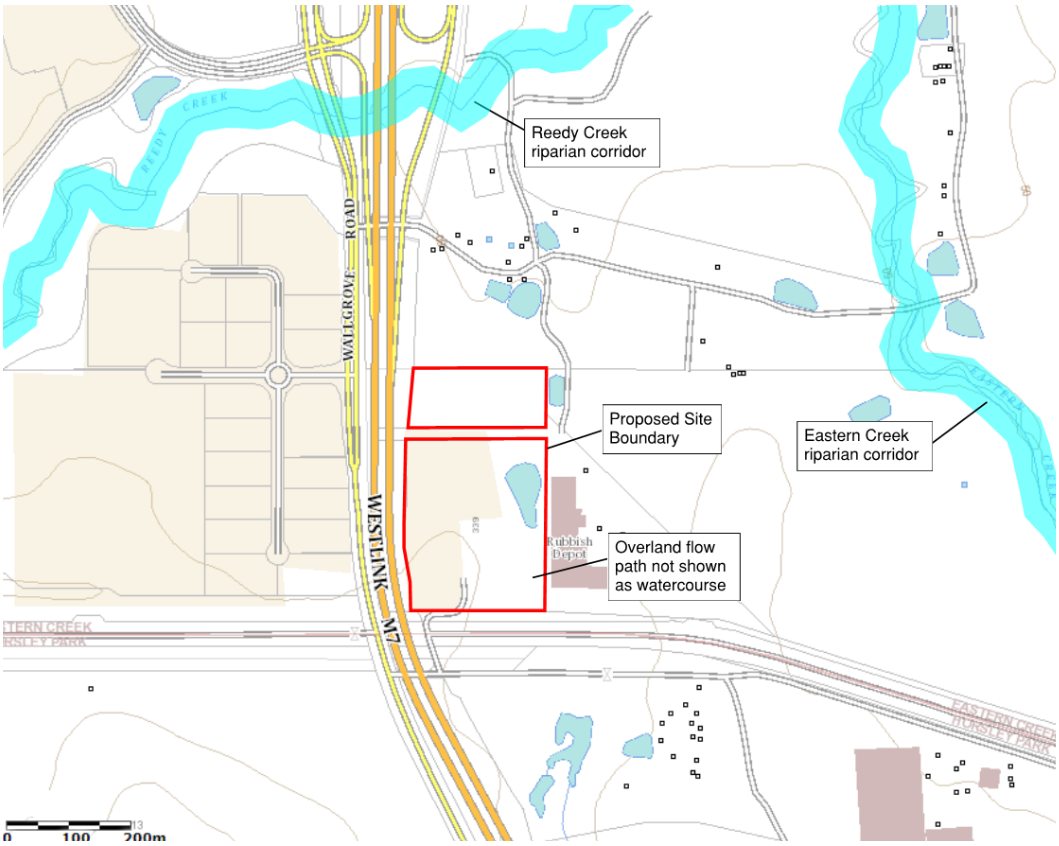


Figure 6 Riparian corridors near proposal site (base map source: NSW Maps (Six Maps) accessed 01/05/2020)

2.8 Flooding

Council flood studies

Blacktown City Council is currently undertaking a flood investigation for Eastern Creek which also includes the Reedy Creek floodplain. In response to a request for flood information at the site, on 20 April 2020 BCC provided preliminary flood maps for the 1% AEP and Probable Maximum Flood (PMF) events from this investigation. Extracts from these flood maps are included in Figure 7 and Figure 8. These maps show flooding along the overland flow path and farm dam at the east of the site.

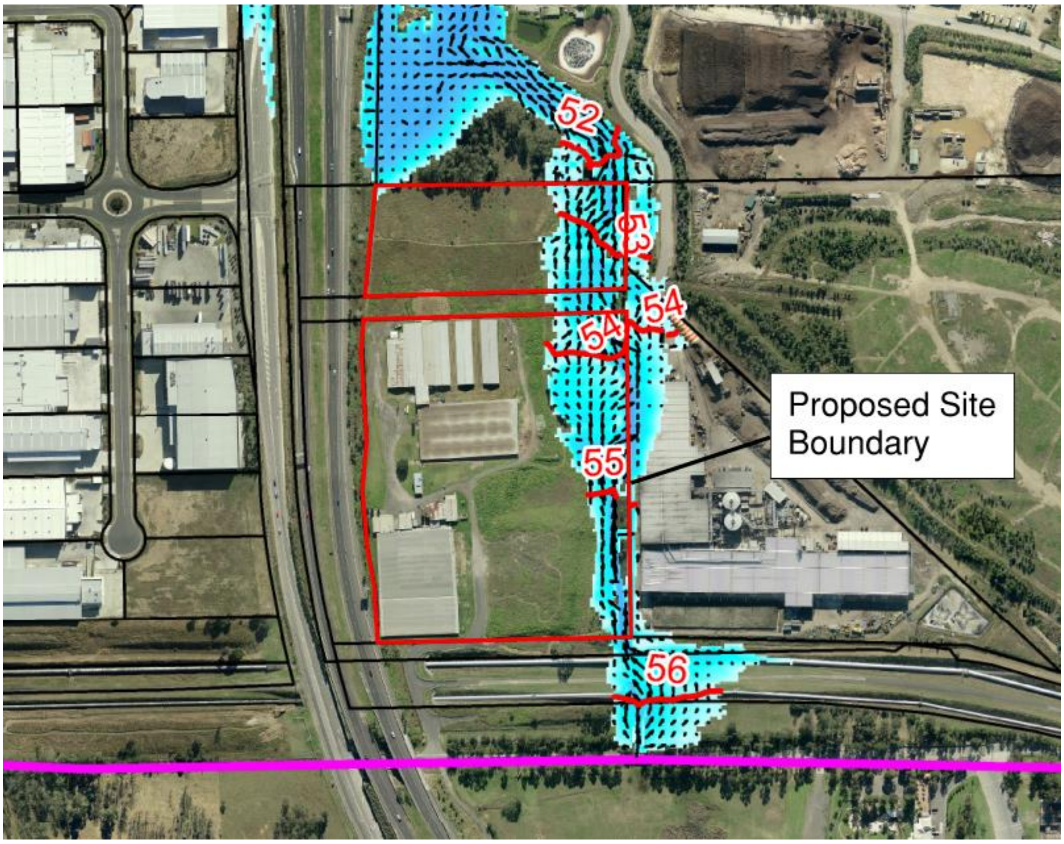


Figure 7 Extract of BCC preliminary 1% AEP flood maps

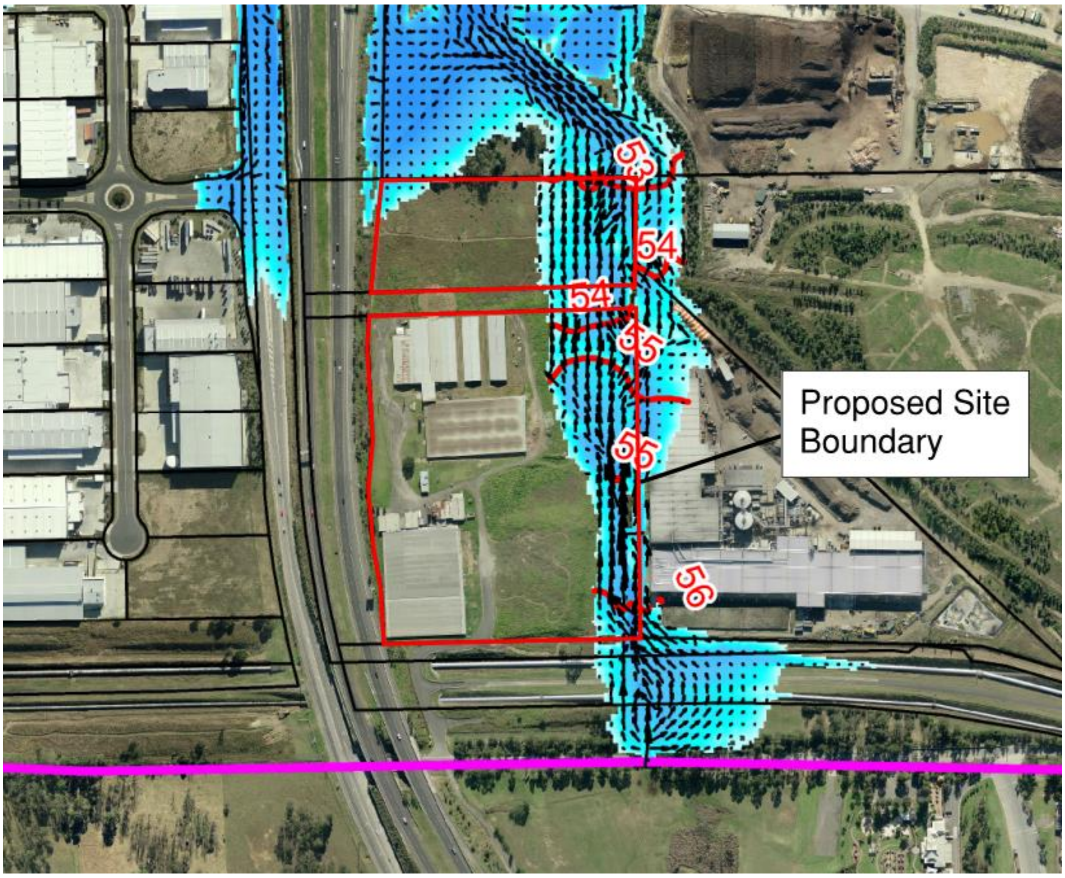


Figure 8 Extract of BCC preliminary PMF flood map

Flood mapping on the BCC GIS MapsOnline portal shows that the proposal site is not within the flood plain of Reedy Creek or Eastern Creek. It is understood that previous Council flood investigations did not include the proposal site. An extract from the MapsOnline portal is included in Figure 9.

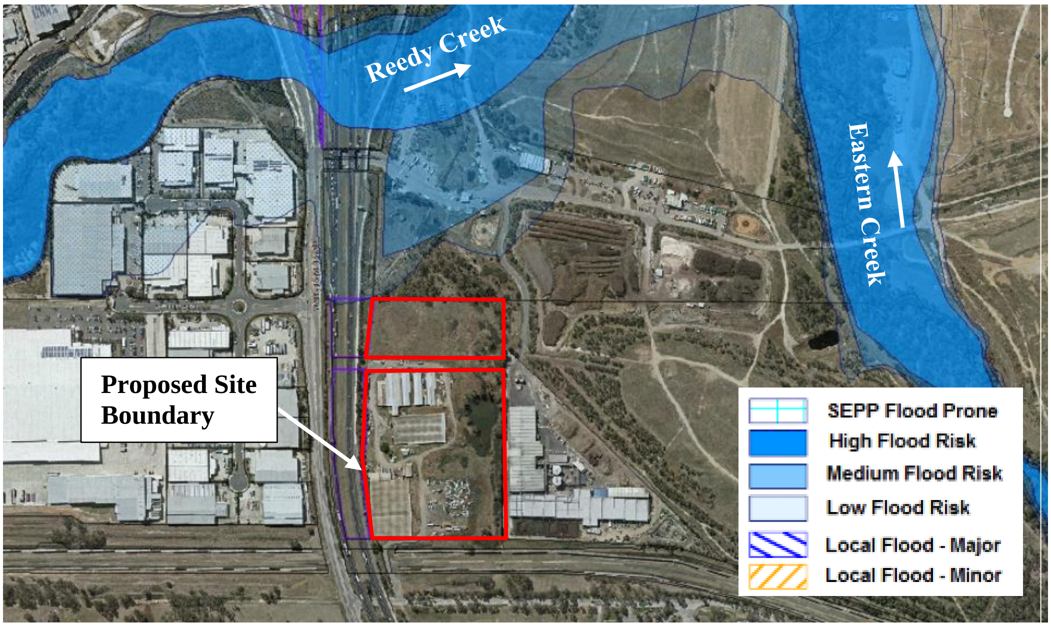


Figure 9 Extract from BCC MapsOnline showing mapped flood risk zones adjacent to the proposal site

Site specific flood assessment

In order to assess existing flooding conditions at the proposal site Arup has undertaken a site-specific flood investigation. A full summary of this investigation, including a comprehensive set of flood maps, is included in the Site Flood Impact Assessment report in Appendix A. Results of this investigation show flooding at the site along the overland flow path which runs from south to north along the eastern site boundary. Overland flow enters the site from the Water NSW site to the south and exits at the northern boundary. In all events flooding is shown to mix between the overland flow path and the farm dam at the proposal site. Flooding is also shown to be present at the GRL site to the east. A summary of flooding at the site for each of the 5% AEP, 1% AEP, 1% AEP climate change and PMF scenarios is included in the following sections.

5% AEP flood event

An extract from the 5% AEP existing conditions flood level map is included in Figure 10. In the 5% AEP flood event peak, flood depths across the southern portion of the site are generally less than 600mm. An exception is at a localised depression in the south-east of the site adjacent to the 55mAHD contour, where the peak depth is 1.3m and water spills into the neighbouring GRL property. The estimated peak flood level at the upstream (southern) site boundary is 55.4mAHD, and 53mAHD at the downstream (northern) boundary of the southern portion of the site.

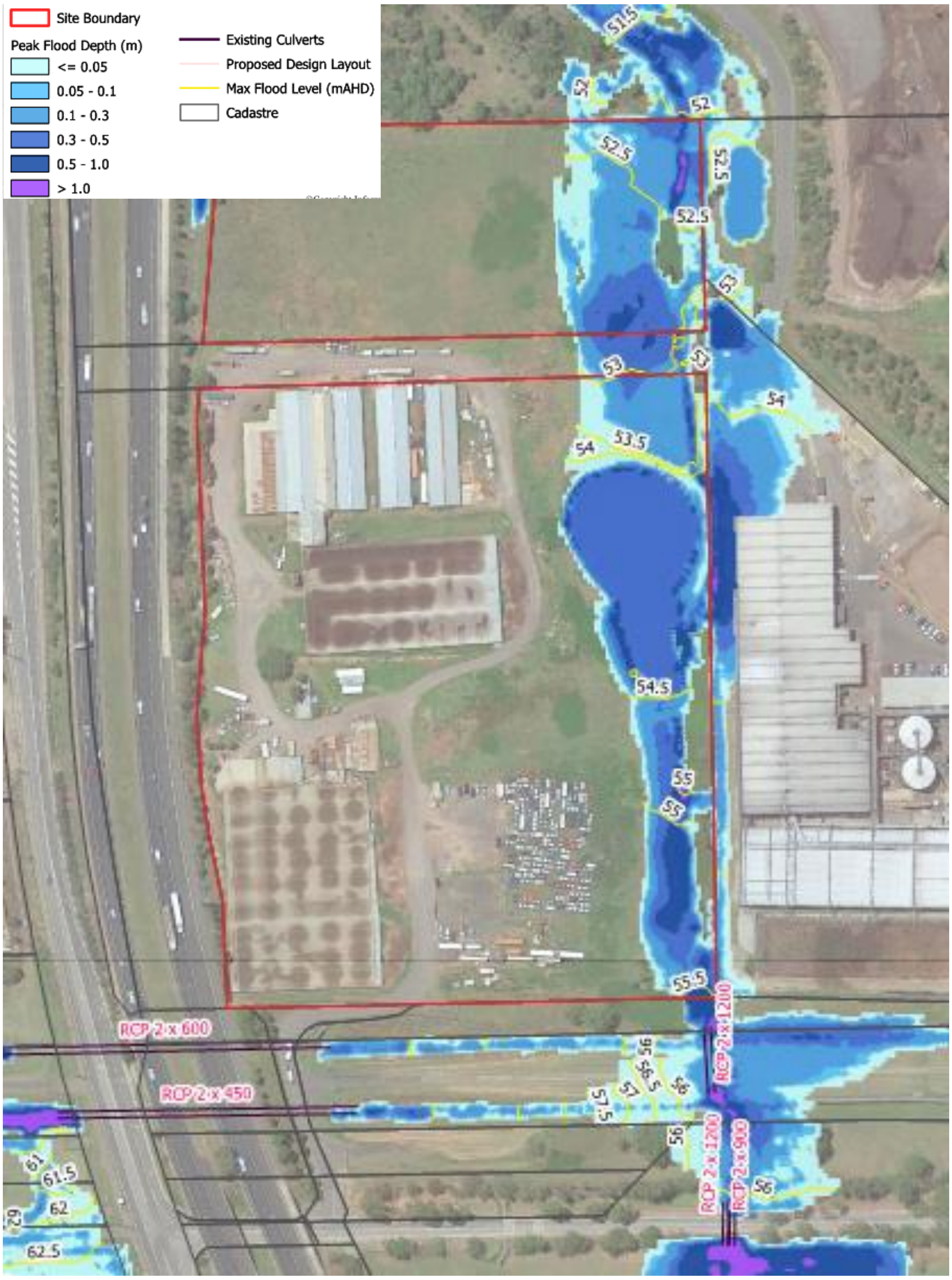


Figure 10 Extract of 5% AEP existing conditions flood level map

An extract from the 5% AEP existing conditions flood velocity map is included in Figure 11. The maximum flow velocity at the site in the existing 5% AEP event is typically less than 1m/s, with localised areas with velocities between 1m/s and 2m/s.

Figure 11 Extract of 5% AEP existing conditions flood velocity map

An extract from the 5% AEP provisional hydraulic hazard map is included in Figure 12. This shows that most of the flooded area at the site is low hazard. The overland flow path can be identified by the areas of intermediate and high hazard, which correspond to greater flow depths. The diversion of the overland flow path into the GRL site is clearly visible with areas of intermediate and high hazard at the GRL site in this area.

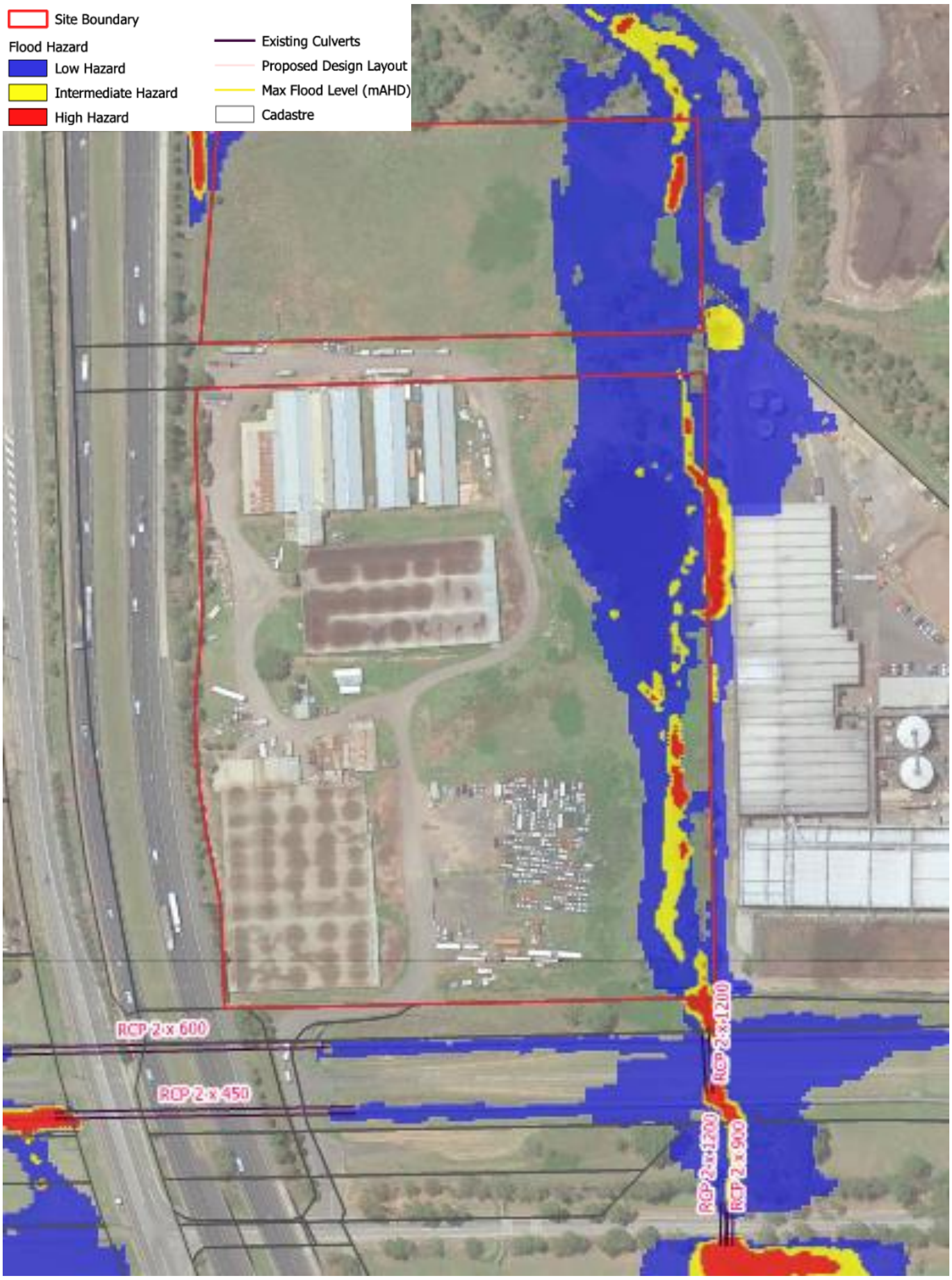


Figure 12 Extract of 5% AEP existing conditions flood hazard map

1% AEP flood event

An extract from the 1% AEP existing conditions flood level map is included in Figure 13. In the 1% AEP flood event flood depths at the site are generally less than 720mm. The exception is at a localised depression in the south-eastern portion of the site where depths reach 1.42m where water spills into the neighbouring GRL site. The estimated peak flood level at the upstream (southern) site boundary is 55.5mAHD, and 53.1mAHD at the downstream (northern) boundary of the southern portion of the site.

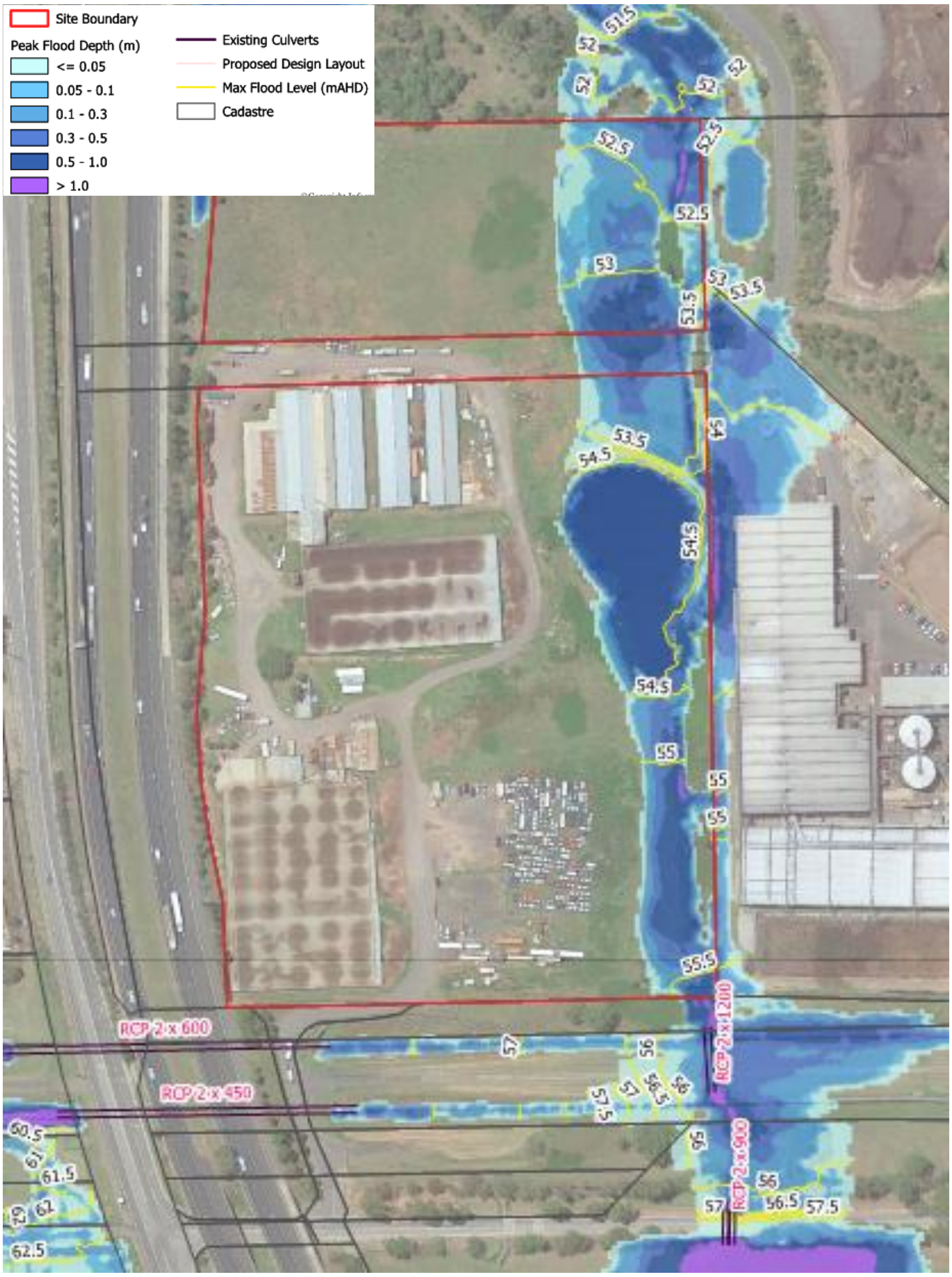


Figure 13 Extract of 1% AEP existing conditions flood level map

An extract from the 1% AEP existing conditions flood velocity map is included in Figure 14. Flow velocity at most of the flooded area at the site is less than 1m/s with areas along the overland flow path with velocities between 1m/s and 2m/s. Flow velocities at the GRL site adjacent the eastern boundary exceed 2m/s in a small area.

Figure 14 Extract of 1% AEP existing conditions flood velocity map

An extract from the 1% AEP provisional hydraulic hazard map is included in Figure 15. This map is similar to the 5% AEP map with the majority of the flood affected portion of the site low hazard, with areas of intermediate and high hazard along the overland flow path. Areas of intermediate and high hazard can be seen at the GRL site.

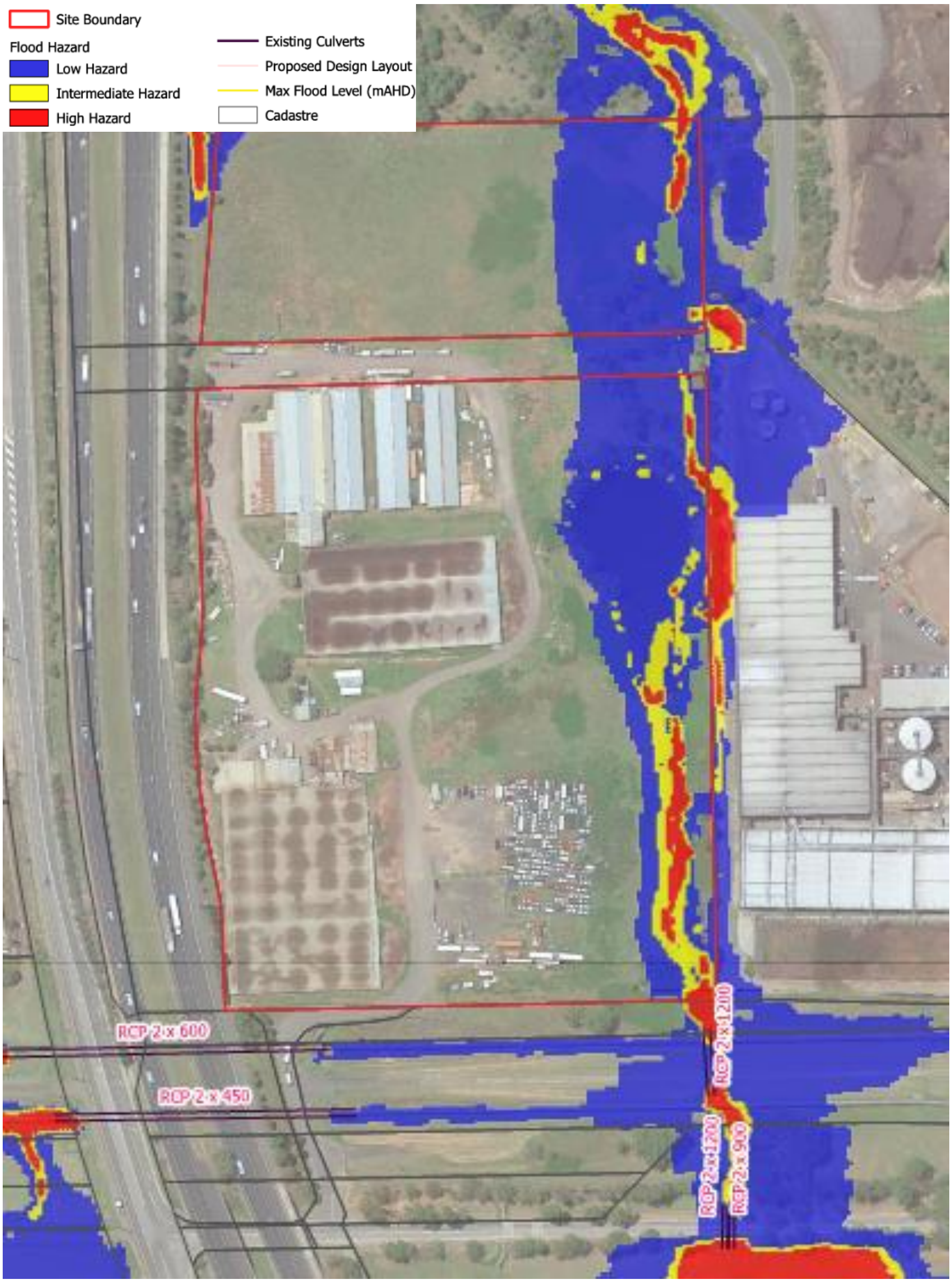


Figure 15 Extract of 1% AEP existing conditions flood hazard map

1% AEP flood event inclusive of climate change

An extract from the 1% AEP existing conditions flood map inclusive of climate change is included in Figure 16. Flood depths at the site are slightly higher in the 1% AEP climate change scenario compared to the base 1% AEP simulation, with a maximum depth at the site of 1.45m. Flood depths are generally less than 820mm across the site. The estimated peak flood level at the upstream (southern) site boundary is 55.6mAHD, and 53.2mAHD at the downstream (northern) boundary of the southern portion of the site.

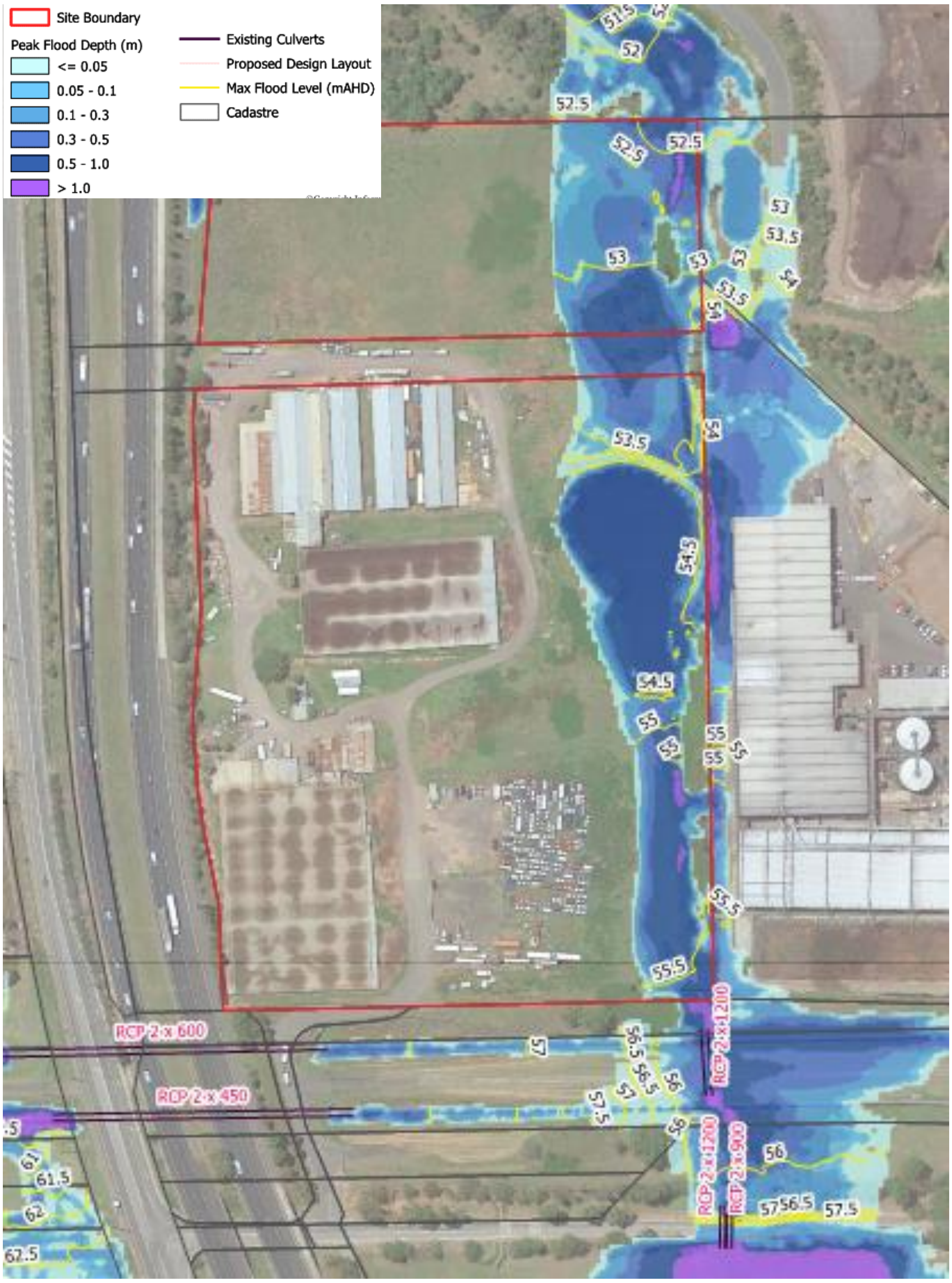


Figure 16 Extract of 1% AEP climate change existing conditions flood level map

An extract from the 1% AEP existing conditions flood velocity map inclusive of climate change is included in Figure 17. Flow velocities along the overland flow path are above 1m/s across a larger area compared to the 1% AEP map.

Figure 17 Extract of 1% AEP climate change existing conditions flood velocity map

An extract from the 1% AEP provisional hydraulic hazard map inclusive of climate change is included in Figure 18. These results show a larger area along the overland flow path with intermediate and high hydraulic hazard compared with the 1% AEP event.

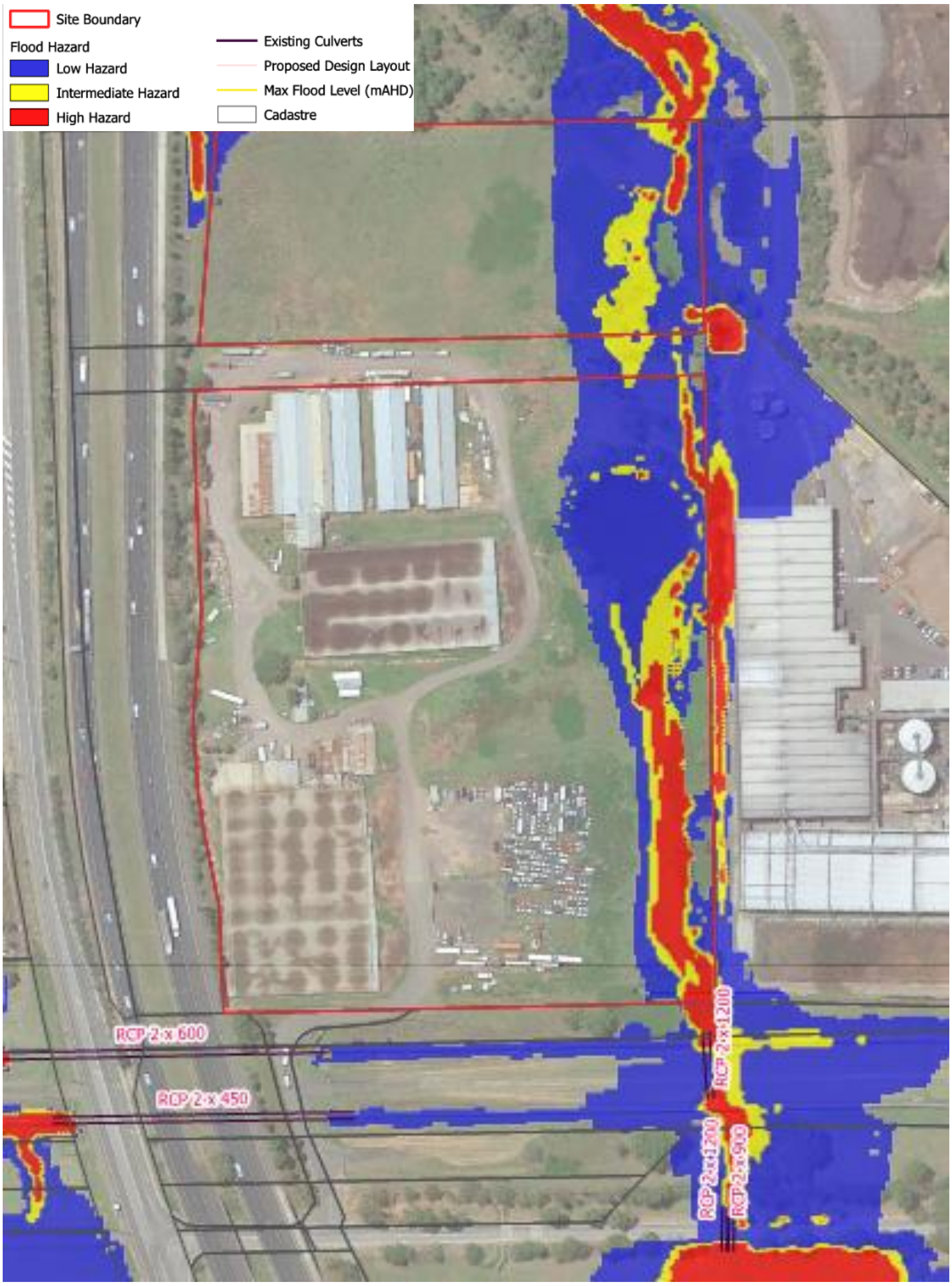


Figure 18 Extract of 1% AEP climate change existing conditions flood hazard map

PMF

An extract from the PMF existing conditions flood level map is included in Figure 19. Peak flood depth in the PMF reaches a maximum of 1.5m across the site, with the exception of the location where flows spill into the GRL site which reaches a depth of 2.2m. The estimated peak flood level at the upstream (southern) site boundary is 56.1mAHD, and 53.6mAHD at the downstream (northern) boundary of the southern portion of the site. The western portion of the site remains flood-free.

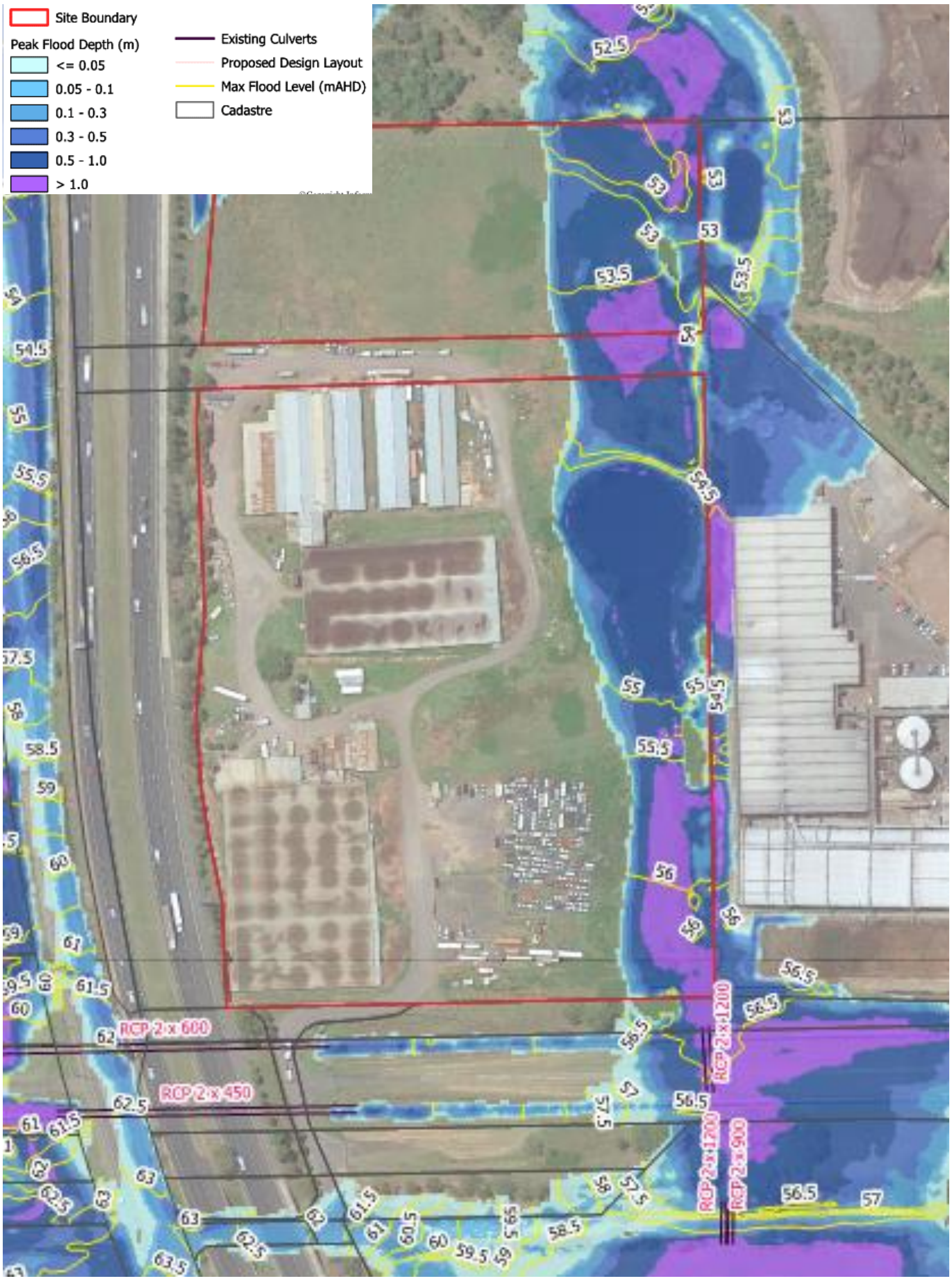


Figure 19 Extract of PMF existing conditions flood level map

An extract from the PMF existing conditions flood velocity map is included in Figure 28. Velocity of water entering the site is estimated to be 1.84m/s and exiting the site at 1.53m/s, reaching to the maximum of 4.2m/s in the middle of the site.

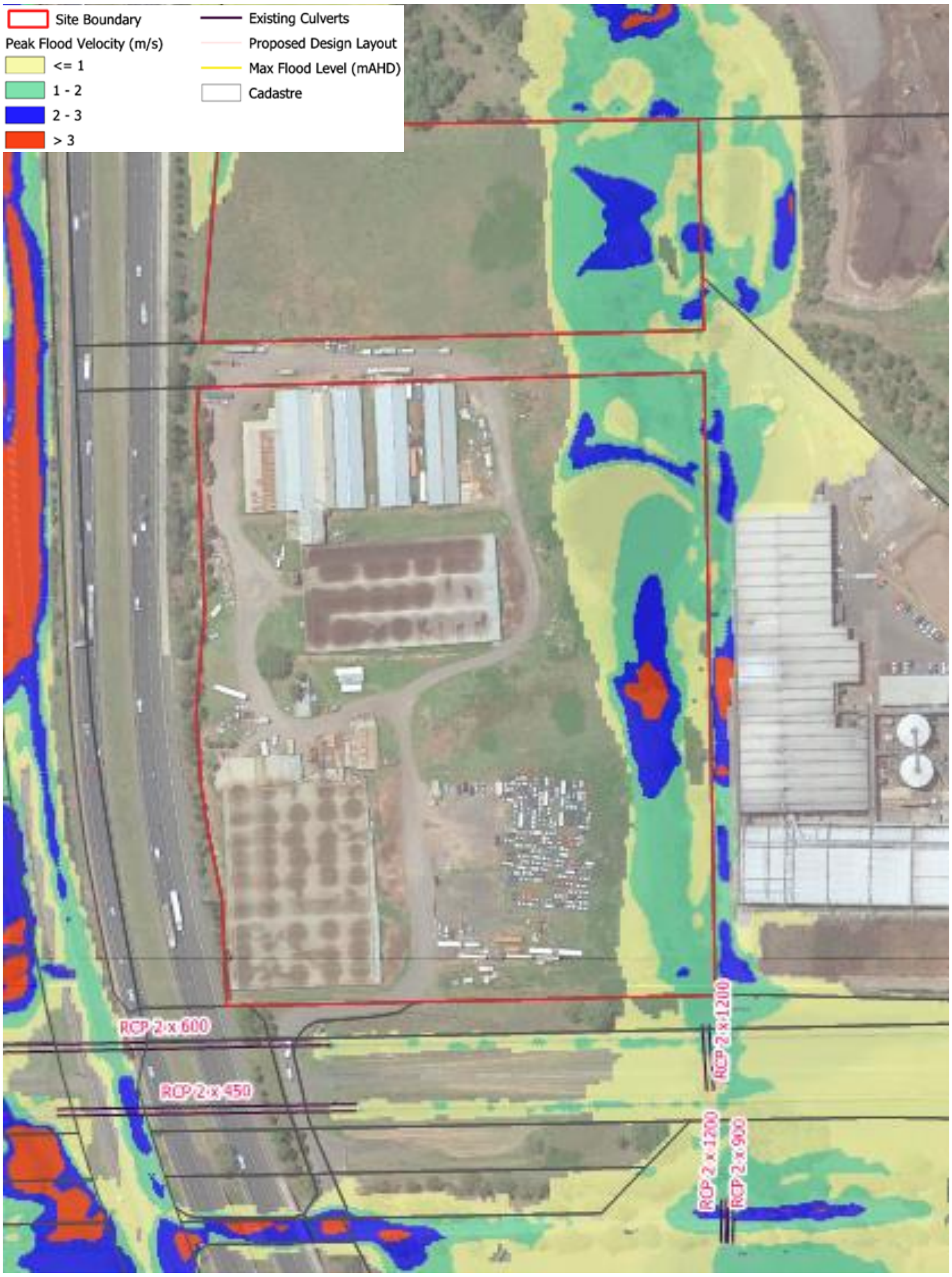


Figure 20 Extract of PMF existing conditions flood velocity map

An extract from the PMF provisional hydraulic hazard map is included in Figure 31. In this event most of the flooded area at the site and surrounding area is classified as high hazard.

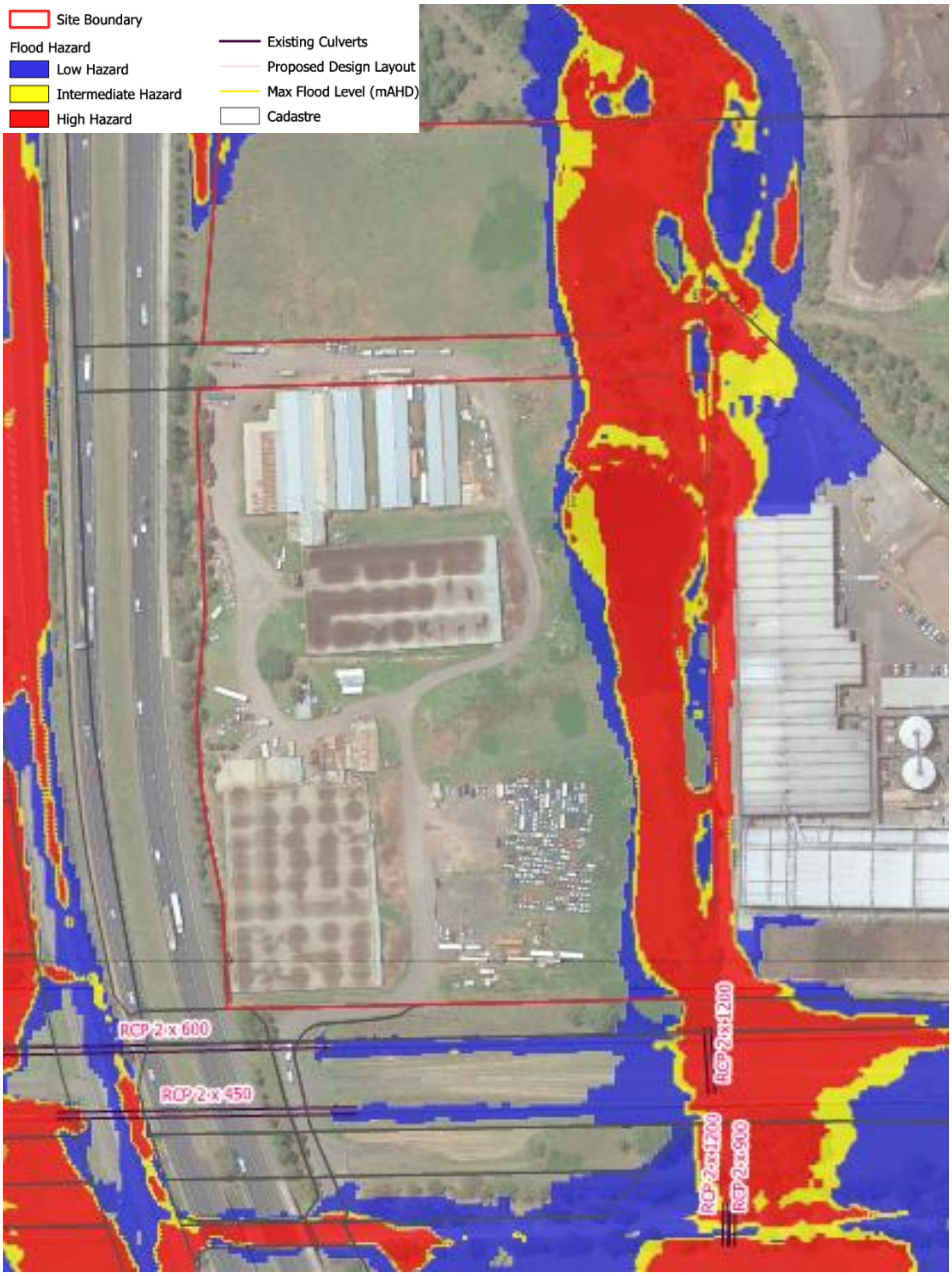


Figure 21 Extract of PMF existing conditions flood hazard map

3 Methodology

This Section outlines the methodology used to define the baseline and undertake the environmental assessment of potential impacts of the proposal on hydrology and flooding, including definition of the study area used as the basis of the assessment. This Section also presents relevant regulation, legislation and policy governing management of hydrology and flooding as it relates to the proposal.

3.1 Legislative context

3.1.1 New South Wales legislation

The following relevant NSW legislation has been considered when developing the study methodology and undertaking the impact assessment:

- State Environmental Planning Policy (Western Sydney Parklands 2009)
- Water Act (1912)
- Water Management Act (2000)
- Protection of the Environment Operations Act (1997)
- NSW State Rivers and Estuaries Policy (1993)
- NSW Flood Prone Land Policy (2005)
- State Water Management Outcomes Plan (2002)

3.1.2 Guidelines

The following guidelines have also been considered when developing the study methodology and undertaking the impact assessment:

- Blacktown Development Control Plan (Blacktown City Council, 2015)
- NSW Floodplain Development Manual (NSW Government, 2005)
- Guidelines for Riparian Corridors on Waterfront Land (Department of Primary Industries Office of Water, 2012)
- Guidelines for Controlled Activities on Waterfront Land (Natural Resources Access Regulator, 2018**)**
- Neutral of Beneficial Effect on Water Quality Assessment Guideline (Sydney Catchment Authority (now Water NSW), 2015)
- Managing Urban Stormwater: Soils & Construction (Landcom, 2004)
- Managing Urban Stormwater: Treatment Techniques (DECC, 1997)
- Managing Urban Stormwater: Source Control (DECC, 1998)
- Technical Guidelines: Bunding & Spill Management (DECC, 1998)

- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018)
- National Water Quality Management Strategy: Water quality management - an outline of the policies (ANZECC/ARMCANZ, 2000)
- National Water Quality Management Strategy: Policies and principles - a reference document (ANZECC/ARMCANZ, 2000)
- National Water Quality Management Strategy: Implementation guidelines (ANZECC/ARMCANZ, 2000)
- National Water Quality Management Strategy: Australian Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ, 2000)
- National Water Quality Management Strategy: Australian Guidelines for Water Quality Monitoring and Reporting (ANZECC/ARMCANZ, 2000)
- Using the ANZECC Guideline and Water Quality Objectives in NSW (DEC, 2006)
- NSW Government Water Quality and River Flow Environmental Objectives (DECC, 2006)
- Approved Methods for the Sampling and Analysis of Water Pollutants in NSW (DEC, 2004)

Primary consideration in assessing and designing stormwater drainage and water quality management strategies for the site is the Blacktown Development Control Plan (DCP) (Blacktown City Council 2015). Relevant requirements related to flood planning are included in the State Environmental Planning Policy (Western Sydney Parklands 2009). For this reason, the following sections describe the relevant requirements related to hydrology and flooding in these two documents.

3.1.3 Blacktown Development Control Plan (Blacktown City Council 2015)

The Blacktown DCP includes requirements for stormwater drainage design, water quality pollutant reduction targets, on-site detention, flooding and erosion, sediment and pollution control. These requirements have formed the basis for the proposed site stormwater management strategy. Relevant BCC requirements are summarised in the following sections.

Water quality

Part J of the DCP includes controls related to Water Sensitive Urban Design and Integrated Water Cycle Management. According to Section 4.2, all developments must achieve the minimum percentage reduction of post development average annual pollutant loads summarised in Table 4.

Table 4 BCC water quality pollutant reduction targets

Pollutant	% Post Development Average Annual Load Reduction
Total suspended solids	85%
Total phosphorus	65%
Total nitrogen	45%
Gross pollutants	90%
Total hydrocarbons	90%

On site detention

The site is located within the Hawkesbury Nepean Catchment area. However, according to Part J of the DCP the development must manage post development peak flows in accordance with BCC's Engineering Guide for Development or Upper Parramatta River Catchment Trust On-Site Stormwater Detention Handbook version 4 (2005). Based on consultation with BCC, the BCC On-Site Detention Deemed to Comply Tool, which is based on the UPRCT requirements, should be used to size on-site detention storages.

Flooding

Section 10 of the DCP addresses local overland flooding. For local overland flooding, site specific development constraints will apply in relation to building finished floor levels, restrictions on cut or fill and flood compatible building designs.

Erosion, Sediment and Pollution Control

During the construction phase all works or activities are to be undertaken in accordance with Managing Urban Stormwater: Soils and Construction (The Blue Book).

Part J of the DCP also requires that the post development duration of stream forming flows shall be no greater than 3.5 times the pre-developed duration of stream forming flows. This is referred to as the stream erosion index.

3.1.4 State Environmental Planning Policy (Western Sydney Parklands 2009)

Clause 14A of the State Environmental Planning Policy (Western Sydney Parklands 2009) relates to flood planning. This clause states that for development in areas below the flood planning level, the consent authority must be satisfied that the development:

(a) is compatible with the flood hazard of the land, and

(b) is not likely to significantly adversely affect flood behaviour resulting in detrimental increases in the potential flood affectation of other development or properties, and

(c) incorporates appropriate measures to manage risk to life from flood, and

(d) is not likely to significantly adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses, and

(e) is not likely to result in unsustainable social and economic costs to the community as a consequence of flooding.

3.2 Method

3.2.1 Water quality

Existing conditions water quality monitoring

BCC has provided test results for Reedy Creek for a six-month period from 2008 to 2009. These results provide an indication of the typical water quality in Reedy Creek downstream of the proposal site.

As part of the proposal, surface water sampling from the farm dam and overland flow path have been undertaken as part of the site contamination assessment. Testing included typical water quality indicators such as dissolved oxygen, pH, total nitrogen and total phosphorus. These test results provide an indication of the quality of existing surface water flows at the site.

Construction water quality monitoring

The contractor will be responsible for monitoring the quality of stormwater discharged from the site construction area via sedimentation basins during construction. Ongoing monitoring of water quality in the overland flow path through the site, including at the site discharge point will also be undertaken throughout construction.

Operational water quality monitoring

During site operations it is proposed to permanently monitor stormwater discharge at the outlet from the on-site detention basin. As all site stormwater runoff from the development area will be directed to the basin, this will enable the quality of runoff from the site to be monitored effectively. The permanent testing will monitor a range of parameters representative of general water quality, including:

- Dissolved oxygen (DO)
- Turbidity
- pH
- Total suspended solids
- Total nitrogen
- Total phosphorus

Operational water quality treatment

In order to assess the water quality performance of the stormwater management strategy of the operational facility MUSIC modelling software has been used. MUSIC was developed by the Cooperative Research Centre for Catchment Hydrology (CRCCH) and is used industry wide to assess the water quality performance of urban catchments. MUSIC is appropriate for the assessment of catchment areas of up to 100km^2 using a continuous simulation approach.

MUSIC can be used to determine if proposed changes to land use are capable of meeting mandated water quality objectives (CRC, 2002). The primary water quality parameters modelling in MUSIC are Gross Pollutants (GP), Total Suspended Solids (TSS), Total Phosphorus (TP) and Total Nitrogen (TN).

As the site is located within BCC LGA, MUSIC Link for BCC has been adopted. MUSIC Link fixes the rainfall and evaporation data for the proposal to values appropriate for the area, using 6-minute rainfall data for 1967 to 1976 from the 067035 Liverpool (Whitlam Centre) meteorological station. This station is located approximately 13km south of the site.

The MUSIC model for the site has been developed by breaking the site into sub-catchments based on land use and the site grading. The model also includes the proposed stormwater treatment train at the site. MUSIC modelling results have then been compared with BCC stormwater pollutant reduction targets.

A modified MUSIC model has also been used to calculate the Stream Erosion Index (SEI) to confirm compliance with BCC requirements.

3.2.2 Flood impact assessment

A site-specific Flood Impact Assessment has been undertaken to assess existing and post development flood conditions at the proposal site. This assessment also considers impacts associated with the proposal.

For the purposes of this investigation an XP-RAFTS hydrological model was developed to assess rainfall and runoff from the upstream catchment area. The hydrological model uses Australian Rainfall and Runoff (AR&R, 2019) rainfall data. This data was input into a two-dimensional TUFLOW hydraulic model to assess flooding in the catchment area. The model has been developed using a combination of topographical survey and LiDAR data for the site and upstream catchment area.

The model was used to determine suitable dimensions for the realigned overland flow channel through the site and other site earthworks. The proposed design was determined based on several iterations in order to mitigate any increases in flood levels at neighbouring sites.

The modelling assessed flooding for the 5% Annual Exceedance Probability (AEP), 1% AEP and Probable Maximum Flood (PMF) events.

A 1% AEP climate change scenario was simulated to assess the potential impact of climate change on flooding at the site. The United Nations International Panel for Climate Change (IPCC) has undertaken climate modelling and research to describe four future potential climate scenarios based on the concentration of greenhouse gas emissions that may occur in the following decades. These scenarios have been termed as Representative Concentration Pathways (RCP) and are designated as 2.6, 4.5, 6.0, and 8.5. AR&R (2019) recommends the use of low (4.5) and high (8.5) RCPs for impact assessments. For the purpose of this study, only the high concentration pathway, RCP8.5, was assessed. RCP8.5 estimates that rainfall intensities will increase by 19.7%. As such, a rainfall multiplier of 1.197 was applied to the 1% AEP storm to analyse potential changes in flood behaviour due to climate change.

A detailed description of the flood modelling methodology, validation and results is included in the Flood Impact Assessment Report in Appendix A.

3.2.3 Site stormwater quantity management

All runoff from the developed portion of the site will be conveyed via the minor and major stormwater network to the bioretention and on-site detention basin. The size of the detention component of the basin was determined using the BCC On-Site Detention Deemed to Comply spreadsheet (version 1.9).

3.2.4 Sydney Water drinking catchment

In response to the SEARs, a demonstration of a neutral or beneficial impact on the quality of the water in the bulk water supply infrastructure is required. This assessment follows the Neutral of Beneficial Effect on Water Quality Assessment Guideline (Sydney Catchment Authority (now Water NSW), 2015).

3.2.5 Risk-based Framework for Considering Waterway Health Outcomes

The NSW DPIE Environment, Energy and Science Group SEARs submission requested that the submission consider the Risk-based Framework for Considering Waterway Health Outcomes in Strategic Land-use Planning Decisions (State of NSW and Office of Environment and Heritage, 2017). This document has been considered and it is noted that it is targeted at strategic land use planning in the context of catchment management, and catchment management authorities, and therefore is not specifically relevant to the assessment of individual development applications.

The proposal has been assessed against BCC water quality pollutant reduction targets which are more suitable for assessing a development of this type. Adherence with these targets has been demonstrated for the proposal through the incorporation of rainwater harvesting, gross pollutant traps, bioretention and revegetation of the overland flow path in the proposal. These strategies contribute to the overall aims of the Considering Waterway Health Outcomes in Strategic Land-use Planning Decisions (State of NSW and Office of Environment and Heritage, 2017) document.

3.2.6 Water balance

A site water balance assessment has been undertaken to assess potable water demands, rainwater harvesting, sewer discharges and stormwater runoff from the site. The water balance uses 20 years of daily rainfall data from 2000 to 2019 from the Prospect Reservoir meteorological station. This data has been used to assess average annual water flows at the site. Rainfall data from 1967 to 1976 from the 067035 Liverpool (Whitlam Centre) meteorological station, which BCC recommend using for the water quality assessment, has also been used to validate the results.

3.3 Study area

3.3.1 Site stormwater management

The study area for the site stormwater management assessment for the proposal is limited to the southern section as shown in Figure 22. This is because all drainage infrastructure civil works and will occur in this area. This study area relates to the assessment of site stormwater runoff and drainage, on-site detention and stormwater quality management.

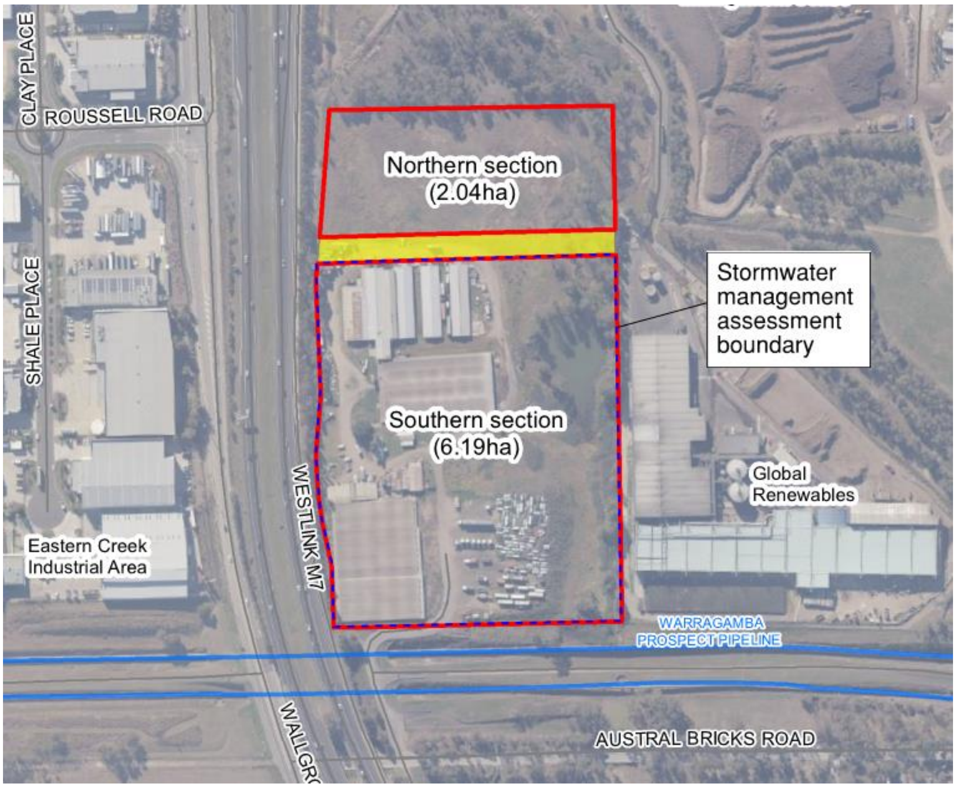


Figure 22 Study area for site stormwater management assessment

3.3.2 Flood impact assessment

The study area for the flood impact assessment of the proposal is shown in Figure 23. This area incorporates the upstream catchment area and extends downstream of the site to the model boundary so that it can assess any off-site impacts outside of the proposal site.

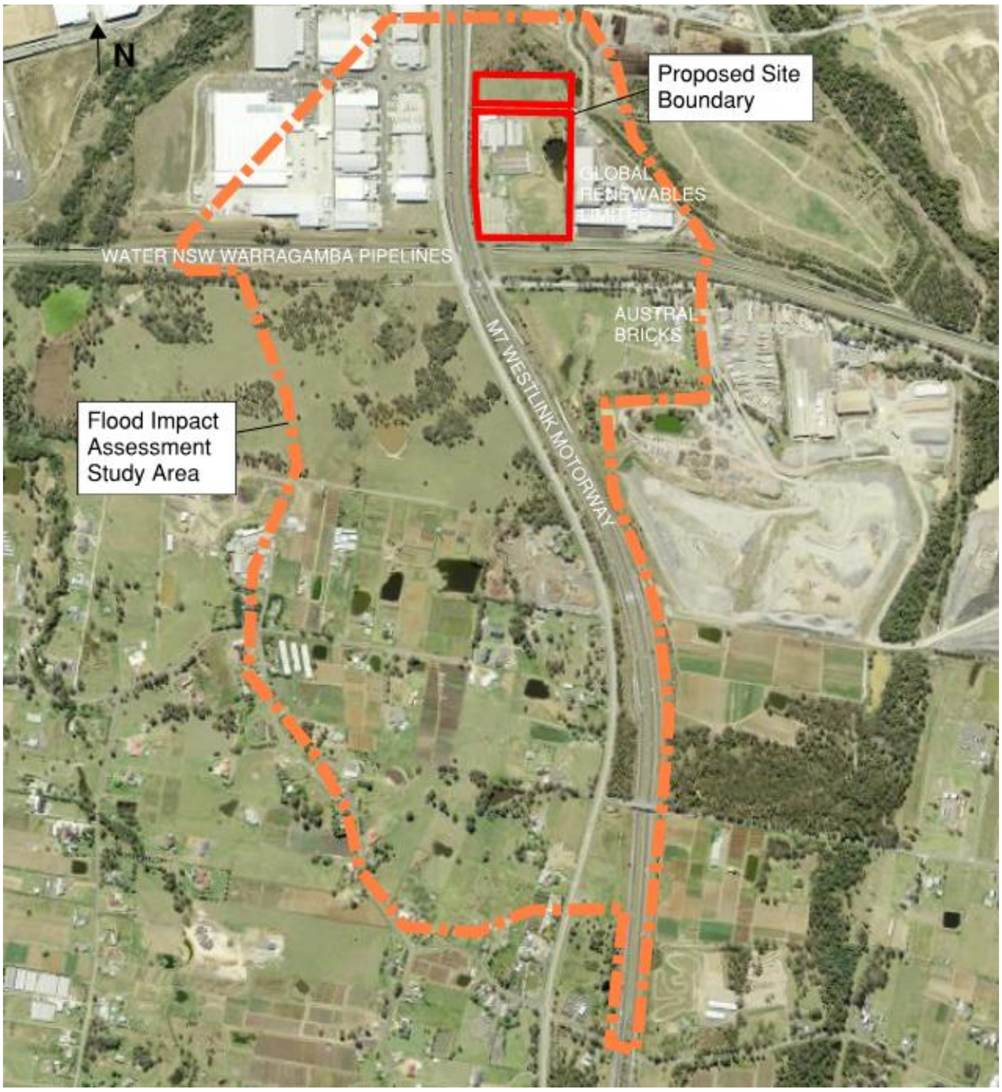


Figure 23 Study area for site flood impact assessment

4 Impact assessment

This Chapter details the hydrology and flooding impact assessment in relation to both construction and operational impacts.

4.1 Construction

4.1.1 Sediment and erosion control

Soils on the site are expected to exhibit high erodibility (Technical Report F). These characteristics will need to be considered as part of the construction phase sediment and erosion control strategy. Based on soil testing one sample showed indicated Potential Acid Sulfate Soils (PASS) soils may be present at the site (Technical Report G). Further testing prior to construction is recommended to confirm the presence of PASS. The presence of PASS will need to be considered as part of the sediment and erosion control strategy for the site.

Careful planning with regard to the phasing of clearing, excavation, stockpiling, and filling stages across the site will be required to effectively manage runoff from the site during construction. This will need to be considered in relation to the implementation of mitigation and control measures and stormwater runoff quality monitoring.

A preliminary erosion and sediment control plan has been prepared for the proposal and is included in Appendix B. A detailed Soil and Water Management Plan is to be developed for the construction stage, with reference to relevant guidelines, in particular, Managing Urban Stormwater Soils and Construction Volume 1 (Landcom, 2004).

Potential strategies that have been outlined in the preliminary plan include:

- Shaker pads at construction access points
- Sediment fences
- Cut-off drains
- Check dams
- Sediment basins

The detailed Soil and Water Management Plan will also need to consider sediment and erosion control measures for the realignment of the overland flow path. This should include the following measures:

- Timing of works to avoid wet periods
- Installation of temporary rock check dams in the realigned channel and downstream
- Bank stabilisation with geofabric materials

- Placement of sediment fencing downstream of works boundary
- Planting of vegetation as early as possible and attention to promote establishment

The final design, sizing and location of these measures will be determined based on the proposed phasing of site works. The final Soil and Water Management Plan will be submitted prior to issue of the Construction Certificate and should include a detailed description of the proposed overall approach and specific erosion and sediment control measures including:

- Proposed phasing of works
- Location of shaker pads and construction access points
- Location of sediment fences
- Size and location of cut-off drains and check dams
- Size and location of sediment basins, including any interim basins
- Location of stormwater discharge points and where applicable, pump rates from sedimentation basins
- Proposed groundwater management strategies, in particular for building bunker excavation
- Proposed water quality and quantity monitoring strategies during construction
- Details of a proposed strategy for post-construction rehabilitation of the site.

4.1.2 Farm dam decommissioning

During the construction phase the farm dam at the site will be decommissioned. The contractor will be responsible for preparing a Dewatering Management Plan which outlines strategies for the use of the water stored in the dam and controls for reducing environmental impacts. The management plan should include:

- Implementation of the construction surface water quality monitoring program to manage and limit the discharge of suspended solids into the receiving environment.
- Identification of discharge points for stored water and sediments. Where possible stored water will be spread across the site and used for dust suppression.
- Sampling of sediment samples to determine the associated contamination risk. If contaminants are identified, remediation strategies will be defined to minimise impacts on the receiving environment.
- Control measures to follow during dewatering to release/rehome native aquatic fauna and remove of potential exotic fauna.

4.1.3 Construction phase flood risk management

All construction compounds and main construction access tracks are to be located outside of the existing 1% AEP flood extent identified in the Flood Impact Assessment Report (refer Appendix A). The establishment of temporary drainage on site as outlined in Section 4.1.1 will be important to safely manage site stormwater runoff and minimise the risk of flooding during constriction.

Realignment of the existing overland flow path will be undertaken early in the construction program. This will reduce the flood risk at the site during construction and allow works, including site filling, over the existing flow path to occur subsequently.

4.1.4 Construction water demand

The estimated total construction timeframe is three and quarter years (39 months). Main civil works would occur during finite periods between months 6 and 36.

An estimate of potable water demand during construction was prepared by Rider Levett Bucknall in 2020. The average monthly water use is estimated to be 1240kL, with a maximum of 1240kL and minimum of 30kL. The total water demand for the construction phase is estimated to be 22,500kL.

It is anticipated that the existing Water NSW water connection would be utilised during early stages of construction until the permanent Sydney Water connection has been installed. Water collected in sediment basins could be reused for dust suppression on the construction site.

4.2 Operation and maintenance

4.2.1 Stormwater management strategy

Concept stormwater drainage design

The concept stormwater drainage design includes a minor network of inlet pits and pipes. Two trunk lines will collect stormwater from hardstand areas and rainwater tank overflows from roofs and discharge first to the bioretention basin, before overflowing into the OSD basin in large rainfall events. The western trunk line runs north from the south-western corner of the site, before following the access road around the building to the basins. The eastern trunk line also starts at the south-western corner of the site and runs east before following the visitor access road to the north towards the basins. The proposed stormwater pipe network is designed for the 5% Average Exceedance Interval (AEP) critical storm event in accordance with the requirements of the BCC Engineering Guidelines (2018) for industrial developments.

Consistent with BCC water sensitive urban design (WSUD) principles, the bioretention basin will mitigate water quality impacts associated with the proposal. To this end, the bioretention basin will include a permanent pond depth and will include filtration media which will be planted with suitable nutrient removing vegetation.

The major network follows the same general alignment as the pipe network, with overland flow beyond the capacity of the pipe network conveyed via a combination of kerb and gutter and spoon drains in the road network and hardstand areas towards the basins at the north-east of the southern portion of the site.

The existing overland flow path which runs from south to north along the eastern site boundary will be maintained with flows separated from site runoff. The channel will be formalised as a trapezoidal channel with a 300mm deep low-flow meander in the base. Previously the channel entered the neighbouring GRL site to the east for a section of approximately 50m. It is proposed that this section will be removed and the channel will be replaced within the proposal site through this section which will benefit the GRL site. Site stormwater will discharge from the OSD basin to the overland channel at the north-east corner of the southern portion of the proposal site.

The proposed site stormwater drainage network is shown in Figure 24 and drawings are included in Appendix C.

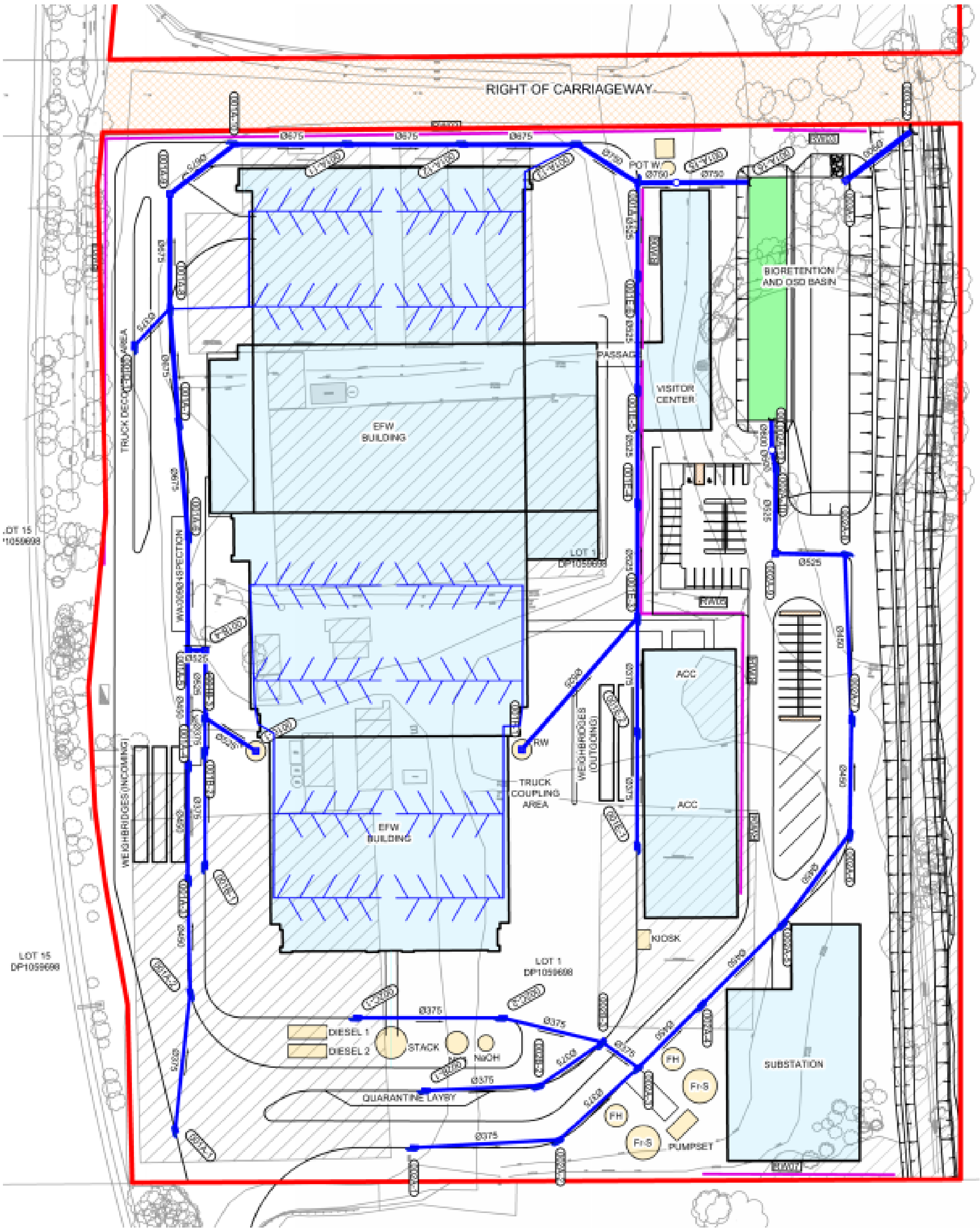


Figure 24 Proposed site stormwater network

Works to occur on the 2.04 ha northern section of the site include the clearing of weeds and exotic vegetation within the existing overland flow channel which is confined to the eastern section of this parcel of land. Therefore, the site stormwater concept plan and assessment is limited to the southern portion of the site.

Stormwater quality treatment

The proposed stormwater quality treatment train for the southern portion of the site has been designed to comply with BCC stormwater pollutant reduction targets. This approach is appropriate for this type of development and the use of local water quality targets is consistent with the objectives of the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC, 2000).

The proposed treatment of site stormwater runoff includes the following elements:

- Rainwater harvesting of main building roof runoff for reuse in plant process
- Site runoff through each trunk drain will pass through a gross pollutant trap prior to discharge to the basin
- A bioretention basin with a 600m^2 base filter area
- Realignment and revegetation of the overland flow path

The site has been split into sub-catchments to appropriately represent the proposed stormwater drainage network. Impervious fractions for each sub-catchment have been estimated from the design drawings. A summary of these sub-catchments is included in Table 5.

Table 5 MUSIC model sub-catchments

Sub-catchment	% Impervious	Area (ha)
Roof West	100%	0.753
Roof East	100%	0.825
Visitor Centre Roof	100%	0.093
Access Roads West	86%	1.804
Access Roads East	90%	1.49
Bioretention/OSD Basin Direct Rainfall	14%	0.414
Overland flow channel	0%	0.811
Total		6.19

The schematisation of the MUSIC water quality model is shown in Figure 25.

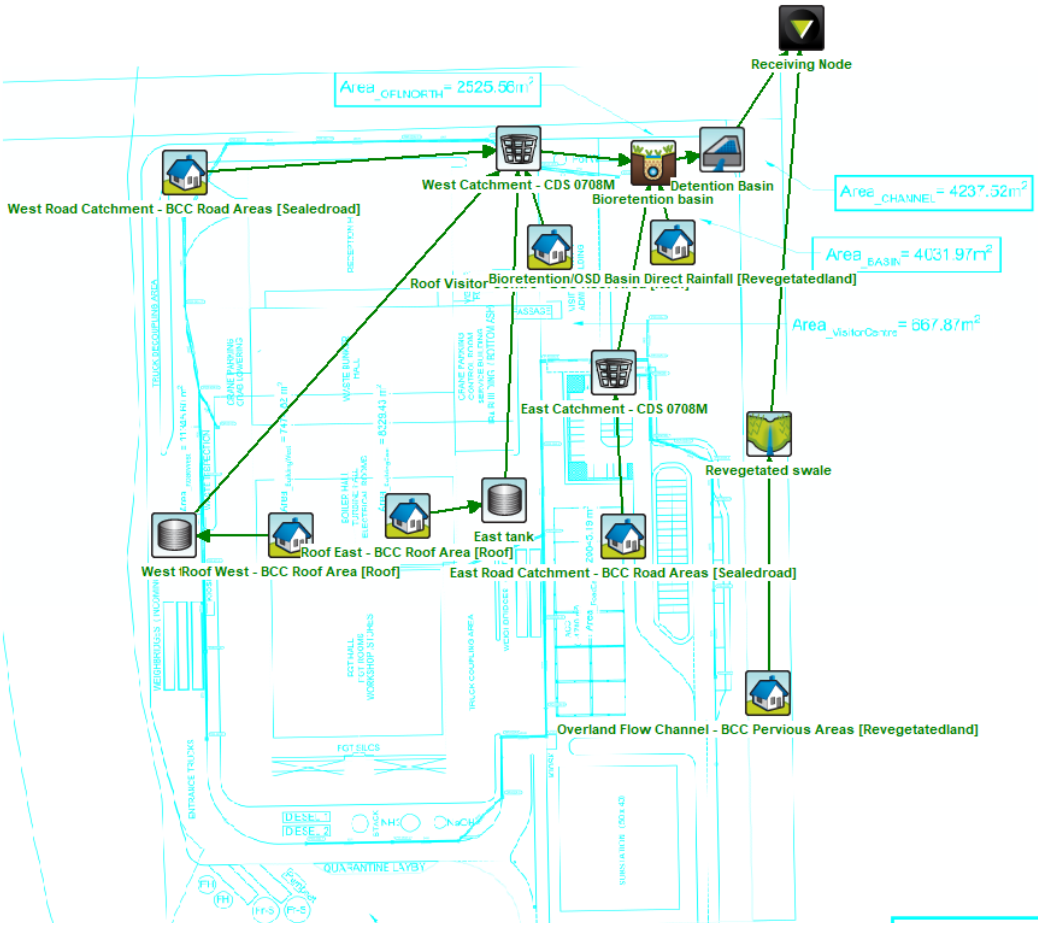


Figure 25 MUSIC model schematisation

The pollutant reduction results from the MUSIC model are summarised in Table 6. The full MUSIC Link report is included in Appendix E. These results demonstrate compliance with BCC requirements.

Table 6 Summary of MUSIC model results

Pollutant	Source load (kg/yr)	Residual Load (kg/yr)	Reduction	Target Reduction	Target Achieved (Yes/No)
Total Suspended Solids	8160	1040	87.2%	85%	Yes
Total Phosphorus	15.2	4.25	72.1%	65%	Yes
Total Nitrogen	84.3	44.8	46.8%	45%	Yes
Gross Pollutants	929	0	100%	90%	Yes

The discharge from the OSD basin will be installed with permanent water quality monitoring devices. These devices can be used to identify when maintenance will be required. General maintenance tasks are summarised in Table 7.

Table 7 Summary of stormwater maintenance tasks

Maintenance task	Frequency	Procedure
Overland flow path		
Check density of vegetation to ensure healthy growth of plants and that minimum 700mm height is maintained.	3 months	Replant and/or fertilise, prune, and water in accordance with BCC landscape consultant specifications or NATSPEC Chapter 0259. Replace dead or dying plants
Check for weed infestation	3 months	Remove any weed infestation. Ensure root ball of weed is removed. Replace with specified vegetation if required.
Inspect flow path for excessive sediment or litter build up	6 months	Remove sediment and litter. Dispose in accordance with BCC requirements
Check for evidence of channelization, scour and erosion	6 months and after heavy rainfall event	Reinstate eroded areas to the original channel design profile. May include replacing top soil and securing with biodegradable fabric. Replant with specified vegetation if required
Bioretention basin		
Check items listed under overland flow path	Refer to overland flow path section above	Refer to overland flow path maintenance tasks
Check density of vegetation to ensure healthy growth of plants and that minimum height is maintained.	3 months	Replant and/or fertilise, prune, and water in accordance with landscape consultant specifications
Check for sediment / litter/debris accumulation in inlet pipes	3 months and after heavy rainfall event	Remove sediment and dispose in accordance with BCC requirements
Check for sediment smothering biofiltration system vegetation	6 months and after heavy rainfall event	Remove sediment and dispose in accordance with BCC requirements.
Check for evidence of prolonged ponding, surface clogging or “boggy” filter media surface	6 months and heavy rainfall event	Remove sediment and dispose in accordance with BCC requirements. Check filter media has not been compacted / damaged or clogged.
Reconstruction of filter media	10 – 15 years	Replace filter media & planting in accordance with BCC and landscape consultant specifications. Reconstruction should preferably

		occur after a reasonably dry period so filter media is dry
OSD basin		
Check items listed under overland flow path	Refer to overland flow path section above	Refer to overland flow path maintenance tasks
Inspect inlet and outlet pipes where bypass channel crosses under maintenance access track.	3 months and after heavy rainfall event	
Inspect orifices and outlet pipes and remove any blockages	6 months and after heavy rainfall event	Remove grate and screen to inspect orifice and outlet pipe. Remove debris if found in accordance with BCC requirements.
Inspect pit sump for damage or blockages	6 months and after heavy rainfall event	Remove grate and screen, if required. Remove sediment / sludge build up and check orifice is clear
Inspect storage area and remove debris or litter	6 months and after heavy rainfall event	Remove debris and floatable material
Inspect overflow weir and remove any blockage	6 months and after heavy rainfall event	Ensure weir is free of blockage.
Inspect walls (internal and external) for cracks or spalling	Annually	Remove grate to inspect internal walls. Repair as necessary
Check attachment of orifice plate and screen to pit wall	Annually	Remove grate and screen. Ensure plate and screen are mounted securely. Tighten fixings if necessary and seal any gaps. Compare diameter to design (refer work-as-executed) and ensure edge is not pitted or damaged
Compare storage volume to volume approved	Annually / after major storm	Compare actual storage available with Work-as-Executed plans. If volume loss is greater than 5%, arrange for rectification.
Inlet and junction pits		
Inside of pits	6 months	Remove grate and inspect internal walls and base, repair where required. Remove any collected sediment, debris and litter.
		Check step irons to ensure fixings are secure and irons free from corrosion

Outside of Pits	4 months and after heavy rainfall event	Clean grate of collected sediment, debris, litter and vegetation
General stormwater system		
General inspection of complete stormwater drainage system	2 years	Inspect all drainage structures noting any dilapidation in structures and carry out repairs that are required.
Gross pollutant traps		
Inspect and remove accumulated litter	3 - 6 months depending on pollutant loads	Remove lid and inspect sump. Remove litter with vacuum hose or mechanical grab

Runoff from sensitive areas

Runoff from sensitive areas, where there is a risk of spills of chemicals or hydrocarbons, will be bunded to prevent overflow to the surrounding area. Oil and water separators will also be installed to treat runoff from these areas. This treatment is proposed for the following areas:

- Ammonia tanks
- Diesel refuelling area
- Electrical substation

Sensitive areas will be regularly inspected for spills. Oil and water separators will be monitored and maintained in accordance with the requirements and recommendations of the manufacturer.

Stormwater quantity management

On-site detention for site runoff will be provided in an open basin at the north-eastern corner of the site. The basin will fill via the overflow of the bioretention basin, which will be filled by the trunk stormwater network. Discharge from the basin will be through a multiple outlet discharge pit and orifice arrangement. The basin will also include an emergency overflow spillway.

The basin has been designed with a storage capacity of 3000m^3. The required storage volume has been determined using the BCC On-Site Detention Deemed to Comply Tool which is based on recommended storage volumes set out in the Upper Parramatta River Catchment Trust On-site Stormwater Detention Handbook (2005). This calculation is included in Appendix F.

Stream erosion index

The stream erosion index provides an indication of the potential for a development to cause erosion of the downstream waterway. BCC requires that the post development duration of stream forming flows shall be no greater than 3.5

times the pre-developed duration of stream forming flows. Based on an estimated pre-development critical stream forming flow of 0.12m^3/s the calculated stream erosion index for the site is 2.8, which is acceptable.

Overland flow channel realignment

As part of the proposal the existing overland flow channel through the southern portion of the site will be realigned to form a trapezoidal channel. It is proposed to remove the connection with the existing section of the overland flow path that runs into the adjacent GRL site, with the channel to continue within the proposal site. This will reduce flooding at the GRL site in frequent flood events.

The proposed channel base width is 6m at the southern boundary, which allows flows from the Water NSW site to safely enter the site, before narrowing to 3m wide and continuing at this width to the northern boundary of the southern portion of the site. A 300mm deep meandering low flow channel is proposed to run along the base of the channel to maintain the characteristics of a natural channel and provide aquatic habitat. Side slopes are proposed to be 1 in 3, with suitably sized rock placed along the sides and base to prevent erosion.

The overland flow channel will be planted with suitable native vegetation in accordance with the Biodiversity Development Assessment Report (Technical Report Q) and consistent with a Manning's number of 0.04. Typical cross-sections of the proposed overland flow channel with a 6m and 3m base width are shown in Figure 26.

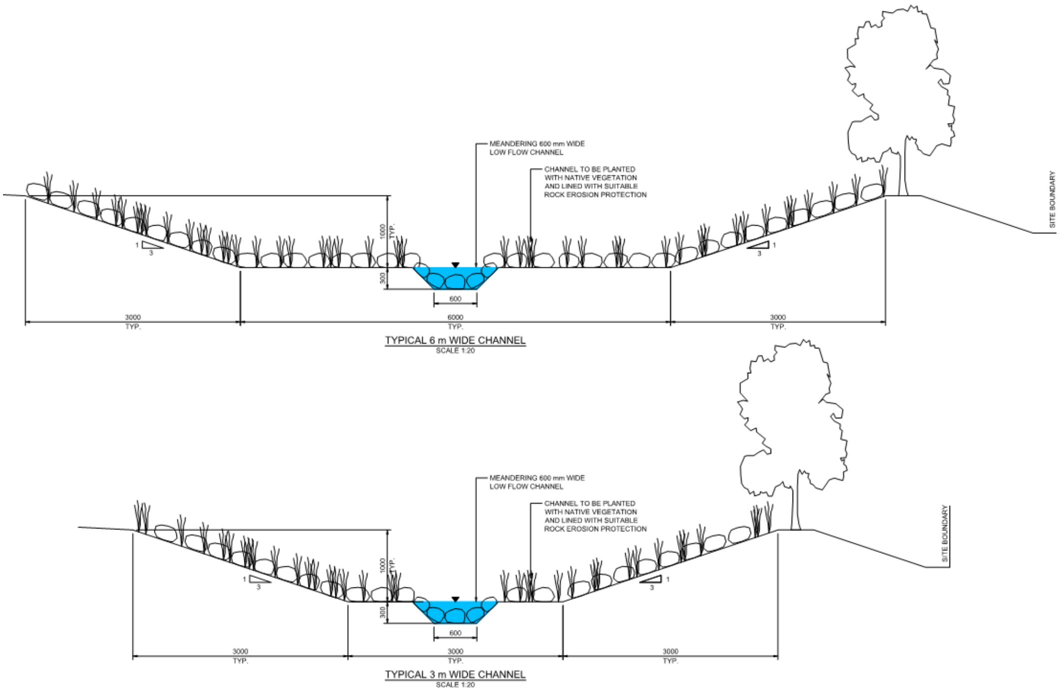


Figure 26 Typical cross sections of realigned overland flow path

Riparian corridors

As noted in section 2.7, the overland flow path through the site is not defined as a watercourse in NSW Maps (Six Maps) and so does not have a defined riparian corridor that needs to be considered as part of the realignment. The overland flow path realignment would not directly interact with either the Reedy Creek or Eastern Creek riparian corridors. However, improvements to the overland flow path through revegetation and the provision of a low-flow channel would provide water quality benefits to these downstream watercourses.

Neutral or beneficial impact on bulk water supply infrastructure

Under the State Environmental Planning Policy (Western Sydney Parklands) 2009, for consent to be granted the proposal must have “a neutral or beneficial impact” on the quality of the water in the bulk water supply infrastructure shown on the Bulk Water Supply Infrastructure Map. These maps include Prospect Reservoir.

Stormwater discharge from the site drains to the north with the overland flow path meeting with Reedy Creek which subsequently drains into Eastern Creek, this flow path is illustrated in Figure 27. Eastern Creek ultimately drains to South Creek then via the Nepean and Hawkesbury rivers to sea.

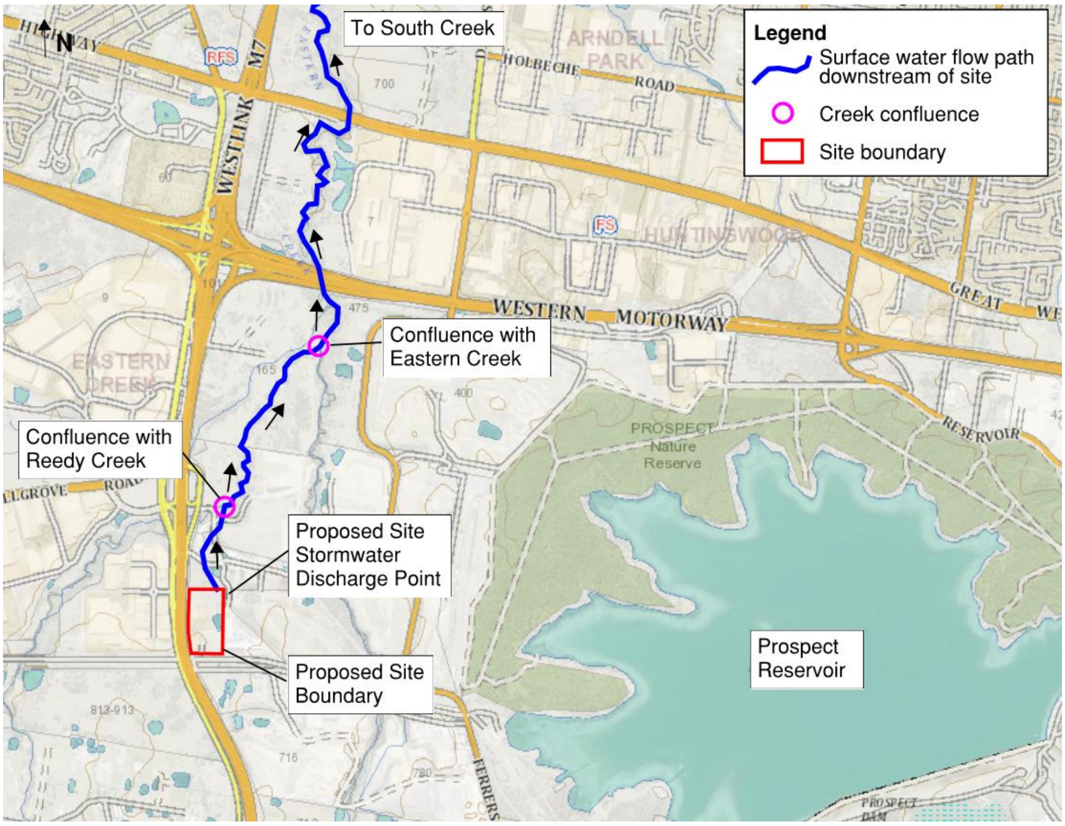


Figure 27 Downstream flow path for surface water discharge from proposal site

As the proposal is not located within the surface water catchment area for Prospect Reservoir, there is no pathway for site runoff to have any impact on water quality in the reservoir or other bulk water supply infrastructure. According to the Neutral of Beneficial Effect on Water Quality Assessment Guideline (Sydney Catchment Authority, 2015), if the development is not in the drinking water catchment, the neutral or beneficial assessment is not required.

4.2.2 Water balance

A water balance assessment has been undertaken for the site to estimate annual potable water demands, sewage discharges and stormwater runoff from the site. The water balance used 20 years of rainfall data from 2000 to 2019 at the Prospect Reservoir weather station. More detail regarding utility demands and connections is included in Technical Report P: Utilities and services assessment report.

Water demand

Energy from waste process

The operations consist of two incineration lines with a process demand of 4.5L/s each. The lines are assumed to operate for 8,000hrs/year. Except for scheduled shutdowns, the plant will typically operate 24 hours a day, therefore, the estimated daily plant process demand is 9L/s or 778kL/day. This water could be supplied by harvested rainwater or potable water.

Water consumption has been optimised such that water is wholly consumed by the process with water lost to a combination of steam or quenching of incinerator bottom ash. Therefore, no remaining process water is discharged to sewer.

Site and staff facilities

The potable water demand for staff facilities such as bathrooms, kitchens and facility washdowns and cleaning is estimated to be 26kL/day.

Water supply

Rainwater tanks

Two 100kL rainwater tanks will collect runoff from either side of the main building roof. Rainwater collected in these tanks will be used to supply process water in the building. These tanks have been sized to provide a continuous 6 hour supply for this purpose. Rainwater will be used whenever it is available. It is estimated that on average 12,000kL of rainwater can be harvested and reused each year.

Recycled Water

In consultation with Sydney Water, consideration was given to the option of supplying the site with recycled water to service the process water demand. However, this was ultimately not pursued for the following reasons:

- The nearest current supply point for recycled water was in the Parramatta area. This is approximately 10km from the site which is too far to be economical.
- Sewer mining of a trunk sewer would require the construction of a new wastewater treatment plant in addition to rising mains to the site. Due to the up-front capital costs and spatial requirements for the plant, this option was not deemed to be feasible.

Potable water

Potable water will be used to supply staff amenities, general site demands as well as the demand for process water that is not met by rainwater harvesting. The estimated total annual demand is 281,000kL.

Water discharge

Sewer

The sewer discharge from the site will be equal to the staff facilities and site maintenance/washdown demand of 26kL/day which equates to an average annual discharge of 9,000kL.

Site stormwater runoff

The site stormwater runoff will be conveyed to the proposed bioretention and on-site detention basin at the north-east of the site via the site drainage network. This will include overflow from the rainwater tanks when they are full. Site stormwater runoff will be discharged from the basin to the overland flow path. The estimated annual site stormwater discharge from rainfall on the site is 33,000kL. An additional 5,000kL per year is estimated to be lost to soil infiltration from pervious areas at the site.

Results summary

A summary of the results of the site water balance is included in Table 8.

Table 8 Site water balance summary

Water source/demand	**Average annual total (kL)**	
	Inflow	**Outflow**
Rainfall on site	50,000	
Rainwater used for process		12,000
Stormwater discharge from site		32,000
Stormwater infiltration and evapotranspiration on pervious areas		6,000
Potable water supply	281,000	
Potable water used for process		272,000

Discharge to sewer	9,000

In order to validate these results, the water balance was also calculated using rainfall data from 1967 to 1976 at the Liverpool (Whitlam Centre) meteorological station, which was used for water quality modelling. In addition, estimated annual rainwater reuse was verified using the MUSIC water quality model. Average annual estimates from each method are within 25% of each other, which is considered acceptable. Detailed water balance calculations are included in Appendix D.

4.2.3 Post-development flooding

The following sections include a short discussion of the post-development conditions results for each flood event modelled.

5% AEP flood event

An extract from the 5% AEP post-development conditions flood level map is included in Figure 28. This map shows that in the 5% AEP flood event overland flow in the southern portion of the site is contained within the realigned overland flow channel, with a smaller extent of flooding compared to existing conditions. The estimated peak flood level at the upstream (southern) site boundary is 55.4mAHD, and 53mAHD at the downstream (northern) boundary of the southern portion of the site. Some flooding is still present at the GRL site, this is due to floodwaters entering the GRL site at its southern boundary from the Water NSW site.

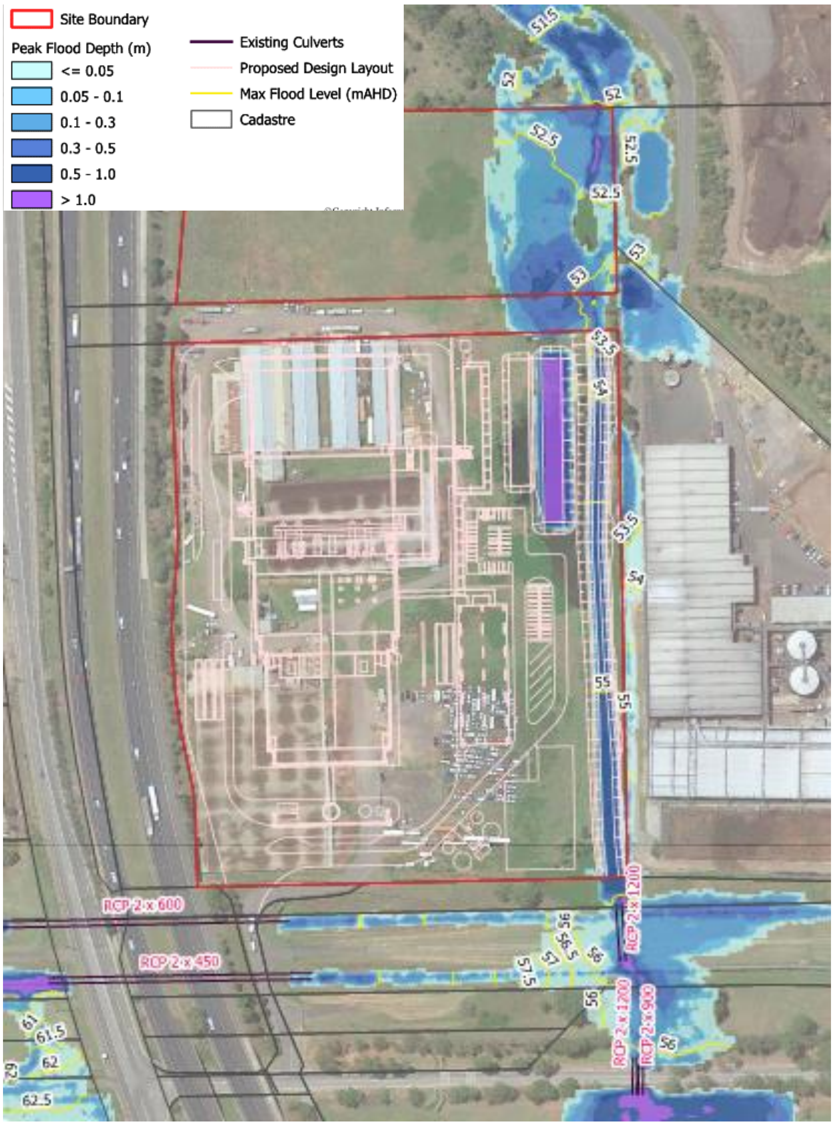


Figure 28 Extract of 5% AEP post development conditions flood level map

An extract from the 5% AEP post-development flood velocity map is included in Figure 29. This map shows velocities within the realigned overland flow channel are typically between 1m/s and 2m/s, with some velocities greater than 2m/s at the north of the southern portion of the site.

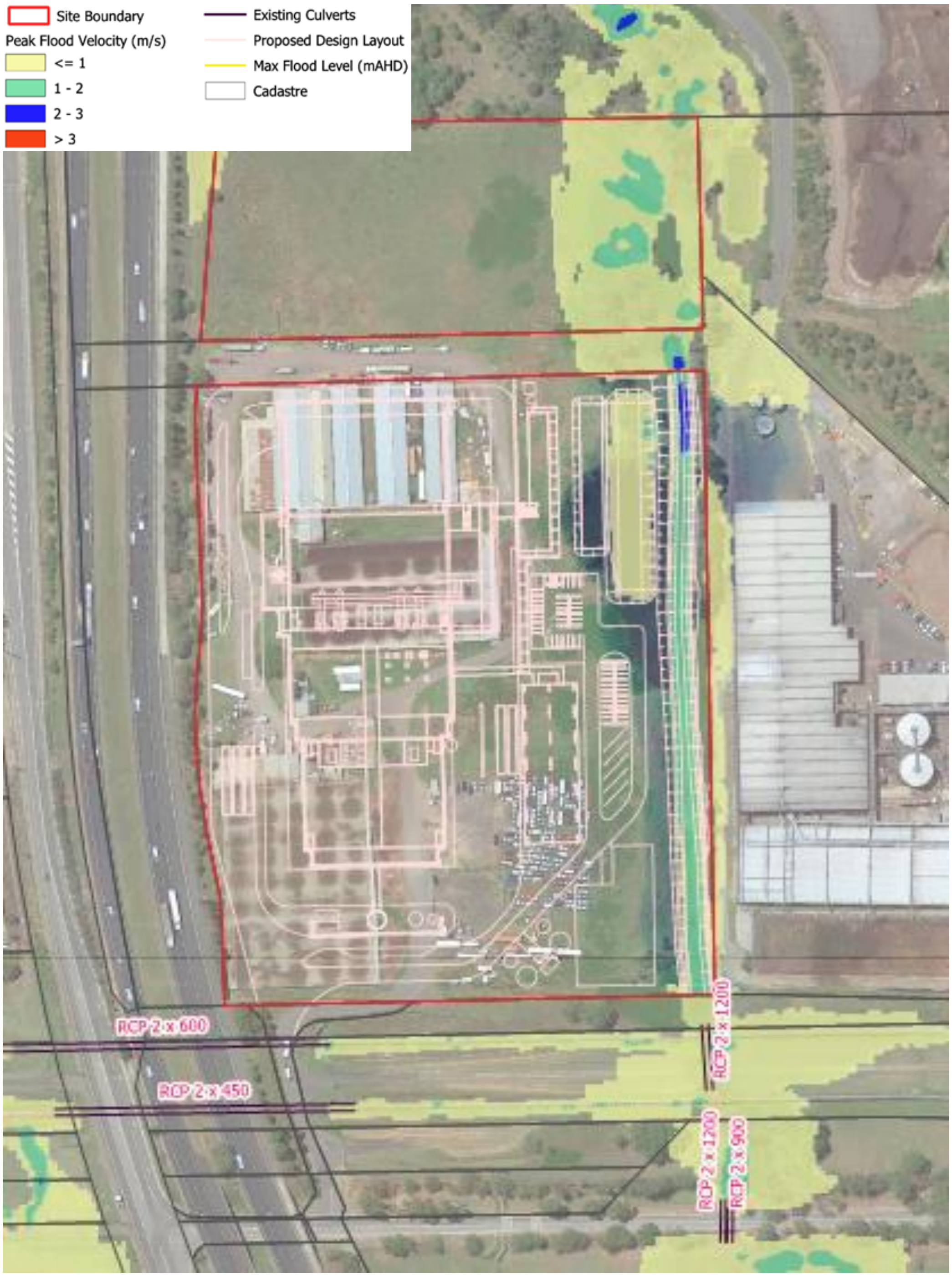


Figure 29 Extract of 5% AEP post development conditions flood velocity map

An extract from the 5% AEP post-development provisional hydraulic hazard map is included in Figure 30. This map shows high hazard along the realigned overland flow channel, due to the concentration of flows. With this flooding now occurring in a clearly defined channel, the risk associated with flooding can be managed through appropriate signage at the site to deter people from entering during rainfall events. Hydraulic hazard at the GRL site is low, with hazard at the now removed overland flow path diversion reduced from intermediate and high hazard to low hazard. Hazard to the south and north of the site is unchanged.

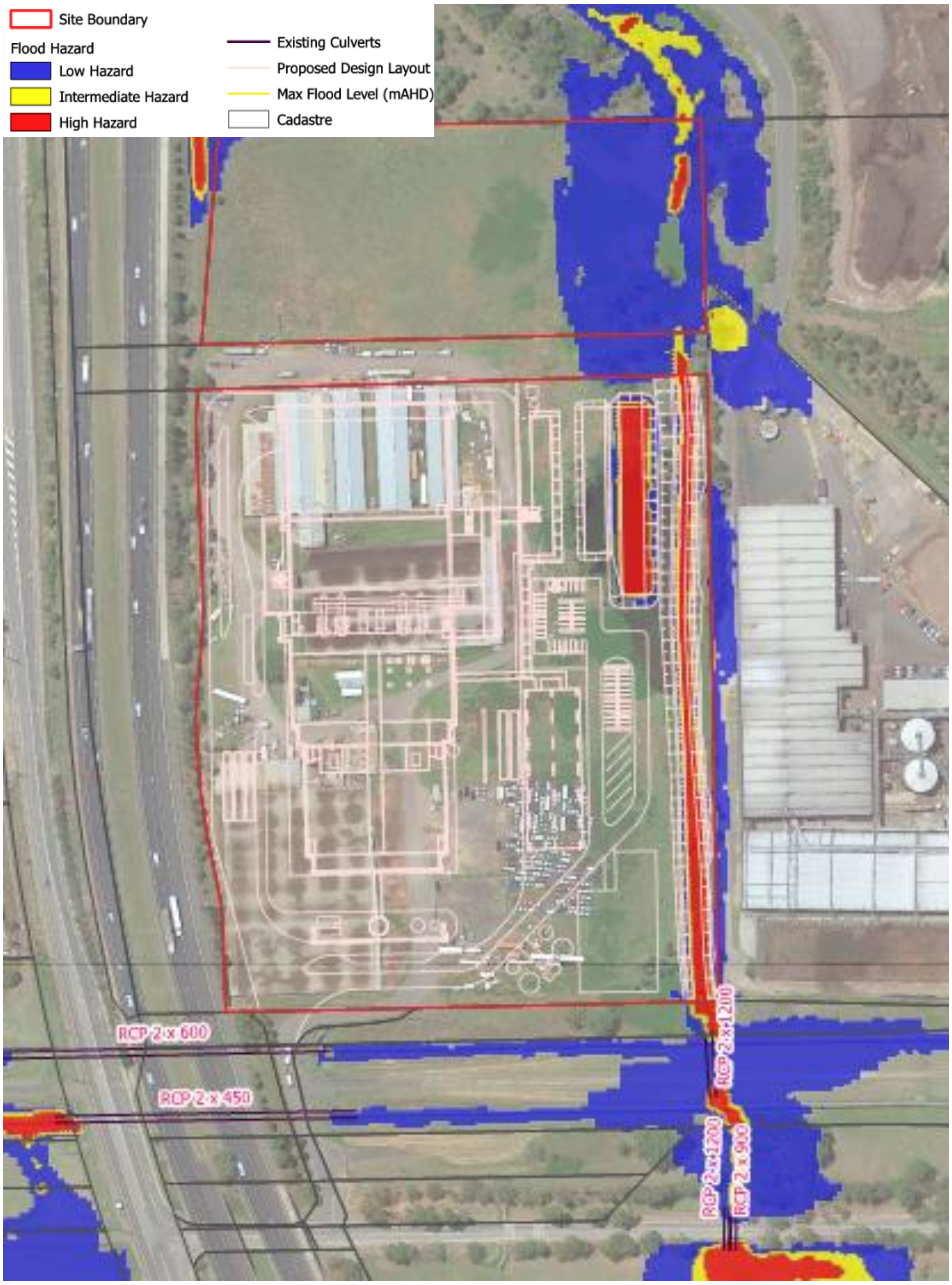


Figure 30 Extract of 5% AEP post development conditions flood hazard map

1% AEP flood event

An extract from the 1% AEP post-development conditions flood level map is included in Figure 31. In the 1% AEP flood event flood depths at the site are generally less than 1m. Similar to the 5% AEP event, flooding at the site is contained to the realigned overland flow channel through the site. Site stormwater runoff is managed in the OSD basin. The estimated peak flood level at the upstream (southern) site boundary is 55.5mAHD, and 53.1mAHD at the downstream (northern) site boundary, as per existing conditions.

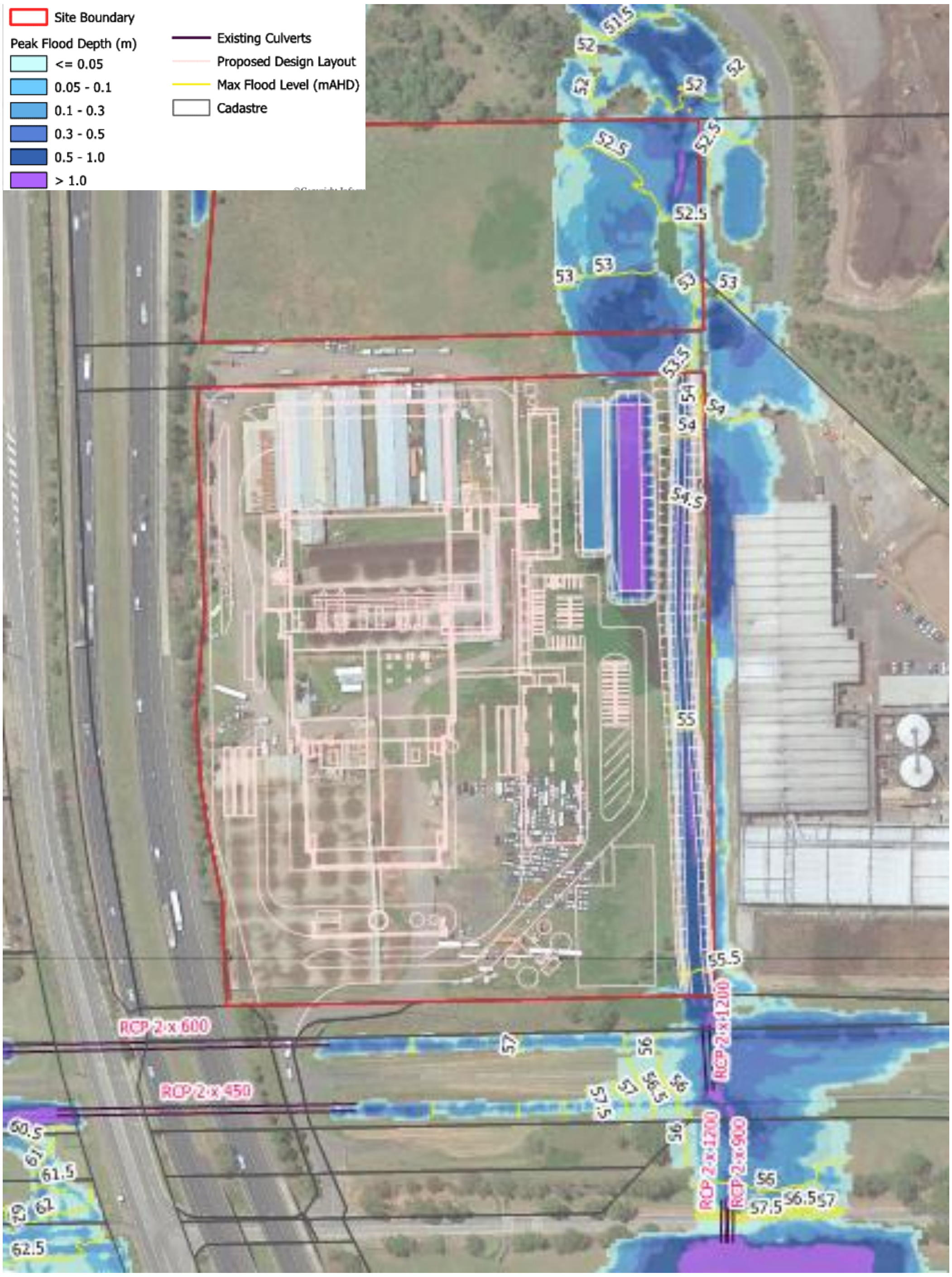


Figure 31 Extract of 1% AEP post development conditions flood level map

An extract from the 1% AEP post-development flood velocity map is included in Figure 32. Similar to the 5% AEP event, this map shows velocities within the realigned overland flow channel are typically between 1m/s and 2m/s, with some velocities greater than 2m/s at the north of the southern portion of the site. Appropriate erosion protection measures will be included in the realigned overland flow channel to manage these flow velocities.

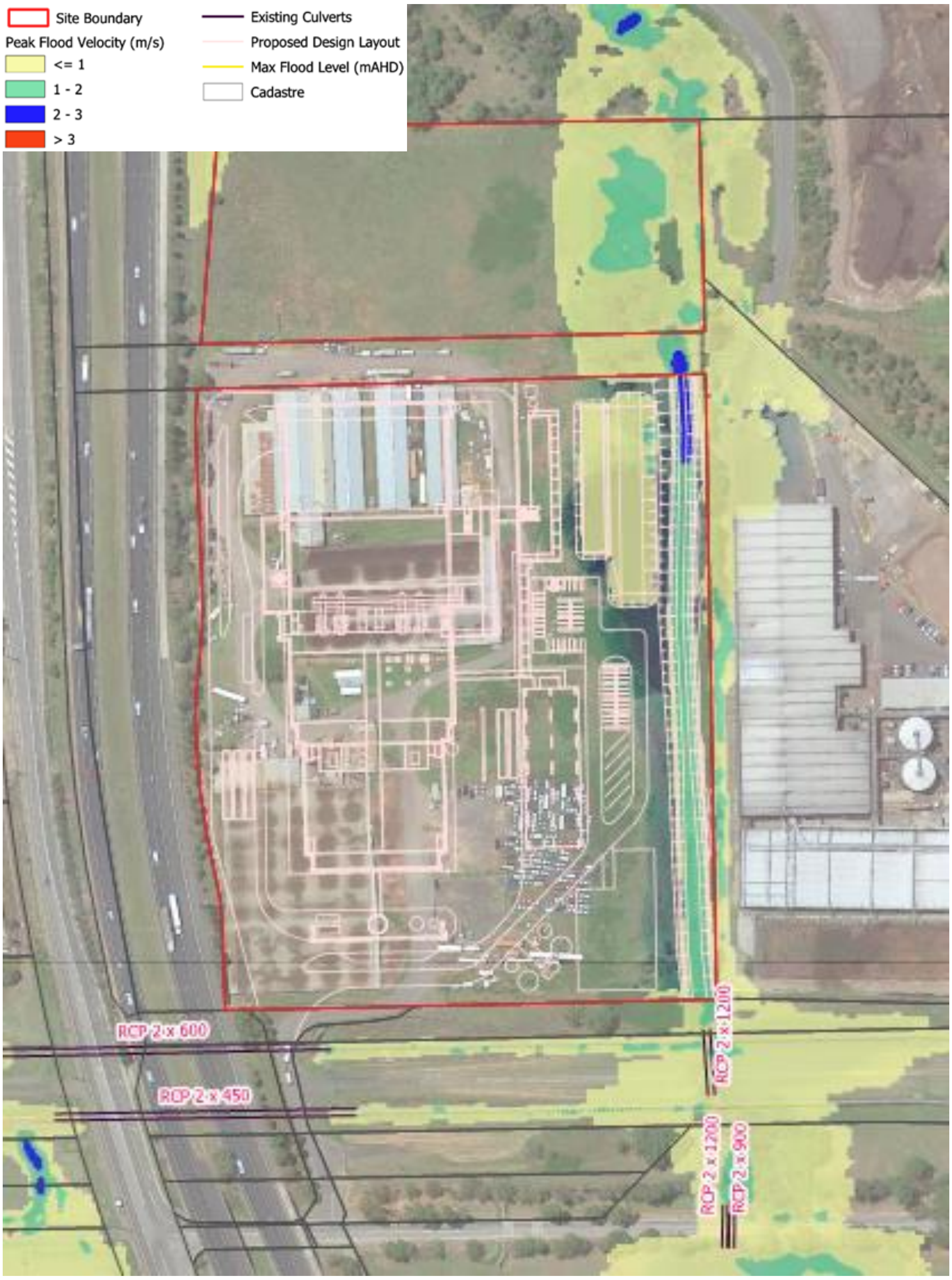


Figure 32 Extract of 1% AEP post development conditions flood velocity map

An extract from the 1% AEP post-development provisional hydraulic hazard map is included in Figure 33. Similar to the 5% AEP map, high hazard is shown along the realigned overland flow channel, due to the concentration of flows. Hydraulic hazard at the GRL site is low, with some localised areas of intermediate and high hazard. Compared to existing conditions the extent of intermediate and high hazard at the GRL site is significantly reduced, which would represent a reduction in flood risk at this site. Hazard to the south and north of the site is unchanged.

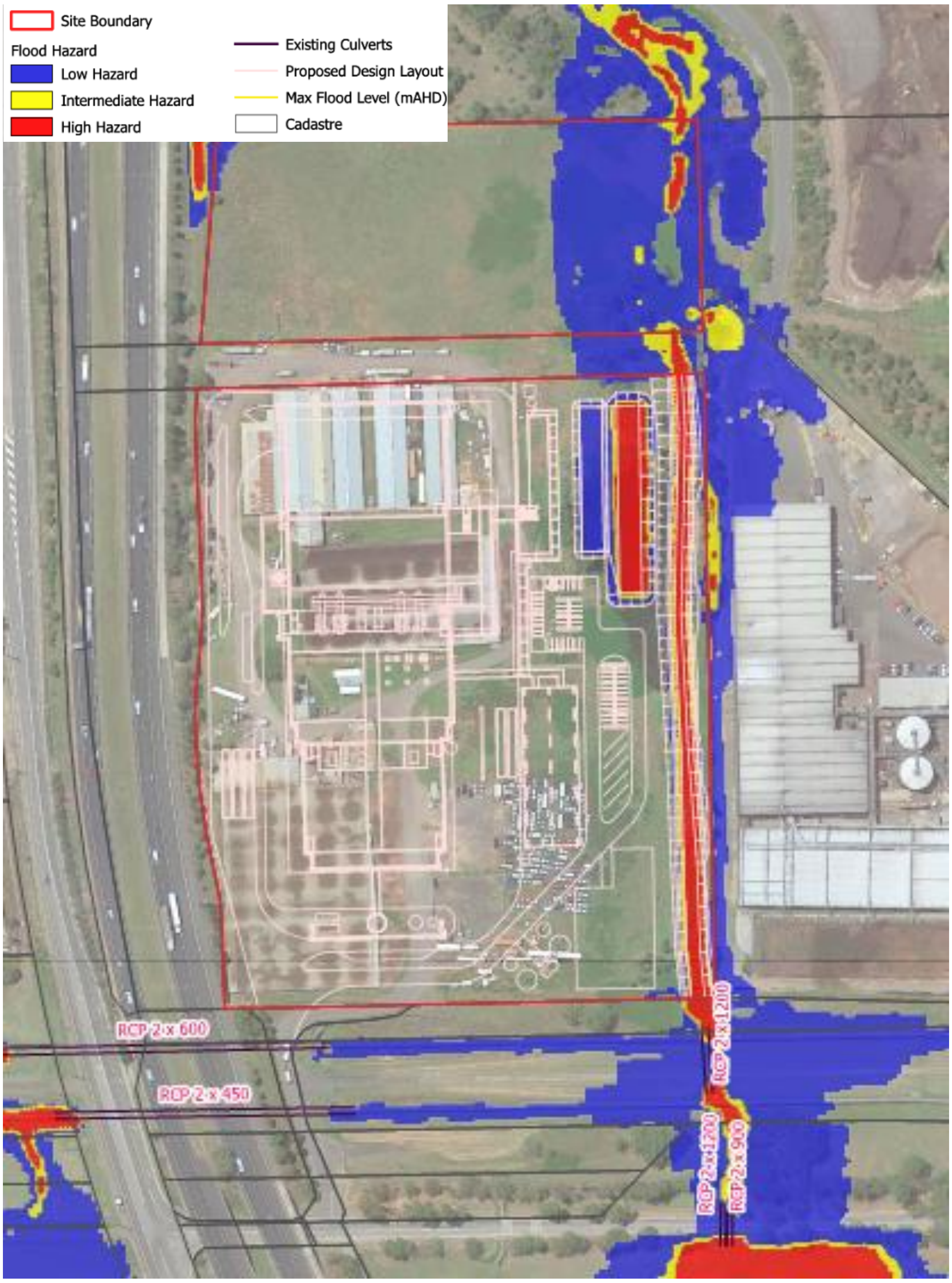


Figure 33 Extract of 1% AEP post development conditions flood hazard map

1% AEP flood event inclusive of climate change

An extract from the 1% AEP post-development flood level map inclusive of climate change is included in Figure 34. Flood depths at the site are slightly higher in the 1% AEP climate change scenario compared to the base 1% AEP simulation. Peak flood depths reach a maximum of 1.45m in the overland flow channel. The estimated peak flood level at the upstream (southern) site boundary is 55.6mAHD, and 53.6mAHD at the downstream (northern) boundary of the southern portion of the site. These flood levels are significantly lower than the proposed EfW main building and visitor centre and would therefore, would not impact on the operations of the facility.

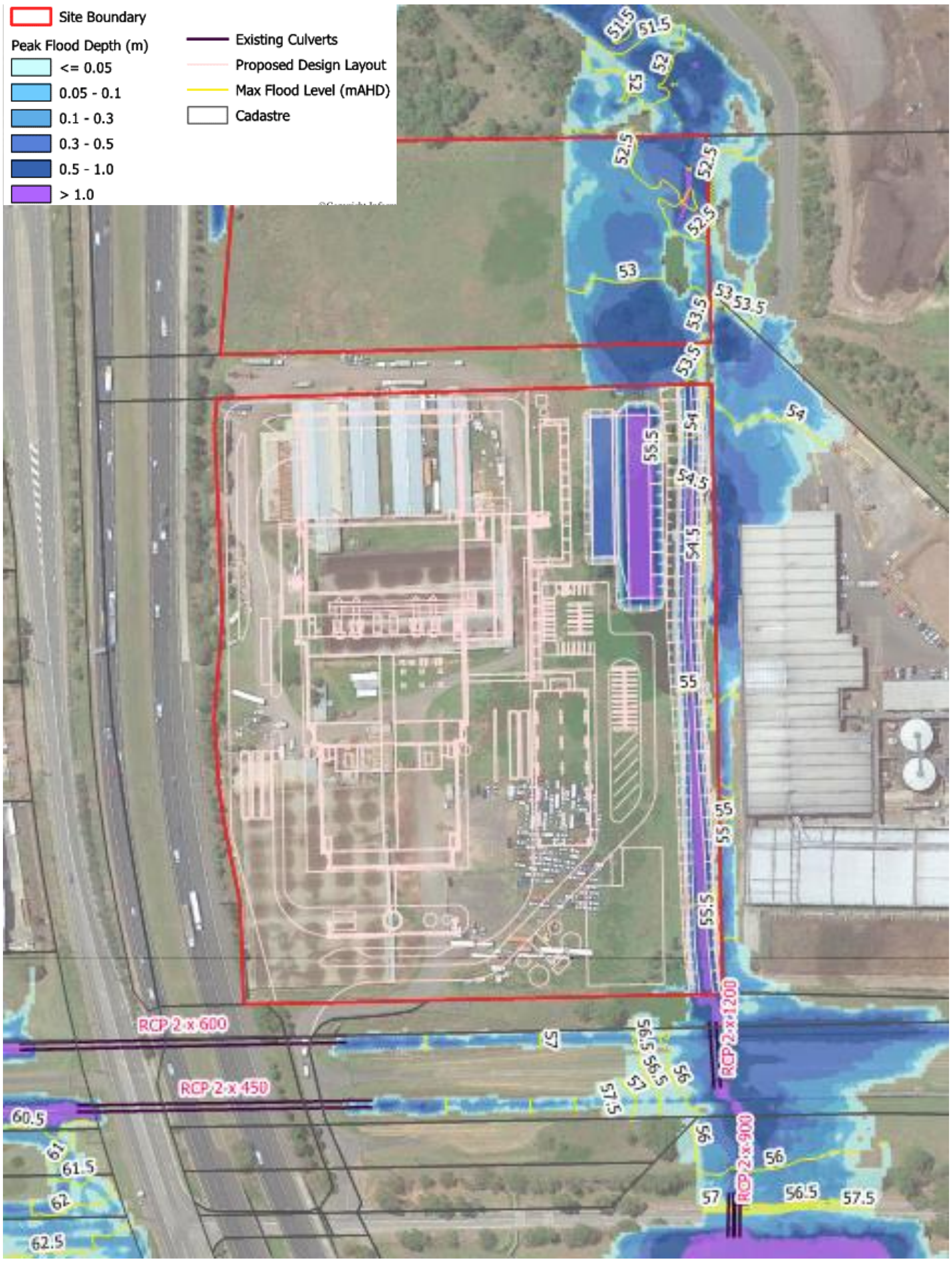


Figure 34 Extract of 1% AEP climate change post development conditions flood level map

An extract from the 1% AEP post-development conditions flood velocity map inclusive of climate change is included in Figure 35. Velocity in the realigned overland flow channel is typically between 1m/s and 2m/s, with some velocities greater than 2m/s at the north of the southern portion of the site. Flow velocities at some locations at the GRL site are greater than 2m/s.

Figure 35 Extract of 1% AEP climate change post development conditions flood velocity map

An extract from the 1% AEP post-development conditions provisional hydraulic hazard map inclusive of climate change is included in Figure 36. Hydraulic hazard at the southern portion of the development site are unchanged compared to the 1% AEP event. At the GRL site the extent of intermediate and high hazard is greater than in the 1% AEP event but similar to the existing conditions climate change scenario. Hazard to the south and north of the site is generally unchanged compared to existing conditions.

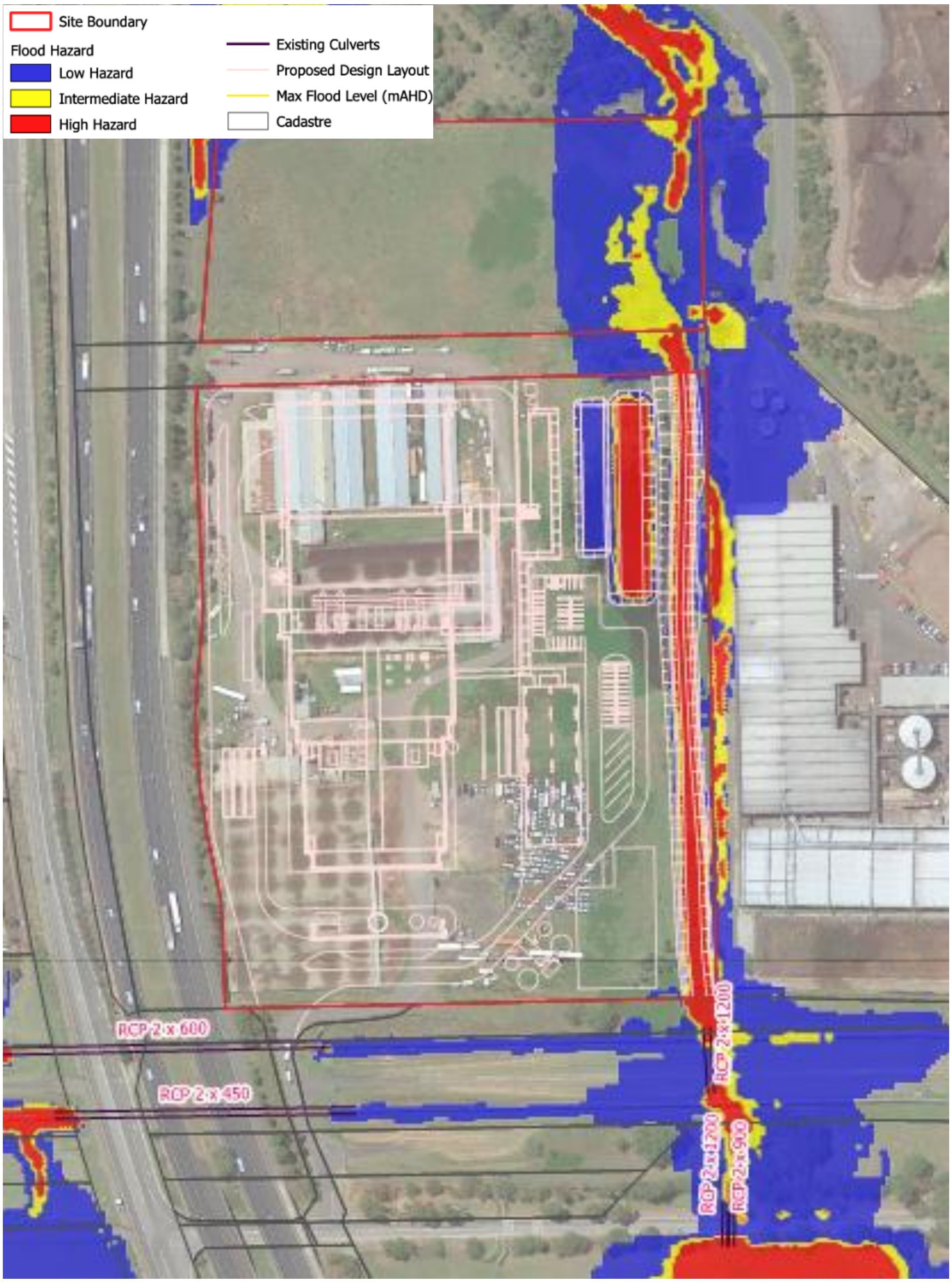


Figure 36 Extract of 1% AEP climate change post development conditions flood hazard map

PMF

An extract from the PMF post-development flood level map is included in Figure 37. The maximum peak flood depth at the site in the PMF is 1.85m in the overland flow channel at the south of the site. The estimated peak flood level at the upstream (southern) site boundary is 56.5mAHD, and 53.6mAHD at the downstream (northern) boundary of the southern portion of the site. The western portion of the site is shown to remain flood-free and therefore, evacuation from the facility in the event of the PMF would not be required.

Figure 37 Extract of PMF post development conditions flood level map

An extract from the PMF post-development flood velocity map is included in Figure 38. Velocity in the realigned overland flow path typically exceeds 2m/s with maximum velocities above 3m/s in some locations. High velocities are also shown at the GRL site.

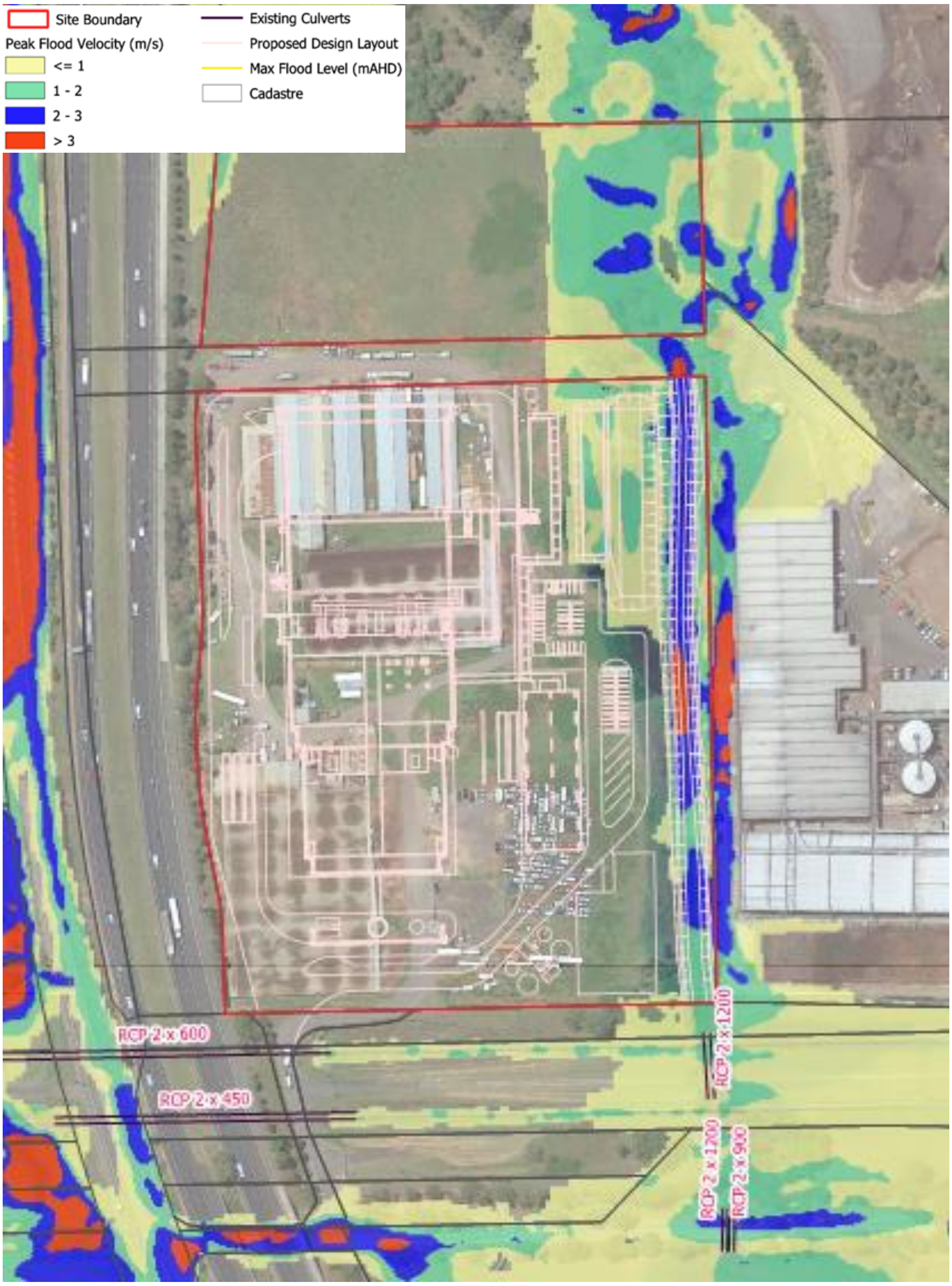


Figure 38 Extract of PMF post development conditions flood velocity map

An extract from the PMF provisional hydraulic hazard map is included in Figure 39. In this event most of the flooded area at the site and surrounding area is classified as high hazard.

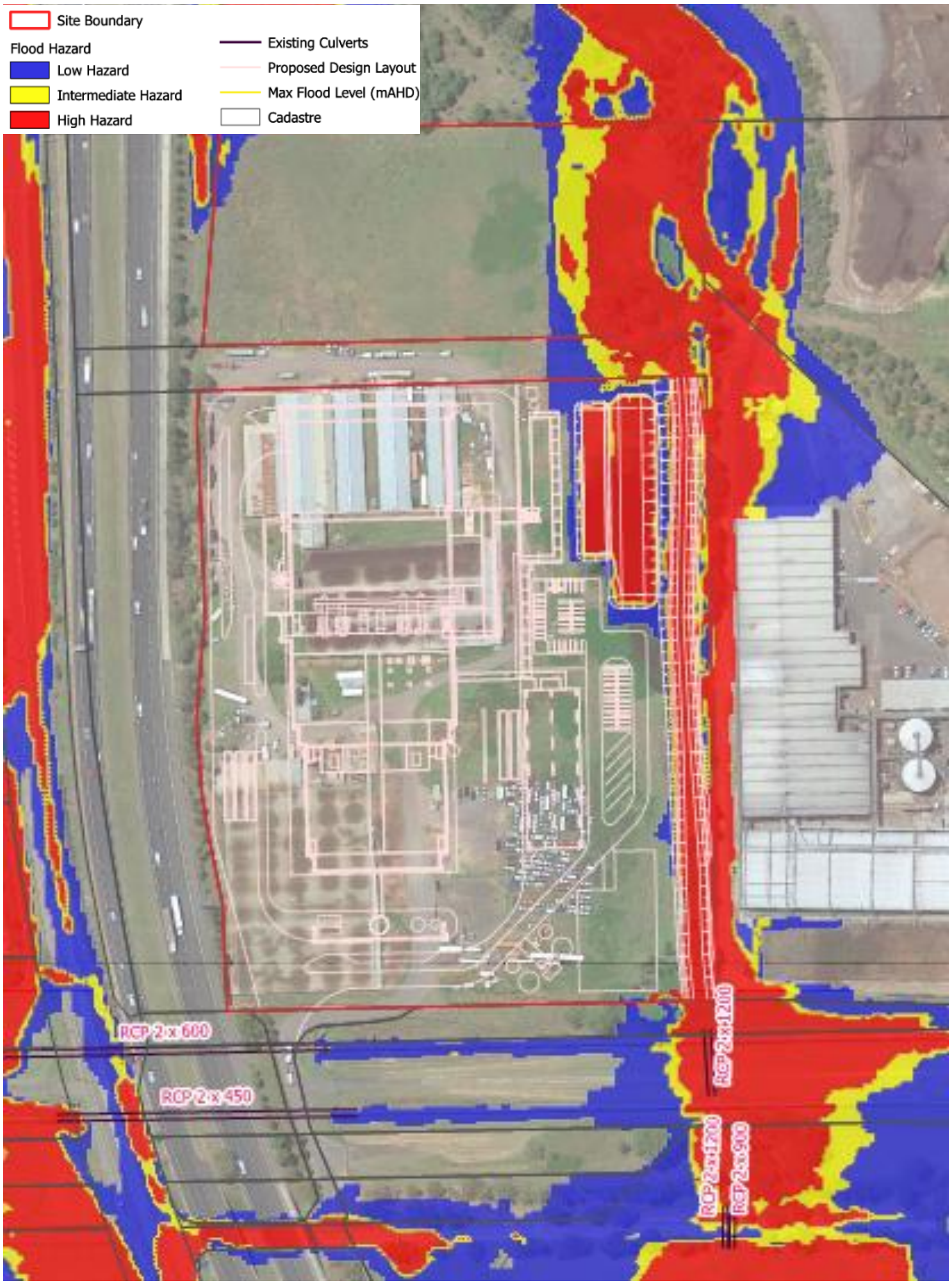


Figure 39 Extract of PMF post development conditions flood hazard map

4.2.4 Flood impact assessment

Flood impacts associated with the proposal have been assessed in terms of changes in flood levels and velocity between existing and post development conditions. These results are presented and discussed in the following sections.

5% AEP flood event

An extract from the 5% AEP change in flood level map is included in Figure 40. This map shows that in post development conditions flood levels are reduced at the Water NSW site to the south and the GRL site to the east, with a substantial area that was previously flooded now dry. The small area showing an increase of between 10mm and 50mm to the north of the site can be attributed to localised instabilities in the flood model.

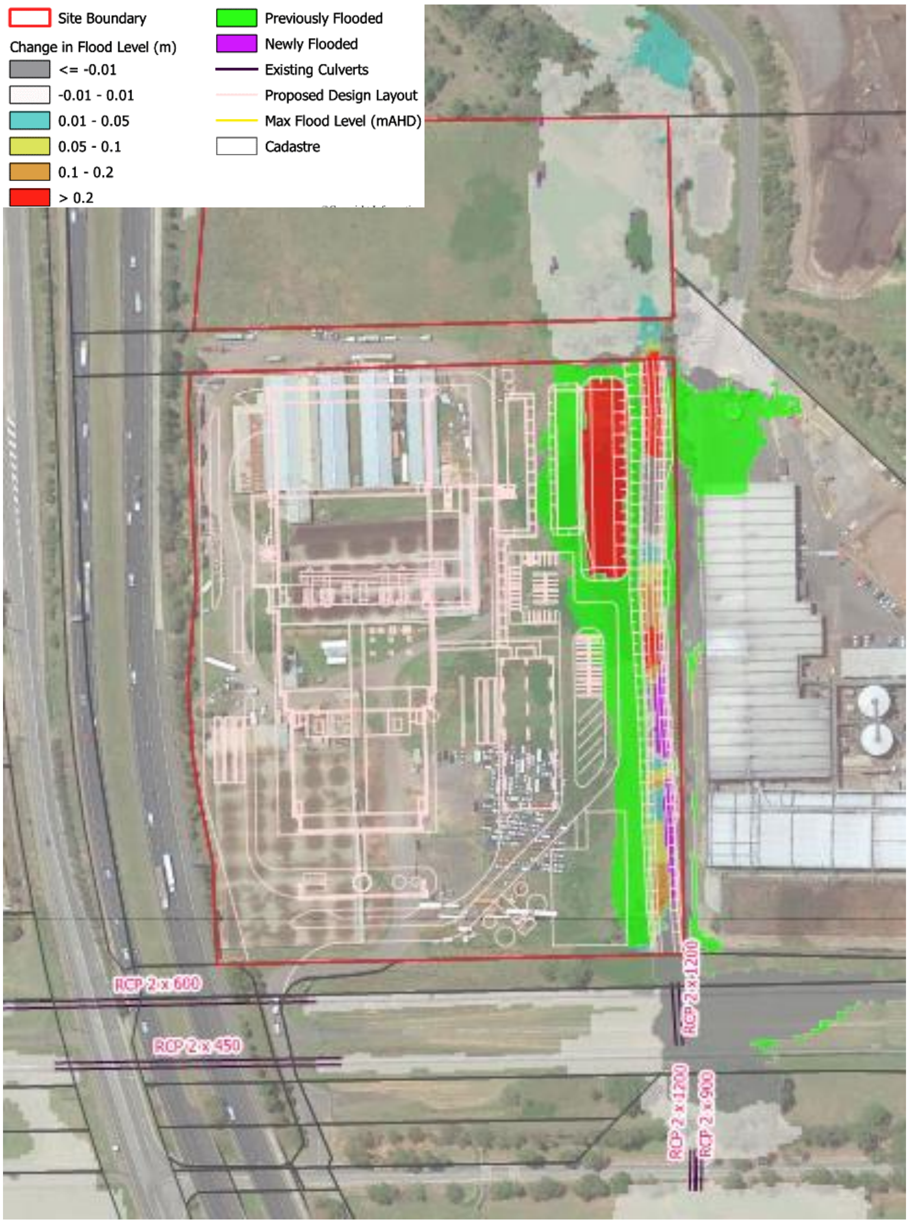


Figure 40 Extract of change in flood level 5% AEP map

An extract from the 5% AEP change in flood velocity map is included in Figure 41. This map shows some increases in velocity at the GRL site. These increases coincide with reductions in flow depth. As shown in the provisional hazard maps, the proposal does not result in an increase in hydraulic hazard at the GRL site and therefore, the overall flood risk would not be increased.

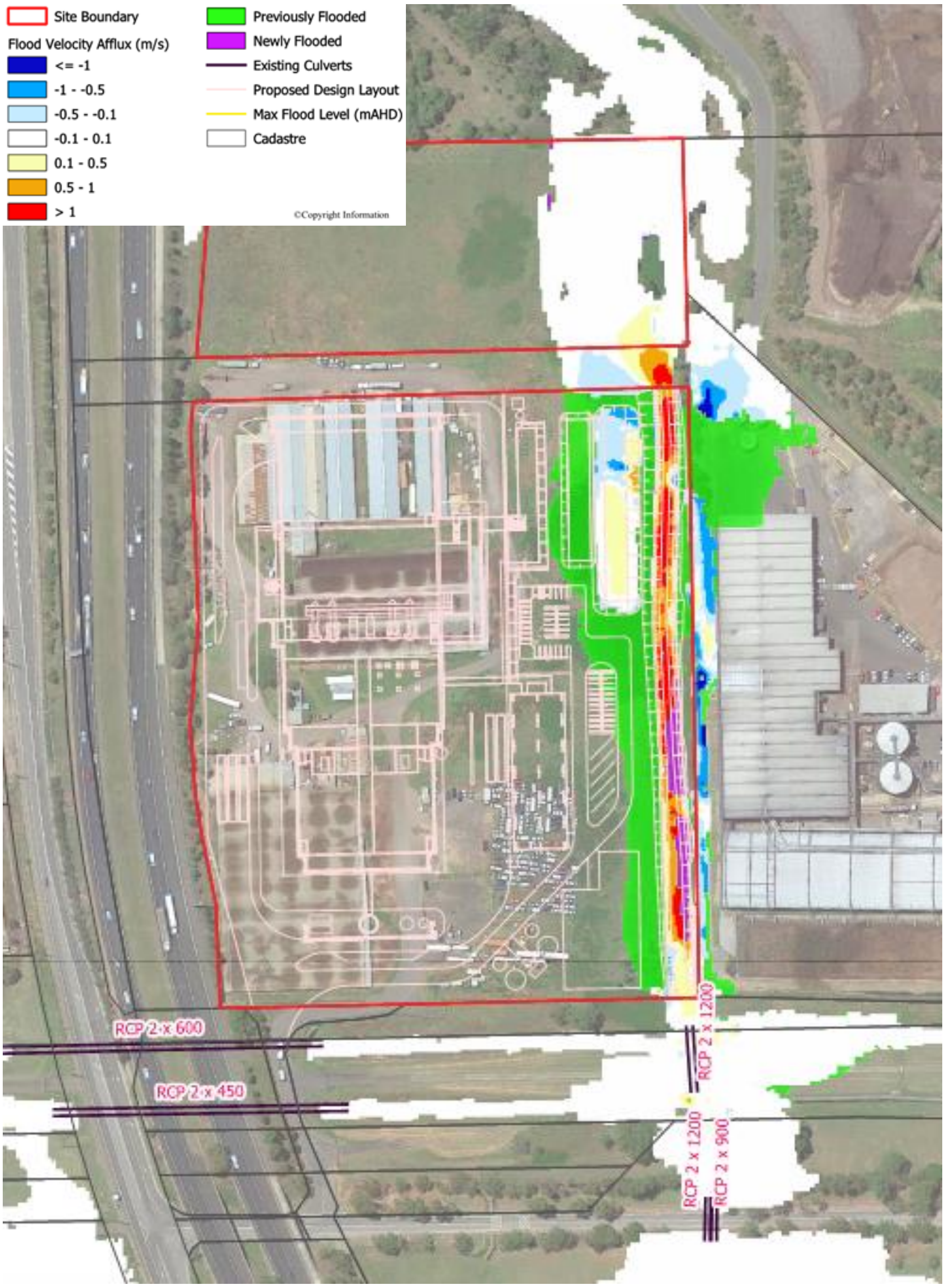


Figure 41 Extract of change in velocity 5% AEP map

1% AEP flood event

An extract from the 1% AEP change in flood level map is included in Figure 42. Similar to the 5% AEP results, these results show a reduction in peak flood levels at the Water NSW and GRL sites.

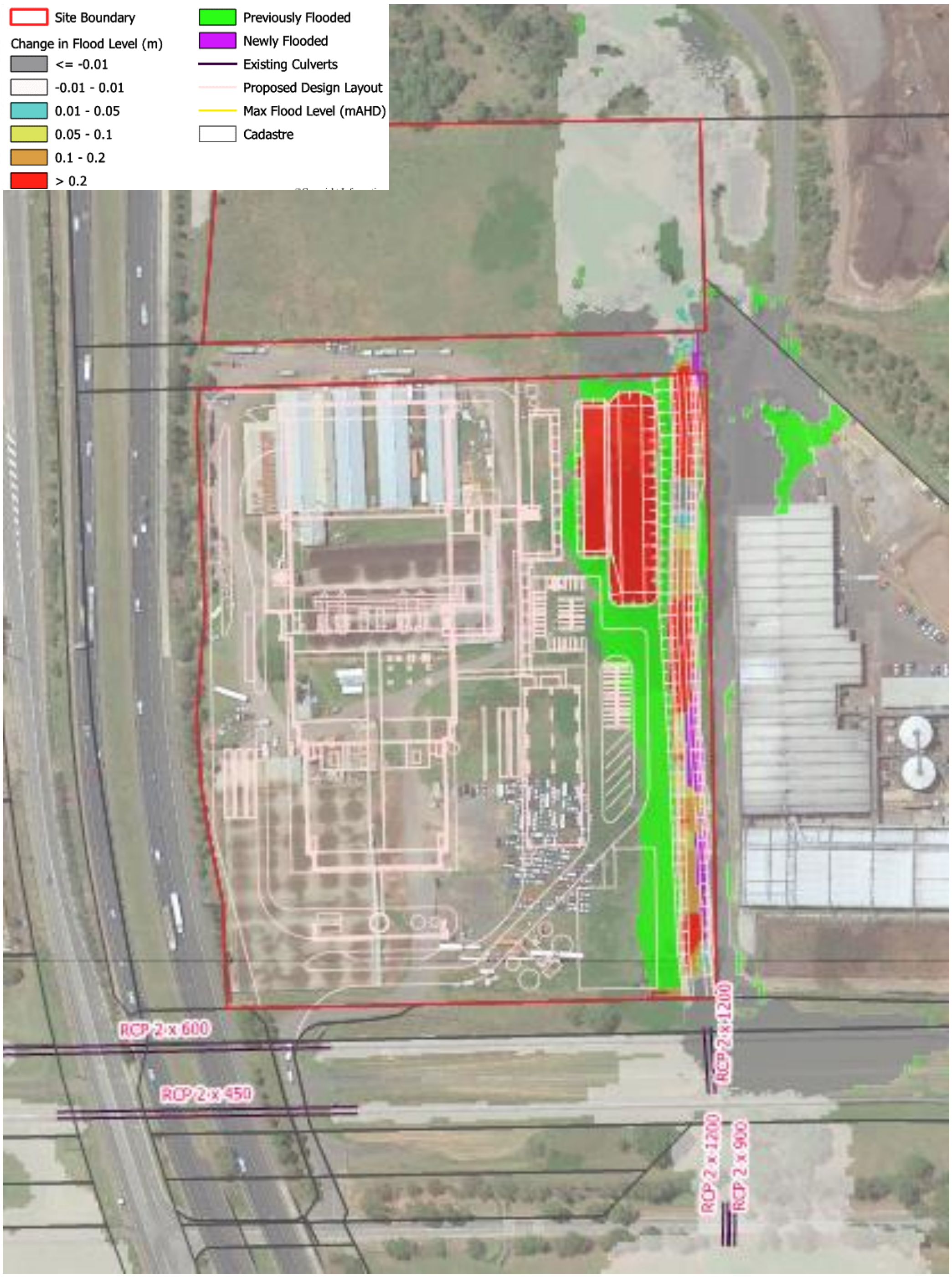


Figure 42 Extract of change in flood level 1% AEP map

An extract from the 1% AEP change in flood velocity map is included in Figure 43. This map shows some increases in velocity at the GRL site. These increases at the GRL site coincide with reductions in flow depth. As shown in the provisional hazard maps, the proposal does not result in an increase in hazard at the GRL site and therefore, the overall flood risk would not be materially increased.

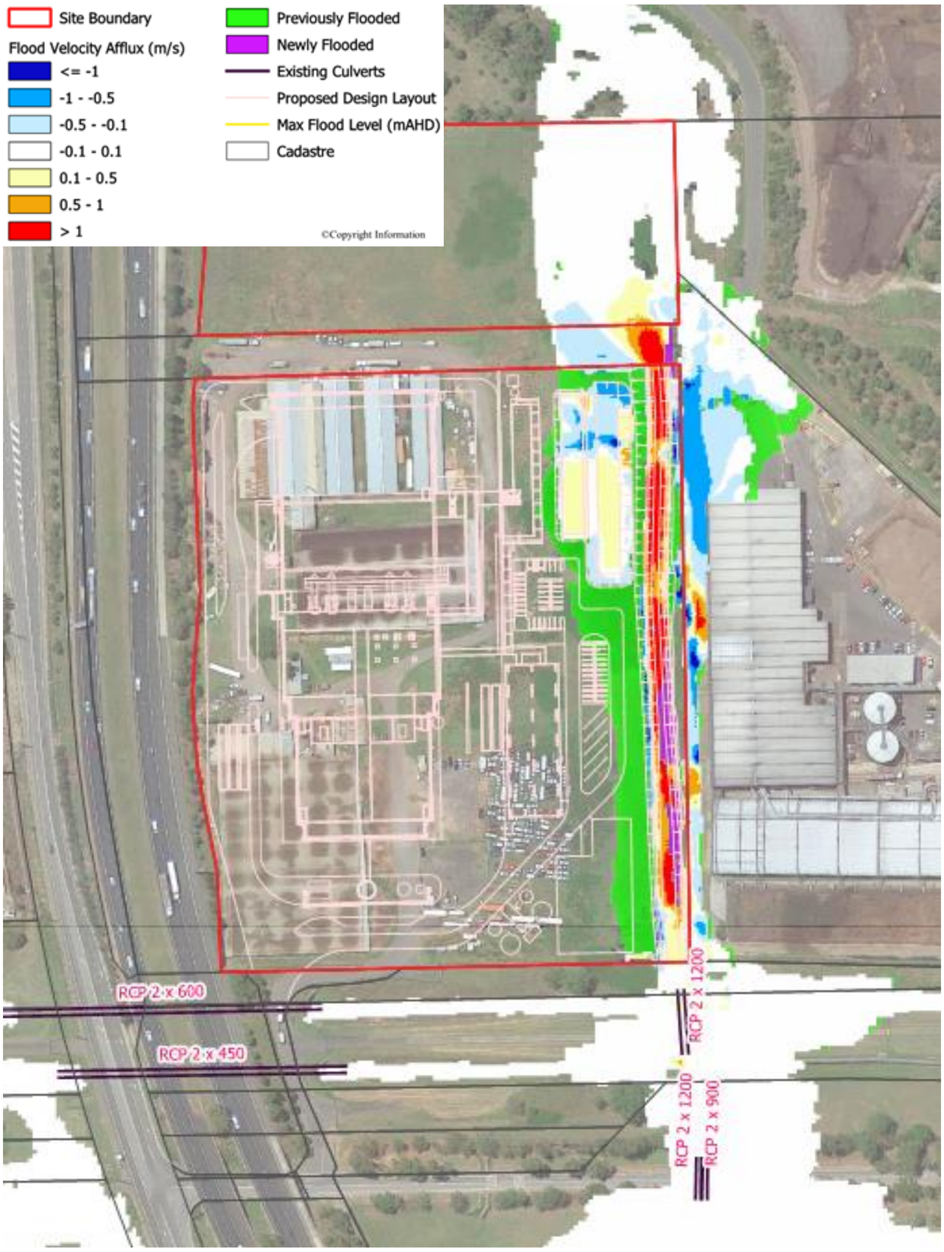


Figure 43 Extract of change in velocity 1% AEP map

These results when considered in conjunction with the provisional hazard mapping demonstrate that the proposal will not result in an increase in flood levels or hazard at adjacent properties in the 5% AEP of 1% AEP events and therefore, will not materially impact the flood risk on these properties. This is consistent with the requirements of the State Environmental Planning Policy (Western Sydney Parklands 2009).

PMF

An extract from the PMF change in flood level map is included in Figure 44. These results show some increases in flood levels at the Water NSW, Austral Bricks and GRL sites. However, as these areas are already subject to flooding with depths of greater than 1m, it is not considered that this increase would result in a material change to the flood risk in these areas.

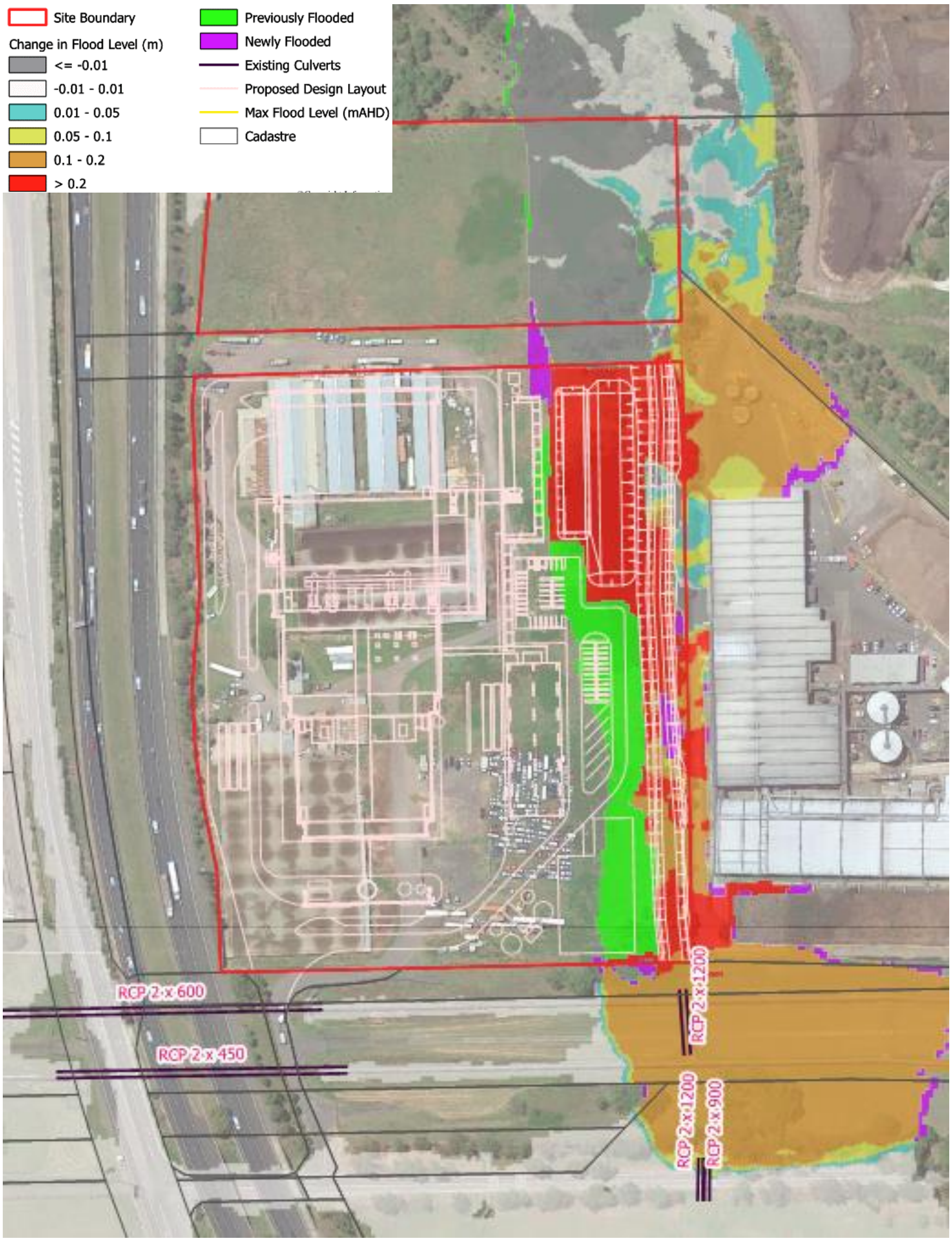


Figure 44 Extract of change in flood level PMF map

An extract from the PMF change in flood velocity map is included in Figure 45. These results show some increases in velocity at the GRL site. Increases of greater than 1m/s are concentrated in areas with reductions in flow depths. As noted previously, these areas would already be severely flooded in the PMF, and the increase in velocity is not expected to change the flood risk in the PMF event.

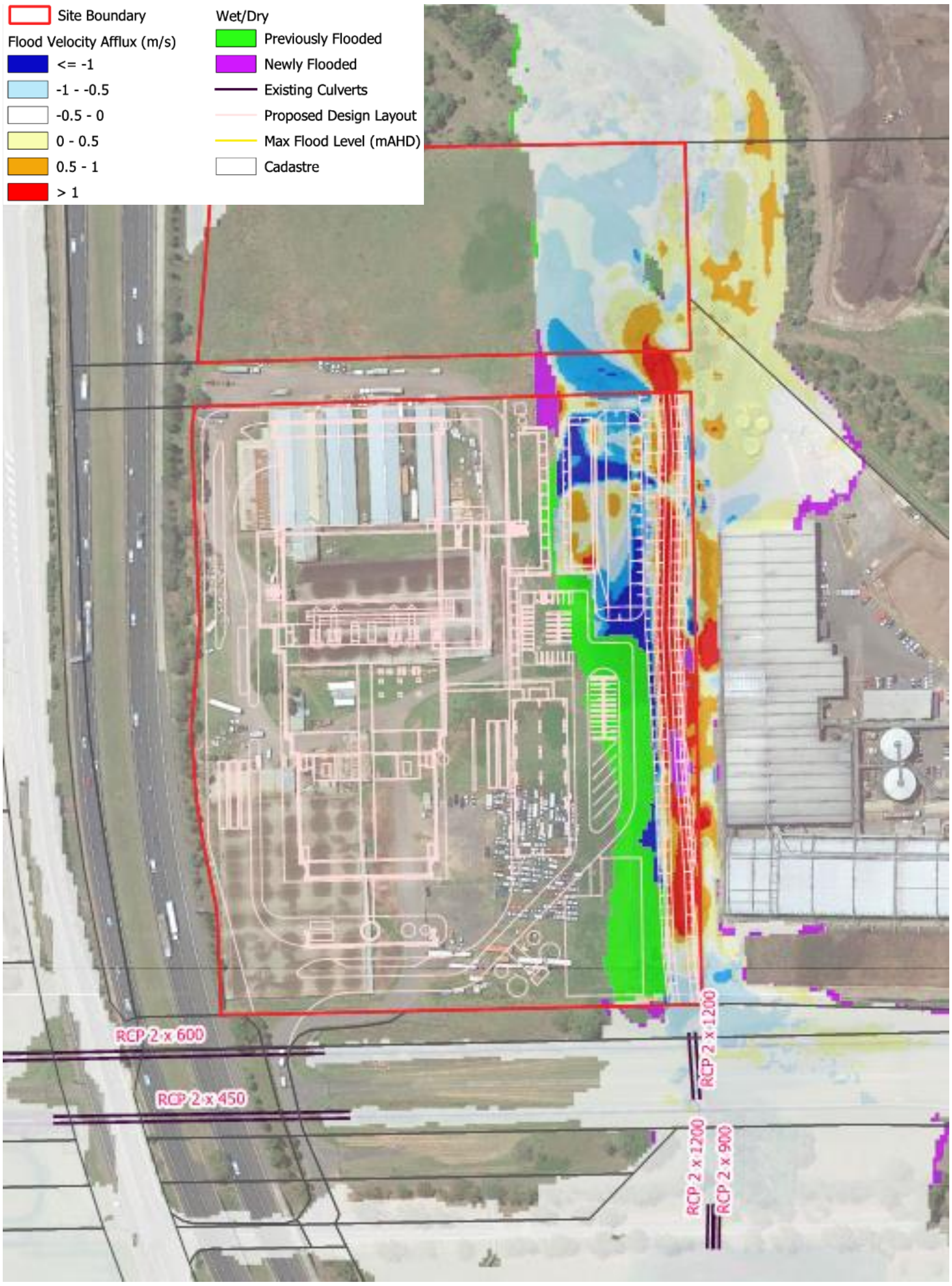


Figure 45 Extract of change in velocity PMF map

5 Proposed mitigation measures

This Section outlines proposed mitigation and management measures that have been developed to mitigate the potential hydrology and flooding impacts of the proposal during construction and operation.

5.1 Construction

During the construction phase impacts on the environment will be mitigated by adopting the following strategies:

- Implement a Soil and Water Management Plan comprising of cut-off drains, shaker pads, check dams and sediment basins. This will improve the quality of stormwater runoff from the site and minimise downstream environmental impacts.
- Implement a Dewatering Management Plan for the decommissioning of the farm dam.
- Reuse stormwater collected in sediment basins for dust suppression.
- Locate site facilities and construction access tracks away from the existing overland flow path and identified 1% AEP flood extent. This will provide a level of flood immunity to these facilities and minimise flood impacts on neighbouring properties.
- Realign the overland flow path at the start of the construction program.

5.2 Operation

The design for the proposal includes numerous features that will act to mitigate hydrology, surface water and flooding impacts. These include:

- The concept drainage design incorporates water sensitive urban design elements which enable the proposal to meet BCC pollutant reduction targets, including:
  - Rainwater harvesting system to collect runoff from the main building and reuse it for the EfW process
  - Gross pollutant traps
  - Bioretention basin
  - Revegetation of the overland flow channel
- Stormwater runoff from the proposal site will be controlled by an on-site detention basin which will minimise downstream flooding impacts
- Runoff from sensitive areas with the potential to cause spills of chemicals or hydrocarbons will be contained by bunding and runoff will pass through oil and water separators

- Site earthworks and the realignment of the overland flow path has been designed such that it does not result in any increases in flood levels or hydraulic hazard on adjacent properties in the 5% AEP and 1% AEP flood events
- The overland flow channel realignment would remove the section on the neighbouring Global Renewables Site. This will reduce the risk of flooding in small events at this site.

5.3 Ongoing considerations

As the design of the proposal is finalised and contractors are appointed, further consideration of a number of issues will be required in order to mitigate hydrology and flooding issues during construction and operations. In particular:

- The contractor will need to prepare the Soil and Water Management Plan, with consideration to proposed construction works and staging
- The Dewatering Management Plan for the decommissioning of the farm dam will need to be finalised and implemented at an appropriate time in the construction program
- As the proposal design is finalised, achievement of water quality, on-site detention, stormwater discharge and flood impact objectives will need to be confirmed
- The design of permanent erosion protection measures in the realigned overland flow channel and basin spillway will need to be developed further during later design stages.

6 Conclusions

A hydrology and flooding assessment has been completed for the proposal incorporating the surrounding area. This has considered impacts associated with stormwater quality, quantity, site water balance and flooding. This assessment has concluded the following:

- The existing site includes a farm dam and stormwater overland flow path which runs from south to north adjacent to the eastern site boundary which is subject to flooding.
- As part of the proposal the farm dam will be decommissioned, and the overland flow path will be realigned as a trapezoidal channel with a low-flow meander.
- The contractor will be responsible for preparing a construction Soil and Water Management Plan. A preliminary strategy has been prepared which includes sediment fences, cut-off drains, check dams and sediment basins. This strategy will minimise water quality impacts on downstream waterways.
- The contractor will also be responsible for preparing a Dewatering Management Plan for the decommissioning of the farm dam. This will include testing of water and sediment and disposing of dam water across the site as much as possible.
- A site water balance assessment has been completed for the proposal site which has provided an estimate of operational rainwater harvesting potential, potable water demand, sewer discharge and stormwater discharge. The opportunity to utilise recycled water was considered but was not deemed feasible for the proposal.
- The proposal includes an interconnected bioretention and OSD basin along with GPTs which will manage the quality and quantity of stormwater discharged from the site in accordance with BCC requirements.
- Flood modelling has demonstrated that this channel and proposed changes to the site topography will not result in an increase in flood levels at adjacent properties for events up to and including the 1% AEP and will not increase flood hazard at adjacent properties for events up to and including the PMF. Therefore, the proposal will not materially impact the flood risk at these properties.

Through this assessment, compliance with proposal SEARs and relevant legislation relating to hydrology and flooding has been demonstrated.

References

Ball *et al.*, 2019. Australian Rainfall and Runoff Guidelines

Blacktown City Council, accessed February 2020, GIS MapsOnline portal (http://maps.blacktown.nsw.gov.au/)

Blacktown City Council, ongoing draft extracts received March 2020. Reedy Creek Flood Study

Blacktown City Council, 2018. Engineering Guidelines

Blacktown City Council, 2015. Blacktown Development Control Plan

NSW Government, 2009, State Environmental Planning Policy (Western Sydney Parklands)

Bureau of Meteorology, 2020, accessed 12 February 2020. Design rainfall depths

Fairfield City Council, 2013. The Rural Area Flood Study - Ropes, Reedy and Eastern Creeks

NATSPEC, 2020. Chapter 0259 – Landscape Maintenance

NSW State Government, 2005. NSW Floodplain Management Manual

State of NSW and Office of Environment and Heritage, 2017. Risk-based Framework for Considering Waterway Health Outcomes in Strategic Land-use Planning Decisions

NSW Government Spatial Services, Accessed February – May 2020. SIX Maps NSW Maps

The United Nations International Panel for Climate Change (IPCC), 2013. AR5 Climate Change 2013: The Physical Science Basis

World Meteorological Organisation, 2009. Manual on Estimation of Probable Maximum Precipitation (PMP)

Appendix A

Site Flood Impact Assessment Report

Cleanaway & Macquarie Capital

Western Sydney Energy and Resource Recovery Centre

Flood Impact Assessment Report

WSERRC-ARU-SYD-WAEM-RPT-0002

Final | 4 June 2020

Job number 264039

Arup Pty Ltd ABN 18 000 966 165

Arup
Level 5
151 Clarence Street
Sydney NSW 2000
Australia
www.arup.com

ARUP

Executive summary

An energy-from-waste facility is proposed at 339 Wallgrove Road, Eastern Creek. To support the Environmental Impact Statement submission, an assessment of flood conditions at the site has been undertaken that considers both existing and post development conditions.

Based on a review of available topographical and flood data an overland flow path was identified through the proposal site which runs from south to north adjacent to the eastern boundary. The assessment of existing conditions estimated 1% Average Exceedence Probability (AEP) peak flood levels along the overland flow path ranging from 55.5mAHD at the upstream (southern) site boundary to 53.1mAHD at the downstream (northern) boundary of the southern portion of the site.

As part of the proposal, the site would be re-graded and the existing overland flow path would be realigned as a trapezoidal channel running along the eastern site boundary. The proposed channel base width is 6m at the southern boundary, which allows flows from the Water NSW site to safely enter the site, before narrowing to 3m wide and continuing at this width to the northern boundary. A 300mm deep meandering low flow channel is proposed to run along the base of the channel to maintain the characteristics of a natural channel and provide aquatic habitat.

An assessment of post development flood behaviour at the site has demonstrated that overland flow entering the site at the southern boundary can be conveyed by the overland flow channel. Flood modelling has demonstrated that this channel and proposed changes to the site topography will not result in an increase in flood levels at adjacent properties for events up to and including the 1% AEP, and will not increase flood hazard at adjacent properties for events up to and including the PMF. Therefore, the proposal will not materially impact the flood risk at these properties. These results are consistent with the requirements of the State Environmental Planning Policy (Western Sydney Parklands 2009). Furthermore, adequate freeboard above 1% AEP flood levels is provided to the EfW main building and visitor centre with both also located above the Probable Maximum Flood (PMF) level.

Contents

Tables

Figures

Appendices

Abbreviations and glossary

Abbreviations	
AR&R	Australian Rainfall and Runoff (AR&R) is a national guideline document, data and software suite that can be used for the estimation of design flood characteristics in Australia
AEP	Annual Exceedance Probability (AEP) refers to the probability of a flood event occurring in any year
BoM	Bureau of Meteorology
PMP	Probable Maximum Precipitation: the greatest depth of precipitation for a given duration meteorologically possible for a given size storm area at a particular location at a particular time of year
PMF	The Probable Maximum Flood (PMF) is the flood that may be expected from the most severe combination of critical meteorological and hydrologic conditions that are reasonably possible in a particular drainage area
GSDM	Generalised Short Duration Method for calculating PMP
IPCC	United Nations International Panel for Climate Change (IPCC)
RCP	A Representative Concentration Pathway (RCP) is a greenhouse gas concentration trajectory adopted by the IPCC
RFFE	Regional flood frequency estimation
Proposal (the)	The purpose of the proposal is to build an energy-from-waste (EfW) facility that can generate up to 55 megawatts (MW) of power by thermally treating up to 500,000 tonnes per year of residual municipal solid waste (MSW) and residual commercial and industrial (C&I) waste streams that would otherwise be sent to landfill.

Reliance statement

The sole purpose of this report, flood models and the associated services performed by Arup is to assess flood behaviour at the proposal site for existing and proposed conditions in accordance with the scope of services set out in the contract between Arup and Cleanaway/Macquarie Capital.

Arup derived the data from information available in the public domain or provided to Arup at the times outlined in the report. Where information was not available, dimensions of cross-drainage culverts were estimated based on visual inspections. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the project and subsequent data analysis, and re-evaluation of the data, findings, observations and conclusions expressed in the report. Arup has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in the report, to the extent permitted by law.

All flood models, whether numerical, analytical or physical, rely on a set of assumptions and requirements to accurately simulate the flow conditions. As no model will provide an exact representation of the complexity of the actual flow, it is important for engineers to understand these assumptions, as they form the limitations of that method. Ignoring or violating these assumptions and limitations or failing to critically analyse the model will produce inaccurate results.

No responsibility is accepted by Arup for use of any part of this report in any other context. This modelling data has been prepared on behalf of, and for the exclusive use of Cleanaway/Macquarie Capital, and is subject to, and issued in accordance with, the provisions of the contract between Arup and Cleanaway/Macquarie Capital. Arup accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report by any third party.

1 Introduction

The purpose of this report is to describe the Flood Impact Assessment that has been undertaken for the proposed energy-from-waste (EfW) facility at 339 Wallgrove Road, Eastern Creek. The report includes an assessment of existing conditions at the site, using hydrologic and hydraulic flood models developed for the project. These models have also been used to assess post-development flood conditions with consideration to any flood impacts.

2 Site description

2.1 Site location

The proposal site is located at 339 Wallgrove Road, Eastern Creek. The site is bounded by the M7 Motorway to the west, the Water NSW Warragamba Pipelines to the south and the Global Renewables Limited (GRL) alternative waste treatment facility to the east and the SUEZ Eastern Creek Waste Management Centre to the north. The proposed development will be contained within the southern section of the site.

A stormwater overland flow path passes through the site from south the north adjacent to the eastern boundary. This overland flow path eventually discharges to Reedy Creek approximately 400m north of the site. The site location is shown in Figure 1.

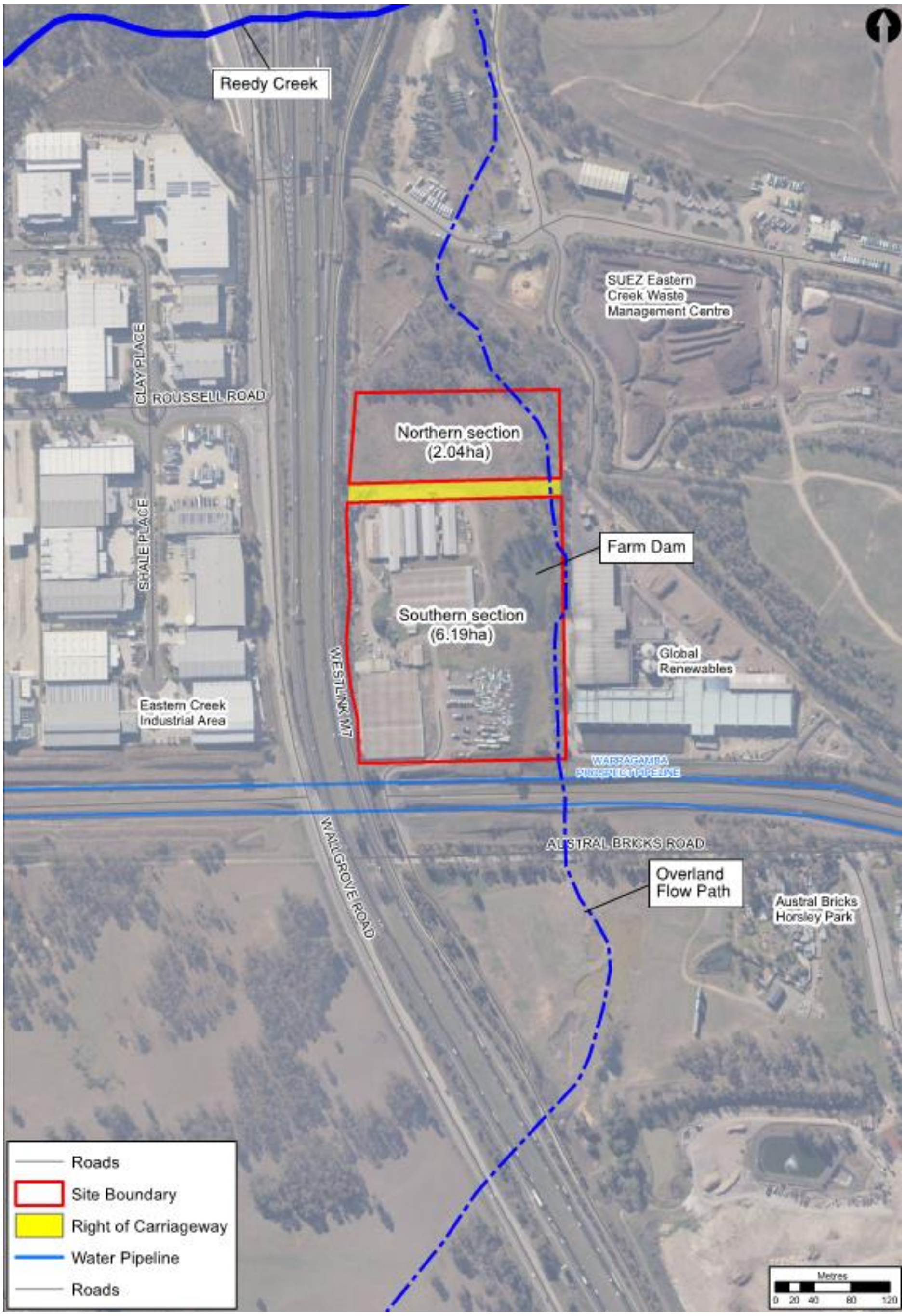


Figure 1 Site locality plan

2.2 Site topography

Existing levels at the southern section of the site range from approximately 62mAHD at the south-west of the site to approximately 52mAHD at the north of the site. The south-west of the site is the highest portion of the site. The area occupied by existing buildings in the western portion of the site is raised in comparison to the eastern portion of the site where the farm dam is situated, and the overland flow path runs from south to north.

The car park at the southeast of the site sits at approximately 60mAHD with a 5m high embankment down to the vegetated area and overland flow path. This embankment reduces in height to approximately 2m immediately north-east of the farm dam.

The M7 motorway adjacent to the site is elevated several metres above the ground level of the site. The level difference is typically overcome with an embankment however, there is a 30m long retaining wall located at the south-western corner of the site, outside of the site boundary.

2.3 Stormwater drainage

Site drainage

The existing site stormwater network includes a series of ill-defined open drains, the farm dam and the overland flow path. There is minimal piped stormwater drainage within the site with building downpipes discharging to the adjacent surface. The farm dam can be seen in the aerial photograph in Figure 2.

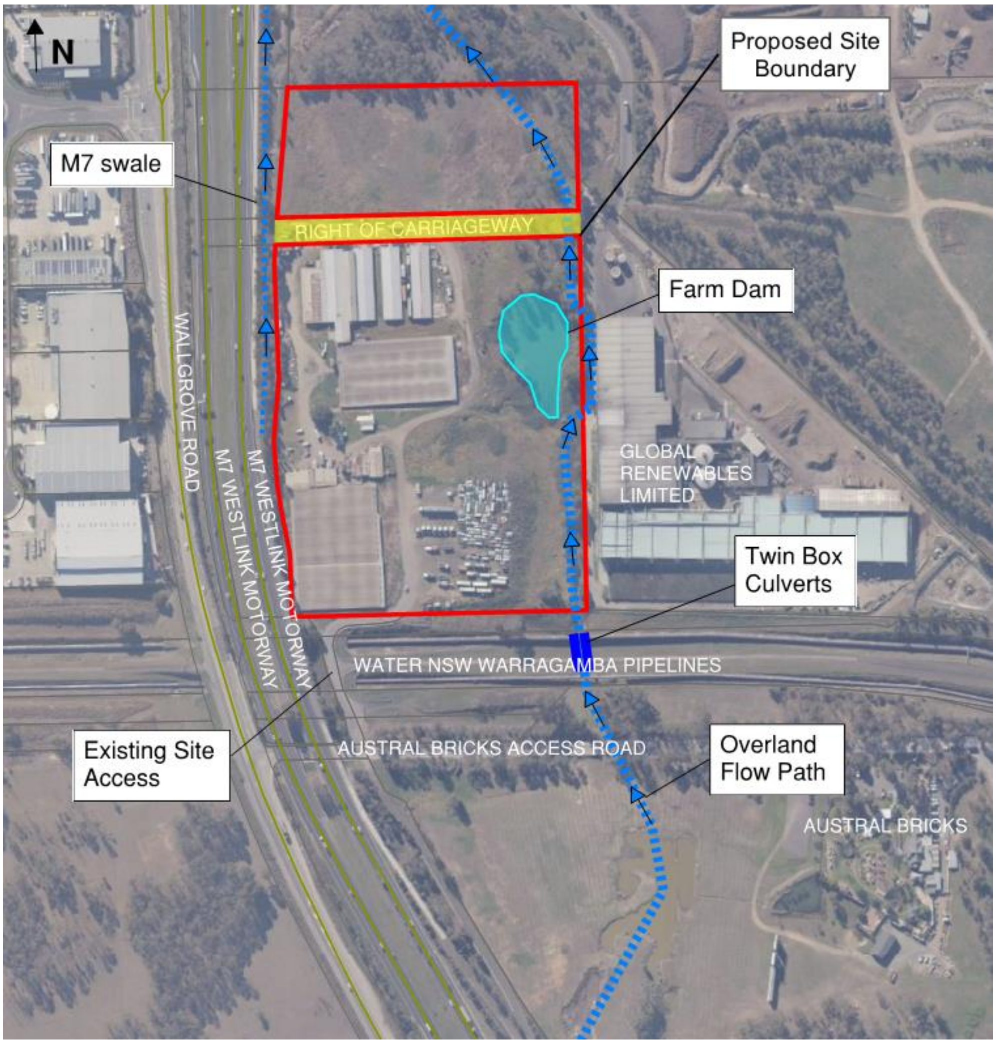


Figure 2 Key stormwater features at proposal site and surrounding area

Overland flow path

An overland flow path runs from south to north along the eastern boundary of the site. This flow path enters the site via twin culverts from the Water NSW land to the south. The flow path enters the GRL site for approximately 50m before flowing back into the proposal site. Based on a site inspection, the overland flow path appears to be separate from the farm dam, however, there is likely to be some mixing of flows during significant rainfall events. The overland flow path eventually discharges to Reedy Creek approximately 400m north of the site.

Levels along the overland flow path through the southern section of the site range from approximately 54.5mAHD at the south-eastern corner of the site to 52.5mAHD at the north-eastern corner of site. The overland flow path is overgrown with invasive vegetation.

The approximate alignment of the overland flow path along with key stormwater features at the GRL site is shown in Figure 2 and Figure 3.

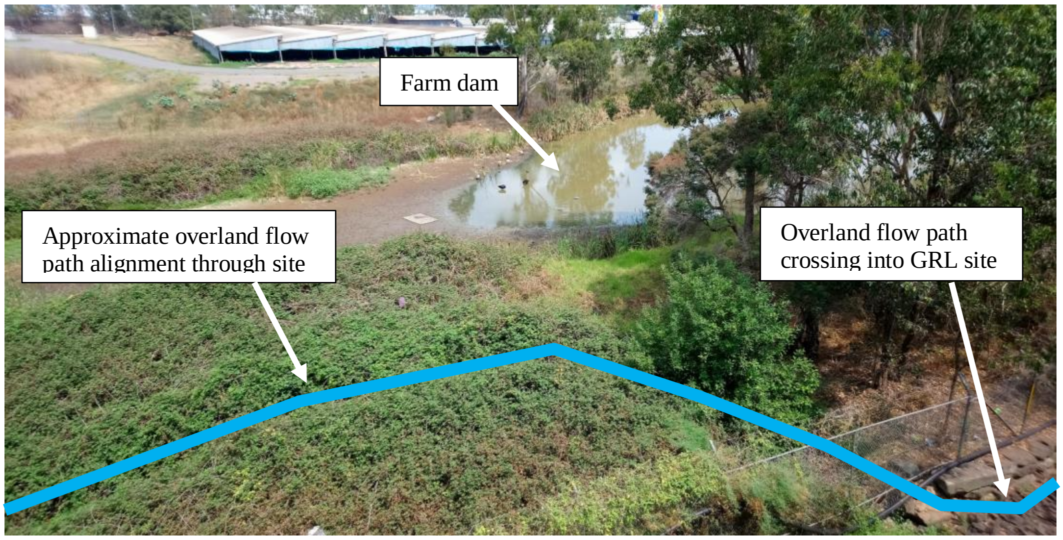


Figure 3 Photograph looking west towards proposal site from GRL site

A separate open stormwater drain is located within the M7 Motorway property boundary which collects and conveys stormwater from the section of the M7 Motorway adjacent to the proposal site. This drain has been designed such that stormwater does not discharge to the proposal site. Stormwater runoff from a small portion of the proposal site adjacent to the western boundary, comprising approximately 5% of the site, currently flow overland into the M7 Motorway drain.

2.4 Stormwater catchment areas

Internal Catchment

The internal site catchment generally drains from south to north and west to east. Existing buildings have downpipes that discharge to the surrounding ground with flows conveyed overland flow to the east. Scoured flow paths are evident in the gravel and grassed areas. These flows eventually make their way to the overland flow channel and farm dam located at the lower (eastern) part of the site.

Small areas of hard standing at the west of the southern portion of the site are graded to the west, conveying overland flows into the open drain serving the M7. This open drain flows north and ultimately discharges into Reedy Creek north of the site.

Existing hard standing and the large parking/laydown area fall to the east conveying overland flows to the overland flow channel and farm dam at the east of the site. The farm dam appears to be bunded thereby controlling flows leaving the site. From the farm dam spillway, the densely vegetated overland flow path conveys flows northwards then north-west. This flow path merges with another channel prior to passing through a culvert under the main entrance road of Eastern Creek Waste Management Centre. After the culvert crossing, another man-made channel directs flows northwards before discharging into Reedy Creek.

External Catchments

A review of aerial photography and LiDAR data for the area upstream of the proposal site was undertaken to identify any possible upstream catchments draining to the site. Based on this review, a catchment area of approximately 1.2km^2 was identified that drains to the proposal site, this area is shown in Figure 4 Upstream stormwater catchment area and overland flow path. The flow path from this catchment area crosses Wallgrove Road, the M7 Motorway and the Warragamba Pipelines before entering the proposal site. The upstream catchment is generally flat. There is the potential for online storage and flow attenuation upstream of Wallgrove Road, at the farm dams at the Austral Bricks site and within the Water NSW land.

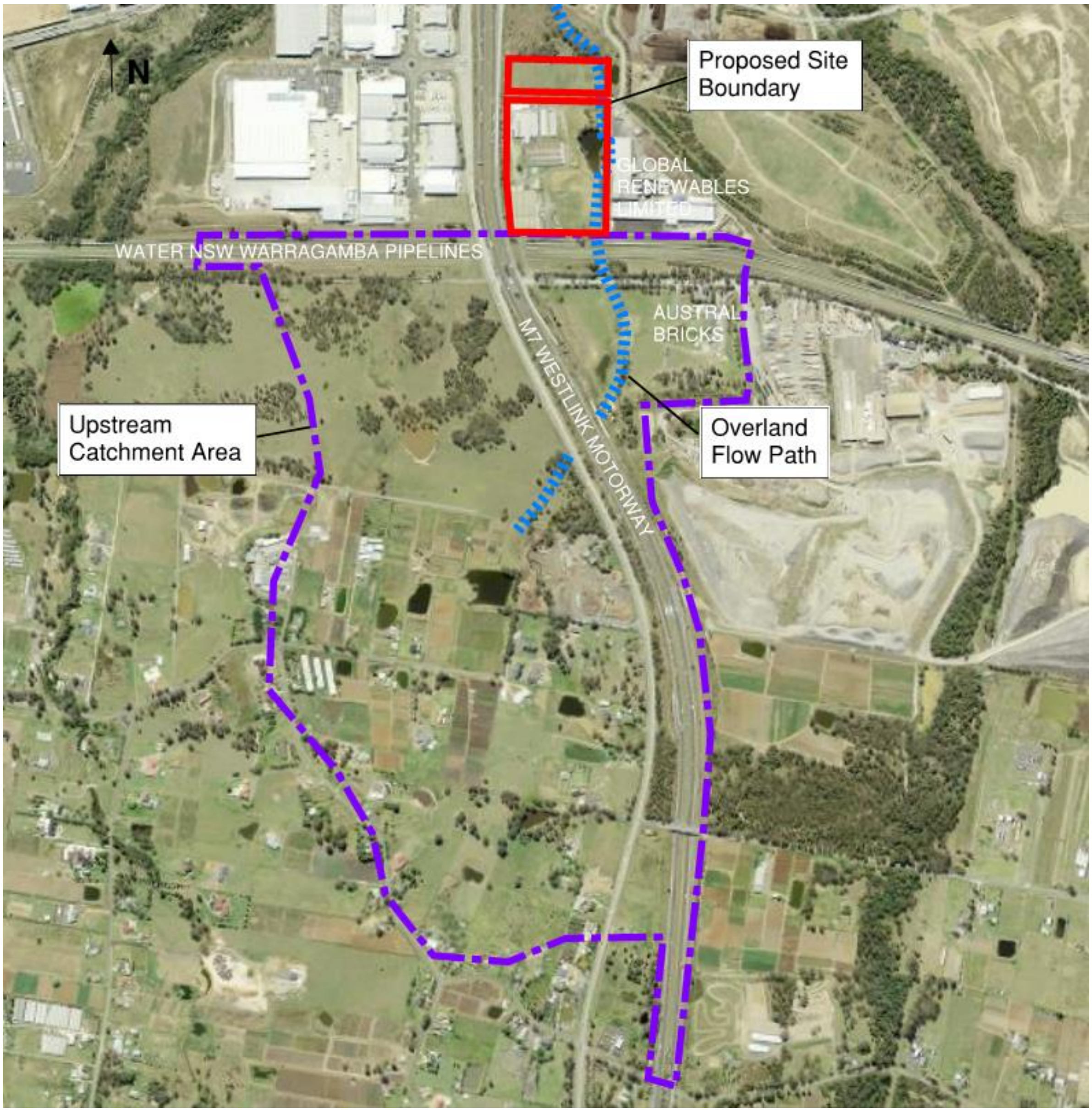


Figure 4 Upstream stormwater catchment area and overland flow path

The catchment draining to the site mainly consists of rural residential lots, agricultural areas, local farm dams for irrigation, and open areas of short grass. It covers an area of approximately 1.2km^2. The main watercourse is an open natural channel of ephemeral occurrence. It is a tributary to Reedy Creek, which in turn is a tributary to the larger Eastern Creek.

A number of drainage structures act as hydraulic controls during storms events:

- Culverts beneath Wallgrove Road, west of the M7 motorway
- Culverts beneath the M7 Motorway along overland flow path
- Culverts beneath the M7 Motorway parallel to Warragamba pipelines
- Culverts beneath the Austral Bricks access road, east of M7 motorway

- Culverts beneath Warragamba pipelines.

The location of these culverts are shown in Figure 5

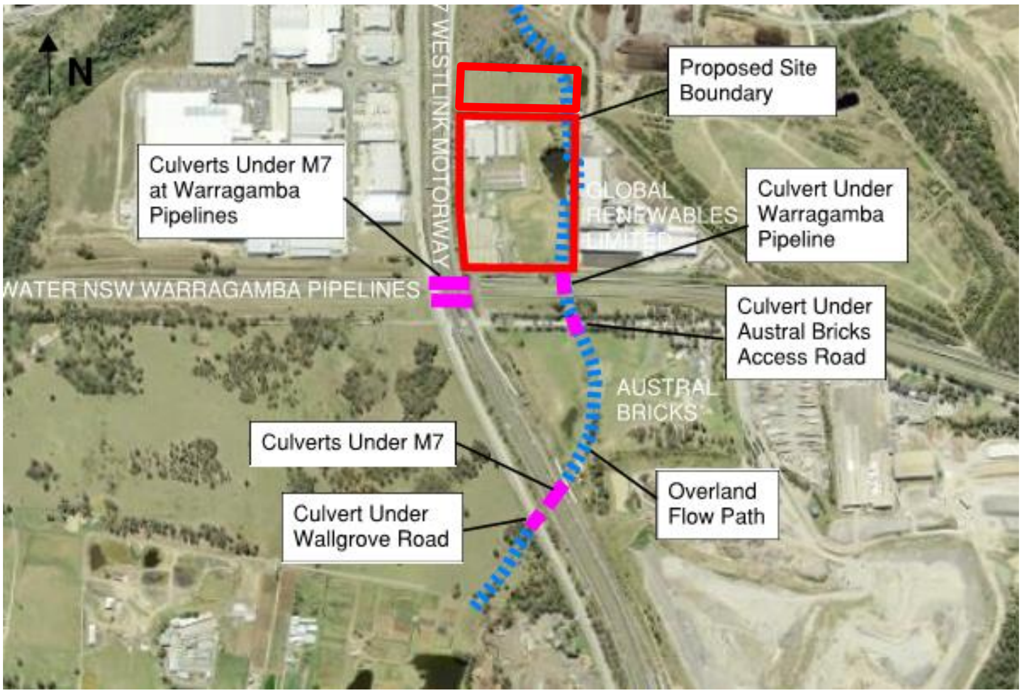


Figure 5 Hydraulic structures in catchment upstream of site

3 The proposal

The purpose of the proposal is to build an energy-from-waste (EfW) facility that can generate up to 58 megawatts (MW) of power by thermally treating up to 500,000 tonnes per year of residual municipal solid waste (MSW) and residual commercial and industrial (C&I) waste streams that would otherwise be sent to landfill.

The proposal would be supported by the construction of site infrastructure including:

- Internal roads.
- Weighbridges.
- Parking and hardstand areas.
- Stormwater infrastructure.
- Fencing.
- Landscaping.

3.1 Post development site grading

As part of the proposal the site will be regraded to facilitate the construction and operation of the proposed facility. This will include general levelling of the majority of the site, with suitable grading achieved to manage site stormwater runoff. To this end, parts of the site will be raised, in particular at the south of the site.

The existing overland flow path which runs from south to north along the eastern site boundary will be maintained with flows separated from site runoff. The channel will be formalised as a trapezoidal channel with a 300mm deep low-flow meander in the base. Previously the channel entered the neighbouring GRL site to the east for a section of approximately 50m, it is proposed that this section will be removed and the channel will be replaced within the proposal site through this section.

The proposed channel base width is 6m at the southern boundary, which allows flows from the Water NSW site to safely enter the site, before narrowing to 3m wide and continuing at this width to the northern boundary. A 300mm deep meandering low flow channel is proposed to run along the base of the channel to maintain the characteristics of a natural channel and provide aquatic habitat. Side slopes are proposed to be 1 in 3, with suitably sized rock placed along the sides and base to prevent erosion.

The overland flow channel will be planted with suitable native vegetation in accordance with the Vegetation Management Plan and consistent with a Manning’s number of 0.04. Typical cross-sections of the proposed overland flow channel with a 6m and 3m base width are included in Figure 6.

Figure 7 shows the post development design terrain incorporated in the flood model. The design of the proposed channel conveys flows entering the site towards the north. The channel has been designed to match the capacity of the existing overland flow channel through the site. Overland flow in this channel will be kept separate from site stormwater runoff.

Two interconnected basins are proposed to manage site stormwater runoff, these are shown at the north-east of the proposal site. The western portion of the basin will act as a bioretention water quality basin, while the eastern portion will act as an OSD basin and include an outlet structure and emergency overflow spillway. The OSD basin and outlet structure has been designed to adhere to Blacktown City Council OSD requirements.

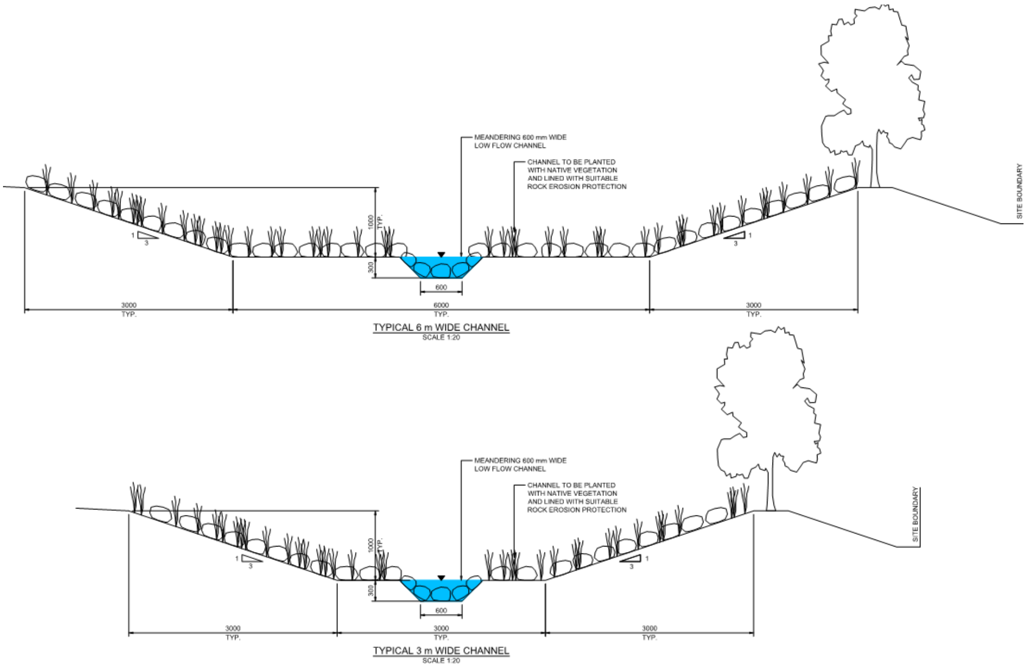


Figure 6 Typical cross sections of realigned overland flow path

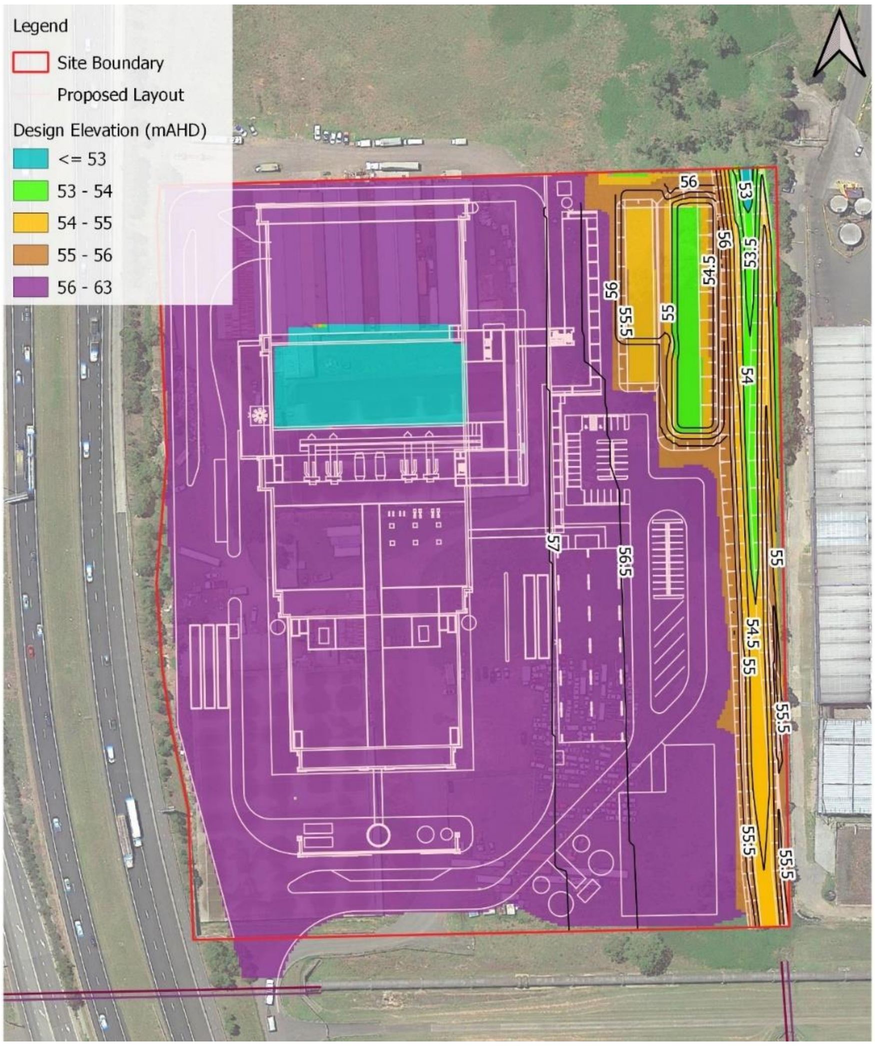


Figure 7 Post development terrain

4 Previous flood investigations

Blacktown City Council are currently undertaking a flood investigation for Eastern Creek which also includes the Reedy Creek floodplain. In response to a request for flood information at the site, on 20 April 2020 Blacktown City Council provided preliminary flood maps for the 1% Annual Exceedance Probability (AEP) and Probable Maximum Flood (PMF) events from this investigation. Extracts from these flood maps are included in Figure 8 and Figure 9. These maps show flooding along the overland flow path and farm dam at the east of the site.

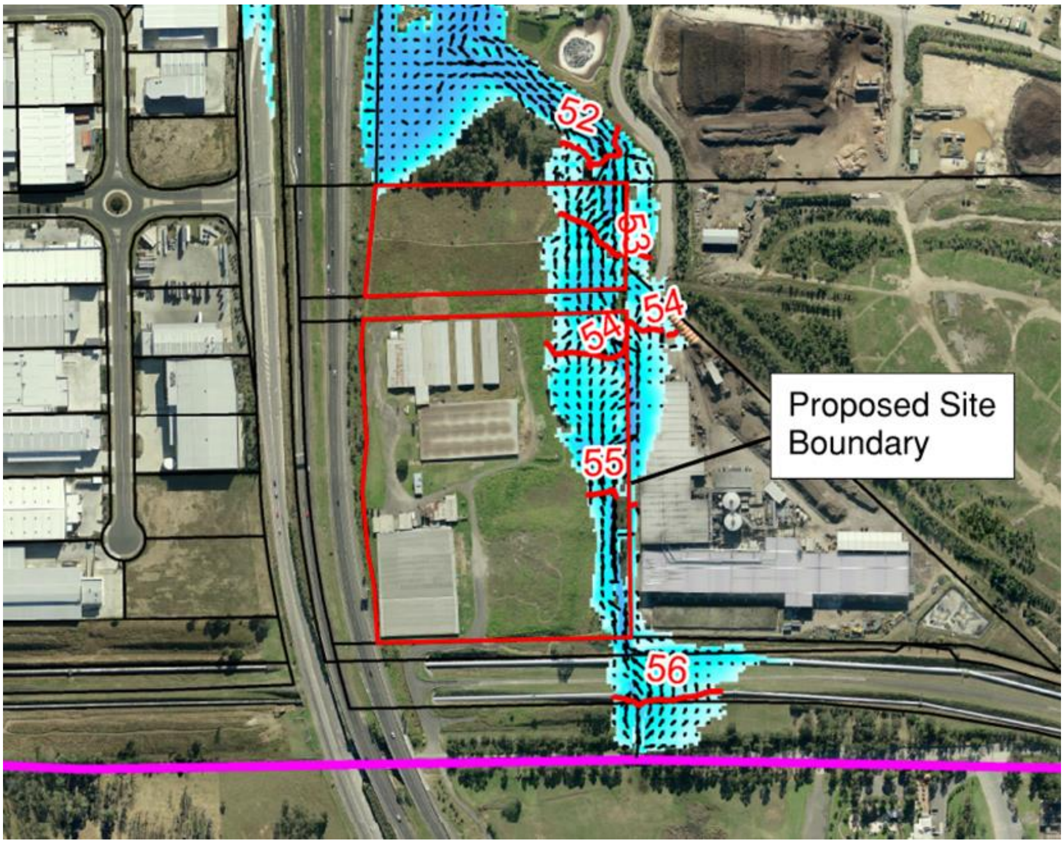


Figure 8 Extract of Blacktown City Council preliminary 1% AEP flood maps

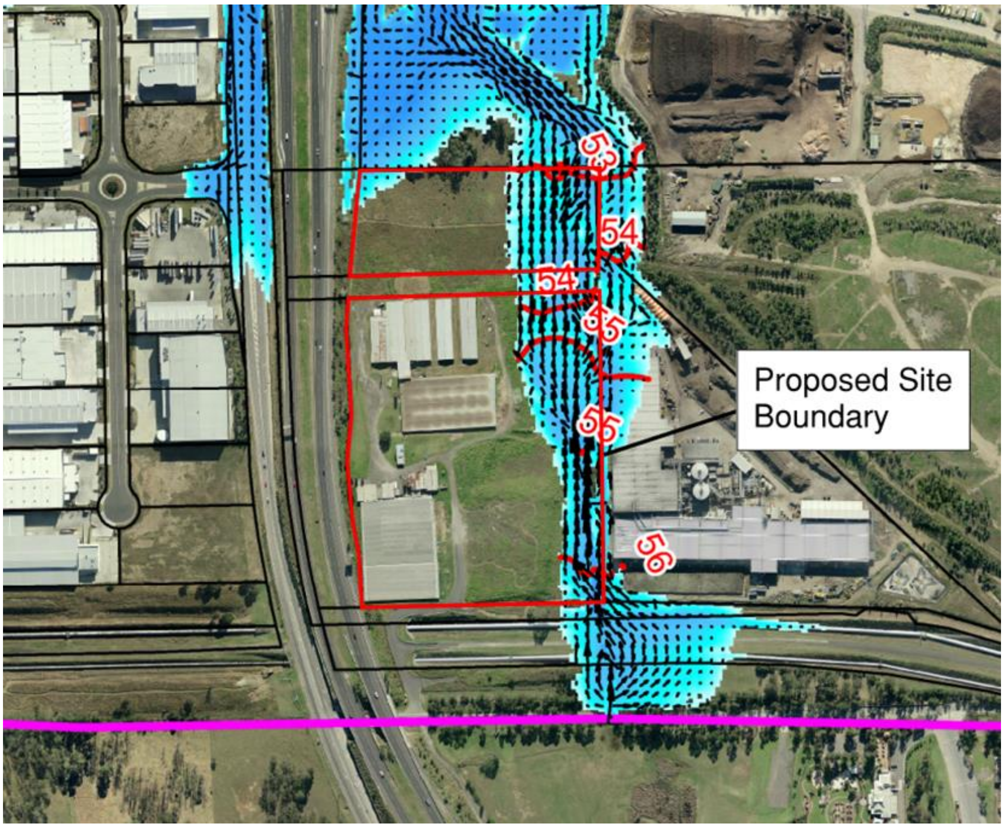


Figure 9 Extract of Blacktown City Council preliminary PMF

Current published flood mapping on the Blacktown City Council GIS MapsOnline portal shows that the proposal site is not within the flood plain of Reedy Creek or Eastern Creek. It is understood that the previous Council flood investigations informing this mapping did not include the proposal site. An extract from the MapsOnline portal is included in Figure 10.

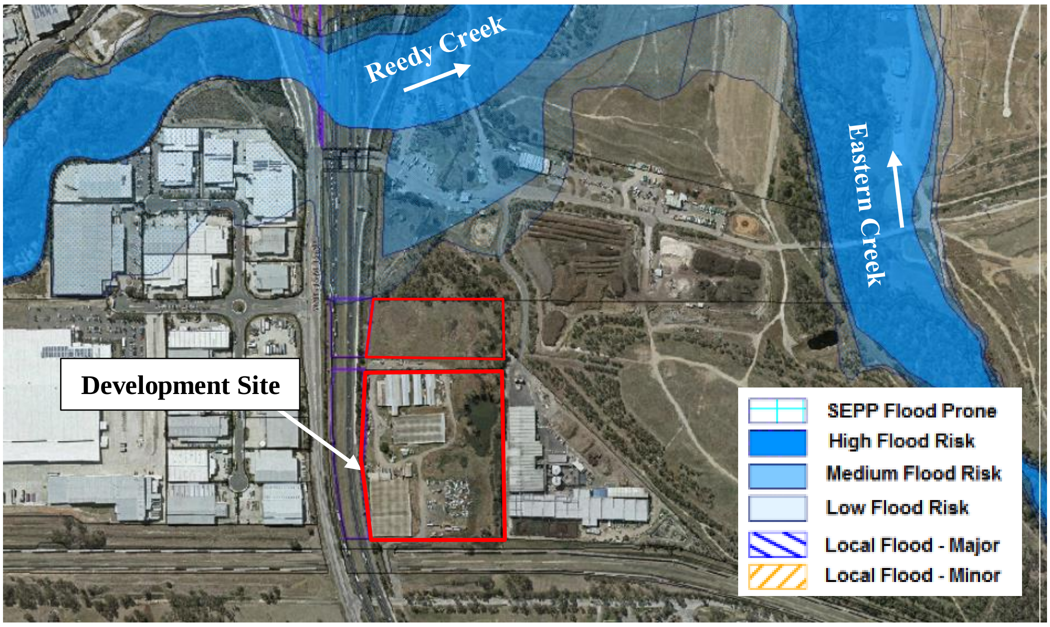


Figure 10 Extract from BCC MapsOnline showing mapped flood risk zones adjacent to the proposal site

5 Flood assessment criteria

The State Environmental Planning Policy (Western Sydney Parklands 2009) applies to the proposal site. Clause 14A of this policy of relates to flood planning and is relevant to the proposal. This clause states that for development in areas below the flood planning level, the consent authority must be satisfied that the development:

(a) is compatible with the flood hazard of the land, and

(b) is not likely to significantly adversely affect flood behaviour resulting in detrimental increases in the potential flood affectation of other development or properties, and

(c) incorporates appropriate measures to manage risk to life from flood, and

(d) is not likely to significantly adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses, and

(e) is not likely to result in unsustainable social and economic costs to the community as a consequence of flooding.

6 Methodology

Flood behaviour at the site has been derived using a set of flood models:

- Hydrological modelling to convert design rainfall estimates into runoff
- Hydraulic modelling to convert runoff into flow velocity and depth.

The following sections detail the process for developing these models.

Catchment physical data used in flood models

Data utilised in this study has been compiled from various sources. Table 1 describes the various datasets utilised in establishing the flood models.

Table 1 Datasets utilised in this study

Data type	Description
LiDAR topographical information	Gridded ground elevations spaced at 1m interval. Sourced from NSW Government – Spatial Services. Used to delineate catchments and inform hydraulic model's ground level.
Ground survey	Topographical ground survey of project site dated 04/11/2019. Used to inform ground level in hydraulic model.
Culvert structures beneath various roads	During a site inspection on 15/01/2020 a number of hydraulic structures along the main overland flow path were identified. Record copy drawings were requested from relevant authorities and where this information was not made available, estimated dimensions from the site inspection were used.
Aerial imagery	Sourced from Google Satellite and Google Maps
AR&R Design Rainfall	Intensity-Frequency-Duration (IFD) data sourced from Bureau of Meteorology (BoM). Design temporal patterns sourced from AR&R Data Hub.

6.1 Flood Hazard

Provisional flood hazard categories have been derived as per Figure L2 In Appendix L of the NSW Floodplain Management Manual (NSW State Government, 2005). Figure 11 displays the different hazard categories.

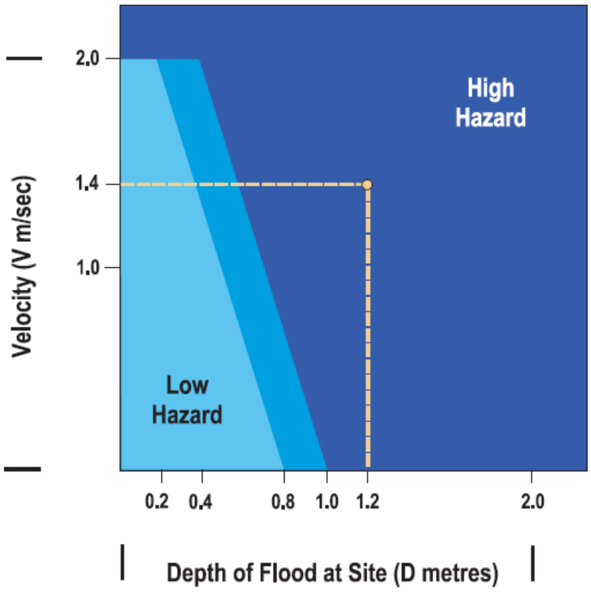


Figure 11 Provisional flood hazard categories. NSW Floodplain Development Manual (2005)

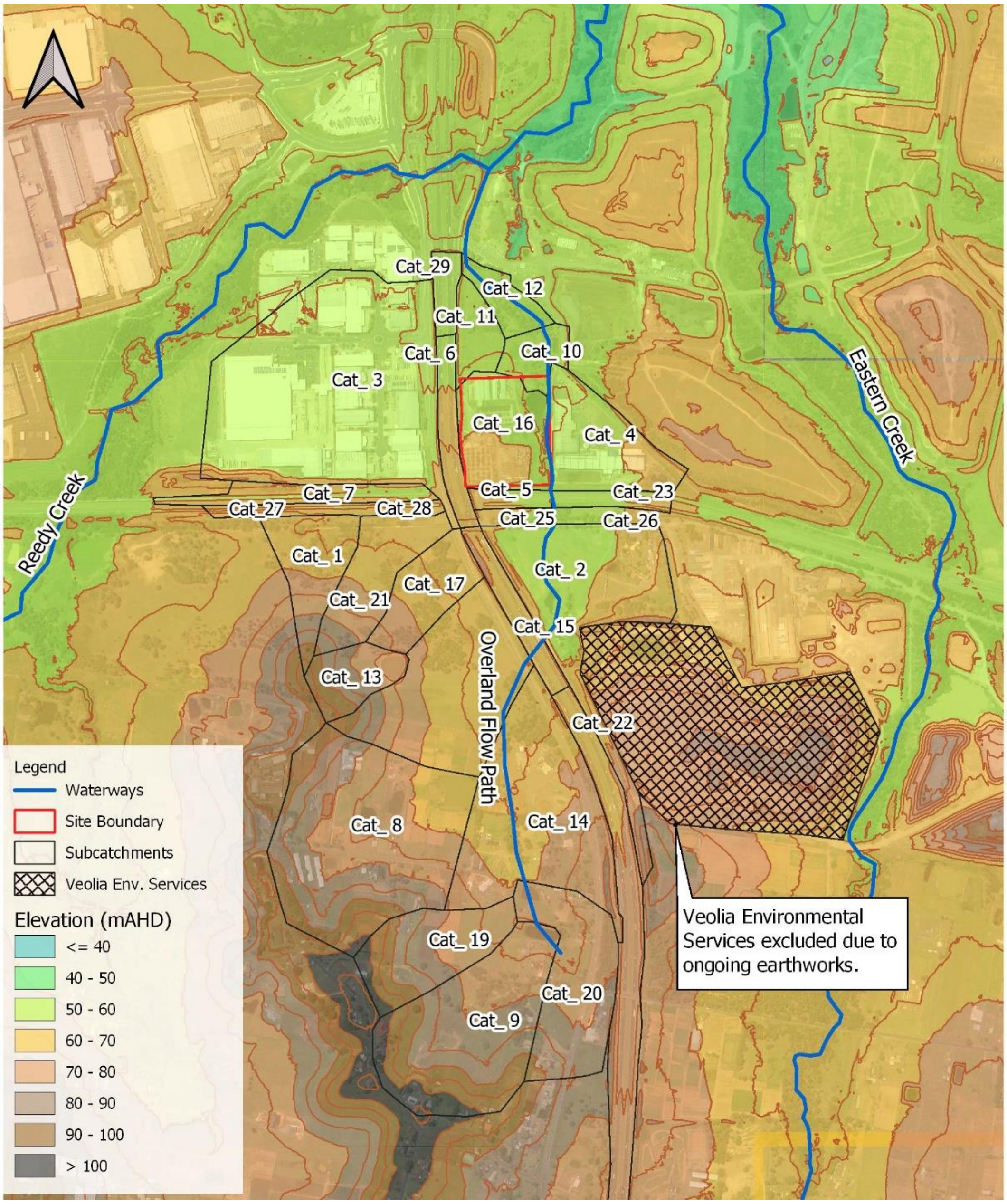
6.2 Hydrological model (XP-RAFTS)

The process of transforming design rainfall at the site and upstream catchment into runoff has been developed utilising the hydrological modelling software XP-RAFTS. XP-RAFTS is widely used in Australia to simulate rainfall-runoff processes in catchments. It uses a set of parameters commonly derived from Digital Terrain Models (DTM), aerial imagery, ground survey, amongst others, to produce flood hydrographs.

XP-RAFTS incorporates current Australian Rainfall and Runoff (AR&R, Ball, et al. 2019) procedures for design flood estimation.

Sub-catchment delineation

The catchment area represented in XP-RAFTS covers approximately 1.8km^2 and consists of 29 sub-catchments. This includes areas, such as Cat_3 that are not located upstream of the site but have the potential to interact with flows from the proposal site. Sub-catchment delineation was performed taking into consideration that resulting inflows are representative of catchment runoff when incorporated into the hydraulic model. Sub-catchment delineation for this study is depicted in Figure 12.



Veolia Environmental Services excluded due to ongoing earthworks.

Figure 12 Sub-catchment layout

A summary of sub-catchment parameters adopted in the XP-RAFTS model is presented Table 2.

Table 2 XP-RAFTS model existing case sub-catchment properties

ID	Total Area (ha)	Impervious (%)	ID	Total Area (ha)	Impervious (%)
Cat_1	4.97	0	Cat_15	2.49	60
Cat_2	13.41	5	Cat_16	6.38	68
Cat_3	28.12	96	Cat_17	4.52	7
Cat_4	6.87	86	Cat_18	13.01	4
Cat_5	1.00	1	Cat_19	6.81	3

ID	Total Area (ha)	Impervious (%)	ID	Total Area (ha)	Impervious (%)
Cat_6	2.47	66	Cat_20	8.96	15
Cat_7	3.02	0	Cat_21	5.59	0
Cat_8	20.96	5	Cat_22	8.43	30
Cat_9	14.54	2	Cat_23	1.34	0
Cat_10	2.16	0	Cat_25	0.83	0
Cat_11	2.36	0	Cat_26	1.06	0
Cat_12	2.05	0	Cat_27	1.45	0
Cat_13	3.31	0	Cat_28	0.48	0
Cat_14	15.92	40	Cat_29	1.34	80

Design rainfall

Design rainfall data was sourced from the Bureau of Meteorology (BoM, 2020). BoM provides design rainfall depths for different design frequencies and storm durations Table 3 presents adopted Intensity-Frequency-Duration (IFD) data for this study.

Table 3 Adopted IFD for the current study

	Annual Exceedance Probability (AEP) rainfall (mm)						
Duration	**63.20%**	**50%**	**20%**	**10%**	**5%**	**2%**	**1%**
15 min	13.9	15.7	21.7	25.7	29.7	35	39.1
20 min	15.9	18	24.7	29.4	33.9	40	44.6
25 min	17.5	19.8	27.1	32.1	37.1	43.7	48.8
30 min	18.8	21.2	29	34.4	39.6	46.7	52.2
45 min	21.8	24.5	33.2	39.2	45.2	53.3	59.7
1 hour	24	26.9	36.2	42.7	49.3	58.1	65.1
1.5 hour	27.4	30.6	40.8	48.1	55.5	65.5	73.6
2 hour	30.2	33.5	44.6	52.5	60.6	71.7	80.7
3 hour	34.7	38.5	51.1	60.1	69.4	82.5	93.1
4.5 hour	40.2	44.7	59.4	70.1	81.2	96.8	109
6 hour	45	50.1	66.9	79.1	91.9	110	124
9 hour	53	59.2	80	95.2	111	133	151
12 hour	59.6	67	91.5	110	128	154	175

IFD values have been obtained using catchment centroid coordinates:

- Latitude: -33.82
- Longitude: 150.854

Areal reduction factors

Design rainfall information is usually provided in the form of IFD tables that relate to defined locations within a catchment. Normally, flood estimates are required for catchments which are sufficiently large that design point rainfall information would not be representative of the areal distribution of the rainfall over the whole catchment. In reality, large catchments are less likely to experience high intensity storms simultaneously over the whole catchment than smaller catchments, as such, Areal Reductions Factors (ARF) are applied on design rainfall estimates to distribute point rainfall estimates over catchments larger than $1km^2$.

ARFs have been adopted in the model in accordance to AR&R 2019 for catchment areas between $1km^2$ and $10km^2$ and storm durations less than 12 hours. Table 4 describes the ARFs that have been adopted for different design rainfalls and durations.

Table 4 ARF values for different storm events for the site

Duration	50% AEP	20% AEP	10% AEP	5% AEP	2% AEP	1% AEP
1 min	0.9035	0.9026	0.902	0.9014	0.9005	0.8999
2 min	0.9302	0.9293	0.9286	0.928	0.9271	0.9264
3 min	0.9424	0.9415	0.9408	0.9401	0.9392	0.9386
4 min	0.9498	0.9489	0.9482	0.9475	0.9466	0.9459
5 min	0.9549	0.954	0.9533	0.9526	0.9516	0.9509
10 min	0.9679	0.9669	0.9662	0.9654	0.9644	0.9636
15 mm	0.9738	0.9727	0.9719	0.9711	0.9701	0.9693
20 min	0.9774	0.9762	0.9754	0.9746	0.9735	0.9726
25 min	0.9798	0.9786	0.9778	0.9769	0.9757	0.9748
30 min	0.9816	0.9804	0.9795	0.9786	0.9774	0.9765
45 min	0.9851	0.9838	0.9828	0.9817	0.9804	0.9794
1 hour	0.9873	0.9858	0.9846	0.9835	0.982	0.9809
1.5 hours	0.9898	0.988	0.9867	0.9854	0.9836	0.9823
2 hours	0.9913	0.9893	0.9878	0.9863	0.9843	0.9828
3 hours	0.9931	0.9909	0.9892	0.9876	0.9854	0.9837
4.5 hours	0.9946	0.9928	0.9914	0.99	0.9882	0.9868
6 hours	0.9955	0.9943	0.9935	0.9926	0.9915	0.9906
9 hours	0.9965	0.9959	0.9954	0.9949	0.9943	0.9938
12 hours	0.9971	0.9965	0.996	0.9955	0.9949	0.9944

Design temporal patterns

Temporal patterns of rainfall describe how precipitation falls over a specific length of time. Current AR&R guidelines recommend the adoption of an ensemble of temporal patterns to minimise inaccuracies and uncertainties associated with adopting a single temporal pattern (AR&R 1987). The current guidelines present two groups of temporal patterns:

- Design point temporal patterns
- Design areal temporal patterns

The selection of the temporal pattern is based on the area and probability of the event. Point temporal patterns are recommended to be used for catchment areas less than 75km^2 (AR&R 2019). As such, point temporal patterns have been adopted for this study.

AR&R 2019 divides Australia into 12 temporal pattern regions. The proposed site is located within the East Coast South region.

An ensemble of 10 temporal patterns is available across four AEP groups as described in Table 5.

Table 5 AEP groups as laid out in Australian Rainfall and Runoff Book 2, Chapter 3

AEP Group	AEP Range
Very Rare	Rarest 10 within region
Rare	Rarer than 3.2% AEP
Intermediate	Between 3.2% and 14.4% AEP
Frequent	More frequent than 14.4% AEP

Rainfall losses and pre-burst

The main physical processes that contribute to rainfall losses are normally:

- Interception
- Depression storage
- Infiltration
- Transmission loss

Current AR&R (Ball, et al. 2019) guidelines discuss methods to represent rainfall losses. The method that is traditionally used in typical design flood estimation is the “initial loss/continuing loss” method. The adopted initial loss is presented in Table 6 and is based on the recommended “probability neutral burst loss” values for NSW. The adoption of these values is based on current AR&R guidelines and rainfall losses adopted in flood studies adjacent to the site.

Table 6 Probability neutral burst loss table of values

Duration (min)	**50% AEP**	**20% AEP**	**10% AEP**	**5% AEP**	**2% AEP**	**1% AEP**
60	26.7	15.6	14.3	14.4	12.3	10.2
90	30.3	16.7	14.6	14.2	12.7	11.6
120	31.1	16.3	13.5	12.7	12	9
180	26.1	14.1	12.4	12.2	11.2	9.6
360	27.1	15.9	13.5	12.7	10.1	6.9
720	28.3	19.6	18.4	17.2	14.4	8
1080	29.4	21.7	21.1	19.7	17.7	9.7
1440	33.2	25.3	24.7	23.6	22.9	13.9
2160	36	28.8	28.7	28	24.4	12.3
2880	40.5	35.2	35.8	40.1	30.7	15.9
4320	41.3	35.6	35.3	42.1	34.5	20.4

A continuous loss of 2.3mm/h was adopted as recommended in the AR&R Data Hub. This is consistent with the South Creek Flood Study (Penrith City Council, 2015) which was previously completed for South Creek which is also a rural area with similar flood regime and catchment characteristics.

PMP

Probable Maximum Precipitation (PMP) is defined as “the greatest depth of precipitation for a given duration meteorologically possible for a given size storm area at a particular location at a particular time of year” (World Meteorological Organisation, 2009).

The Generalised Short Duration Method (GSDM) was adopted to derive PMP patterns for the study area. The GSDM is applicable to catchment areas smaller than 1,000km^2 and for storm durations not longer than 6 hours and is therefore appropriate for the project site. Table 7 presents estimated PMP for different durations within the catchment.

Table 7 PMP for project site catchment

Time (h)	PMP depth (mm)
0.25	165.9
0.50	239.4
0.75	301.0
1.00	350.0
1.50	399.0
2.00	445.2
2.50	473.9
3.00	499.8
4.00	546.0
5.00	589.4
6.00	620.9

Climate change analysis

Scientific investigations have analysed the impact of increased greenhouse gas emissions on average earth surface temperatures. Changes to atmospheric temperatures will likely have the potential to alter rainfall patterns and sea levels. As such, it is sensible to consider the potential impact of climate change on flooding at the site.

The United Nations International Panel for Climate Change (IPCC) has undertaken climate modelling and research to describe four future potential climate scenarios based on the concentration of greenhouse gas emissions that may occur in the following decades. These scenarios have been termed as Representative Concentration Pathways (RCP) and are designated as 2.6, 4.5, 6.0, and 8.5. AR&R (2019) recommends the use of low (4.5) and high (8.5) RCPs for impact assessments. For the purpose of this study, only the high concentration pathway RCP8.5 was assessed.

RCP8.5 estimates that rainfall intensities will increase by 19.7%. As such, a rainfall multiplier of 1.197 was applied to the 1% AEP storm to analyse potential changes in flood behaviour due to climate change.

The project site is located at an elevation and distance far enough from the ocean such that sea level rise will not impact on flooding at the site.

Critical storm duration

This study has investigated 5%, 1% AEP and PMF design flood events. As specified by AR&R 2019, 10 temporal patterns were used for each storm duration from 15 minutes to 12 hours. The critical storm analysis was performed by using the individual median storms. Figure 13 and Figure 14 show the critical storm duration for 1% AEP for 5% AEP storm events respectively upstream of our site. The critical storm duration for each storm event is listed in Table 8.

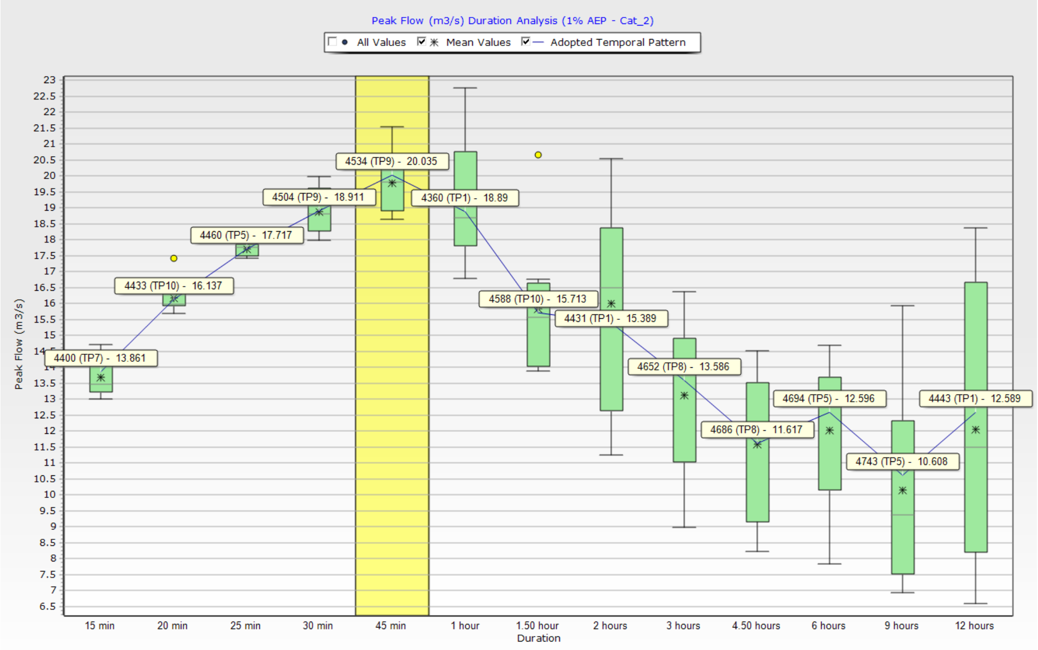


Figure 13 Box-whisker plot showing the critical duration upstream of the proposal site for 1% AEP event

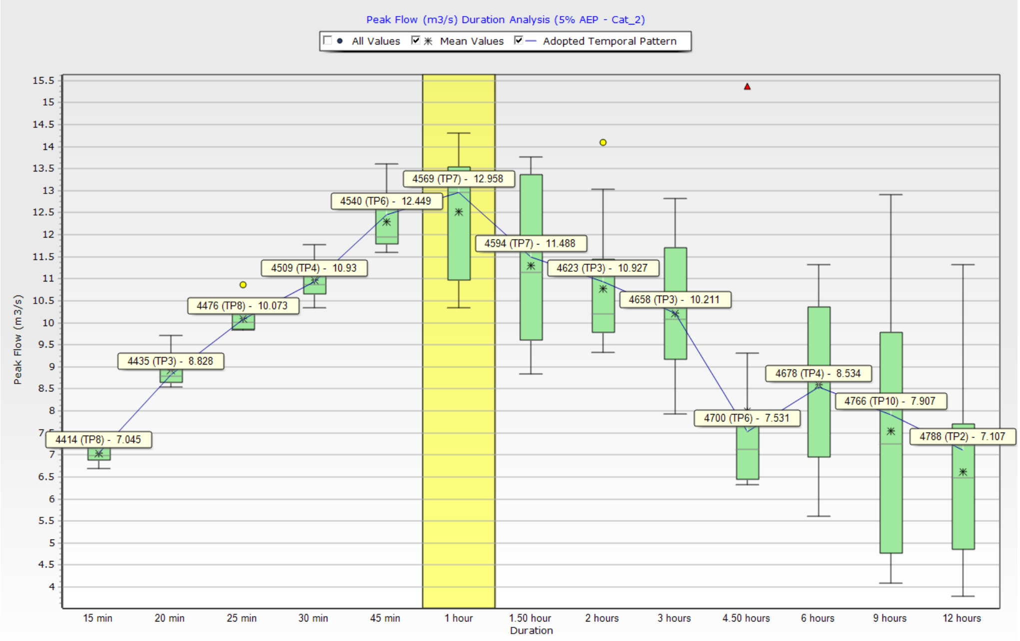


Figure 14 Box-whisker plot showing the critical duration upstream of the proposal site for 5% AEP event

Table 8 Critical storms for each storm event

Storm Event	Critical storms duration	Critical storm temporal pattern
5% AEP	1 hour	TP07
1% AEP	45 minutes	TP09
1% AEP inclusive of climate change	45 minutes	TP09
PMP	45 minutes	GSDM

6.3 Hydraulic model (TUFLOW) build

A TUFLOW 1D/2D hydrodynamic model was established to convert inflow hydrographs, derived in the XP-RAFTS hydrological model, into flow depths and velocities. This model was used to assess flooding at the site in existing and proposed conditions and to assess changes to flood behaviour as a result of the proposed works.

The following sections describe in further detail the assumptions and parameters adopted to establish the hydraulic model.

Model domain and grid size

The TUFLOW model covers an area of approximately 1.2km^2. It was implemented using a square grid size of 2m by 2m. This resolution provides sufficient accuracy to represent watercourses and hydraulic structures without compromising model run-times. The LiDAR dataset at 1m grid resolution and ground survey of the proposal site were utilised to inform ground levels in the TUFLOW model. Figure 15 depicts the TUFLOW hydraulic model layout.

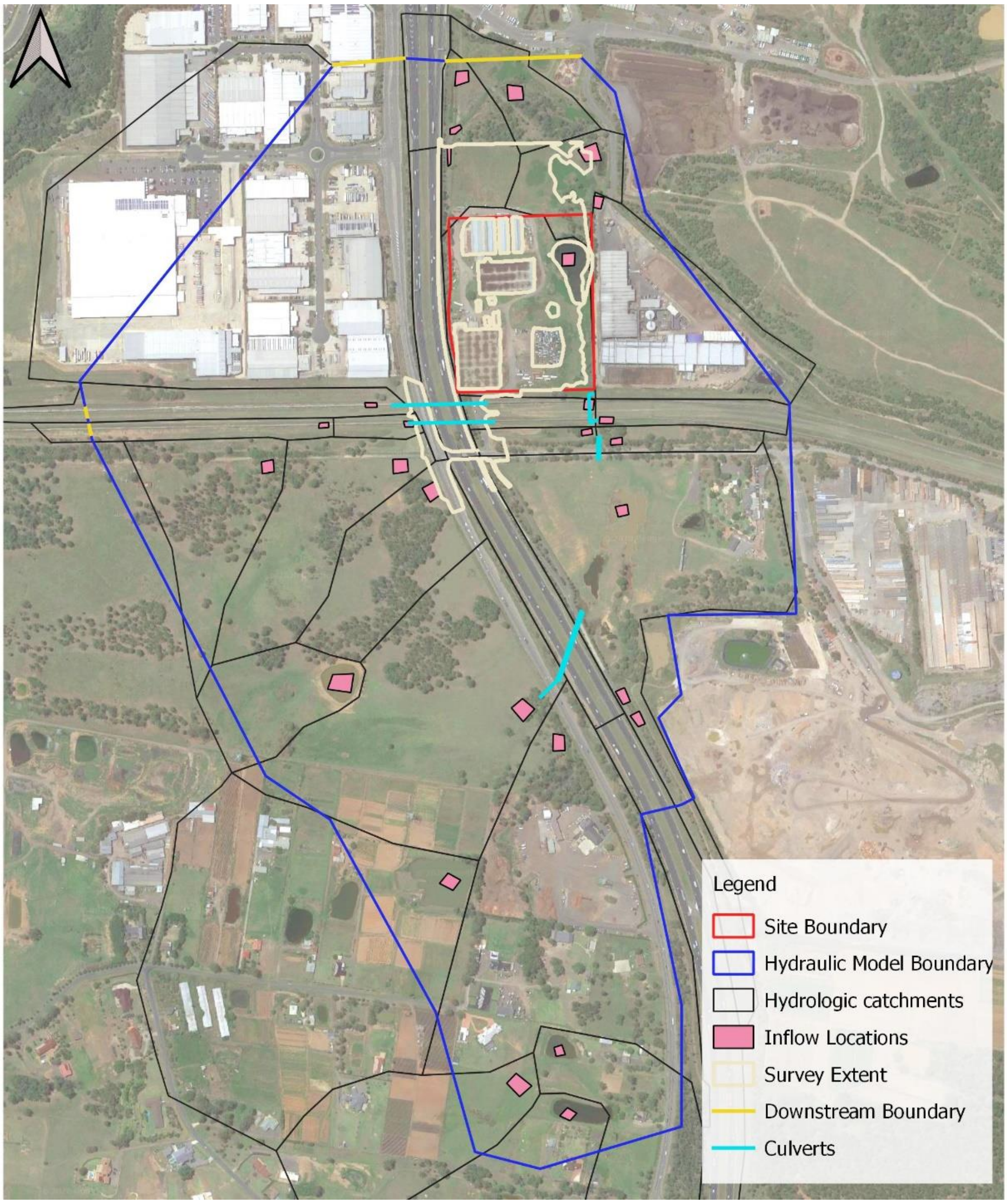


Figure 15 TUFLOW model layout

TUFLOW model build version 2020-01-AA was adopted for this flood assessment. This newly released build allows sub-grid sampling which enables grid sampling at a finer level which results in an improved and more accurate calculation of cell storage. A sub-grid sampling distance of 0.5m was used.

Bed roughness

TUFLOW estimates energy loss due to bed friction using Manning's equation. Bed roughness values across the floodplain have been assigned based on aerial imagery and site inspection.

Assigning bed roughness values to different land types affects flood behaviour. Parameters that affect the estimation of this value include:

- Vegetation type and density;
- Soil roughness and grain size, and;
- Channel sinuosity.

AR&R (2019) provides guidance on a range of recommended values to adopt in hydraulic models depending on the type of vegetation and land use. Table 9 presents the land use type and Manning's 'n' value adopted in this assessment. Figure 16 displays the different land use types within the catchment.

Table 9 Adopted Manning's 'n' value for different land uses

Roughness ID	**Land use**	**Manning's 'n'**
1	Low density vegetated land	0.03
2	Medium density vegetated land	0.05
3	Dense vegetation	0.08
4	Creek bed - moderately vegetated, woody debris	0.05
5	Commercial	0.04
6	Gravel Creek	0.03
7	Roads, carparks, concrete	0.015
8	Farm dams	0.02

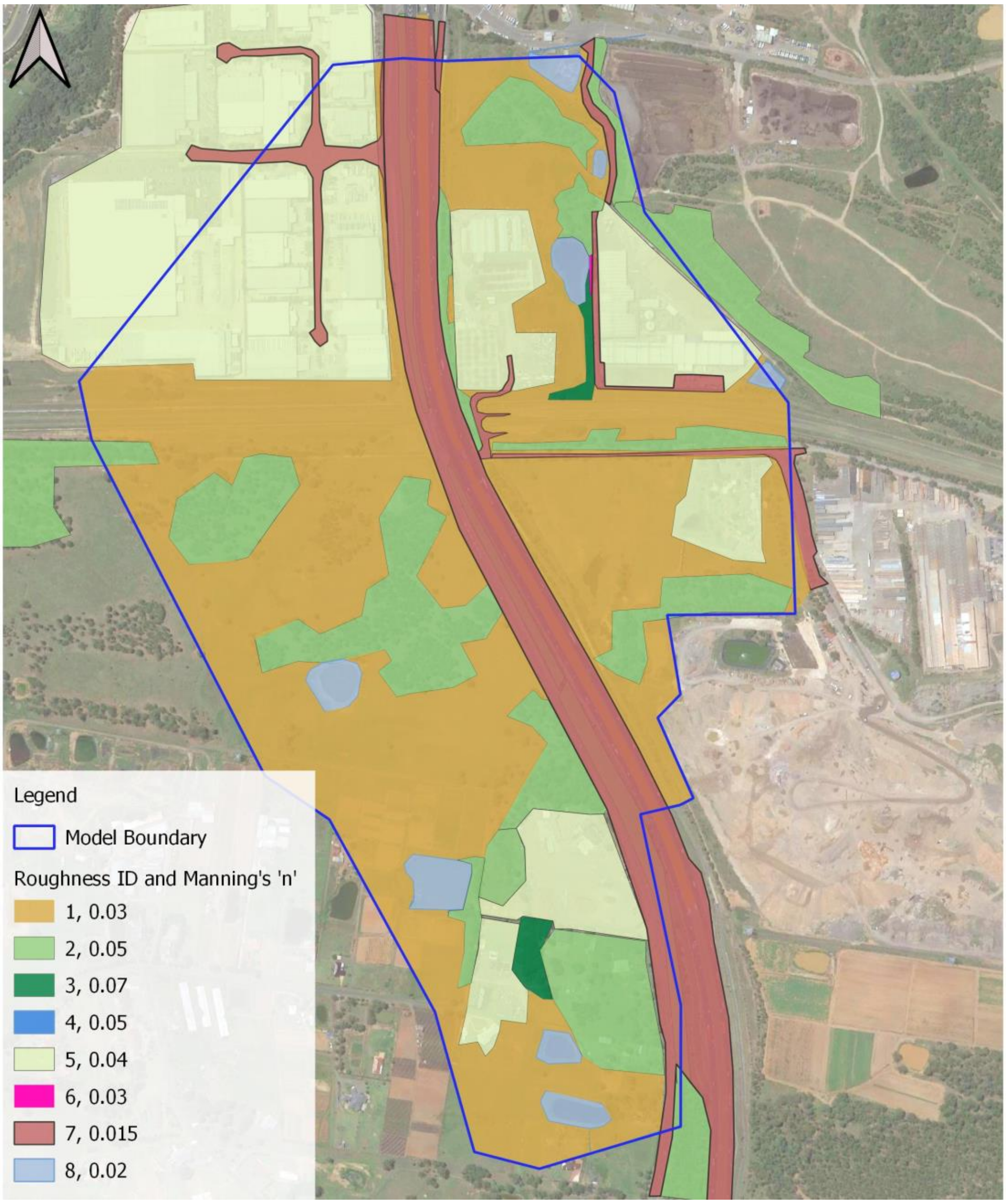


Figure 16 Land use types used in model

Boundary conditions

Runoff into the hydraulic model was sourced from design flow hydrographs derived in XP-RAFTS. Runoff was incorporated at the point source locations shown in Figure 15.

The downstream boundary was set up as a fixed tailwater level of 51mAHD for all modelled events. This was based on an approximation of the 1% AEP flood extent (medium flood risk) at the confluence of Reedy Creek and Eastern Creek shown on the Blacktown City Council GIS MapsOnline portal.

The downstream boundary location is considered sufficiently far downstream of the site to ensure the boundary does not affect flood behaviour near the project site. Another ongoing flood study provided by Blacktown City Council (339 Walgrove Rd Eastern Creek flood study) suggests that the flood levels downstream of the site near the adopted model boundary are between 51mAHD and 52mAHD. This validates the 51mAHD value used in this study.

A sensitivity assessment of the downstream boundary condition was carried out to understand the uncertainty associated with this assumption. The results showed no significant change to peak water levels at site. This is further described in Section 6.4.

Hydraulic structures

A site visit was carried out on 15/01/2020 to observe the current condition of the catchment and identify critical elements that may act as hydraulic controls. Five culvert locations were identified beneath local roads and the M7 Motorway.

Record drawings were requested from relevant authorities to confirm the dimensions of these culverts. However, information was only provided for the culverts running parallel to the Warragamba Pipelines and along the overland flow path under the M7 Motorway. Dimensions of other culverts were estimated based on site visit observations and invert levels were approximated using LiDAR data.

A summary of culvert dimensions incorporated in the model are included in Table 10. Figure 17 depicts the location of the culverts within the catchment.

Table 10 Culvert dimensions

Culvert ID	Dimensions	Source
Culv_01	1 x 900 RCP	Estimated from site visit
Culv_02	2 x 1800 x 1200 RCBC	WestLink M7
Culv_03	1 x 1800 x 1300 RCBC	WestLink M7
Culv_04	2 x 1200 RCP	Estimated from site visit
Culv_05	2 x 900 RCP	Estimated from site visit
Culv_06	2 x 1200 RCP	Estimated from site visit
Culv_07	2 x 450 RCP	WestLink M7
Culv_08	2 x 600 RCP	WestLink M7

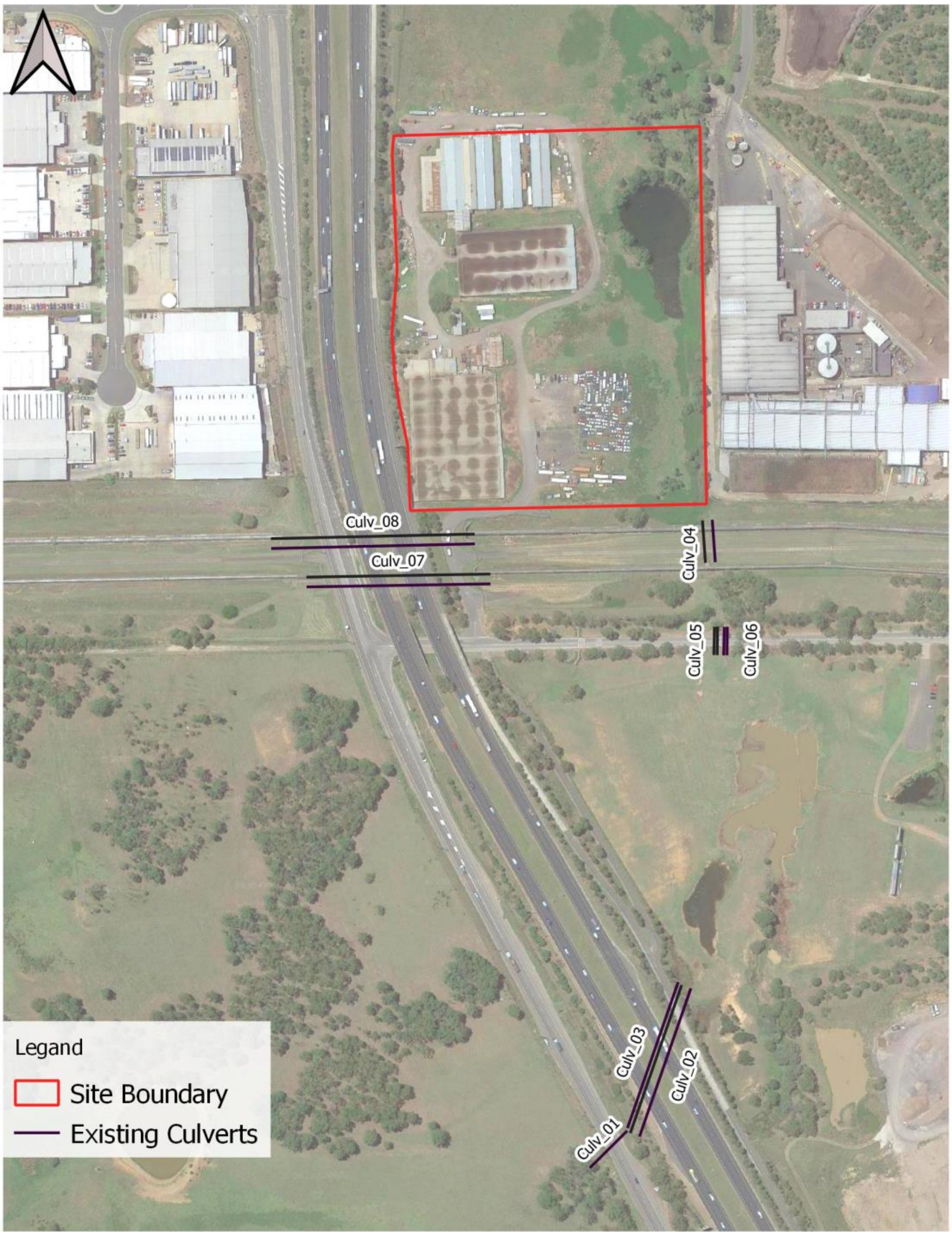


Figure 17 Location of culverts within catchment

Farm dams

A number of farms dams can be seen via aerial imagery within the catchment. The farm dams, although relatively small in size, can influence flood behaviour, especially during frequent events. The modelling approach assumed dams to be full at the start of the simulation. This assumption was considered appropriately conservative to assess the potential peak flood levels that may occur in the catchment.

Culvert blockage assumptions

In accordance with AR&R 2019 guidelines, design flood behaviour considered the potential of debris build up and blockage that may occur at culverts during a flood. An assessment was carried out to determine appropriate culvert blockage factors based on culvert dimensions and observed conditions in the catchment. Based on this assessment a blockage factor of 25% was adopted for all culverts.

6.4 Model verification

Flood model results were verified by comparing flood levels and catchment yields from two studies and an alternative calculation method. These are:

- Preliminary flood map from the Eastern Creek flood investigation (currently draft version) commissioned by Blacktown City Council covering the proposal site and adjoining creeks;
- The Rural Area Flood Study - Ropes, Reedy and Eastern Creeks (Fairfield City Council, 2013) which covers an area south of the project site, and;
- The Regional Flood Frequency Estimation (RFFE) method.

Eastern Creek flood investigation (Blacktown City Council, ongoing)

Blacktown City Council is currently undertaking a flood investigation for Eastern Creek which also includes the Reedy Creek floodplain. In response to a request for flood information at the site, Blacktown City Council provided preliminary flood maps from this investigation. Flood levels provided from this study were used to verify flood levels modelled across the site in this flood impact assessment. Figure 18 presents the flood levels for 1% AEP design event at the proposal site and area to the north in the Council flood map.

The Council flood map shows 1% AEP water levels at the southern section of the site ranging from between 55mAHD and 56mAHD at the southern boundary and between 53mAHD and 54mAHD at the northern boundary of the southern portion of the site. These values are comparable to the 1% AEP water levels from this flood investigation (Figure 19), where water level is at 55.57mAHD at the southern boundary and 53mAHD at the northern boundary of the southern portion of the site. It can be seen that the 55mAHD water level contour is in a similar location in both flood maps.

The downstream boundary in the current study was modelled at constant level of 51mAHD for all events, and the Council flood map shows a 1% AEP water level of between 51mAHD and 52mAHD at this location (Figure 19).

A sensitivity analysis was performed to assess the sensitivity of the results in site to increase and decrease of downstream water level (Section 6.5), in which no change in results was observed.

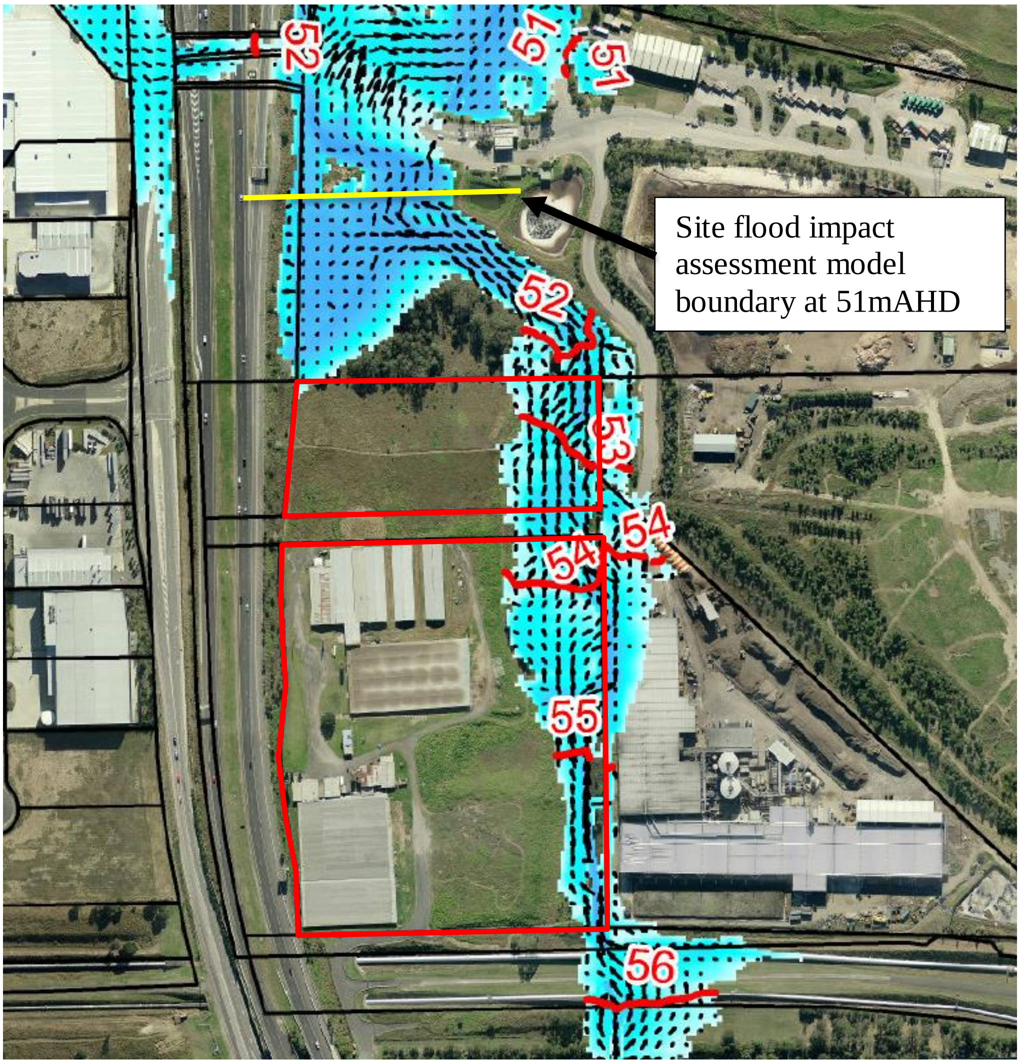


Figure 18 Estimated 1% AEP water levels from Eastern Creek flood investigation (Blacktown City Council, ongoing)

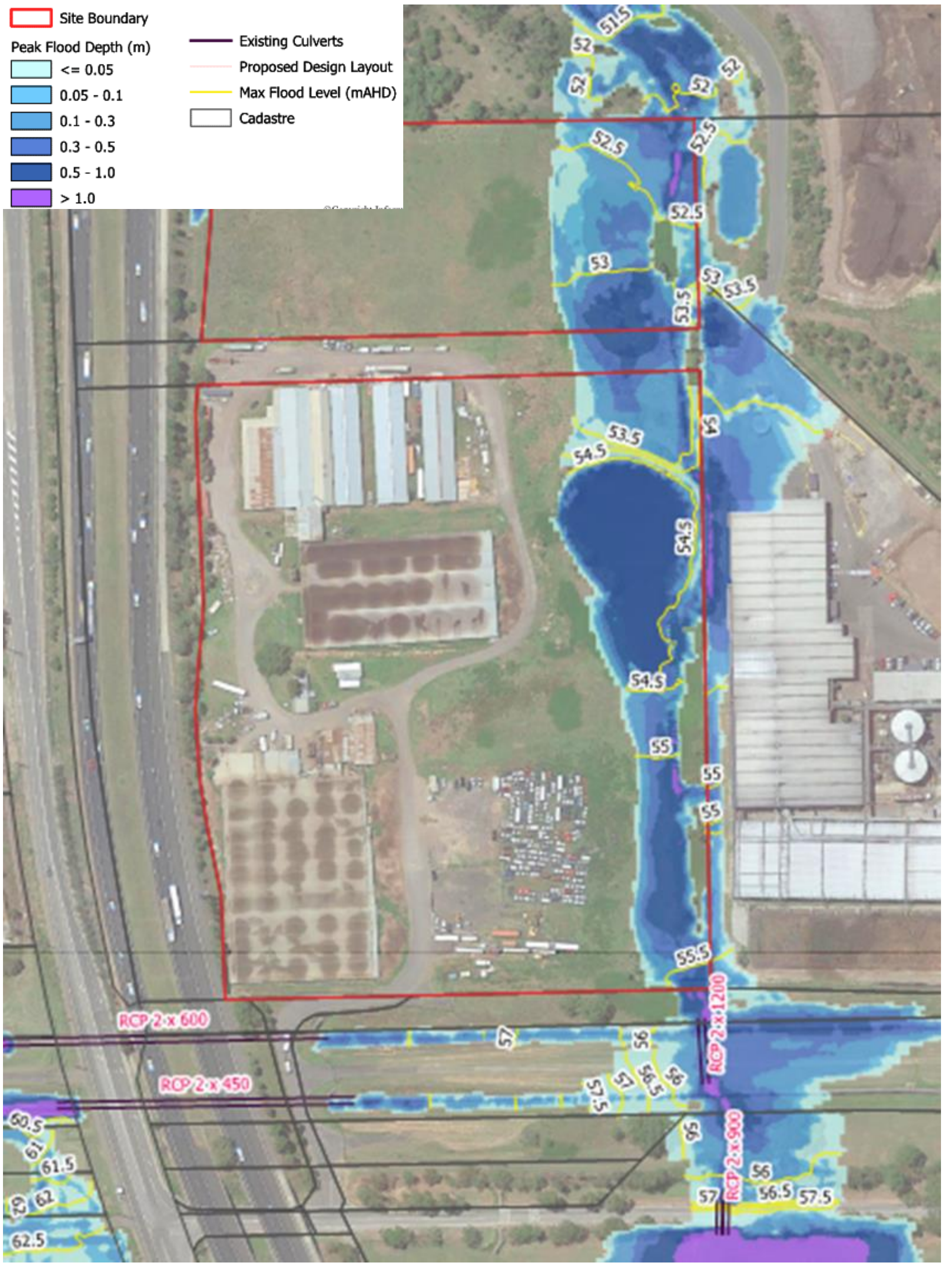


Figure 19 Water level for 1% AEP as modelled for this flood study

Rural Area Flood Study - Ropes, Reedy and Eastern Creeks (Fairfield City Council, 2013)

This flood study was conducted for Fairfield City Council to determine design flood behaviour in three rural catchments: Reedy Creek, Ropes Creek and Eastern Creek. These catchments have been historically subject to flooding. The purpose of this study was to determine the extent and nature of flooding in these catchments. The Eastern Creek catchment is in the vicinity of the project site and therefore was used for the verification of the flood model established herein. The catchment boundary is shown in Figure 20.

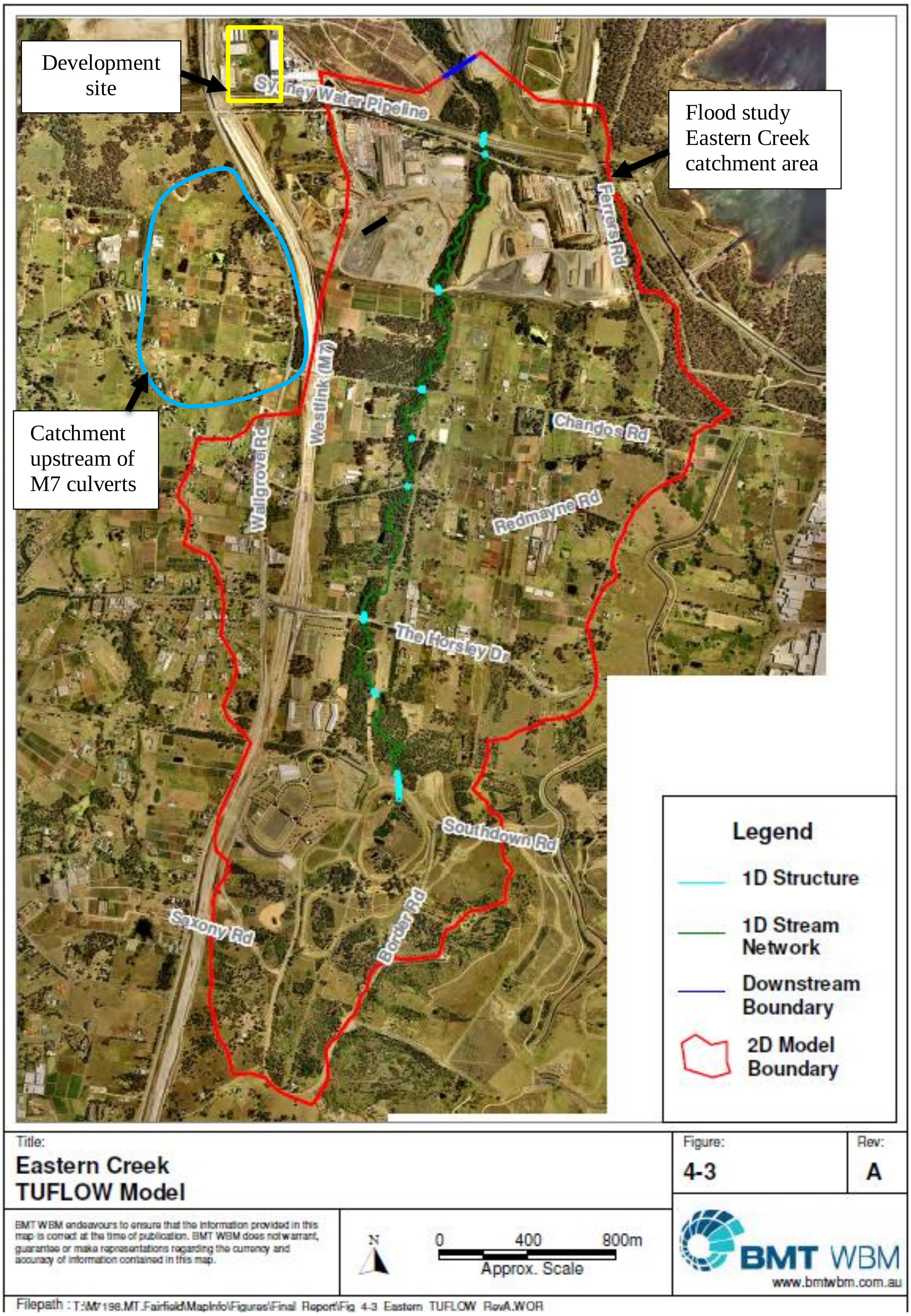


Figure 20 Eastern Creek Study flood study catchment and the catchment upstream of the M7 culverts (Source: Fairfield City Council, Rural Area Flood Study - Ropes, Reedy & Eastern Creeks - Final Report, November 2013)

The catchment yield analysis compared the catchment area of a location reporting the 1% AEP peak runoff in the Rural Area Flood Study against the 1% AEP peak flow from the catchment area draining to the culverts under the M7 Motorway along the overland flow path in this flood investigation. Table 11 summarises the findings of this analysis, which suggests that the yield of current study is 0.196 m^3/s/ha. This value is positioned higher compared to the Rural Area Flood Study, but within an acceptable range.

Table 11 Catchment yield analysis between Rural Area Flood Study and the current flood assessment

Parameter	**Rural Area Flood Study (Fairfield City Council, 2013) – 1 %AEP flood**	**Current study (M7 culverts) – 1% AEP flood**
Flow (m^3/s)	77.9	16.1
Area (ha)	649	82.2
Unitary rate discharge (m^3/s/ha)	0.12	0.196

The Regional Flood Frequency Estimation (RFFE)

The Regional Flood Frequency Estimation (RFFE) technique is a method used to estimate peak flows in rural ungauged catchments utilising gauged data from nearby catchments. The RFFE technique is recommended to be used in catchments with areas between 0.5km^2 and 1,000 km^2. Further information about the method is presented in Book 3 of AR&R 2019.

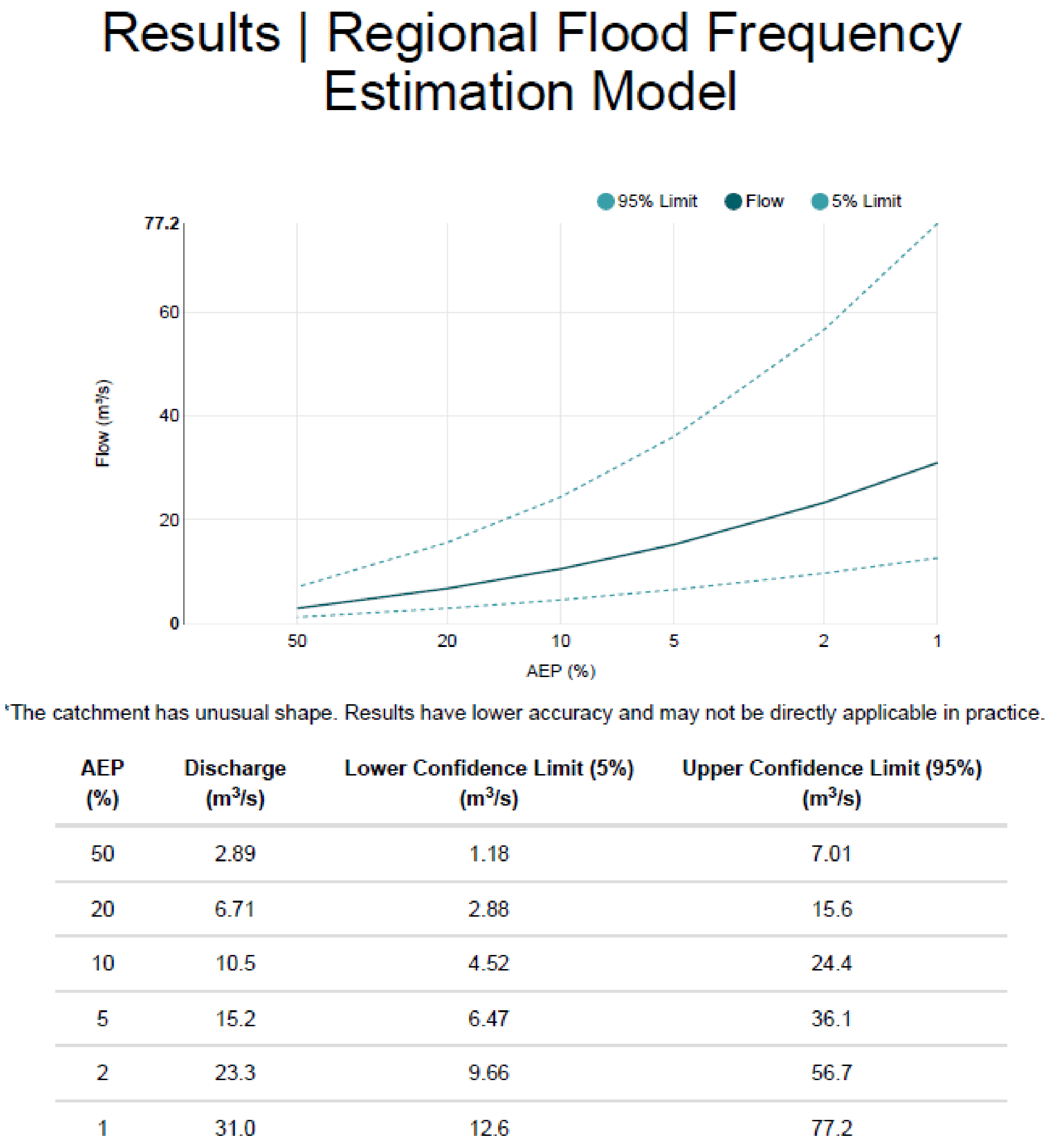
The flow to the culverts under the M7 Motorway along the overland flow path in this study has been used for this assessment. The RFFE method provides a discharge value based on the catchment area and location of the catchment with range of 5% lower and upper confidence levels.

The catchment area contributing to the culverts under the M7 Motorway is 82.2ha, with 16.1m^3/s at the culverts under the M7 Motorway. This flow is in the lower bounds of the confidence limits but within the acceptable range.

Table 12 summarises the comparison between RFFE and flows of to M7 culvert. Figure 21 presents the range of flows based on RFFE model.

Table 12 Comparison of estimated flow at culverts under M7 Motorway

	Current study (M7 culverts) – 1% AEP	**RFFE – 1% AEP**	**Confidence Limit Range – 1% AEP**
Flow (m^3/s)	16.1	31.0	12.6 - 77.2



Results | Regional Flood Frequency Estimation Model

'The catchment has unusual shape. Results have lower accuracy and may not be directly applicable in practice.

AEP (%)	Discharge (m^3/s)	Lower Confidence Limit (5%) (m^3/s)	Upper Confidence Limit (95%) (m^3/s)
50	2.89	1.18	7.01
20	6.71	2.88	15.6
10	10.5	4.52	24.4
5	15.2	6.47	36.1
2	23.3	9.66	56.7
1	31.0	12.6	77.2

Figure 21 Regional Flood Frequency estimation for the proposal site (RFFE, Australian Rainfall and Runoff 2019)

6.5 Sensitivity analysis

A sensitivity analysis was carried out to determine the degree of uncertainty associated with a variety of parameters adopted in the flood model.

AR&R 2019 outlines the recommended criteria for sensitivity analyses of flood models. The 1% AEP flood event existing conditions model was utilised for the base comparison against the other scenarios.

Table 13 lists the sensitivity tests that have been undertaken as part of this study, and Figure 22 indicates the location where results were compared for these tests.

Table 13 Summary of flood model sensitivity tests

Sensitivity Analysis	**Description**	**Results presented in**
Bed roughness sensitivity	Bed roughness values were increased and decreased by 20%	Table 14
Inflow increase	Inflows were increased by 19.17% (climate change factor)	The results presented in Table 15 show that the model shows some sensitivity to an increase in flow, which is to be expected. The greatest impact can be seen at P6, upstream of the culverts under the M7 Motorway along the overland flow path. This is likely due to ponding upstream of the M7 Motorway when the capacity of these culverts is exceeded. Table 15
Culvert blockage	Sensitivity to blockage of culverts was carried out for 50% and 15% blockage factors.	Table 16
Downstream boundary condition	Downstream boundary condition was increased and decreased by 0.5 m	Table 17
Initial loss and continuous loss	Rainfall losses were increased and decreased by 50% of the adopted loss values.	Table 18

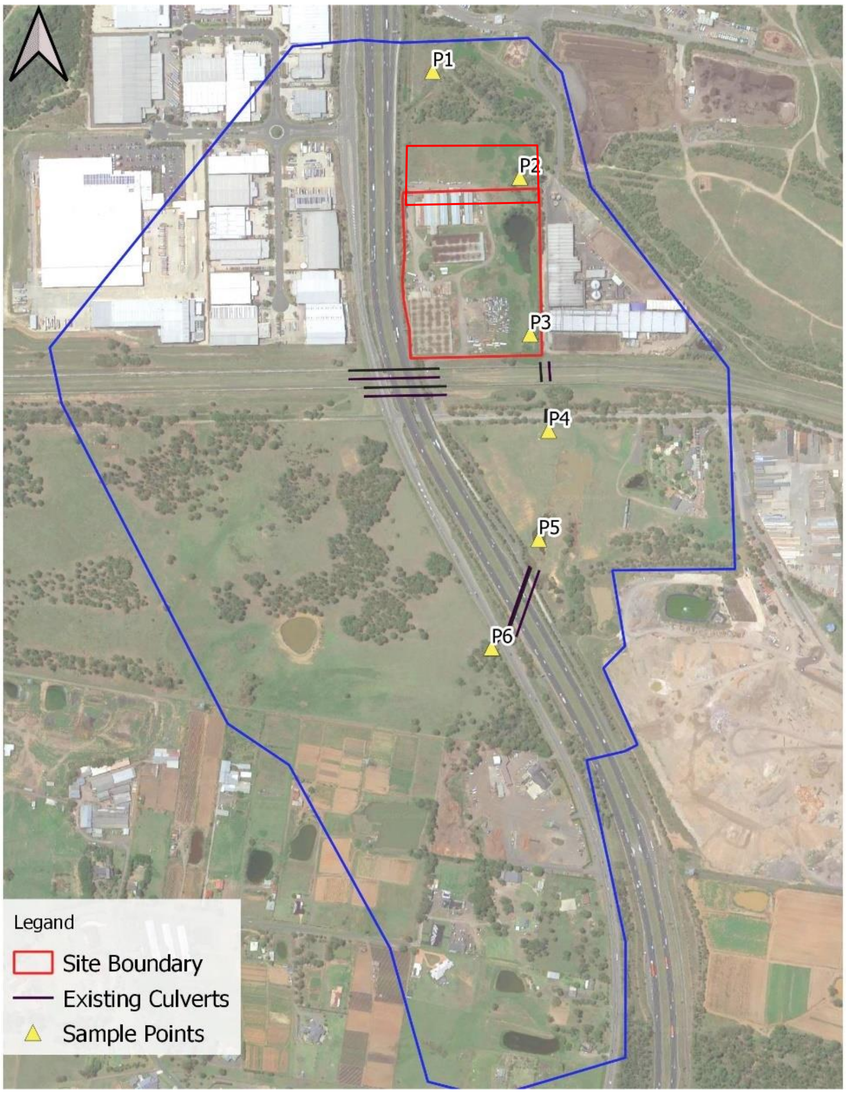


Figure 22 Indicative location of points for sensitivity tests

The results presented in Table 14 indicate that changes to the roughness do not result in significant changes to the 1% AEP peak flood levels at the site.

Table 14 Sensitivity of flood model to changes in roughness

ID	Base model 1% AEP flood levels (mAHD)	Roughness +20% 1% AEP flood levels (mAHD)	Change in flood levels (m)	Roughness -20% 1% AEP flood levels (mAHD)	Change in flood levels (m)
P1	51.05	51.04	-0.006	51.05	0.005
P2	53.07	53.07	0.007	53.06	-0.007
P3	55.21	55.24	0.032	55.17	-0.039
P4	57.65	57.64	-0.010	57.66	0.008
P5	58.52	58.53	0.012	58.51	-0.014
P6	61.56	61.56	0.000	61.56	0.000

The results presented in Table 15 show that the model shows some sensitivity to an increase in flow, which is to be expected. The greatest impact can be seen at P6, upstream of the culverts under the M7 Motorway along the overland flow path. This is likely due to ponding upstream of the M7 Motorway when the capacity of these culverts is exceeded.

Table 15 Sensitivity of model to increase in inflow

ID	Base model 1% AEP flood levels (mAHD)	Inflow +20% 1% AEP flood levels (mAHD)	Change in flood levels (m)
P1	51.05	51.05	0.000
P2	53.07	53.13	0.067
P3	55.21	55.32	0.109
P4	57.65	57.74	0.088
P5	58.52	58.54	0.016
P6	61.56	61.78	0.223

Table 16 presents results for the culvert blockage sensitivity tests. These results indicate low sensitivity to varied blockage factors, with the exception of the area upstream of the M7 Motorway which is shown to be sensitive to a higher blockage factor. As per the flow sensitivity test, this is likely due to ponding upstream of the M7 Motorway as it forms a barrier to overland flow.

Table 16 Sensitivity of model to changes in culvert blockage

ID	Base model 1% AEP flood levels (mAHD)	Hydraulic blockage increase 1% AEP flood levels (mAHD)	Change in flood levels (m)	Hydraulic blockage decrease 1% AEP flood levels (mAHD)	Change in Flood levels (m)
	blockage 25%	**blockage 50%**		**blockage 15%**	
P1	51.05	51.05	0.000	51.05	0.000
P2	53.07	53.02	-0.042	53.05	-0.012
P3	55.21	55.15	-0.062	55.19	-0.018
P4	57.65	57.68	0.028	57.61	-0.035
P5	58.52	58.49	-0.033	58.52	0.001
P6	61.56	61.75	0.196	61.55	-0.004

Table 17 presents results for the model tailwater level sensitivity tests. No sensitivity was shown at the proposal site. The only sensitivity shown was adjacent to the model boundary, where an increase in the tailwater level resulted in an increase in flood levels, which is to be expected. These results confirm the appropriateness of the tailwater level and model boundary locations used in the model.

Table 17 Sensitivity of model to changes in tailwater level

ID	Base model 1% AEP flood levels (mAHD)	Tailwater +0.5m 1% AEP flood levels (mAHD)	Change in flood Levels (m)	Tailwater -0.5m 1% AEP flood levels (mAHD)	Change in flood levels (m)
P1	51.05	51.77	0.722	51.05	0.000
P2	53.07	53.06	-0.002	53.05	-0.012
P3	55.21	55.21	-0.003	55.19	-0.018
P4	57.65	57.65	0.000	57.61	-0.035
P5	58.52	58.52	0.000	58.52	0.001
P6	61.56	61.56	0.000	61.55	-0.004

Table 18 presents results for sensitivity tests for changes to initial and continuing losses in the hydrological model. Generally, the results show that water levels across the catchment are not particularly sensitive to these parameters. One exception is at P4, adjacent to the Warragamba Pipelines, where some sensitivity to an increase in initial and continuous loss can be seen, this is likely due to the depression at this location which creates some localised ponding.

Table 18 Sensitivity of model to changes in initial and continuous losses

ID	Base model 1% AEP flood levels (mAHD)	IL/CL +50% 1% AEP flood levels (mAHD)	Change in flood Levels (m)	IL/CL -50% 1% AEP flood levels (mAHD)	Change in Flood levels (m)
P1	51.05	51.05	0.000	51.05	0.000
P2	53.07	53.03	-0.037	53.11	0.044
P3	55.21	55.15	-0.055	55.28	0.069
P4	57.65	57.51	-0.144	57.71	0.060
P5	58.52	58.50	-0.023	58.53	0.010
P6	61.56	61.50	-0.055	61.63	0.076

7 Existing conditions flood behaviour

Existing conditions flood modelling was carried out for the 5% AEP, 1% AEP, 1% AEP climate change scenario and PMF design flood events. Flood maps were prepared to display flood levels, velocity and provisional hydraulic hazard. A list of existing conditions flood maps is summarised below, these maps are included in Appendix A.

- E.01: Peak flood depths – existing conditions – 5% AEP flood event
- E.02: Peak flood depths – existing conditions – 1% AEP flood event
- E.03: Peak flood depths – existing conditions – 1% AEP flood event inclusive of climate change
- E.04: Peak flood depths – existing conditions – PMF event
- E.05: Flood hazard – existing conditions – 5% AEP flood event
- E.06: Flood hazard – existing conditions – 1% AEP flood event
- E.07: Flood hazard – existing conditions – 1% AEP flood event inclusive of climate change
- E.08: Flood hazard – existing conditions – PMF event
- E.09: Flood velocity – existing conditions – 5% AEP flood event
- E.10: Flood velocity – existing conditions – 1% AEP flood event
- E.11: Flood velocity – existing conditions – 1% AEP flood event inclusive of climate change
- E.12: Flood velocity – existing conditions – PMF event

The flood model results show overland flows following the identified overland flow path crossing Wallgrove Road, the M7 Motorway and the Warragamba Pipelines before entering the site. The main overland flow path through the site flows northwardly along the overland flow path adjacent to the eastern site boundary. In the modelled events flow enters the farm dam as well as continuing along the flow path. Runoff is then conveyed northwards before discharging into Reedy Creek.

There are two sets of twin culverts running parallel to the Warragamba Pipelines in an east-west direction, beneath the M7 Motorway, which provide flow connectivity across the M7 Motorway. These flows are minor compared to the main flow path.

Due to its relatively small catchment area flood response is expected to be relatively fast (in the order of minutes) as such, sufficient flood warning is strictly dependant on rainfall forecast.

7.1 Existing conditions flood results

The following sections include a short discussion of the existing conditions results for each flood event. This section should be read in conjunction with the flood maps presented in Appendix A.

5% AEP flood event

In the 5% AEP flood event peak flood depths across the southern portion of the site are generally less than 600mm. An exception is at a localised depression in the south-east of the site adjacent to the 55mAHD contour, where the peak depth is 1.3m and water spills into the neighbouring GRL property. The estimated peak flood level at the upstream (southern) site boundary is 55.4mAHD, and 53mAHD at the downstream (northern) boundary of the southern portion of the site.

The maximum flow velocity at the site in the existing 5% AEP event is typically less than 1m/s, with localised areas with velocities between 1m/s and 2m/s.

The majority of the site is classified as low hydraulic hazard. The overland flow path can be identified by the areas of intermediate and high hazard, which correspond to greater flow depths. The diversion of the overland flow path into the GRL site is clearly visible with areas of intermediate and high hazard at the GRL site in this area.

1% AEP flood event

In the 1% AEP flood event flood depths at the site are generally less than 720mm. The exception is at a localised depression where depth reaches 1.42m where water spills into the neighbouring GRL site. The estimated peak flood level at the upstream (southern) site boundary is 55.5mAHD, and 53.1mAHD at the downstream (northern) boundary of the southern portion of the site.

Flow velocity at most of the site is less than 1m/s with areas along the overland flow path with velocities between 1m/s and 2m/s. Flow velocities at the GRL site adjacent the eastern boundary exceed 2m/s in a small area.

In the 1% AEP flood event the majority of the site low hazard, with areas of intermediate and high hazard along the overland flow path. Areas of intermediate and high hazard can be seen at the GRL site.

1% AEP flood event inclusive of climate change

Flood depths at the site are slightly higher in the 1% AEP climate change scenario compared to the base 1% AEP simulation, with a maximum depth at the site of 1.45m. Flood depths are generally less than 820mm across the site. The estimated peak flood level at the upstream (southern) site boundary is 55.6mAHD, and 53.2mAHD at the downstream (northern) boundary of the southern portion of the site.

Flow velocities along the overland flow path are above 1m/s across a larger area compared to the 1% AEP map.

Hydraulic hazard mapping shows a larger area along the overland flow path with intermediate and high hydraulic hazard compared with the 1% AEP event.

PMF

Peak flood depth in the PMF reaches a maximum of 1.5m across the site, with the exception of the location where flows spill into the GRL site which reaches a depth of 2.2m. The estimated peak flood level at the upstream (southern) site boundary is 56.1mAHD, and 53.6mAHD at the downstream (northern) boundary of the southern portion of the site. The western portion of the site remains flood-free.

Velocity of water entering the site is estimated to be 1.84m/s and exiting the site at 1.53m/s, reaching to the maximum of 4.2m/s in the middle of the site.

In the PMF most of the flooded area at the site and surrounding area is classified as high hydraulic hazard.

8 Post development flood behaviour

Post development flood modelling was carried out for the 5% AEP, 1% AEP, 1% AEP climate change scenario and PMF design flood events. Flood maps were prepared to display the results and are presented in Appendix A. A list of the flood maps showing post development conditions and changes in flood levels is summarised below:

- D.01: Peak flood depths – post development conditions – 5% AEP flood event
- D.02: Peak flood depths – post development conditions – 1% AEP flood event
- D.03: Peak flood depths – post development conditions – 1% AEP flood event inclusive of climate change

- D.04: Peak flood depths – post development conditions – PMF flood event
- D.05: Flood Hazard – post development conditions – 5% AEP flood event
- D.06: Flood Hazard – post development conditions – 1% AEP flood event
- D.07: Flood Hazard – post development conditions – 1% AEP flood event inclusive of climate change
- D.08: Flood Hazard – post development conditions – PMF event
- D.09: Flood velocity – post development conditions – 5% AEP flood event
- D.10: Flood velocity – post development conditions – 1% AEP flood event
- D.11: Flood velocity – post development conditions – 1% AEP flood event inclusive of climate change
- D.12: Flood velocity – post development conditions – PMF event
- A.01: Changes in peak flood levels – (post development conditions against existing conditions) – 5% AEP flood event
- A.02: Changes in peak flood levels – (post development conditions against existing conditions) – 1% AEP flood event
- A.03 Changes in peak flood levels – (post development conditions against existing conditions) – 1% AEP flood event inclusive of climate change
- A.04: Changes in peak flood levels – (post development conditions against existing conditions) – PMF event
- A.05: Changes in peak velocity – (post development conditions against existing conditions) – 5% AEP flood event
- A.06: Changes in peak velocity – (post development conditions against existing conditions) – 1% AEP flood event
- A.07: Changes in peak velocity – (post development conditions against existing conditions) – 1% AEP flood event inclusive of climate change
- A.08: Changes in peak velocity – (post development conditions against existing conditions) – PMF event

8.1 Post development flood results

Peak flood levels and depths are reported at four critical locations within the site for the post development case. These locations are shown in Figure 23 and the peak flood level and depth at these locations is presented in Table 19.

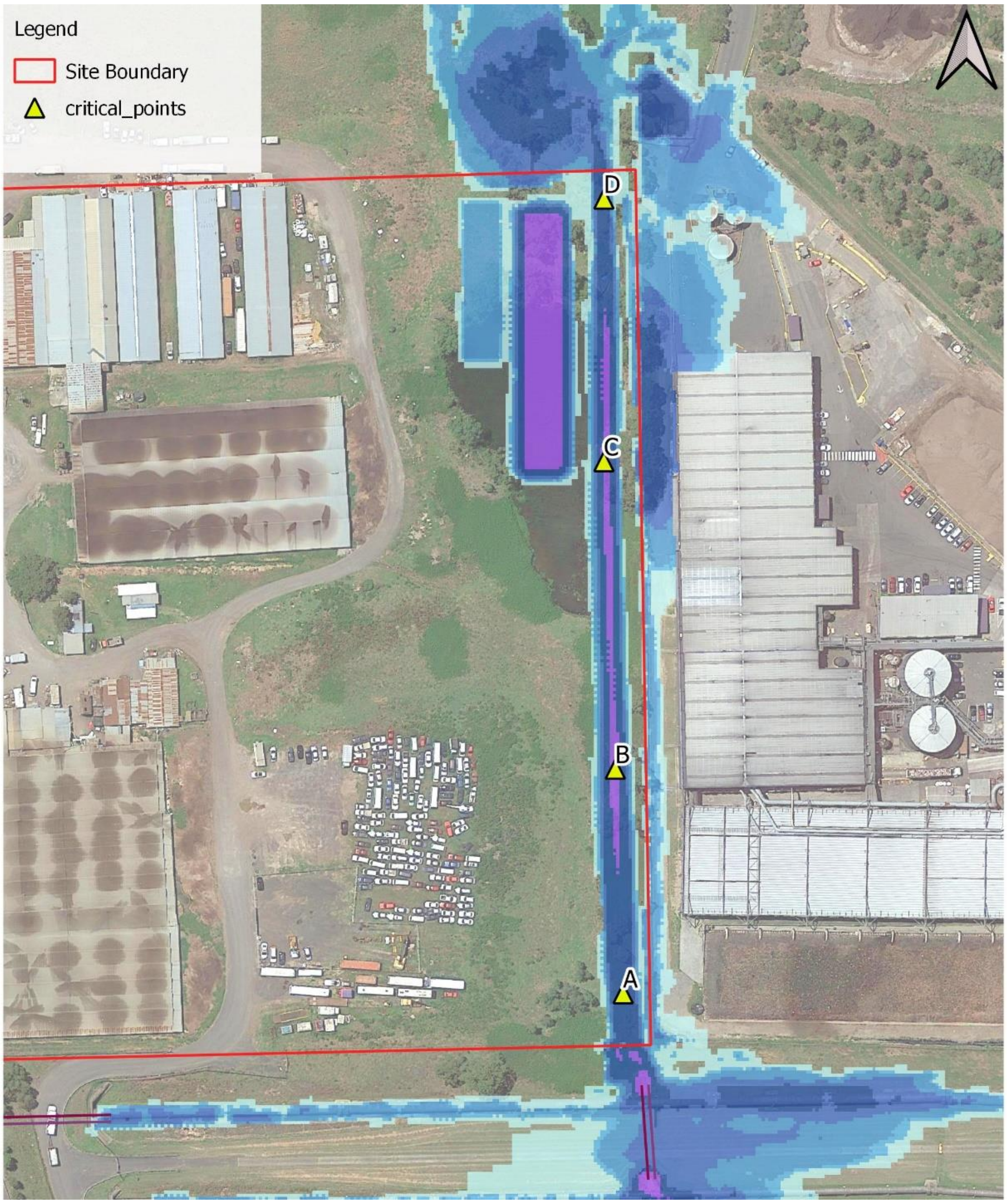


Figure 23 Reporting locations of design flood levels and depths

Table 19 Peak flood level and depth across a number of points – post development case.

Key location	5% AEP event		1% AEP event		1% AEP inc. Climate Change		PMF event	
	Flood Level (mAHD)	Flood Depth (m)	Flood Level (mAHD)	Flood Depth (m)	Flood Level (mAHD)	Flood Depth (m)	Flood Level (mAHD)	Flood Depth (m)
A	55.31	0.76	55.48	0.94	55.61	1.07	56.37	1.83
B	55.06	0.90	55.24	1.07	55.36	1.19	55.99	1.83
C	54.58	0.89	54.75	1.06	54.86	1.17	55.26	1.57
D	53.42	0.54	53.56	0.68	53.66	0.78	54.16	1.27

The following sections include a short discussion of the post development results for each flood event.

5% AEP flood event

In the 5% AEP flood event overland flow in the southern portion of the site is contained within the realigned overland flow channel, with a smaller extent of flooding compared to existing conditions. The estimated peak flood level at the upstream (southern) site boundary is 55.4mAHD, and 53mAHD at the downstream (northern) boundary of the southern portion of the site. Some flooding is still present at the GRL site, this is due to floodwaters entering the GRL site at its southern boundary from the Water NSW site.

Velocities within the realigned overland flow channel are typically between 1m/s and 2m/s, with some velocities greater than 2m/s at the north of the southern portion of the site.

Hydraulic hazard mapping shows high hazard along the realigned overland flow channel, due to the concentration of flows. Hydraulic hazard at the GRL site is low, with hazard at the now removed overland flow path diversion reduced from intermediate and high hazard to low hazard. Hazard to the south and north of the site is unchanged.

1% AEP flood event

In the 1% AEP flood event flood depths at the site are generally less than 1m. Similar to the 5% AEP event, flooding at the site is contained to the realigned overland flow channel through the site. Site stormwater runoff is managed in the OSD basin. The estimated peak flood level at the upstream (southern) site boundary is 55.5mAHD, and 53.1mAHD at the downstream (northern) site boundary, as per existing conditions.

Similar to the 5% AEP event, velocities within the realigned overland flow channel are typically between 1m/s and 2m/s, with some velocities greater than 2m/s at the north of the southern portion of the site. Appropriate erosion protection measures will be included in the overland flow channel to manage these flow velocities.

Similar to the 5% AEP map, high hazard is shown along the realigned overland flow channel, due to the concentration of flow. With this flooding now occurring in a clearly defined channel, the risk associated with flooding can be managed through appropriate signage at the site to deter people from entering during rainfall events. Hydraulic hazard at the GRL site is low, with some localised areas of intermediate and high hazard. Compared to existing conditions the extent of intermediate and high hazard at the GRL site is significantly reduced, which would represent a reduction in flood risk at this site. Hazard to the south and north of the site is unchanged.

1% AEP flood event inclusive of climate change

Flood depths at the site are slightly higher in the 1% AEP climate change scenario compared to the base 1% AEP simulation. Peak flood depths reach a maximum of 1.45m in the overland flow channel. The estimated peak flood level at the upstream (southern) site boundary is 55.6mAHD, and 53.6mAHD at the downstream (northern) site boundary. These flood levels are significantly lower than the proposed EfW main building and visitor centre and would therefore, would not impact on the operations of the facility.

Velocity in the realigned overland flow channel is typically between 1m/s and 2m/s, with some velocities greater than 2m/s at the north of the southern portion of the site. Flow velocities at some locations at the GRL site are greater than 2m/s.

Hydraulic hazard at the southern portion of the development site are unchanged. At the GRL site the extent of intermediate and high hazard is greater than in the 1% AEP event but similar to the existing conditions climate change scenario. Hazard to the south and north of the site is generally unchanged compared to existing conditions.

PMF

The maximum peak flood depth at the site in the PMF is 1.85m in the overland flow channel at the south of the site. The estimated peak flood level at the upstream (southern) site boundary is 56.5mAHD, and 53.6mAHD at the downstream (northern) boundary of the southern portion of the site. The western portion of the site is shown to remain flood-free and therefore, evacuation from the facility in the event of the PMF would not be required.

Velocity in the realigned overland flow path typically exceeds 2m/s with maximum velocities above 3m/s in some locations. High velocities are also shown at the GRL site.

In the PMF most of the flooded area at the site and surrounding area is classified as high hazard.

8.2 Flood impact assessment

Maps depicting changes in flood level and velocity are also presented in Appendix A (Figures A.1 to A.8). Flood modelling results indicate that the proposed works and flood mitigation measures do not result in increases in flood levels outside the project site for the 5% and 1% AEP flood events. Some increases in flood velocity are shown, however these increases coincide with reductions in flood level, and as shown in the provisional hazard maps do not result in an increase in hydraulic hazard. These results when considered in conjunction with the provisional hazard mapping demonstrate that the proposal will not result in an increase in flood levels or hazard at adjacent properties in the 5% AEP of 1% AEP events and therefore, will not materially impact the flood risk on these properties.

Some increases in flood levels are shown outside of the proposal site in the PMF at the Water NSW, Austral Bricks and GRL sites. However, as these areas are already subject to flooding with depths of greater than 1m, it is not considered that this increase would result in a material change to the flood risk in these areas.

9 Conclusion

A flood impact assessment was undertaken to determine the flood behaviour across the proposed redevelopment of energy from waste facility at 339 Wallgrove Road, Eastern Creek. The hydraulic assessment utilised a TUFLOW hydraulic model to study the flood behaviour for both existing and post development scenarios across the site and assess any impacts associated with the proposal.

Flood modelling has demonstrated that this channel and proposed changes to the site topography will not result in an increase in flood levels at adjacent properties for events up to and including the 1% AEP and will not increase flood hazard at adjacent properties for events up to and including the PMF. Therefore, the proposal will not materially impact the flood risk at these properties.

References

Australian Rainfall and Runoff (Ball, et al. 2019), AR&R guidelines

Blacktown City Council GIS, MapsOnline portal, (http://maps.blacktown.nsw.gov.au/) accessed February 2020

Blacktown City Council, ongoing. The 339 Wallgrove Road Eastern Creek flood study, received March 2020

Bureau of Meteorology (BoM, 2020), Design rainfall depths, accessed 12 February 2020

Fairfield City Council, 2013. The Rural Area Flood Study - Ropes, Reedy and Eastern Creeks

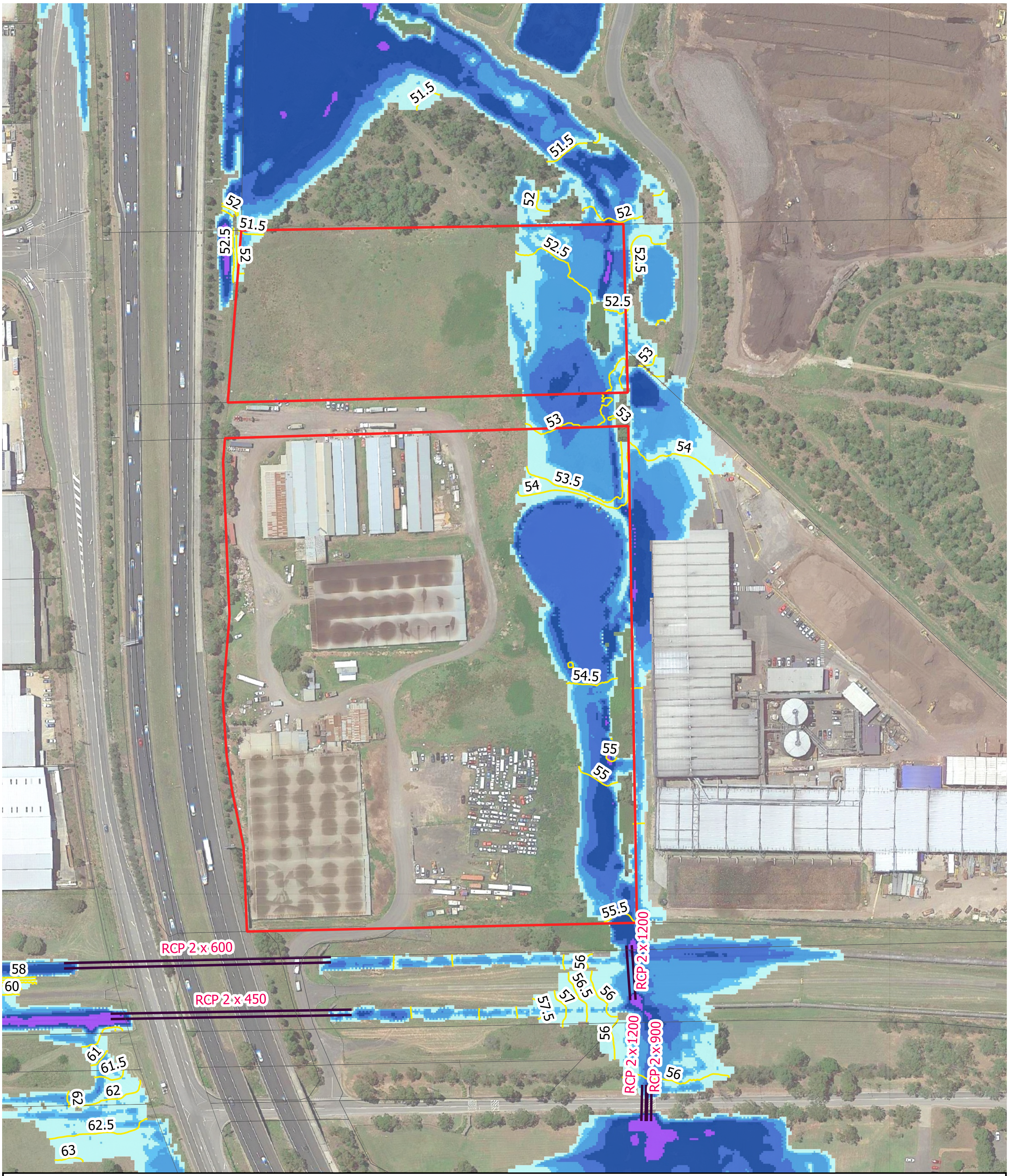
Provisional flood hazard categories have been derived as per Figure L2 In Appendix L of the NSW Floodplain Management Manual (NSW State Government, 2005).

The United Nations International Panel for Climate Change (IPCC), 2013. AR5 Climate Change 2013: The Physical Science Basis

World Meteorological Organisation, 2009. Manual on Estimation of Probable Maximum Precipitation (PMP)

Appendix A

Flood Maps



🟥 Site Boundary

Peak Flood Depth (m)

- ▭ <= 0.05
- ▭ 0.05 - 0.1
- ▭ 0.1 - 0.3
- ▭ 0.3 - 0.5
- ▭ 0.5 - 1
- ▭ > 1

- — Existing Culverts
- — Proposed Design Layout
- — Max Flood Level (mAHD)
- ▭ Cadastre

©Copyright Information

P2	29/5/2020	GK	IVS	AC
P1	15/4/2020	GK	IVS	AC
Issue	Date	By	Chkd	Appd

ARUP

CLEANAWAY
Making a sustainable future possible

MACQUARIE

Level 5, Barrack Place
151 Clarence St
Sydney NSW 2000
Tel +61 (2) 9320 9320
www.arup.com

Client
Cleanaway/Macquarie Capital

Job Title
Western Sydney Energy & Resource Recovery Centre

0 25 50 75 100 Meters

Scale at A4 **1:3000**

Figure Title

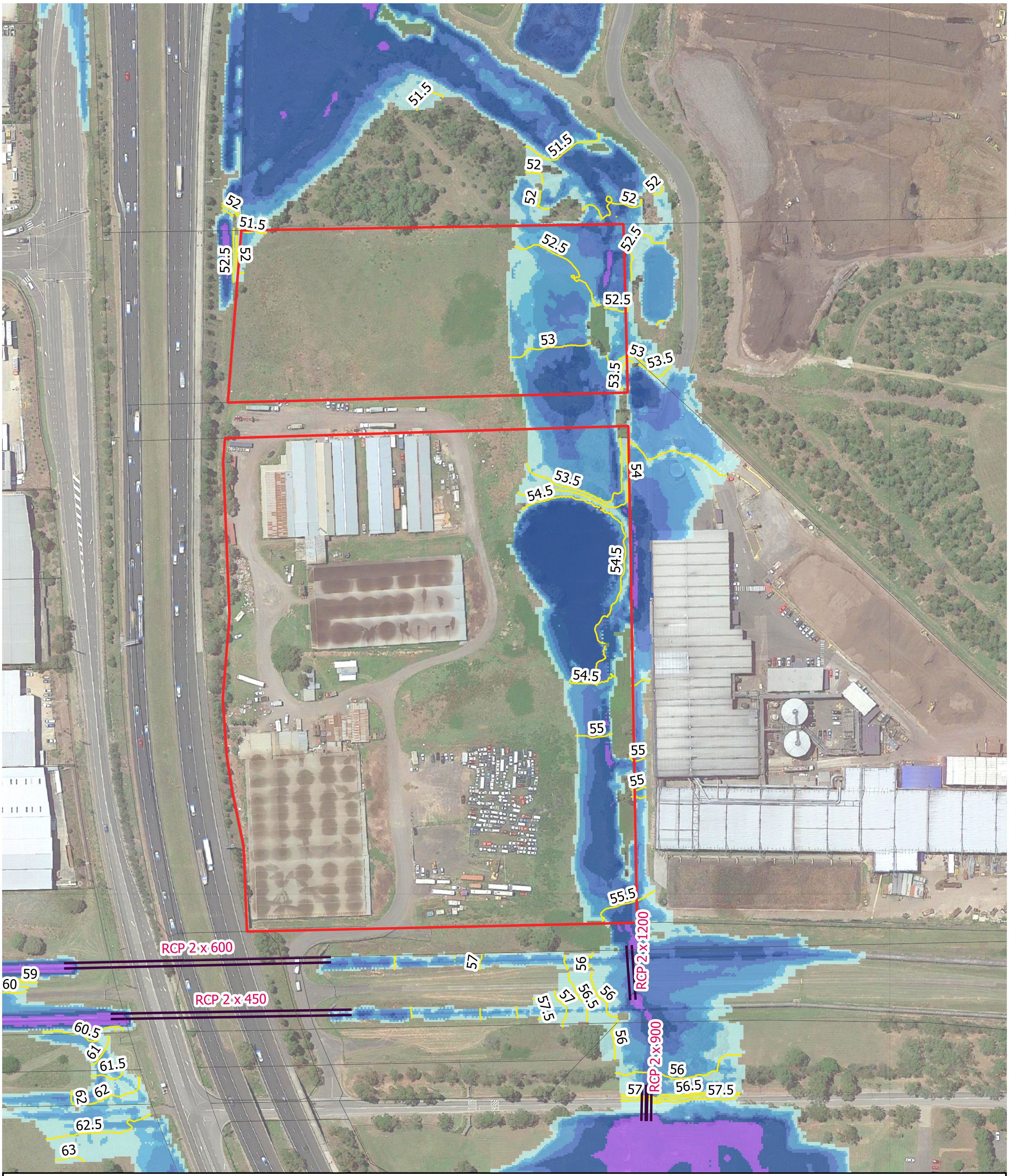
Peak Flood Depth
Existing Case
5% AEP Flood Event

Job No
264039

Figure Status
For Information

Figure No
E.01

Issue
P2



▭ Site Boundary

Peak Flood Depth (m)

- ■ <= 0.05
- ■ 0.05 - 0.1
- ■ 0.1 - 0.3
- ■ 0.3 - 0.5
- ■ 0.5 - 1
- ■ > 1

— Existing Culverts

— Proposed Design Layout

— Max Flood Level (mAHD)

▭ Cadastre

Issue	Date	By	Chkd	Appd
P2	29/5/2020	GK	IVS	AC
P1	15/4/2020	GK	IVS	AC

ARUP

CLEANAWAY
Making a sustainable future possible

MACQUARIE

Level 5, Barrack Place
151 Clarence St
Sydney NSW 2000
Tel +61 (2) 9320 9320
www.arup.com

Client
Cleanaway/Macquarie Capital

Job Title
Western Sydney Energy & Resource Recovery Centre

0 25 50 75 100 Meters

Scale at A4 **1:3000**

Figure Title

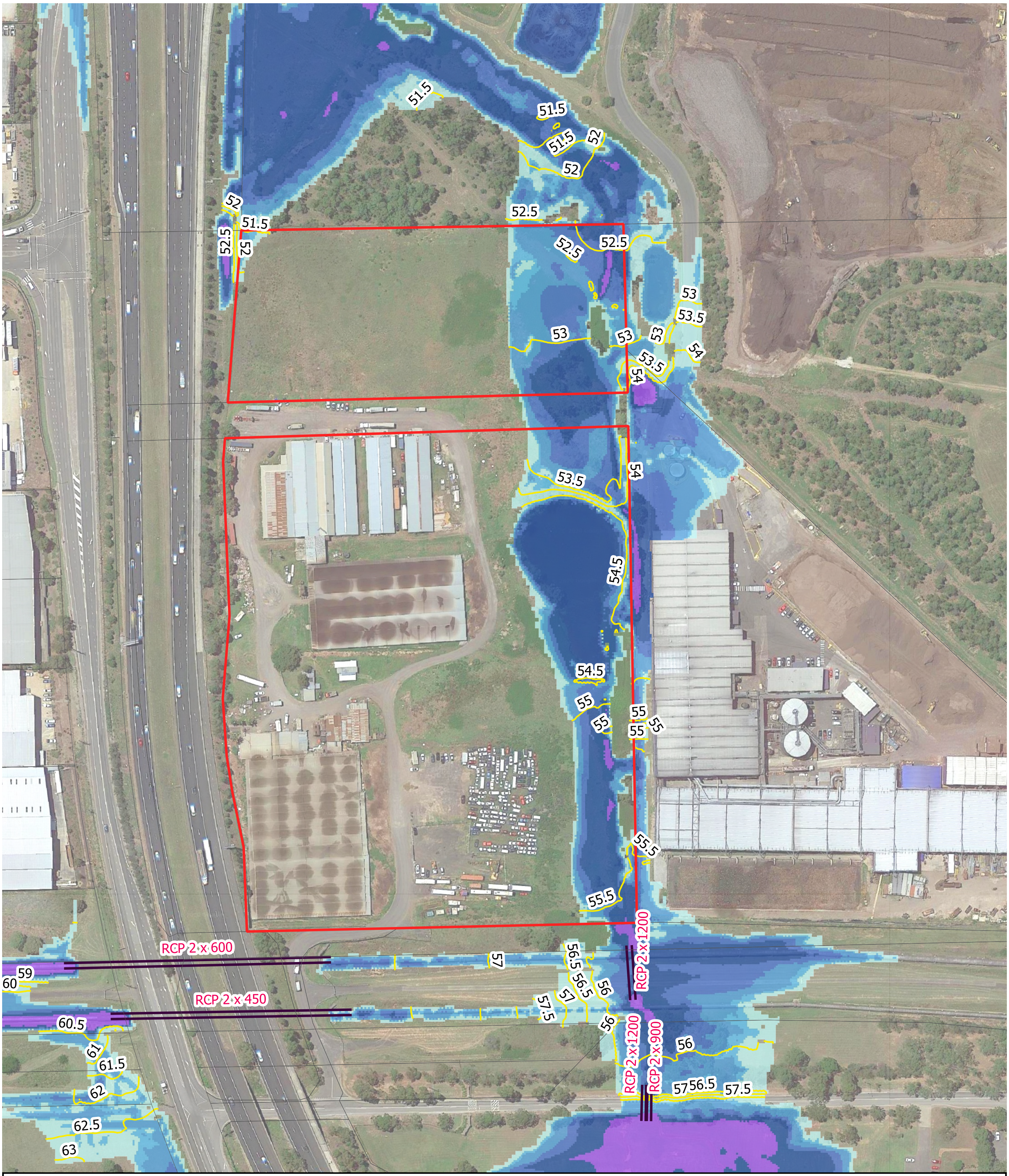
Peak Flood Depth
Existing Case
1% AEP Flood Event

Job No
264039

Figure Status
For Information

Figure No
E.02

Issue
P2



🟥 Site Boundary

Peak Flood Depth (m)

- <= 0.05
- 0.05 - 0.1
- 0.1 - 0.3
- 0.3 - 0.5
- 0.5 - 1
- \> 1

Existing Culverts

Proposed Design Layout

Max Flood Level (mAHD)

Cadastre

P2	29/5/2020	GK	IVS	AC
P1	15/4/2020	GK	IVS	AC
Issue	Date	By	Chkd	Appd

ARUP

CLEANAWAY
MACQUARIE

Level 5, Barrack Place
151 Clarence St
Sydney NSW 2000
Tel +61 (2) 9320 9320
www.arup.com

Client
Cleanaway/Macquarie Capital

Job Title
Western Sydney Energy & Resource Recovery Centre

0 25 50 75 100 Meters

Scale at A4 **1:3000**

Figure Title

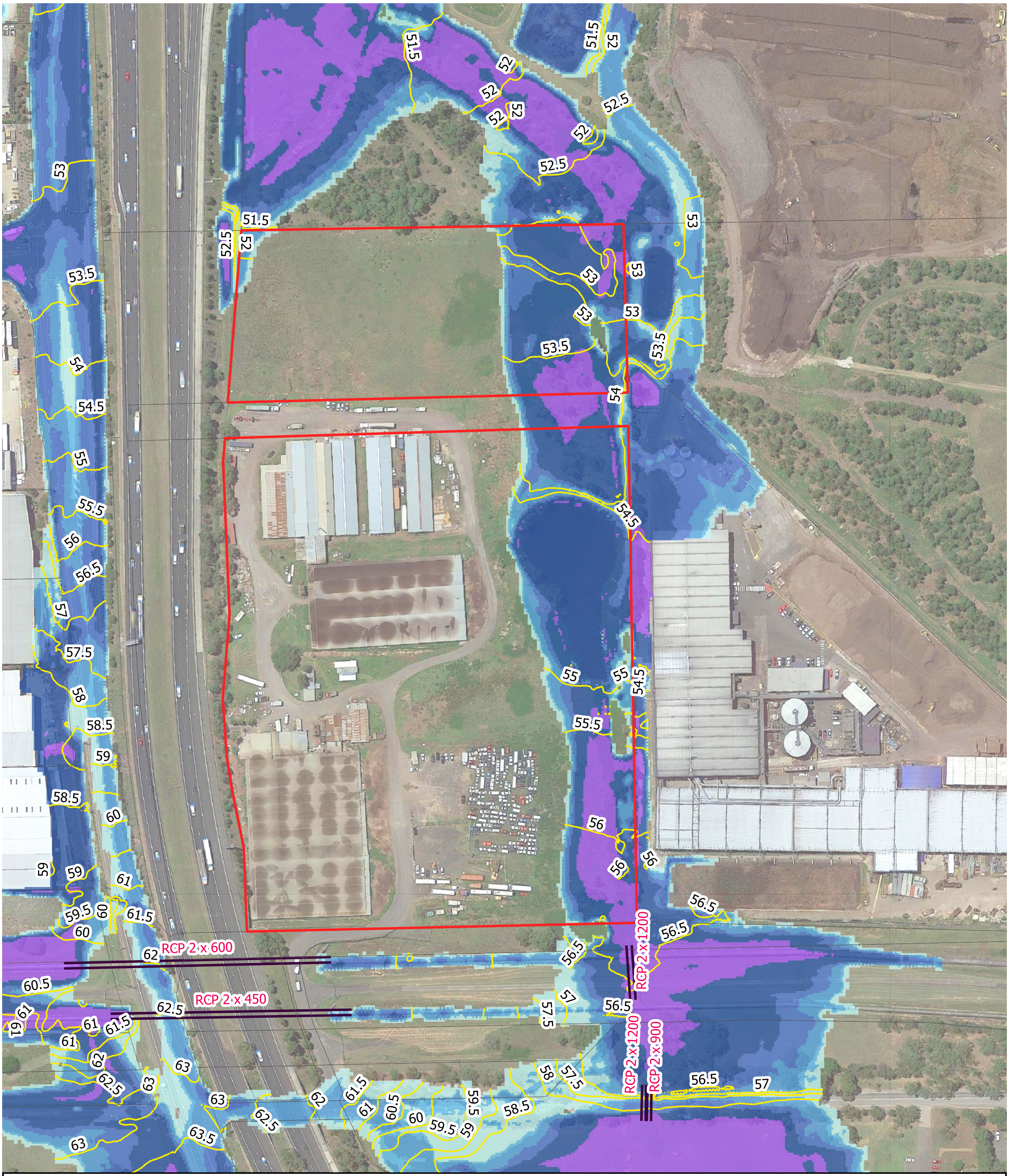
Peak Flood Depth
Existing Case
1% AEP Including Climate Change

Job No
264039

Figure Status
For Information

Figure No
E.03

Issue
P2



🟥 Site Boundary

Peak Flood Depth (m)

- ▨ <= 0.05
- ▨ 0.05 - 0.1
- ▨ 0.1 - 0.3
- ▨ 0.3 - 0.5
- ▨ 0.5 - 1
- ▨ > 1

- ― Existing Culverts
- ― Proposed Design Layout
- ― Max Flood Level (mAHD)
- ▭ Cadastre

P2	29/5/2020	GK	IVS	AC
P1	15/4/2020	GK	IVS	AC
Issue	Date	By	Chkd	Appd

ARUP

CLEANAWAY
Making a sustainable future possible
MACQUARIE

Level 5, Barrack Place
151 Clarence St
Sydney NSW 2000
Tel +61 (2) 9320 9320
www.arup.com

Client
Cleanaway/Macquarie Capital

Job Title
Western Sydney Energy & Resource Recovery Centre

0 25 50 75 100 Meters

Scale at A4 **1:3000**

Figure Title

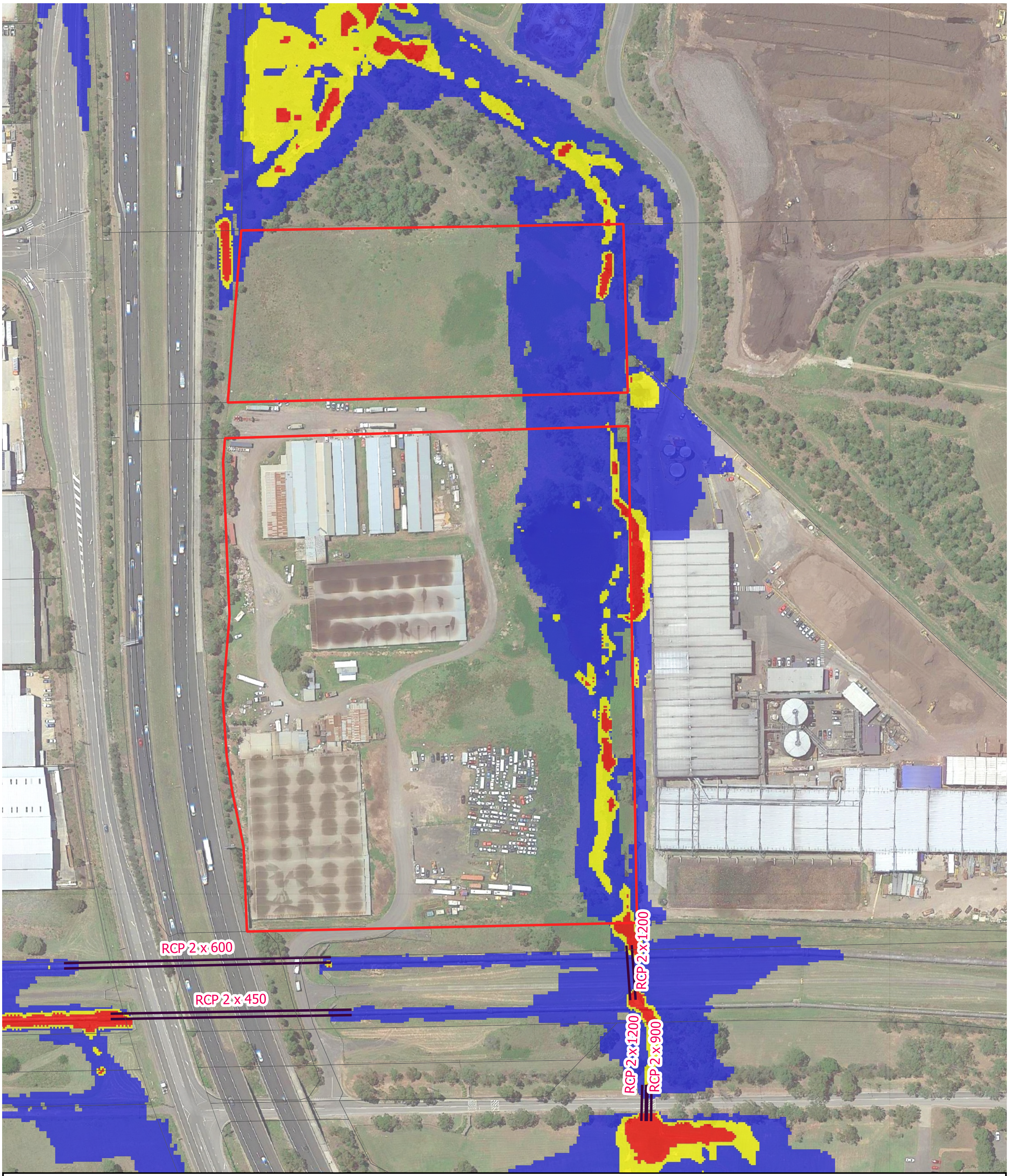
Peak Flood Depth
Existing Case
PMF Flood Event

Job No
264039

Figure Status
For Information

Figure No
E.04

Issue
P2



🟥 Site Boundary

Flood Hazard

🟦 Low Hazard

🟨 Intermediate Hazard

🟥 High Hazard

— Existing Culverts

— Proposed Design Layout

— Max Flood Level (mAHD)

☐ Cadastre

©Copyright Information

P2	29/5/2020	GK	IVS	AC
P1	15/4/2020	GK	IVS	AC
Issue	Date	By	Chkd	Appd

ARUP

CLEANAWAY
Making a sustainable future possible

MACQUARIE

Level 5, Barrack Place
151 Clarence St
Sydney NSW 2000
Tel +61 (2) 9320 9320
www.arup.com

Client
Cleanaway/Macquarie Capital

Job Title
Western Sydney Energy & Resource Recovery Centre

0 25 50 75 100 Meters

Scale at A4 **1:3000**

Figure Title

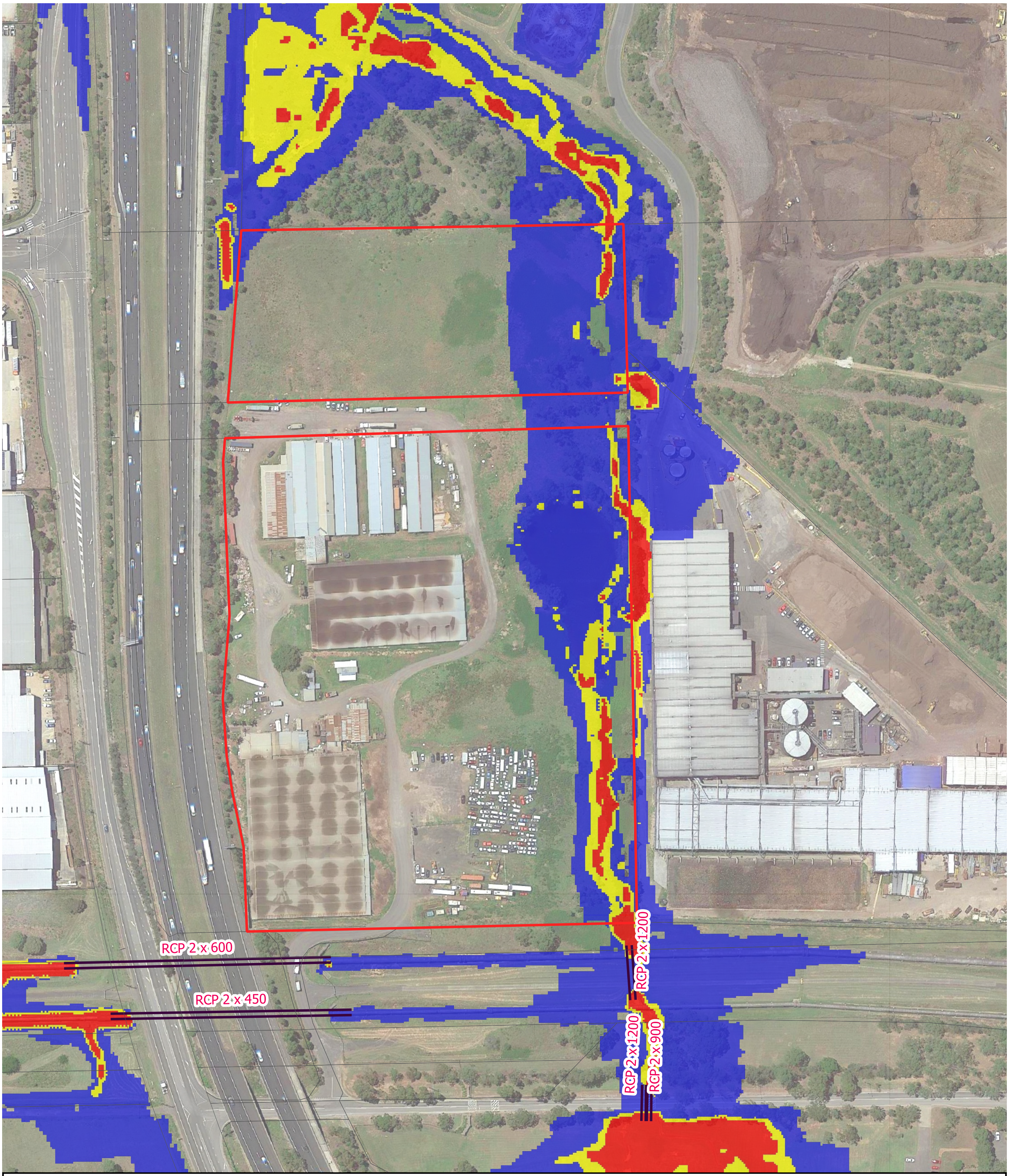
Provisional Flood Hazard
Existing Case
5% AEP Flood Event

Job No
264039

Figure Status
For Information

Figure No
E.05

Issue
P2



□ Site Boundary

Flood Hazard

🟦 Low Hazard

🟨 Intermediate Hazard

🟥 High Hazard

— Existing Culverts

— Proposed Design Layout

— Max Flood Level (mAHD)

□ Cadastre

©Copyright Information

P2	29/5/2020	GK	IVS	AC
P1	15/4/2020	GK	IVS	AC
Issue	Date	By	Chkd	Appd

ARUP

CLEANAWAY

MACQUARIE

Level 5, Barrack Place
151 Clarence St
Sydney NSW 2000
Tel +61 (2) 9320 9320
www.arup.com

Client
Cleanaway/Macquarie Capital

Job Title
Western Sydney Energy & Resource Recovery Centre

0 25 50 75 100 Meters

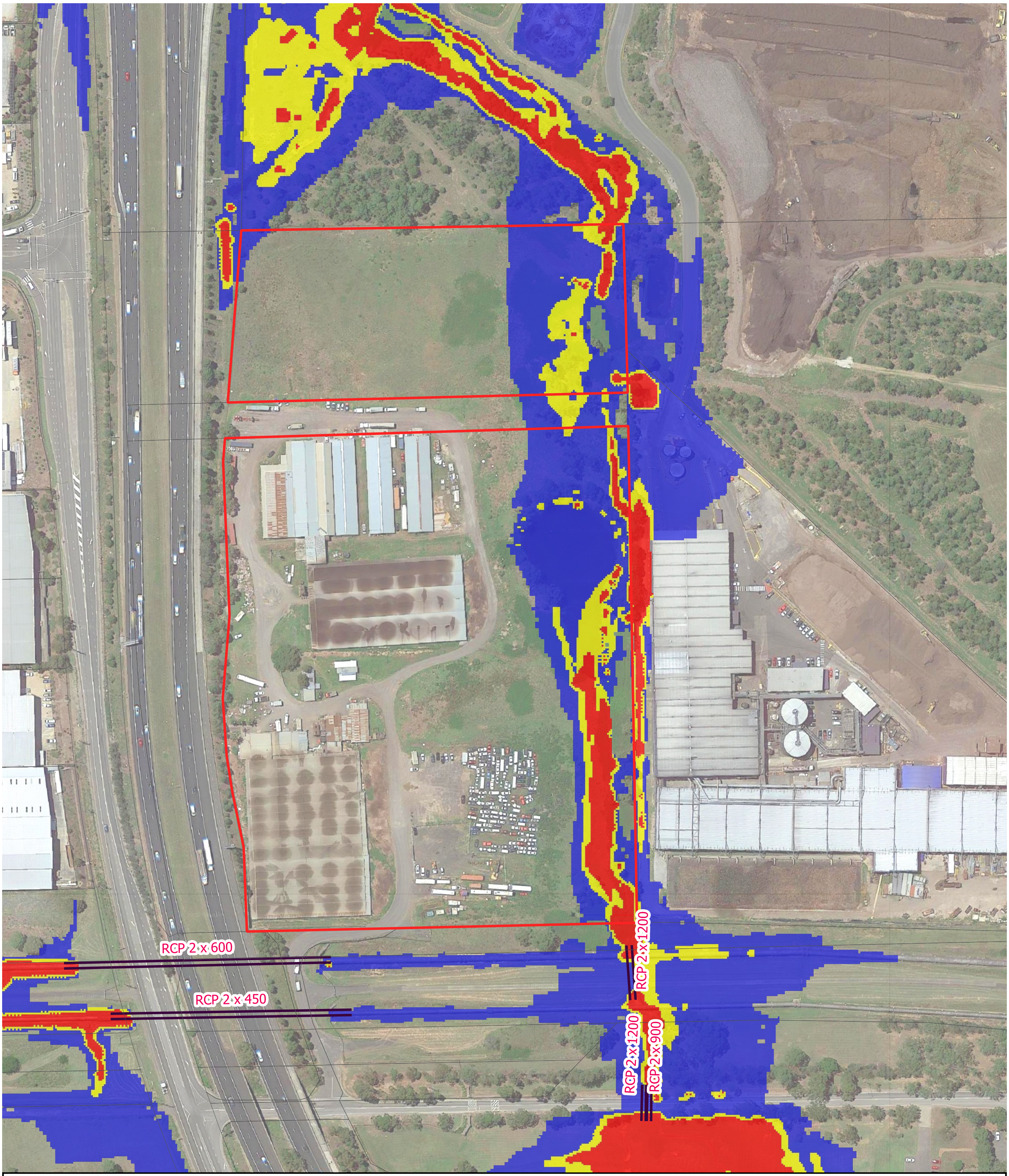
Scale at A4 **1:3000**

Figure Title

Provisional Flood Hazard
Existing Case
1% AEP Flood Event

Job No	Figure Status
264039	**For Information**

Figure No	Issue
E.06	**P2**



□ Site Boundary

Flood Hazard

🟦 Low Hazard

🟨 Intermediate Hazard

🟥 High Hazard

— Existing Culverts

— Proposed Design Layout

— Max Flood Level (mAHD)

□ Cadastre

©Copyright Information

P2	29/5/2020	GK	IVS	AC
P1	15/4/2020	GK	IVS	AC
Issue	Date	By	Chkd	Appd

ARUP

CLEANAWAY
Making a sustainable future possible

MACQUARIE

Level 5, Barrack Place
151 Clarence St
Sydney NSW 2000
Tel +61 (2) 9320 9320
www.arup.com

Client
Cleanaway/Macquarie Capital

Job Title
Western Sydney Energy & Resource Recovery Centre

0 25 50 75 100 Meters

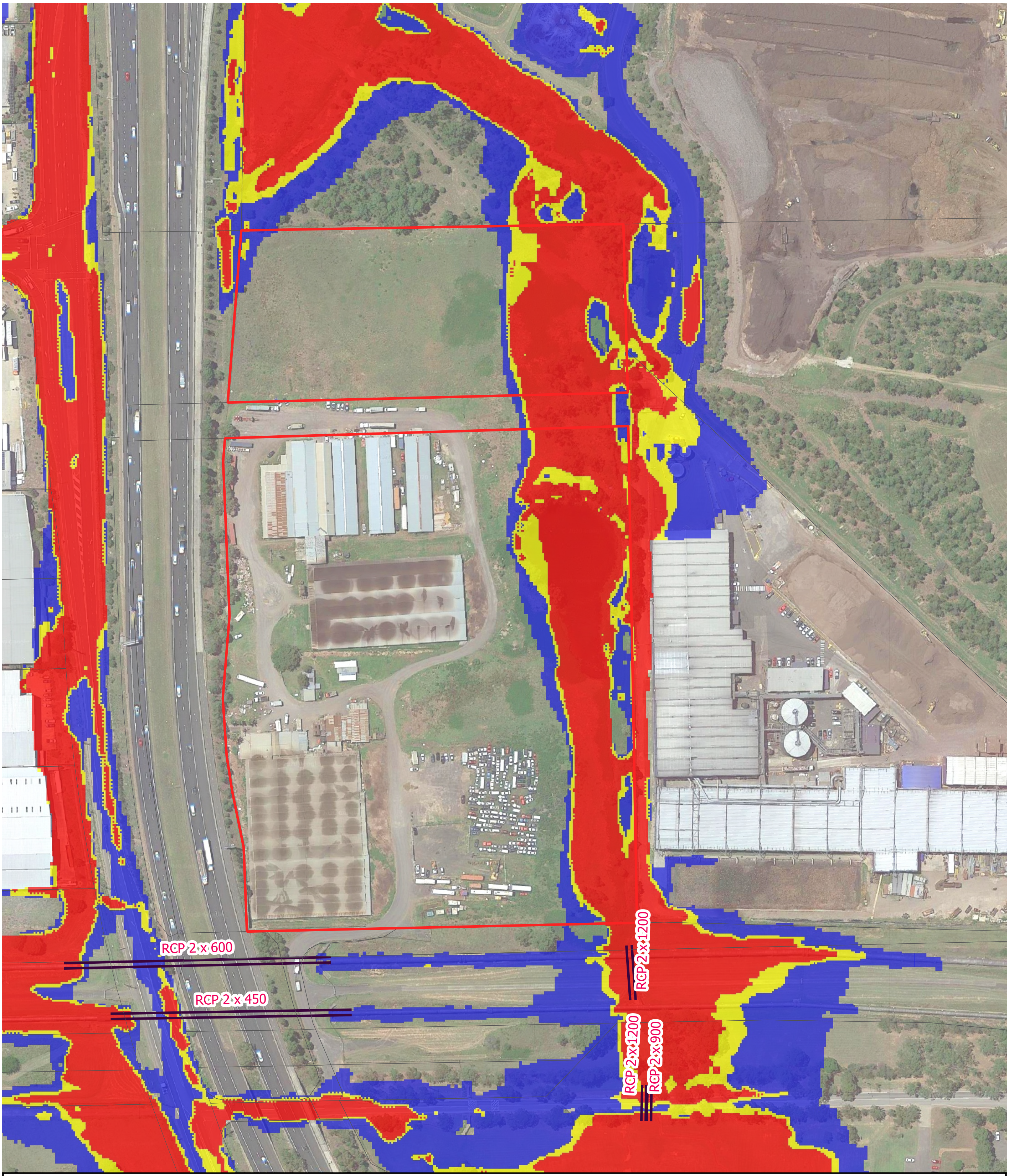
Scale at A4 **1:3000**

Figure Title

Provisional Flood Hazard
Existing Case
1% AEP Including Climate Change

Job No	Figure Status
264039	**For Information**

Figure No	Issue
E.07	**P2**



🟥 Site Boundary

Flood Hazard

🟦 Low Hazard

🟨 Intermediate Hazard

🟥 High Hazard

— Existing Culverts

— Proposed Design Layout

— Max Flood Level (mAHD)

☐ Cadastre

P2	29/5/2020	GK	IVS	AC
P1	15/4/2020	GK	IVS	AC
Issue	Date	By	Chkd	Appd

ARUP

CLEANAWAY

MACQUARIE

Level 5, Barrack Place
151 Clarence St
Sydney NSW 2000
Tel +61 (2) 9320 9320
www.arup.com

Client
Cleanaway/Macquarie Capital

Job Title
Western Sydney Energy & Resource Recovery Centre

0 25 50 75 100 Meters

Scale at A4 **1:3000**

Figure Title

Provisional Flood Hazard
Existing Case
PMF Flood Event

Job No	Figure Status
264039	**For Information**

Figure No	Issue
E.08	**P2**

Site Boundary

Peak Flood Velocity (m/s)

🟨 <= 1

🟩 1 - 2

🟦 2 - 3

🟥 > 3

— Existing Culverts

— Proposed Design Layout

— Max Flood Level (mAHD)

☐ Cadastre

©Copyright Information

P1	29/5/2020	GK	IVS	AC
Issue	Date	By	Chkd	Appd

ARUP

CLEANAWAY
Making a sustainable future possible

MACQUARIE

Level 5, Barrack Place
151 Clarence St
Sydney NSW 2000
Tel +61 (2) 9320 9320
www.arup.com

Client
Cleanaway/Macquarie Capital

Job Title
Western Sydney Energy & Resource Recovery Centre

0 25 50 75 100 Meters

Scale at A4 **1:3000**

Figure Title

Flood Velocity
Existing Case
5% AEP Flood Event

Job No
264039

Figure Status
For Information

Figure No
E.09

Issue
P1

Site Boundary

Peak Flood Velocity (m/s)

🟨 <= 1

🟩 1 - 2

🟦 2 - 3

🟥 > 3

Existing Culverts

Proposed Design Layout

Max Flood Level (mAHD)

Cadastre

©Copyright Information

P1	29/5/2020	GK	IVS	AC
Issue	Date	By	Chkd	Appd

ARUP

CLEANAWAY
MACQUARIE

Level 5, Barrack Place
151 Clarence St
Sydney NSW 2000
Tel +61 (2) 9320 9320
www.arup.com

Client
Cleanaway/Macquarie Capital

Job Title
Western Sydney Energy & Resource Recovery Centre

0 25 50 75 100 Meters

Scale at A4 **1:3000**

Figure Title

Flood Velocity
Existing Case
1% AEP Flood Event

Job No
264039

Figure Status
For Information

Figure No
E.10

Issue
P1

Site Boundary

Peak Flood Velocity (m/s)

- 🟨 <= 1
- 🟩 1 - 2
- 🟦 2 - 3
- 🟥 > 3

Existing Culverts

Proposed Design Layout

Max Flood Level (mAHD)

Cadastre

©Copyright Information

P1	29/5/2020	GK	IVS	AC
Issue	Date	By	Chkd	Appd

ARUP

CLEANAWAY
Making a sustainable future possible

MACQUARIE

Level 5, Barrack Place
151 Clarence St
Sydney NSW 2000
Tel +61 (2) 9320 9320
www.arup.com

Client
Cleanaway/Macquarie Capital

Job Title
Western Sydney Energy & Resource Recovery Centre

0 25 50 75 100 Meters

Scale at A4 **1:3000**

Figure Title

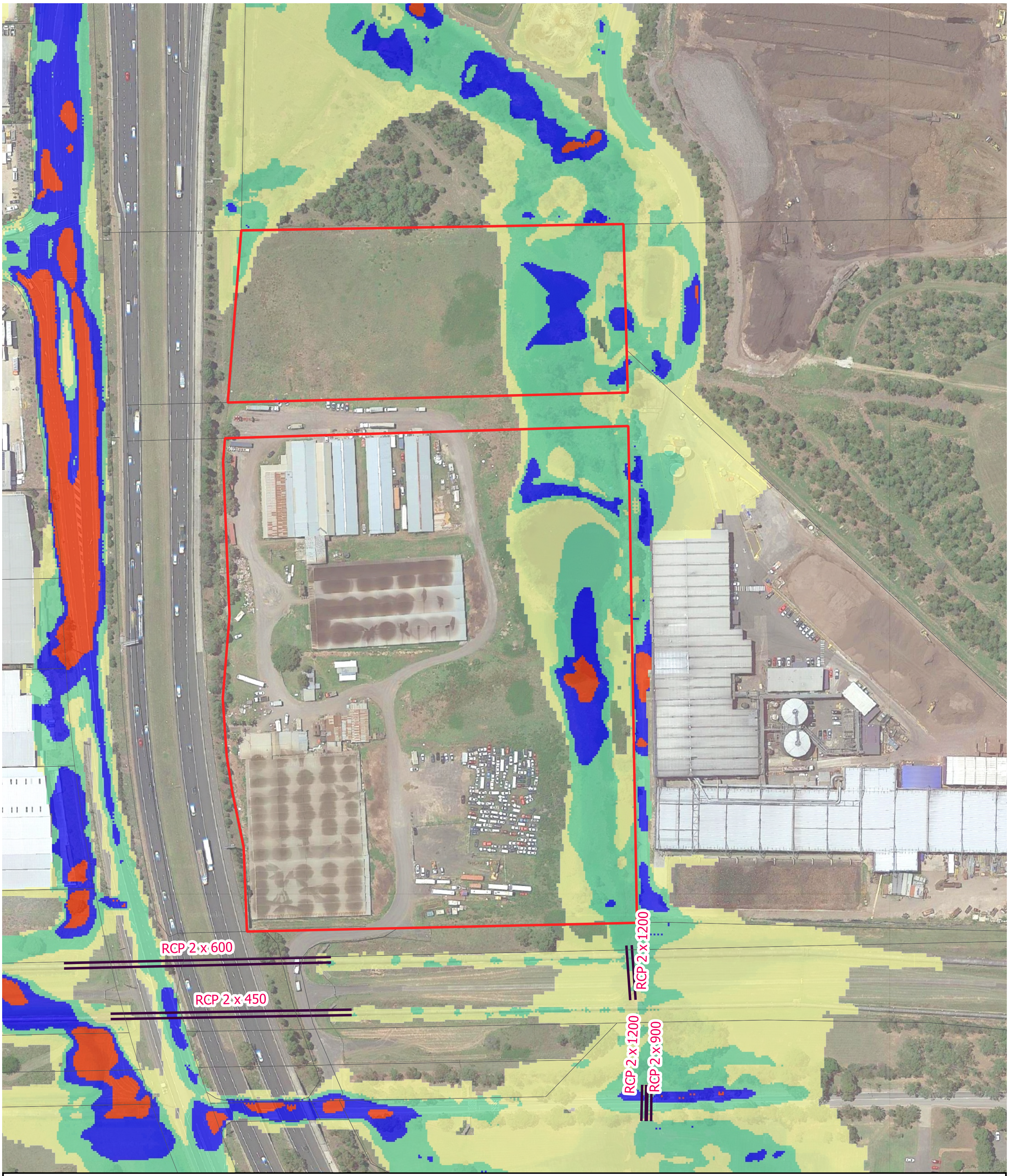
Flood Velocity
Existing Case
1% AEP Including Climate Change

Job No
264039

Figure Status
For Information

Figure No
E.11

Issue
P1



Site Boundary

Peak Flood Velocity (m/s)

- 🟨 <= 1
- 🟩 1 - 2
- 🟦 2 - 3
- 🟥 > 3

Existing Culverts

Proposed Design Layout

Max Flood Level (mAHD)

Cadastre

P1	29/5/2020	GK	IVS	AC
Issue	Date	By	Chkd	Appd

ARUP

CLEANAWAY

Making a sustainable future possible

MACQUARIE

Level 5, Barrack Place
151 Clarence St
Sydney NSW 2000
Tel +61 (2) 9320 9320
www.arup.com

Client
Cleanaway/Macquarie Capital

Job Title
Western Sydney Energy & Resource Recovery Centre

0 25 50 75 100 Meters

Scale at A4 **1:3000**

Figure Title

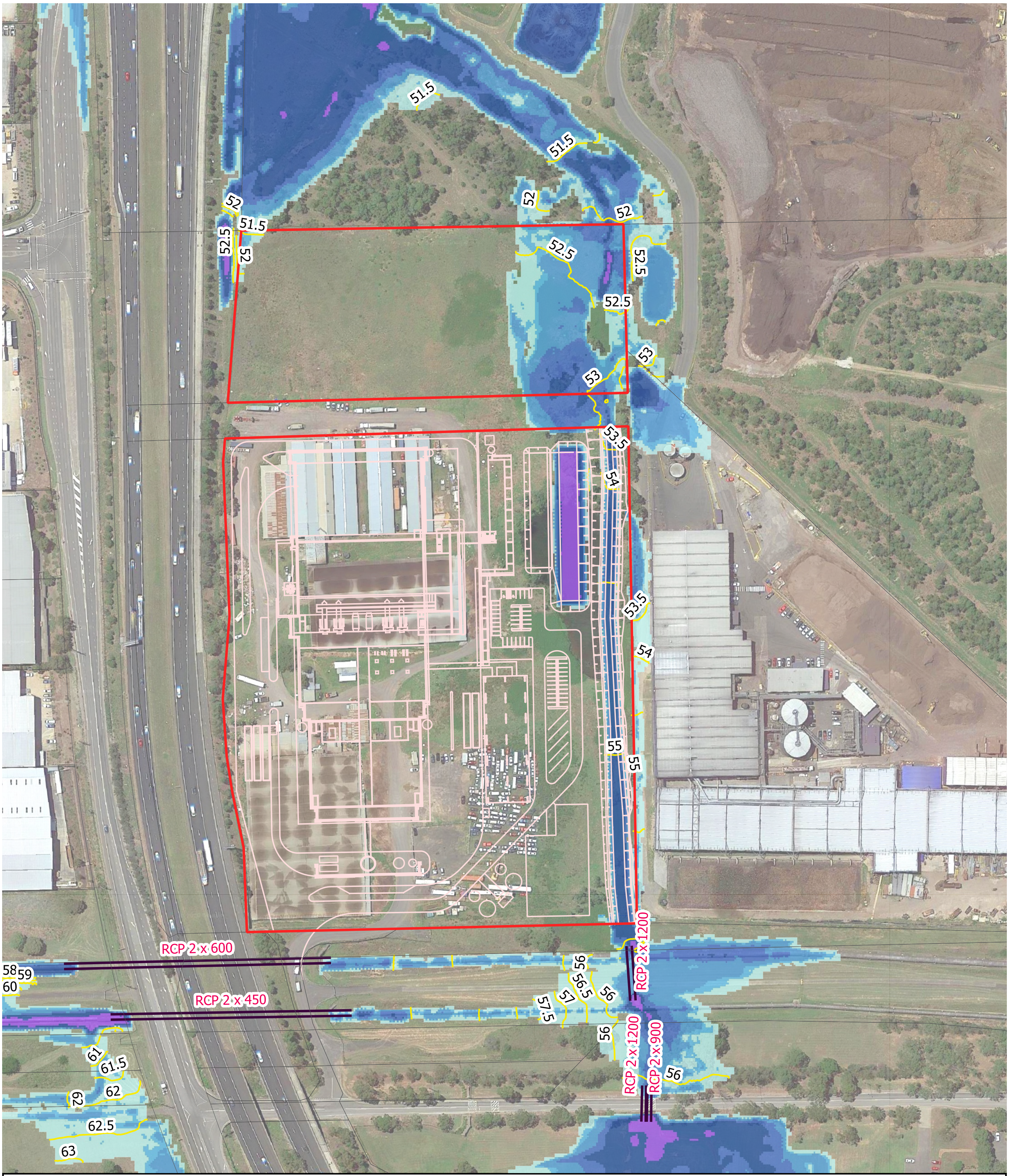
Flood Velocity
Existing Case
PMF Flood Event

Job No
264039

Figure Status
For Information

Figure No
E.12

Issue
P1



▭ Site Boundary

Peak Flood Depth (m)

- ▢ <= 0.05
- ▢ 0.05 - 0.1
- ▢ 0.1 - 0.3
- ▢ 0.3 - 0.5
- ▢ 0.5 - 1
- ▢ > 1

- ━ Existing Culverts
- ━ Proposed Design Layout
- ━ Max Flood Level (mAHD)
- ▭ Cadastre

©Copyright Information

P2	4/6/2020	GK	IVS	AC
P1	15/4/2020	GK	IVS	AC
Issue	Date	By	Chkd	Appd

ARUP

CLEANAWAY
Making a sustainable future possible

MACQUARIE

Level 5, Barrack Place
151 Clarence St
Sydney NSW 2000
Tel +61 (2) 9320 9320
www.arup.com

Client
Cleanaway/Macquarie Capital

Job Title
Western Sydney Energy & Resource Recovery Centre

0 25 50 75 100 Meters

Scale at A4 **1:3000**

Figure Title

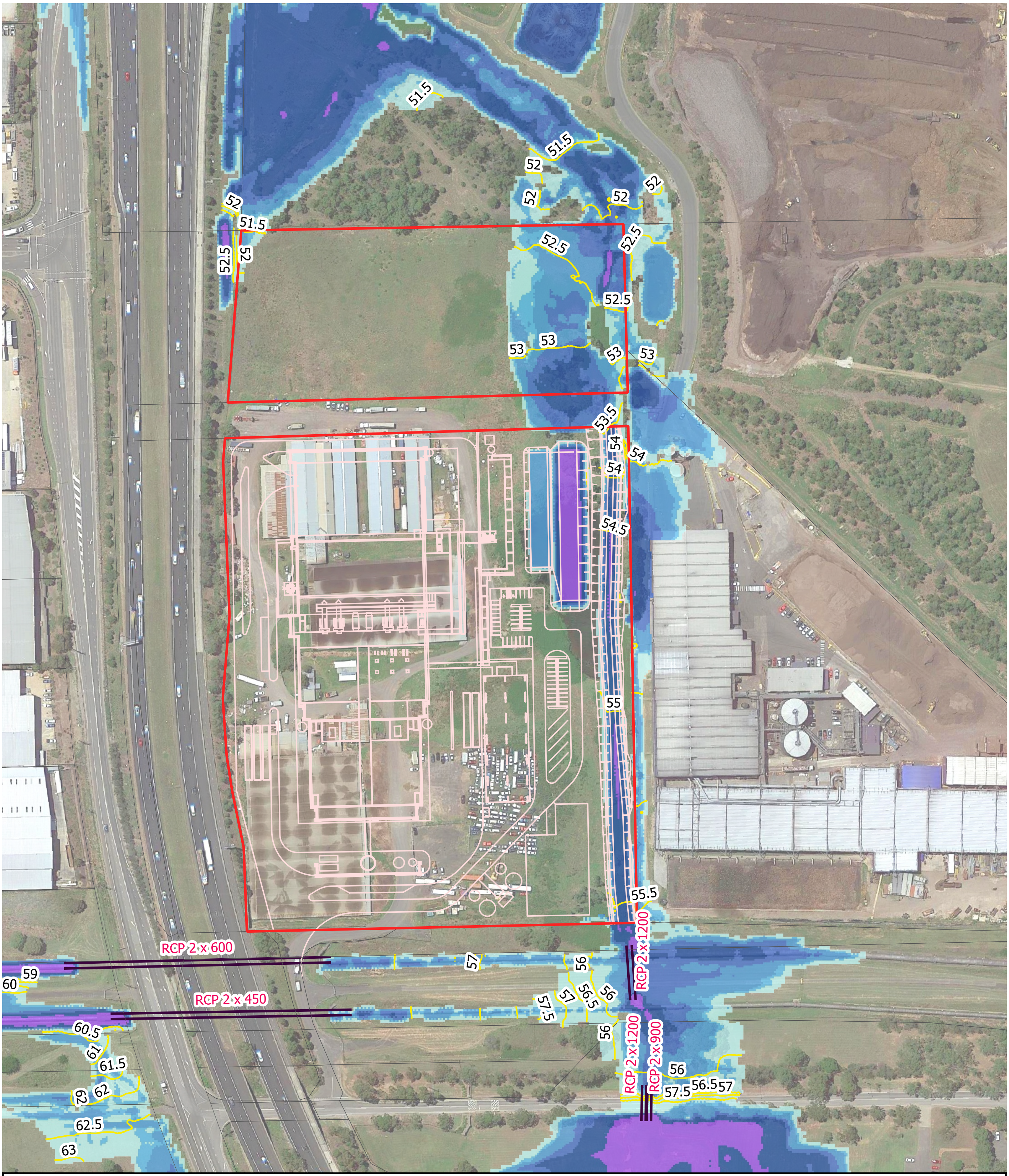
Peak Flood Depth
Post Development Case
5% AEP Flood Event

Job No
264039

Figure Status
For Information

Figure No
D.01

Issue
P2



🟥 Site Boundary

Peak Flood Depth (m)

- ■ <= 0.05
- ■ 0.05 - 0.1
- ■ 0.1 - 0.3
- ■ 0.3 - 0.5
- ■ 0.5 - 1
- ■ > 1

- ━ Existing Culverts
- ━ Proposed Design Layout
- ━ Max Flood Level (mAHD)
- ▭ Cadastre

©Copyright Information

P2	4/6/2020	GK	IVS	AC
P1	15/4/2020	GK	IVS	AC
Issue	Date	By	Chkd	Appd

ARUP

CLEANAWAY
Making a sustainable future possible

MACQUARIE

Level 5, Barrack Place
151 Clarence St
Sydney NSW 2000
Tel +61 (2) 9320 9320
www.arup.com

Client
Cleanaway/Macquarie Capital

Job Title
Western Sydney Energy & Resource Recovery Centre

0 25 50 75 100 Meters

Scale at A4 **1:3000**

Figure Title

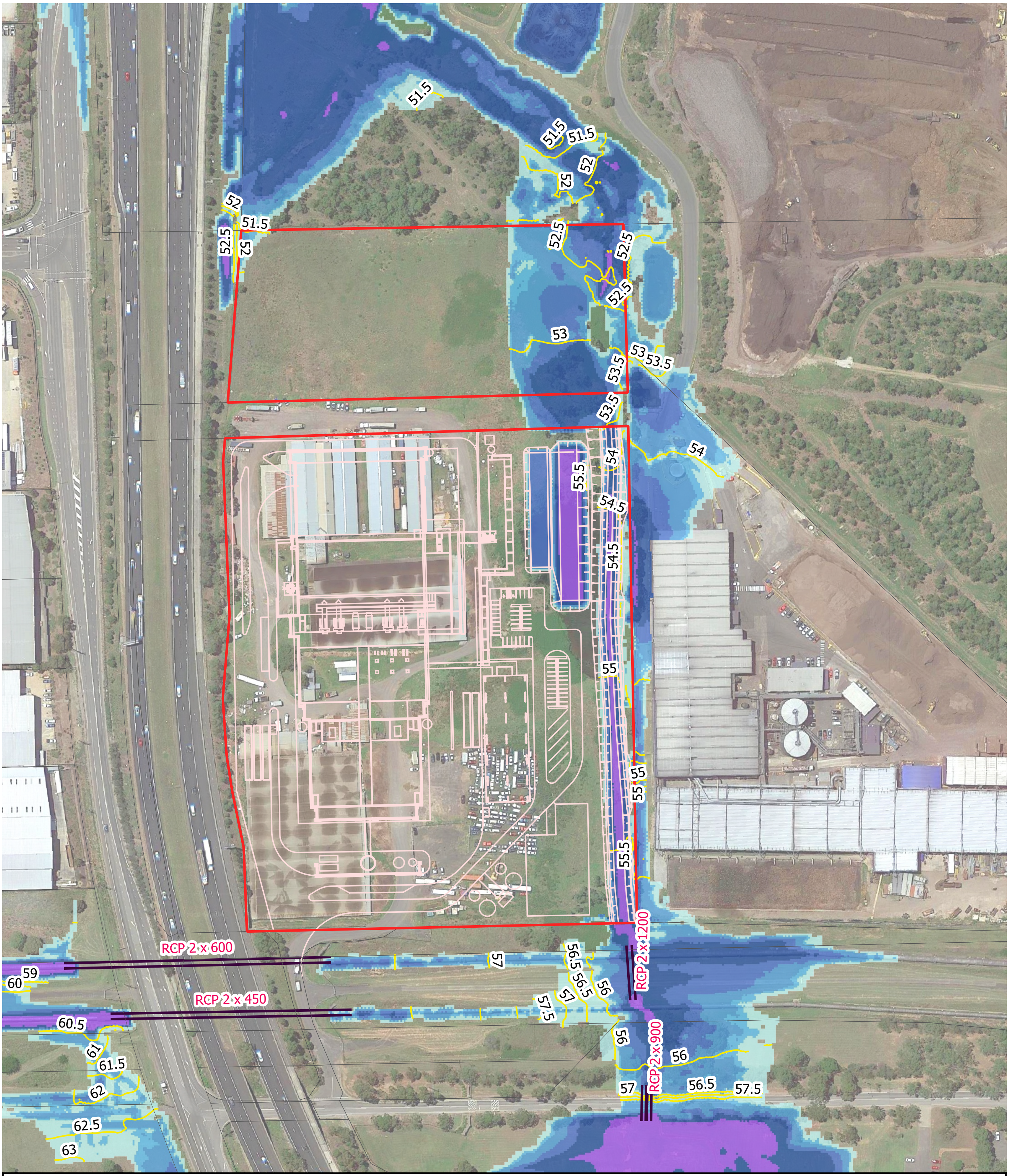
Peak Flood Depth
Post Development Case
1% AEP Flood Event

Job No
264039

Figure Status
For Information

Figure No
D.02

Issue
P2



▭ Site Boundary

Peak Flood Depth (m)

- ▨ <= 0.05
- ▨ 0.05 - 0.1
- ▨ 0.1 - 0.3
- ▨ 0.3 - 0.5
- ▨ 0.5 - 1
- ▨ > 1

— Existing Culverts

— Proposed Design Layout

— Max Flood Level (mAHD)

▭ Cadastre

©Copyright Information

P2	4/6/2020	GK	IVS	AC
P1	15/4/2020	GK	IVS	AC
Issue	Date	By	Chkd	Appd

ARUP

CLEANAWAY
Making a sustainable future possible

MACQUARIE

Level 5, Barrack Place
151 Clarence St
Sydney NSW 2000
Tel +61 (2) 9320 9320
www.arup.com

Client
Cleanaway/Macquarie Capital

Job Title
Western Sydney Energy & Resource Recovery Centre

0 25 50 75 100 Meters

Scale at A4 **1:3000**

Figure Title

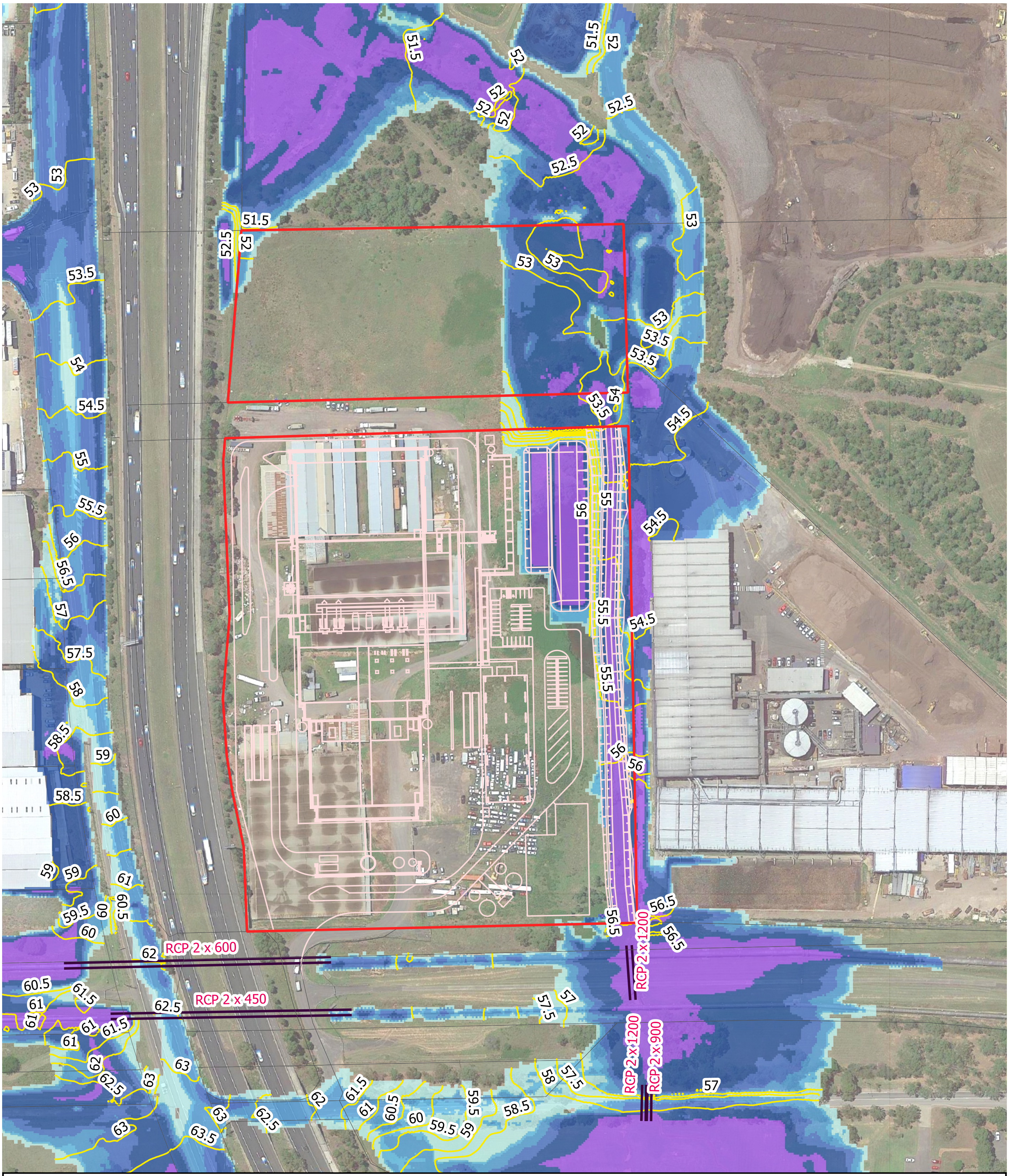
Peak Flood Depth
Post Development Case
1% AEP Including Climate Change

Job No
264039

Figure Status
For Information

Figure No
D.03

Issue
P2



☐ Site Boundary

Peak Flood Depth (m)

🟦	<= 0.05
🟦	0.05 - 0.1
🟦	0.1 - 0.3
🟦	0.3 - 0.5
🟦	0.5 - 1
🟪	> 1

— Existing Culverts

— Proposed Design Layout

— Max Flood Level (mAHD)

☐ Cadastre

P2	4/6/2020	GK	IVS	AC
P1	15/4/2020	GK	IVS	AC
Issue	Date	By	Chkd	Appd

ARUP

CLEANAWAY

MACQUARIE

Level 5, Barrack Place
151 Clarence St
Sydney NSW 2000
Tel +61 (2) 9320 9320
www.arup.com

Client
Cleanaway/Macquarie Capital

Job Title
Western Sydney Energy & Resource Recovery Centre

0 25 50 75 100 Meters

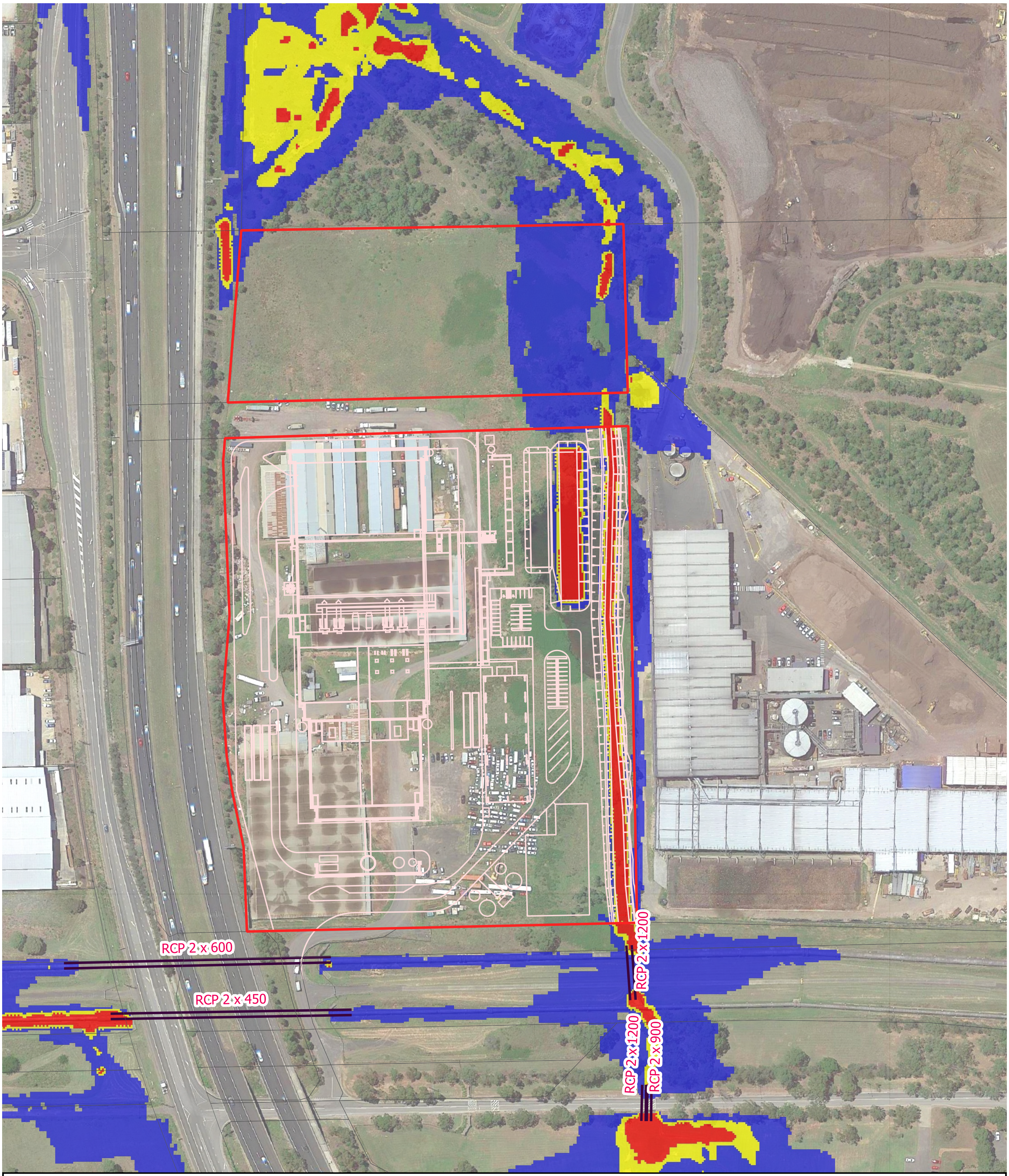
Scale at A4 **1:3000**

Figure Title

Peak Flood Depth
Post Development Case
PMF Flood Event

Job No	Figure Status
264039	**For Information**

Figure No	Issue
D.04	**P2**



🟥 Site Boundary

Flood Hazard

🟦 Low Hazard

🟨 Intermediate Hazard

🟥 High Hazard

— Existing Culverts

— Proposed Design Layout

— Max Flood Level (mAHD)

☐ Cadastre

©Copyright Information

P2	4/6/2020	GK	IVS	AC
P1	15/4/2020	GK	IVS	AC
Issue	Date	By	Chkd	Appd

ARUP

CLEANAWAY
Making a sustainable future possible

MACQUARIE

Level 5, Barrack Place
151 Clarence St
Sydney NSW 2000
Tel +61 (2) 9320 9320
www.arup.com

Client
Cleanaway/Macquarie Capital

Job Title
Western Sydney Energy & Resource Recovery Centre

0 25 50 75 100 Meters

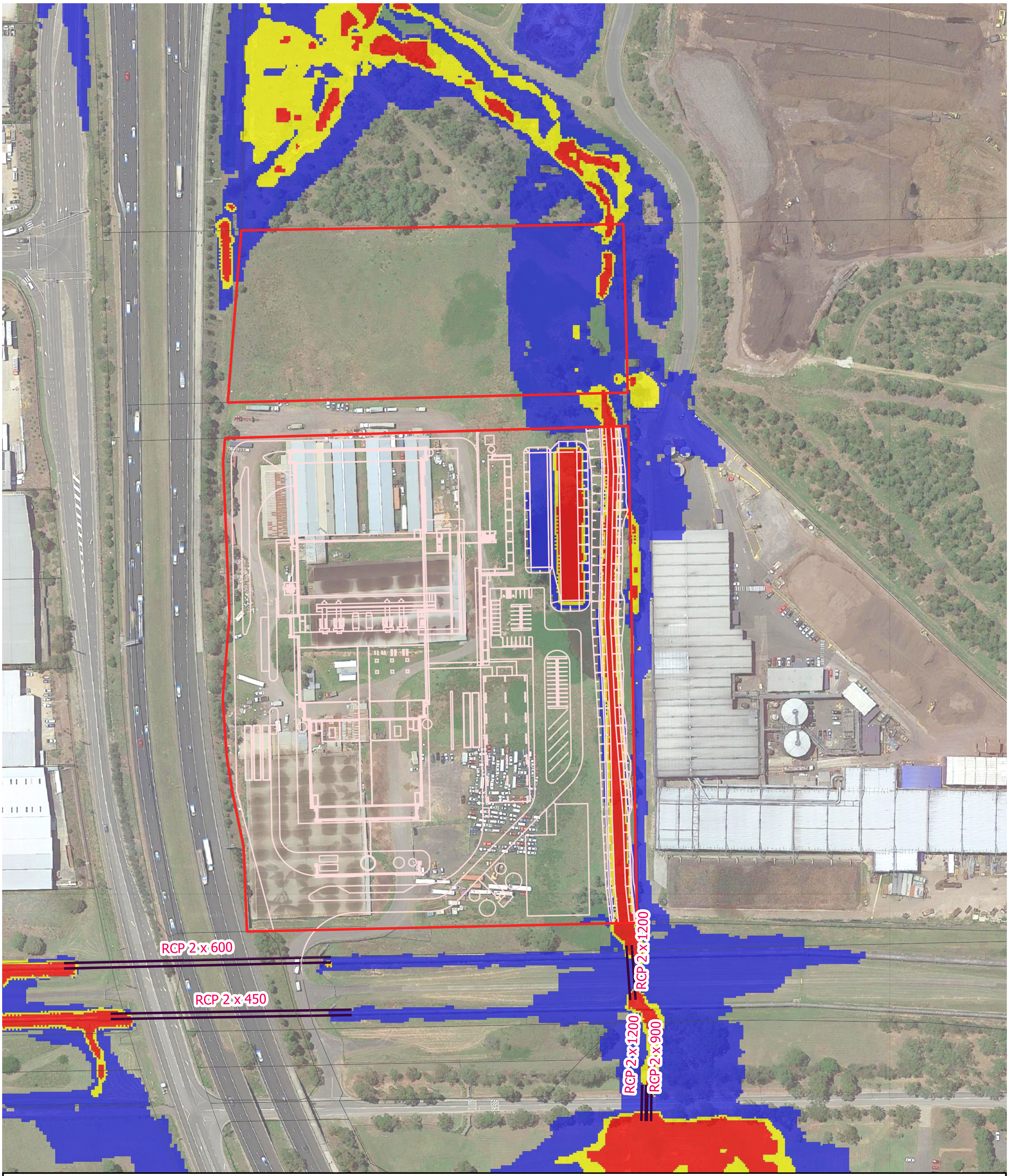
Scale at A4 **1:3000**

Figure Title

Provisional Flood Hazard
Post Development Case
5% AEP Flood Event

Job No	Figure Status
264039	**For Information**

Figure No	Issue
D.05	**P2**



▭ Site Boundary

Flood Hazard

🟦 Low Hazard

🟨 Intermediate Hazard

🟥 High Hazard

— Existing Culverts

— Proposed Design Layout

— Max Flood Level (mAHD)

▭ Cadastre

©Copyright Information

P2	4/6/2020	GK	IVS	AC
P1	15/4/2020	GK	IVS	AC
Issue	Date	By	Chkd	Appd

ARUP

CLEANAWAY
Making a sustainable future possible

MACQUARIE

Level 5, Barrack Place
151 Clarence St
Sydney NSW 2000
Tel +61 (2) 9320 9320
www.arup.com

Client
Cleanaway/Macquarie Capital

Job Title
Western Sydney Energy & Resource Recovery Centre

0 25 50 75 100 Meters

Scale at A4 **1:3000**

Figure Title

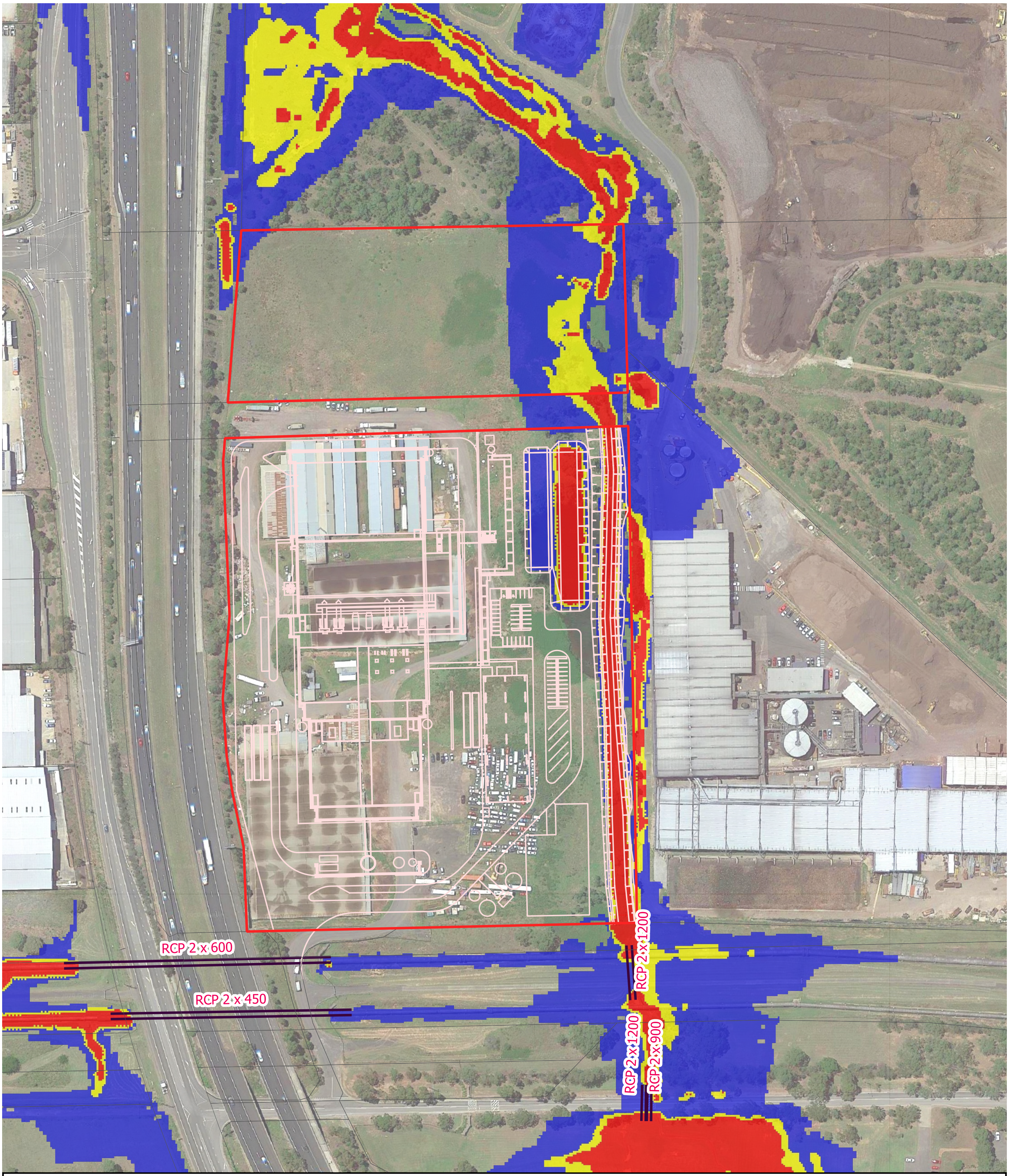
Provisional Flood Hazard
Post Development Case
1% AEP Flood Event

Job No
264039

Figure Status
For Information

Figure No
D.06

Issue
P2



▭ Site Boundary

Flood Hazard

🟦 Low Hazard

🟨 Intermediate Hazard

🟥 High Hazard

— Existing Culverts

— Proposed Design Layout

— Max Flood Level (mAHD)

▭ Cadastre

©Copyright Information

P2	4/6/2020	GK	IVS	AC
P1	15/4/2020	GK	IVS	AC
Issue	Date	By	Chkd	Appd

ARUP

CLEANAWAY

Making a sustainable future possible

MACQUARIE

Level 5, Barrack Place
151 Clarence St
Sydney NSW 2000
Tel +61 (2) 9320 9320
www.arup.com

Client
Cleanaway/Macquarie Capital

Job Title
Western Sydney Energy & Resource Recovery Centre

0 25 50 75 100 Meters

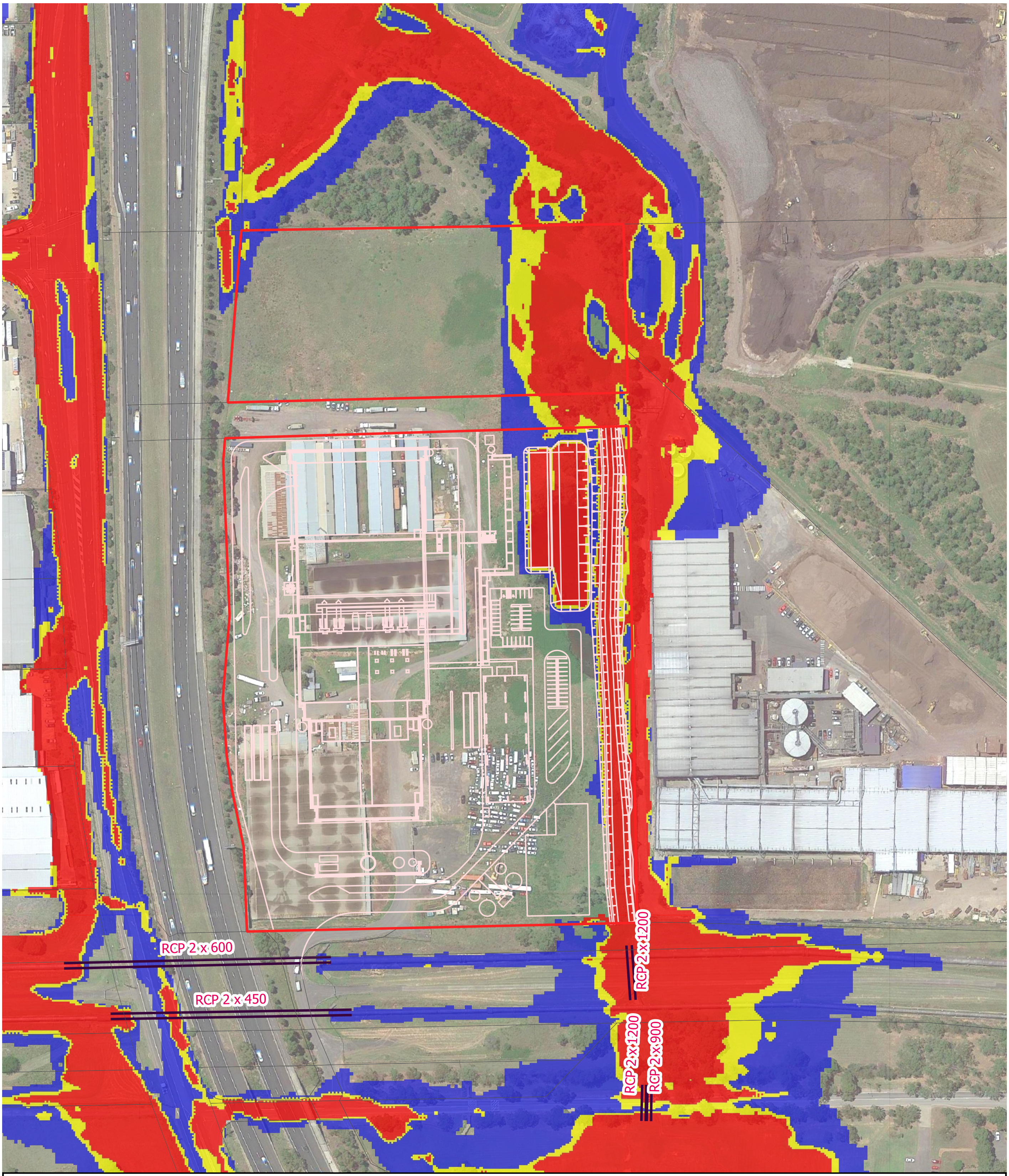
Scale at A4 **1:3000**

Figure Title

Provisional Flood Hazard
Post Development Case
1% AEP Including Climate Change

Job No	Figure Status
264039	**For Information**

Figure No	Issue
D.07	**P2**



▭ Site Boundary

Flood Hazard
🟦 Low Hazard
🟨 Intermediate Hazard
🟥 High Hazard

— Existing Culverts
— Proposed Design Layout
— Max Flood Level (mAHD)
▭ Cadastre

©Copyright Information

P2	4/6/2020	GK	IVS	AC
P1	15/4/2020	GK	IVS	AC
Issue	Date	By	Chkd	Appd

ARUP

CLEANAWAY
Making a sustainable future possible

MACQUARIE

Level 5, Barrack Place
151 Clarence St
Sydney NSW 2000
Tel +61 (2) 9320 9320
www.arup.com

Client
Cleanaway/Macquarie Capital

Job Title
Western Sydney Energy & Resource Recovery Centre

0 25 50 75 100 Meters

Scale at A4 **1:3000**

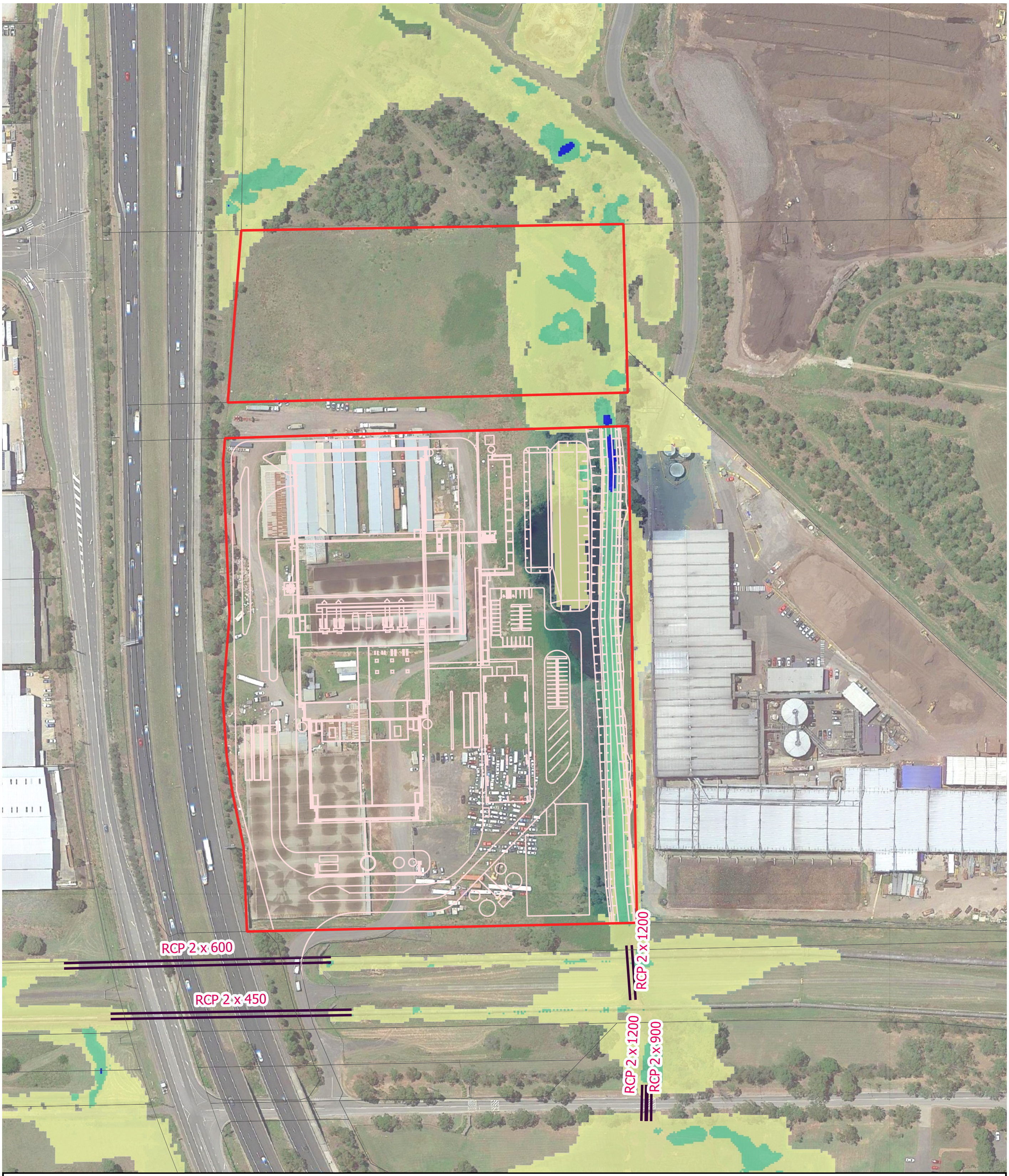
Figure Title
Provisional Flood Hazard
Post Development Case
PMF Flood Event

Job No
264039

Figure Status
For Information

Figure No
D.08

Issue
P2



Site Boundary

Peak Flood Velocity (m/s)

🟨 <= 1
🟩 1 - 2
🟦 2 - 3
🟥 > 3

— Existing Culverts
— Proposed Design Layout
— Max Flood Level (mAHD)
▭ Cadastre

©Copyright Information

P1	4/6/2020	GK	IVS	AC
Issue	Date	By	Chkd	Appd

ARUP

Level 5, Barrack Place
151 Clarence St
Sydney NSW 2000
Tel +61 (2) 9320 9320
www.arup.com

Client
Cleanaway/Macquarie Capital

Job Title
Western Sydney Energy & Resource Recovery Centre

0 25 50 75 100 Meters

Scale at A4 **1:3000**

Figure Title

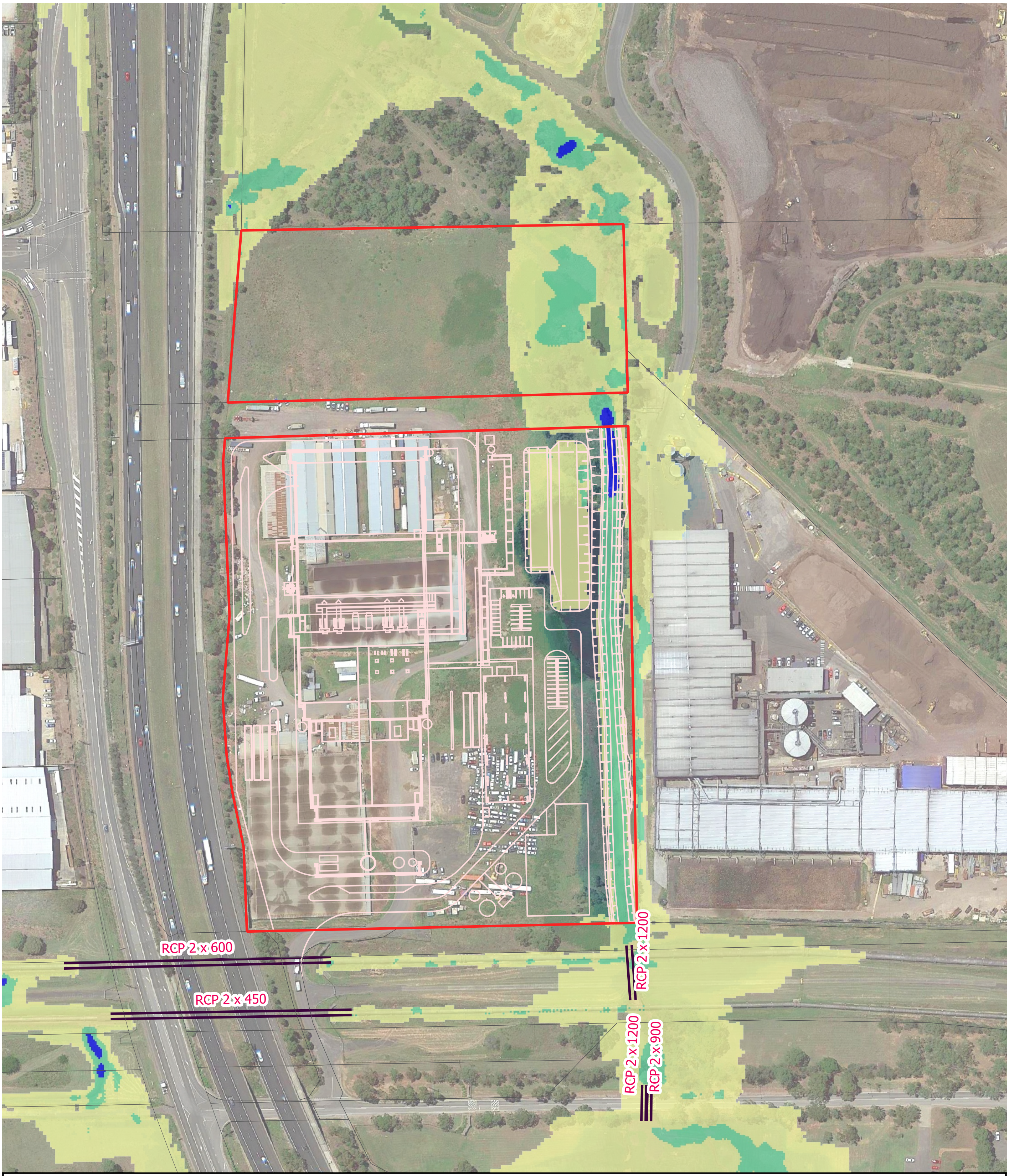
Flood Velocity
Post Development Case
5% AEP Flood Event

Job No
264039

Figure Status
For Information

Figure No
D.09

Issue
P1



Site Boundary

Peak Flood Velocity (m/s)

- 🟨 <= 1
- 🟩 1 - 2
- 🟦 2 - 3
- 🟥 > 3

- — Existing Culverts
- — Proposed Design Layout
- — Max Flood Level (mAHD)
- ☐ Cadastre

©Copyright Information

P1	4/6/2020	GK	IVS	AC
Issue	Date	By	Chkd	Appd

ARUP

CLEANAWAY
Making a sustainable future possible

MACQUARIE

Level 5, Barrack Place
151 Clarence St
Sydney NSW 2000
Tel +61 (2) 9320 9320
www.arup.com

Client
Cleanaway/Macquarie Capital

Job Title
Western Sydney Energy & Resource Recovery Centre

0 25 50 75 100 Meters

Scale at A4 **1:3000**

Figure Title

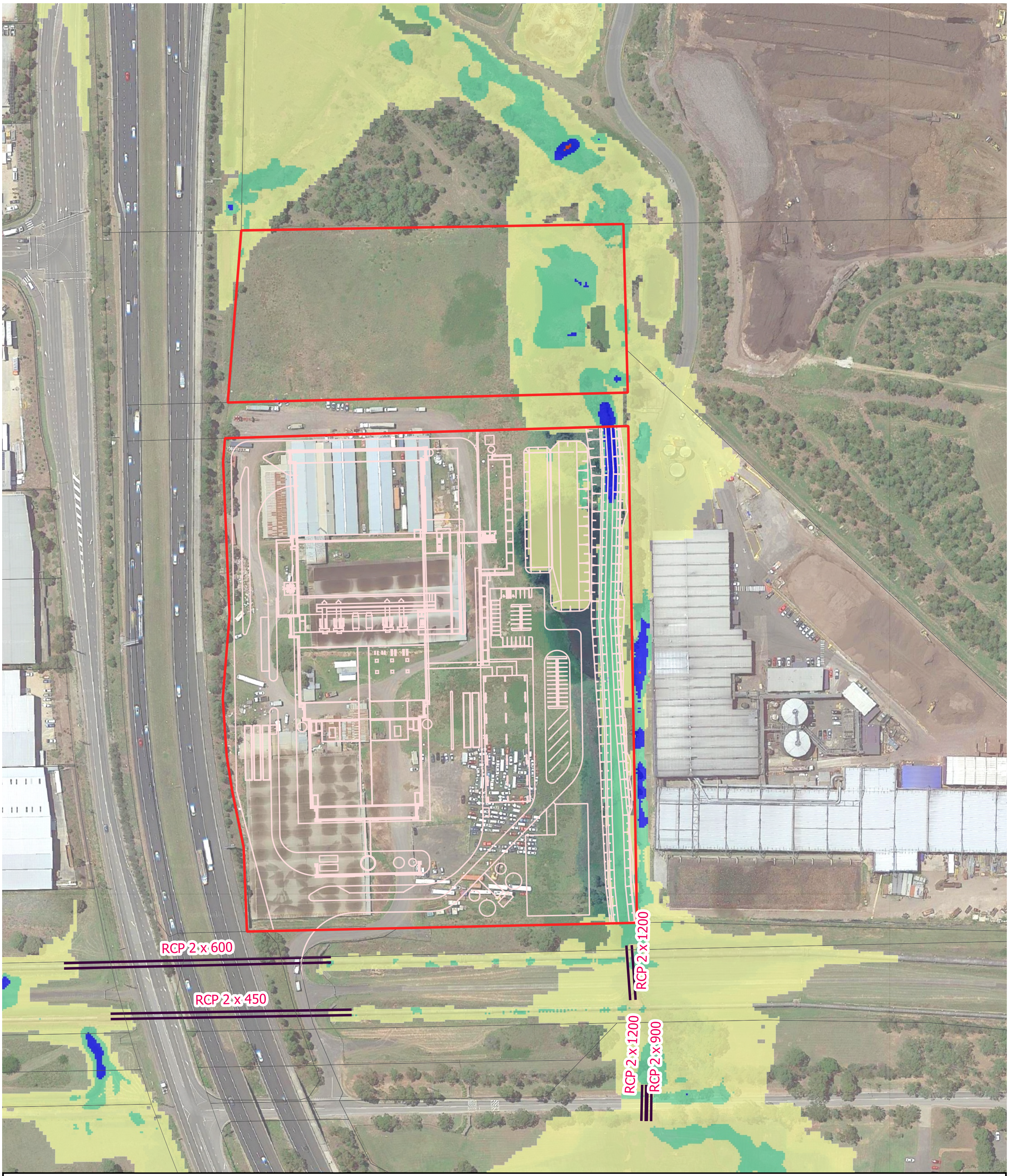
Flood Velocity
Post Development Case
1% AEP Flood Event

Job No
264039

Figure Status
For Information

Figure No
D.10

Issue
P1



Site Boundary

Peak Flood Velocity (m/s)

🟨 <= 1
🟩 1 - 2
🟦 2 - 3
🟥 > 3

Existing Culverts
Proposed Design Layout
Max Flood Level (mAHD)
Cadastre

0 25 50 75 100 Meters

Scale at A4 1:3000

Level 5, Barrack Place
151 Clarence St
Sydney NSW 2000
Tel +61 (2) 9320 9320
www.arup.com

Figure Title

Flood Velocity
Post Development Case
1% AEP Including Climate Change

P1	4/6/2020	GK	IVS	AC
Issue	Date	By	Chkd	Appd

Client
Cleanaway/Macquarie Capital

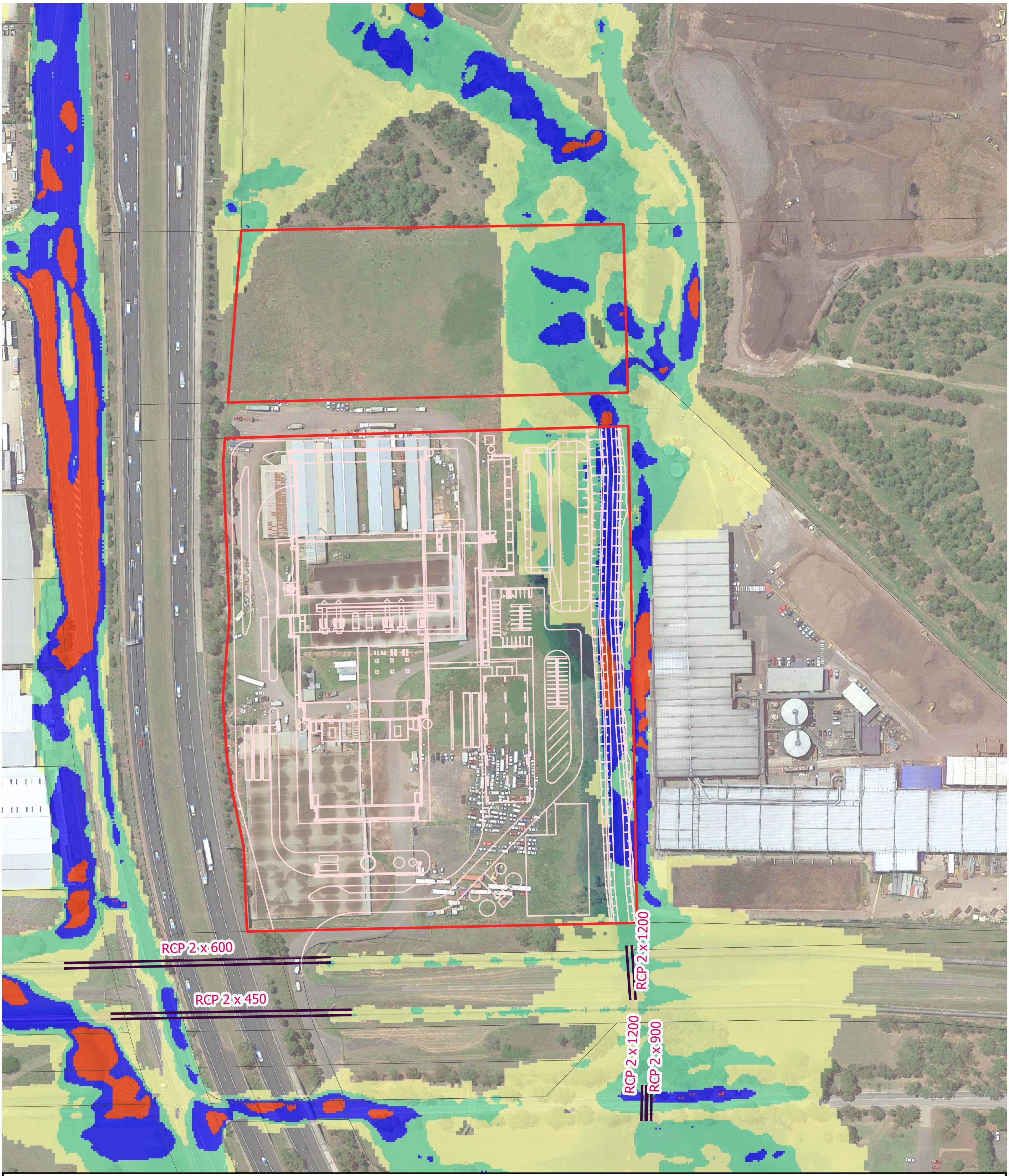
Job Title
Western Sydney Energy & Resource Recovery Centre

Job No
264039

Figure Status
For Information

Figure No
D.11

Issue
P1



Site Boundary

Peak Flood Velocity (m/s)

🟨 <= 1
🟩 1 - 2
🟦 2 - 3
🟥 > 3

Existing Culverts
Proposed Design Layout
Max Flood Level (mAHD)
Cadastre

©Copyright Information

P1	4/6/2020	GK	IVS	AC
Issue	Date	By	Chkd	Appd

ARUP

CLEANAWAY
MACQUARIE

Level 5, Barrack Place
151 Clarence St
Sydney NSW 2000
Tel +61 (2) 9320 9320
www.arup.com

Client
Cleanaway/Macquarie Capital

Job Title
Western Sydney Energy & Resource Recovery Centre

0 25 50 75 100 Meters

Scale at A4 **1:3000**

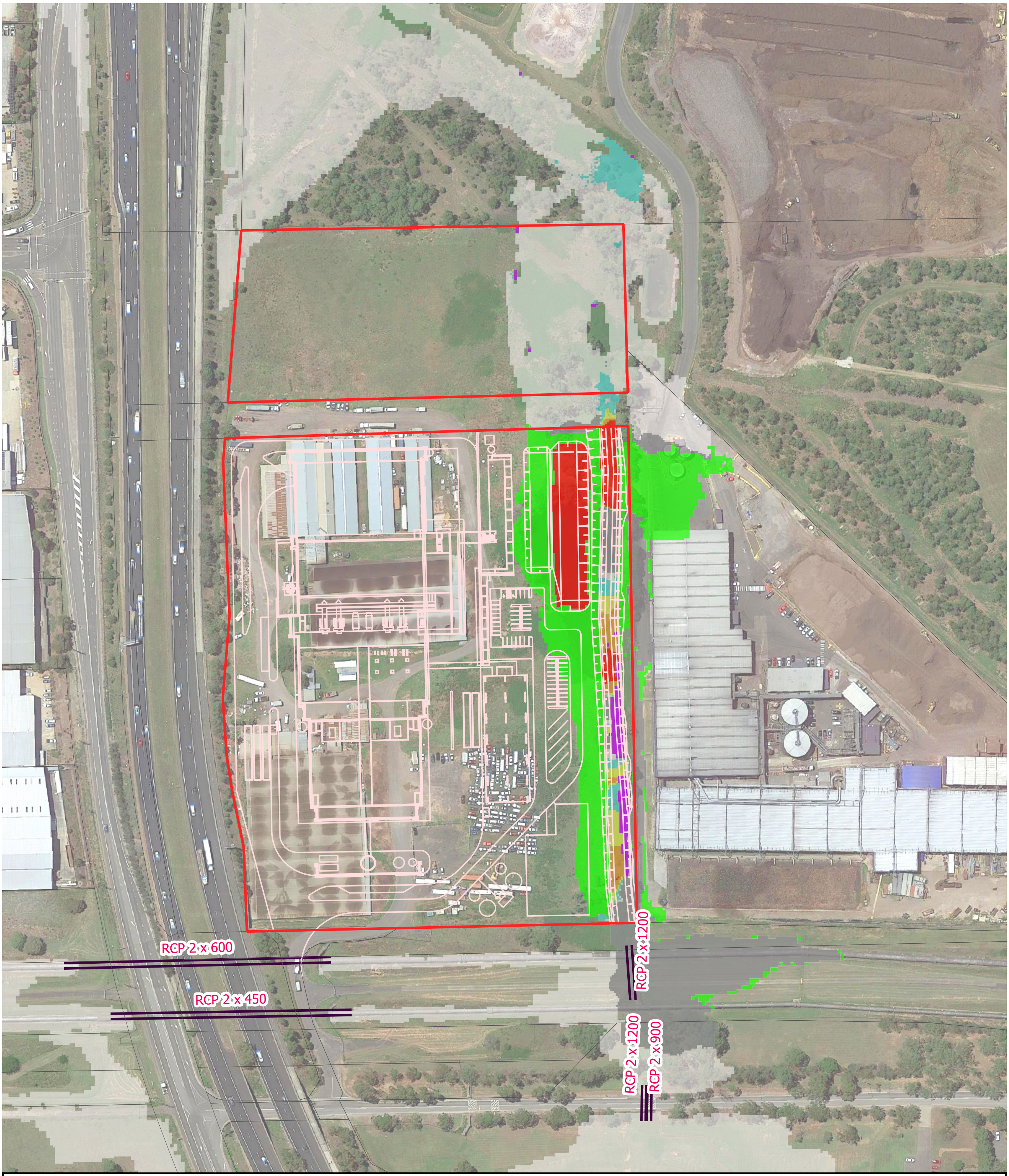
Figure Title
Flood Velocity
Post Development Case
PMF Flood Event

Job No
264039

Figure Status
For Information

Figure No
D.12

Issue
P1



▭ Site Boundary

Change in Flood Level (m)

- 🟫 <= -0.01
- ☐ -0.01 - 0.01
- 🟦 0.01 - 0.05
- 🟨 0.05 - 0.1
- 🟧 0.1 - 0.2
- 🟥 > 0.2

- 🟩 Previously Flooded
- 🟪 Newly Flooded
- — Existing Culverts
- — Proposed Design Layout
- — Max Flood Level (mAHD)
- ☐ Cadastre

©Copyright Information

P2	4/6/2020	GK	IVS	AC
P1	15/4/2020	GK	IVS	AC
Issue	Date	By	Chkd	Appd

ARUP

CLEANAWAY
Making a sustainable future possible

MACQUARIE

Level 5, Barrack Place
151 Clarence St
Sydney NSW 2000
Tel +61 (2) 9320 9320
www.arup.com

Client
Cleanaway/Macquarie Capital

Job Title
Western Sydney Energy & Resource Recovery Centre

0 25 50 75 100 Meters

Scale at A4 **1:3000**

Figure Title

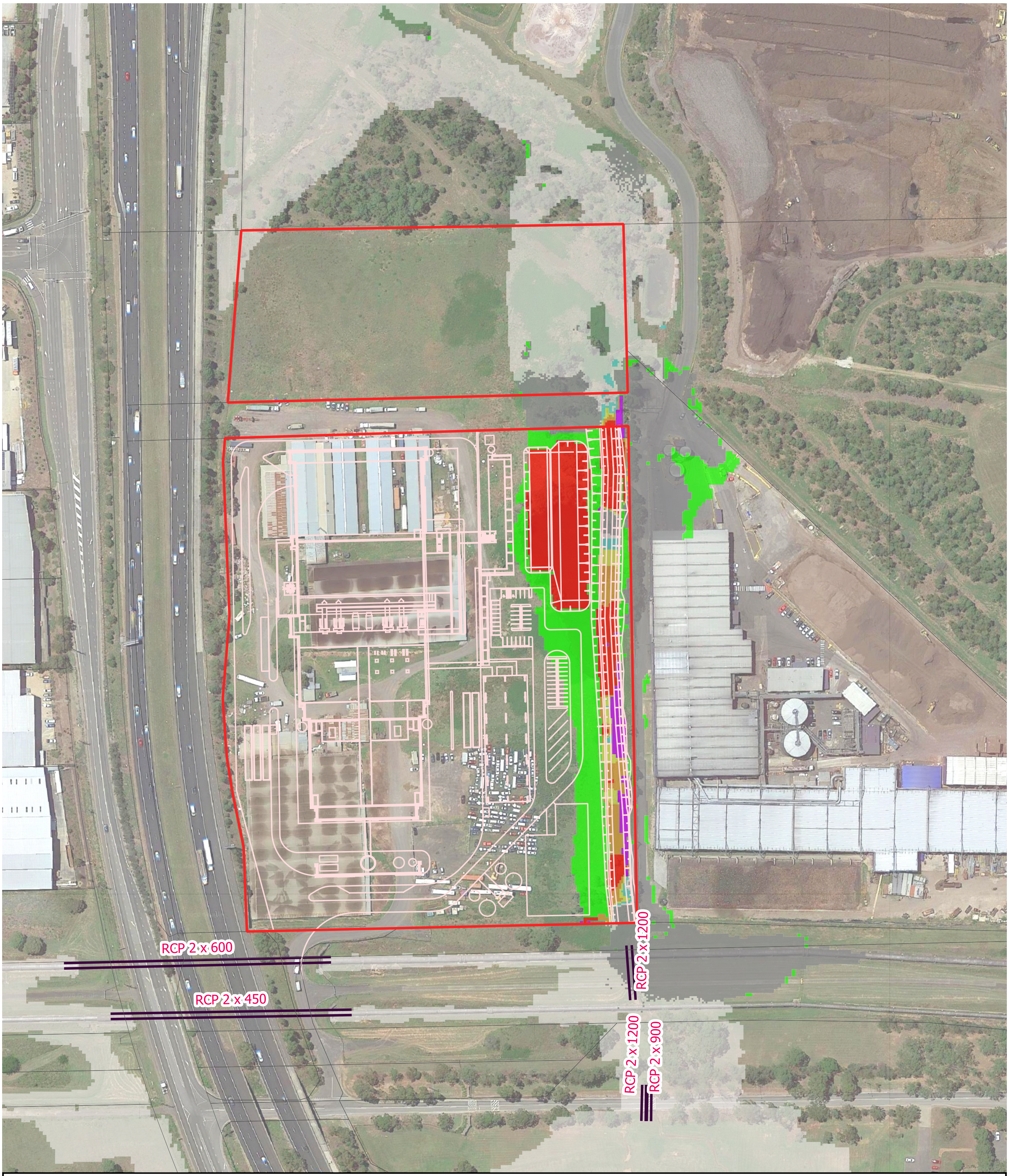
Change in Peak Flood Level
Proposed
5% AEP Flood Event

Job No
264039

Figure Status
For Information

Figure No
A.01

Issue
P2



▭ Site Boundary

Change in Flood Level (m)

⬛	<= -0.01
⬜	-0.01 - 0.01
🟦	0.01 - 0.05
🟨	0.05 - 0.1
🟧	0.1 - 0.2
🟥	> 0.2

🟩	Previously Flooded
🟪	Newly Flooded
—	Existing Culverts
—	Proposed Design Layout
—	Max Flood Level (mAHD)
⬜	Cadastre

©Copyright Information

P2	4/6/2020	GK	IVS	AC
P1	15/4/2020	GK	IVS	AC
Issue	Date	By	Chkd	Appd

ARUP

CLEANAWAY
Making a sustainable future possible

MACQUARIE

Level 5, Barrack Place
151 Clarence St
Sydney NSW 2000
Tel +61 (2) 9320 9320
www.arup.com

Client
Cleanaway/Macquarie Capital

Job Title
Western Sydney Energy & Resource Recovery Centre

0 25 50 75 100 Meters

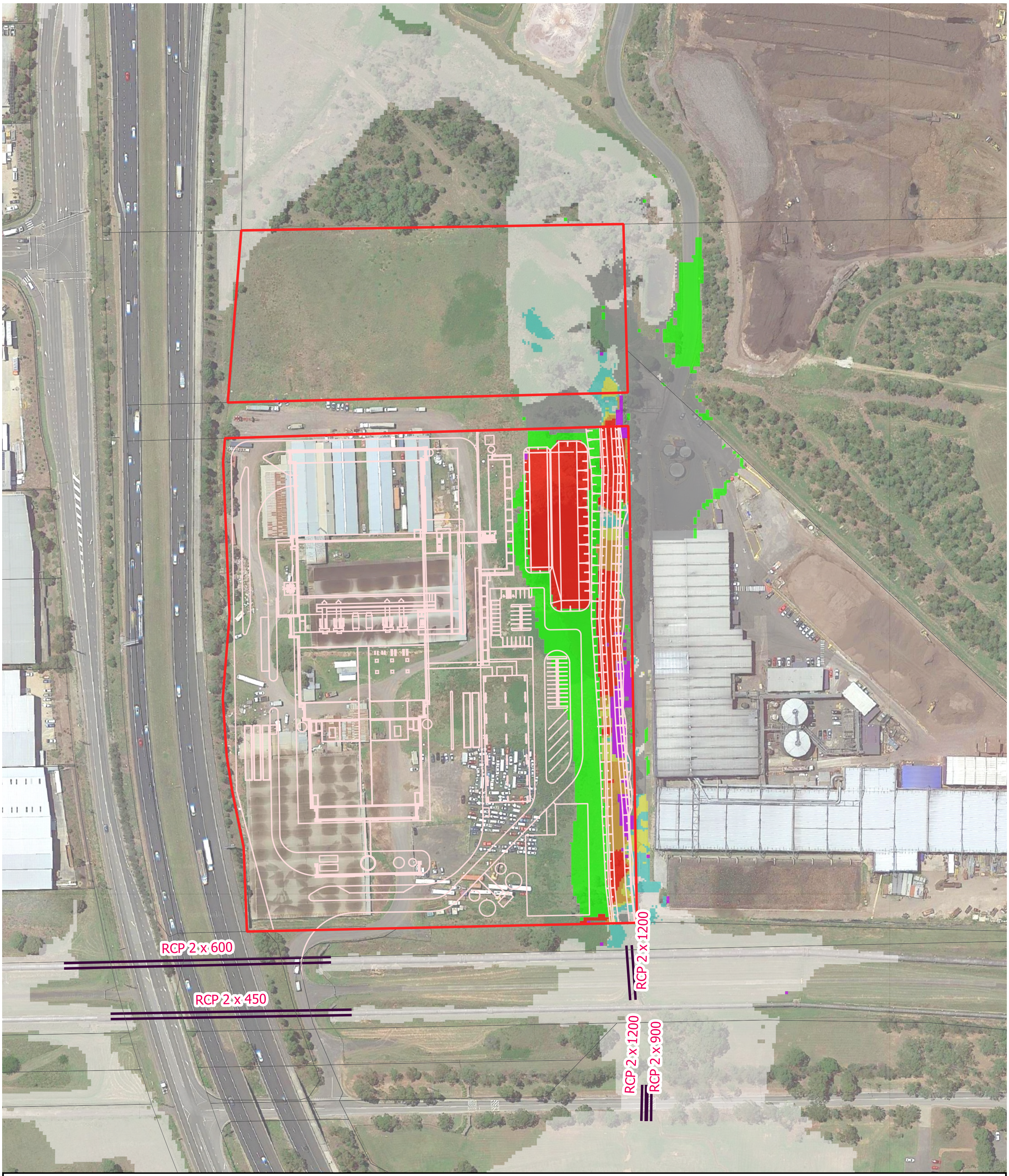
Scale at A4 **1:3000**

Figure Title

Change in Peak Flood Level
Proposed
1% AEP Flood Event

Job No	Figure Status
264039	**For Information**

Figure No	Issue
A.02	**P2**



▭ Site Boundary

Change in Flood Level (m)

■ <= -0.01

□ -0.01 - 0.01

🟦 0.01 - 0.05

🟨 0.05 - 0.1

🟧 0.1 - 0.2

🟥 > 0.2

🟩 Previously Flooded

🟪 Newly Flooded

— Existing Culverts

— Proposed Design Layout

— Max Flood Level (mAHD)

□ Cadastre

P2	4/6/2020	GK	IVS	AC
P1	15/4/2020	GK	IVS	AC
Issue	Date	By	Chkd	Appd

Level 5, Barrack Place
151 Clarence St
Sydney NSW 2000
Tel +61 (2) 9320 9320
www.arup.com

Client
Cleanaway/Macquarie Capital

Job Title
Western Sydney Energy & Resource Recovery Centre

0 25 50 75 100 Meters

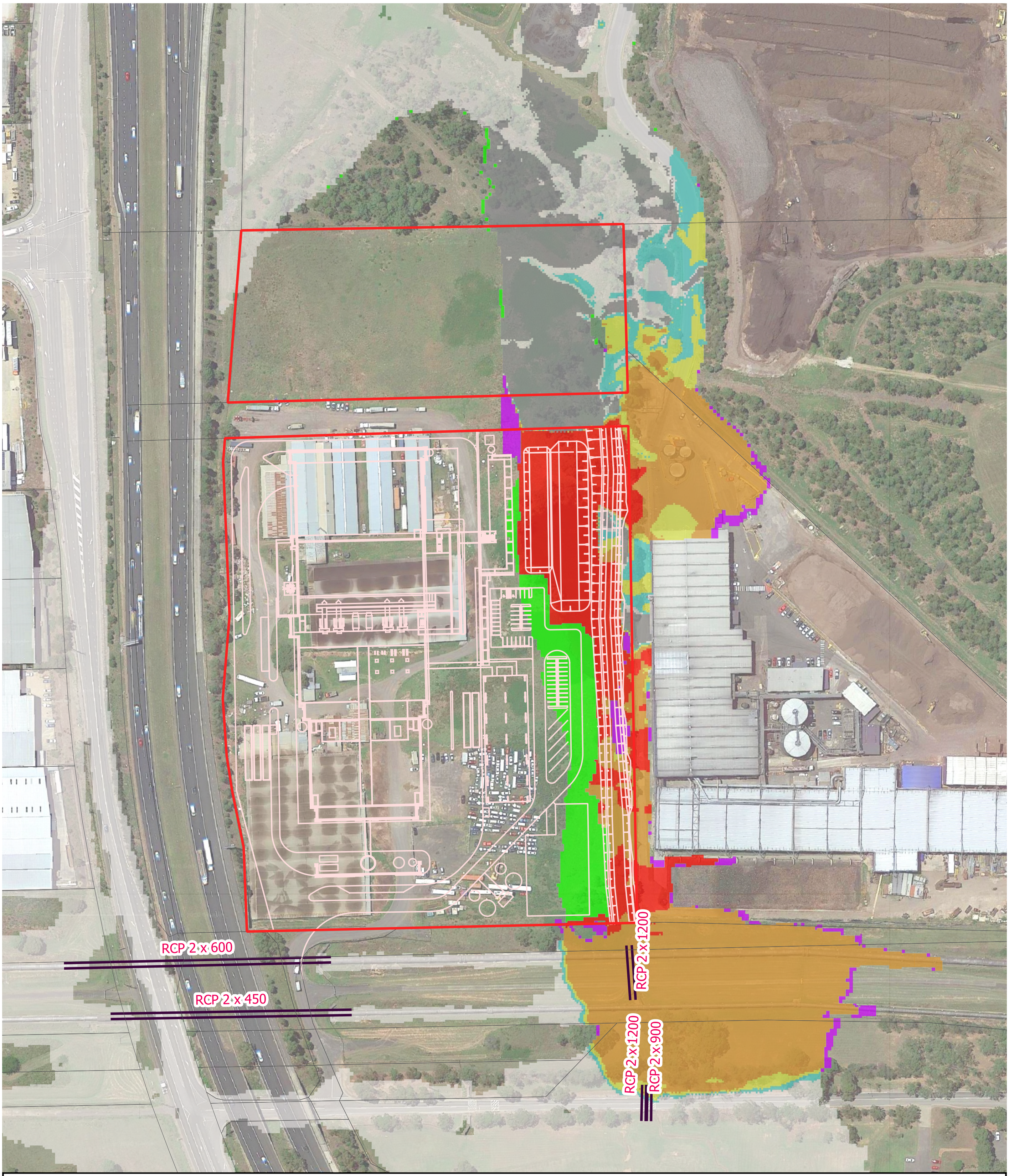
Scale at A4 **1:3000**

Figure Title

Change in Peak Flood Level
Proposed
1% AEP Including Climate Change

Job No	Figure Status
264039	**For Information**

Figure No	Issue
A.03	**P2**



🟥 Site Boundary

Change in Flood Level (m)

▨ <= -0.01

☐ -0.01 - 0.01

▨ 0.01 - 0.05

▨ 0.05 - 0.1

▨ 0.1 - 0.2

🟥 > 0.2

🟩 Previously Flooded

🟪 Newly Flooded

— Existing Culverts

— Proposed Design Layout

— Max Flood Level (mAHD)

☐ Cadastre

P2	4/6/2020	GK	IVS	AC
P1	15/4/2020	GK	IVS	AC
Issue	Date	By	Chkd	Appd

ARUP

CLEANAWAY
Making a sustainable future possible

MACQUARIE

Level 5, Barrack Place
151 Clarence St
Sydney NSW 2000
Tel +61 (2) 9320 9320
www.arup.com

Client
Cleanaway/Macquarie Capital

Job Title
Western Sydney Energy & Resource Recovery Centre

0 25 50 75 100 Meters

Scale at A4 **1:3000**

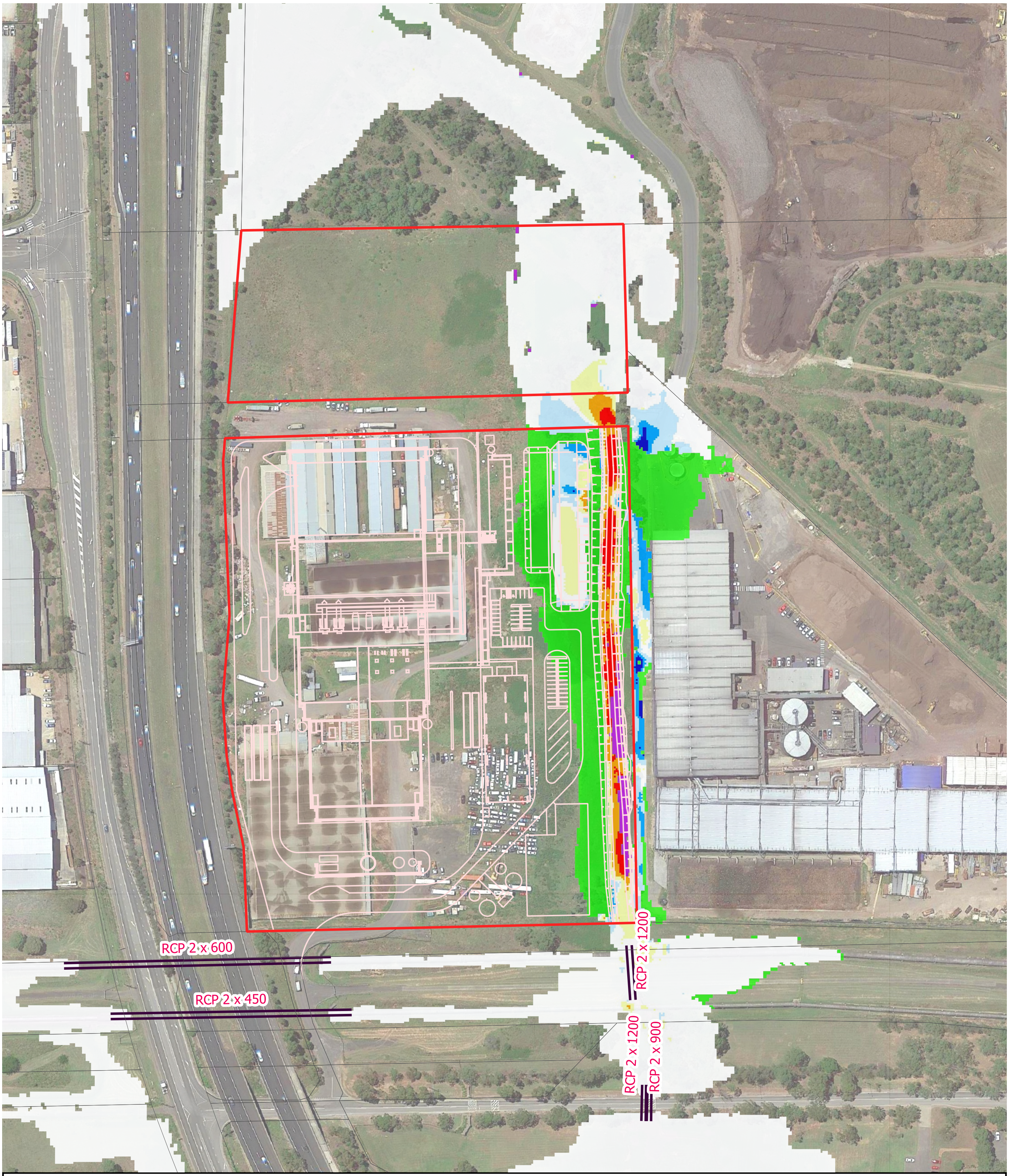
Figure Title
Change in Peak Flood Level
Proposed
PMF Flood Event

Job No
264039

Figure Status
For Information

Figure No
A.04

Issue
P2



▭ Site Boundary

Flood Velocity Afflux (m/s)

- 🟦 <= -1
- 🟦 -1 - -0.5
- 🟦 -0.5 - -0.1
- ☐ -0.1 - 0.1
- 🟨 0.1 - 0.5
- 🟧 0.5 - 1
- 🟥 > 1

- 🟩 Previously Flooded
- 🟪 Newly Flooded
- — Existing Culverts
- — Proposed Design Layout
- — Max Flood Level (mAHD)
- ☐ Cadastre

P1	4/6/2020	GK	IVS	AC
Issue	Date	By	Chkd	Appd

ARUP

CLEANAWAY
Making a sustainable future possible
MACQUARIE

Level 5, Barrack Place
151 Clarence St
Sydney NSW 2000
Tel +61 (2) 9320 9320
www.arup.com

Client
Cleanaway/Macquarie Capital

Job Title
Western Sydney Energy & Resource Recovery Centre

0 25 50 75 100 Meters

Scale at A4 **1:3000**

Figure Title

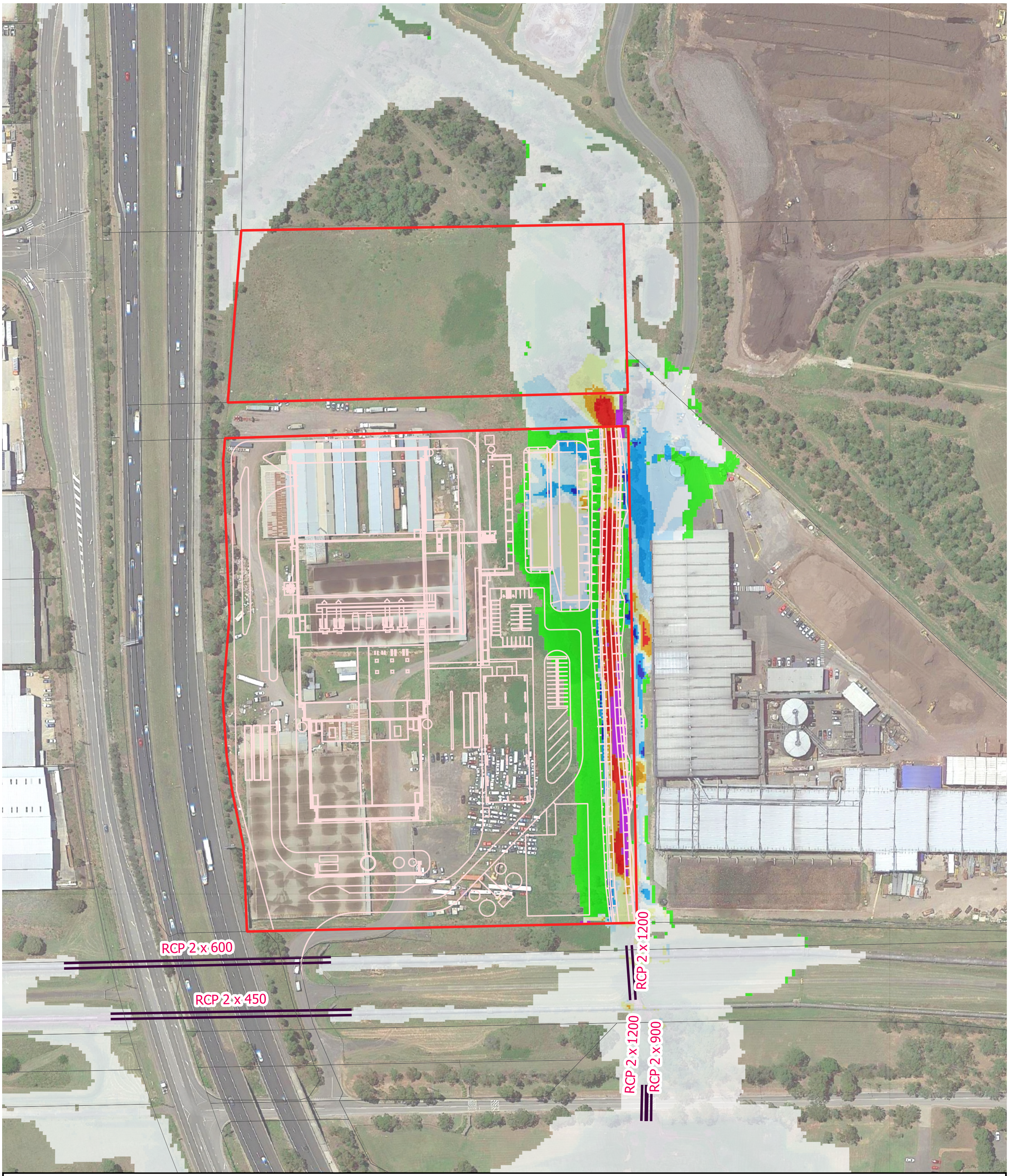
Change in Peak Flood Velocity
Proposed
5% AEP Flood Event

Job No
264039

Figure Status
For Information

Figure No
A.05

Issue
P1



☐ Site Boundary

Flood Velocity Afflux (m/s)

🟦 <= -1

🟦 -1 - -0.5

🟦 -0.5 - -0.1

☐ -0.1 - 0.1

🟨 0.1 - 0.5

🟧 0.5 - 1

🟥 > 1

🟩 Previously Flooded

🟪 Newly Flooded

— Existing Culverts

— Proposed Design Layout

— Max Flood Level (mAHD)

☐ Cadastre

P1	4/6/2020	GK	IVS	AC
Issue	Date	By	Chkd	Appd

ARUP

CLEANAWAY
Making a sustainable future possible

MACQUARIE

Level 5, Barrack Place
151 Clarence St
Sydney NSW 2000
Tel +61 (2) 9320 9320
www.arup.com

Client
Cleanaway/Macquarie Capital

Job Title
Western Sydney Energy & Resource Recovery Centre

0 25 50 75 100 Meters

Scale at A4 **1:3000**

Figure Title

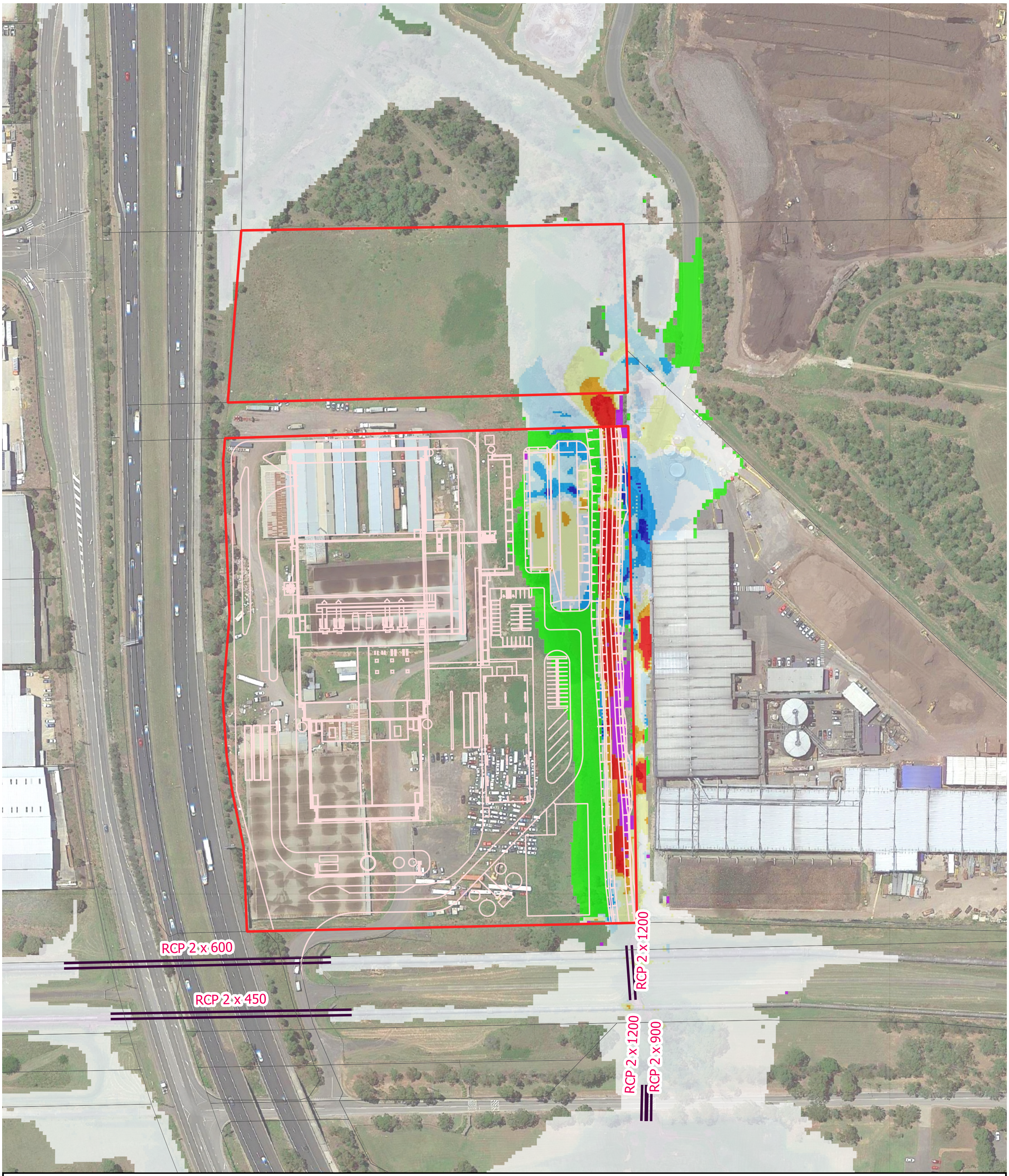
**Change in Peak Flood Velocity
Proposed
1% AEP Flood Event**

Job No
264039

Figure Status
For Information

Figure No
A.06

Issue
P1



🟥 Site Boundary

Flood Velocity Afflux (m/s)

- 🟦 <= -1
- 🟦 -1 - -0.5
- 🟦 -0.5 - -0.1
- ☐ -0.1 - 0.1
- 🟨 0.1 - 0.5
- 🟧 0.5 - 1
- 🟥 > 1

- 🟩 Previously Flooded
- 🟪 Newly Flooded
- — Existing Culverts
- — Proposed Design Layout
- — Max Flood Level (mAHD)
- ☐ Cadastre

©Copyright Information

P1	4/6/2020	GK	IVS	AC
Issue	Date	By	Chkd	Appd

ARUP

CLEANAWAY
Making a sustainable future possible

MACQUARIE

Level 5, Barrack Place
151 Clarence St
Sydney NSW 2000
Tel +61 (2) 9320 9320
www.arup.com

Client
Cleanaway/Macquarie Capital

Job Title
Western Sydney Energy & Resource Recovery Centre

0 25 50 75 100 Meters

Scale at A4 **1:3000**

Figure Title

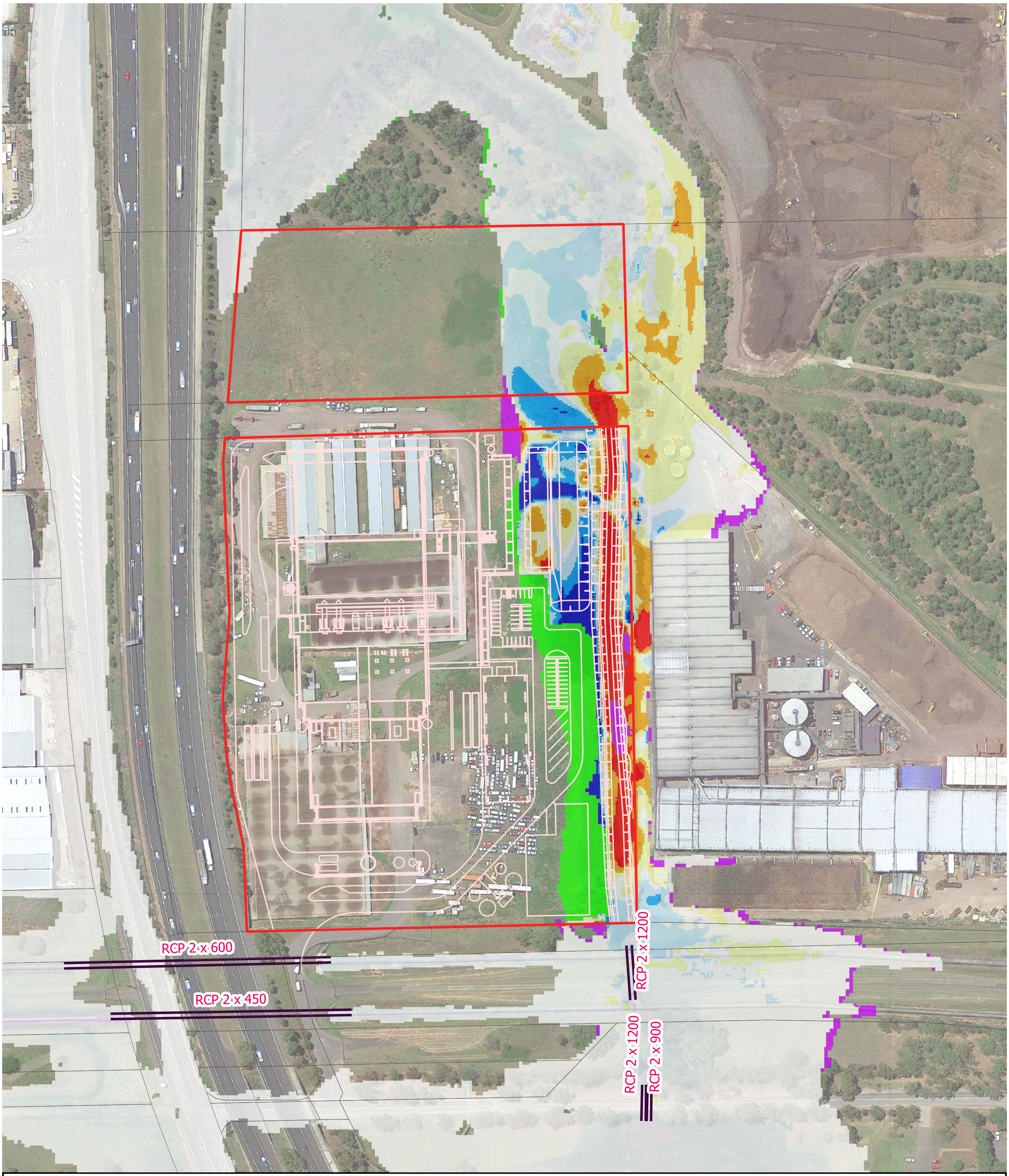
Change in Peak Flood Velocity
Proposed
1% AEP Including Climate Change

Job No
264039

Figure Status
For Information

Figure No
A.07

Issue
P1



☐ Site Boundary

Flood Velocity Afflux (m/s)

- 🟦 <= -1
- 🟦 -1 - -0.5
- 🟦 -0.5 - -0.1
- ☐ -0.1 - 0.1
- 🟨 0.1 - 0.5
- 🟧 0.5 - 1
- 🟥 > 1

- 🟩 Previously Flooded
- 🟪 Newly Flooded
- — Existing Culverts
- — Proposed Design Layout
- — Max Flood Level (mAHD)
- ☐ Cadastre

©Copyright Information

P1	4/6/2020	GK	IVS	AC
Issue	Date	By	Chkd	Appd

ARUP

CLEANAWAY
Making a sustainable future possible

MACQUARIE

Level 5, Barrack Place
151 Clarence St
Sydney NSW 2000
Tel +61 (2) 9320 9320
www.arup.com

Client
Cleanaway/Macquarie Capital

Job Title
Western Sydney Energy & Resource Recovery Centre

0 25 50 75 100 Meters

Scale at A4 **1:3000**

Figure Title

Change in Peak Flood Velocity
Proposed
PMF Flood Event

Job No
264039

Figure Status
For Information

Figure No
A.08

Issue
P1

Appendix B

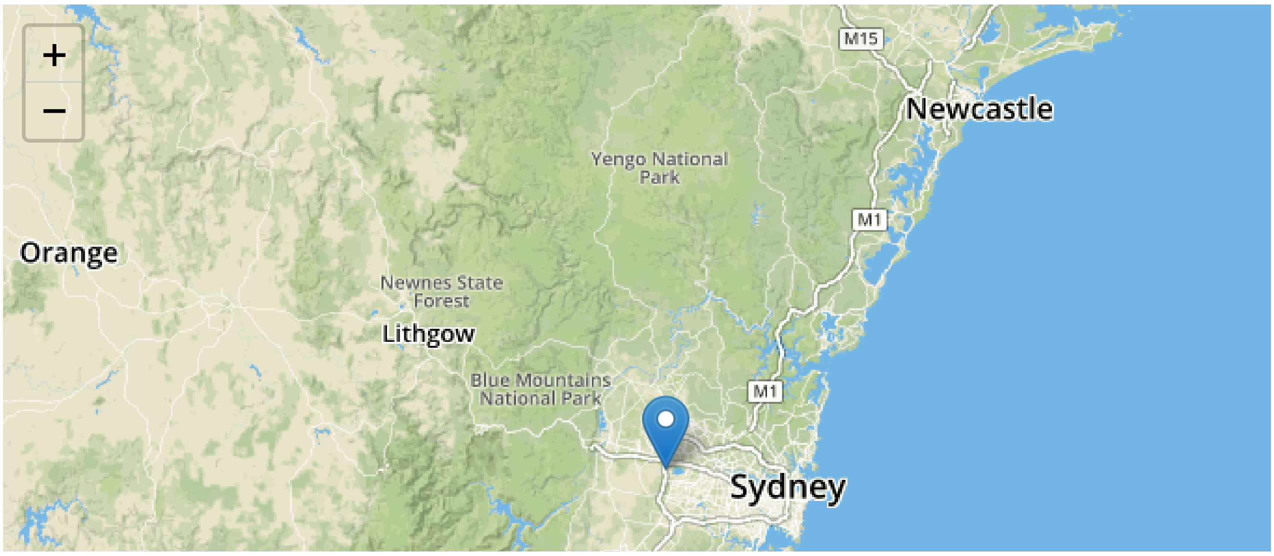
AR&R Data Hub Data

ATTENTION: This site was updated recently, changing some of the functionality. Please see the changelog (./changelog) for further information

Australian Rainfall & Runoff Data Hub - Results

Input Data

Longitude	150.854
Latitude	-33.82
Selected Regions (clear)	
River Region	show
ARF Parameters	show
Storm Losses	show
Temporal Patterns	show
Areal Temporal Patterns	show
BOM IFDs	show
Median Preburst Depths and Ratios	show
10% Preburst Depths	show
25% Preburst Depths	show
75% Preburst Depths	show
90% Preburst Depths	show
Interim Climate Change Factors	show
Probability Neutral Burst Initial Loss (./nsw_specific)	show
Baseflow Factors	show



Leaflet (http://leafletjs.com) | Map data © OpenStreetMap (http://openstreetmap.org) contributors, CC-BY-SA (http://creativecommons.org/licenses/by-sa/2.0/), Imagery © Mapbox (http://mapbox.com)

Data

River Region

Division	South East Coast (NSW)
River Number	12
River Name	Hawkesbury River

Layer Info

Time Accessed	21 February 2020 02:13PM
Version	2016_v1

ARF Parameters

$$ARF = Min\left\{1, \left[1 - a\left(Area^{b} - c\log_{10}Duration\right)Duration^{-d} + eArea^{f}Duration^{g}\left(0.3 + \log_{10}AEP\right) + h10^{iArea\frac{Duration}{1440}}\left(0.3 + \log_{10}AEP\right)\right]\right\}$$

Zone	a	b	c	d	e	f	g	h	i
SE Coast	0.06	0.361	0.0	0.317	8.11e-05	0.651	0.0	0.0	0.0

Short Duration ARF

$$ARF = Min\left[1, 1 - 0.287\left(Area^{0.265} - 0.439\log_{10}(Duration)\right).Duration^{-0.36} + 2.26 \text{ x } 10^{-3} \text{ x } Area^{0.226}.Duration^{0.125}\left(0.3 + \log_{10}(AEP)\right) + 0.0141 \text{ x } Area^{0.213} \text{ x } 10^{-0.021\frac{(Duration-180)^{2}}{1440}}\left(0.3 + \log_{10}(AEP)\right)\right]$$

Layer Info

Time Accessed	21 February 2020 02:13PM
Version	2016_v1

Storm Losses

Note: Burst Loss = Storm Loss - Preburst

Note: These losses are only for rural use and are **NOT FOR DIRECT USE** in urban areas

Note: As this point is in NSW the advice provided on losses and pre-burst on the NSW Specific Tab of the ARR Data Hub (./nsw_specific) is to be considered. In NSW losses are derived considering a hierarchy of approaches depending on the available loss information. The continuing storm loss information from the ARR Datahub provided below should only be used where relevant under the loss hierarchy (level 5) and where used is to be multiplied by the factor of 0.4.

ID	1914.0
Storm Initial Losses (mm)	41.0
Storm Continuing Losses (mm/h)	2.3

Layer Info

Time Accessed	21 February 2020 02:13PM
Version	2016_v1

Temporal Patterns | Download (.zip) (static/temporal_patterns/TP/ECsouth.zip)

code	ECsouth
Label	East Coast South

Layer Info

Time Accessed	21 February 2020 02:13PM
Version	2016_v2

Areal Temporal Patterns | Download (.zip) (./static/temporal_patterns/Areal/Areal_ECsouth.zip)

code	ECsouth
arealabel	East Coast South

Layer Info

Time Accessed	21 February 2020 02:13PM
Version	2016_v2

BOM IFDs

Click here (http://www.bom.gov.au/water/designRainfalls/revised-ifd/?year=2016&coordinate_type=dd&latitude=-33.82&longitude=150.854&sdmin=true&sdhr=true&sdday=true&user_label=) to obtain the IFD depths for catchment centroid from the BoM website

Layer Info

Time Accessed	21 February 2020 02:13PM

Median Preburst Depths and Ratios

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	1.0 (0.038)	1.1 (0.031)	1.2 (0.027)	1.2 (0.025)	2.2 (0.038)	2.9 (0.045)
90 (1.5)	0.4 (0.014)	0.7 (0.017)	0.8 (0.017)	1.0 (0.018)	1.3 (0.019)	1.5 (0.020)
120 (2.0)	0.3 (0.008)	0.8 (0.017)	1.1 (0.021)	1.4 (0.023)	1.9 (0.026)	2.2 (0.028)
180 (3.0)	2.4 (0.062)	3.7 (0.072)	4.5 (0.075)	5.3 (0.077)	3.8 (0.046)	2.6 (0.028)
360 (6.0)	2.3 (0.045)	8.5 (0.127)	12.6 (0.159)	16.5 (0.180)	16.2 (0.148)	16.0 (0.129)
720 (12.0)	1.5 (0.022)	5.2 (0.057)	7.7 (0.070)	10.1 (0.078)	16.2 (0.105)	20.8 (0.119)
1080 (18.0)	1.4 (0.018)	5.7 (0.052)	8.6 (0.064)	11.3 (0.071)	14.6 (0.077)	17.1 (0.079)
1440 (24.0)	0.0 (0.000)	4.1 (0.032)	6.8 (0.044)	9.4 (0.051)	10.7 (0.049)	11.7 (0.047)
2160 (36.0)	0.0 (0.000)	2.1 (0.014)	3.5 (0.019)	4.9 (0.022)	5.4 (0.020)	5.8 (0.019)
2880 (48.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.8 (0.003)	1.5 (0.004)
4320 (72.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)

Layer Info

Time Accessed	21 February 2020 02:13PM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

10% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
90 (1.5)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
120 (2.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
180 (3.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
360 (6.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
720 (12.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
1080 (18.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
1440 (24.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2160 (36.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2880 (48.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
4320 (72.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)

Layer Info

Time Accessed	21 February 2020 02:13PM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

25% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
90 (1.5)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
120 (2.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
180 (3.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
360 (6.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
720 (12.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
1080 (18.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
1440 (24.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2160 (36.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2880 (48.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
4320 (72.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)

Layer Info

Time Accessed	21 February 2020 02:13PM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

75% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	15.4 (0.574)	16.1 (0.446)	16.6 (0.388)	17.0 (0.346)	21.0 (0.361)	23.9 (0.367)
90 (1.5)	12.7 (0.416)	15.9 (0.390)	18.1 (0.376)	20.1 (0.363)	21.2 (0.323)	22.0 (0.299)
120 (2.0)	10.1 (0.301)	21.8 (0.488)	29.5 (0.561)	36.9 (0.609)	34.6 (0.483)	33.0 (0.408)
180 (3.0)	25.4 (0.659)	38.2 (0.748)	46.7 (0.776)	54.8 (0.789)	47.0 (0.570)	41.2 (0.443)
360 (6.0)	23.4 (0.468)	41.3 (0.618)	53.2 (0.672)	64.5 (0.702)	75.4 (0.686)	83.5 (0.671)
720 (12.0)	24.4 (0.364)	32.9 (0.359)	38.5 (0.352)	43.9 (0.342)	56.6 (0.367)	66.1 (0.377)
1080 (18.0)	23.3 (0.292)	32.9 (0.296)	39.2 (0.293)	45.3 (0.286)	54.6 (0.287)	61.6 (0.285)
1440 (24.0)	14.3 (0.159)	25.0 (0.197)	32.0 (0.207)	38.8 (0.212)	41.3 (0.187)	43.1 (0.172)
2160 (36.0)	6.6 (0.062)	16.2 (0.107)	22.5 (0.121)	28.6 (0.129)	35.7 (0.133)	41.0 (0.136)
2880 (48.0)	2.8 (0.024)	4.9 (0.029)	6.3 (0.030)	7.6 (0.030)	16.6 (0.055)	23.3 (0.068)
4320 (72.0)	0.0 (0.000)	0.4 (0.002)	0.7 (0.003)	1.0 (0.003)	7.2 (0.021)	11.9 (0.031)

Layer Info

Time Accessed	21 February 2020 02:13PM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

90% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	47.9 (1.783)	52.8 (1.460)	56.1 (1.312)	59.2 (1.202)	80.9 (1.392)	97.2 (1.493)
90 (1.5)	40.9 (1.337)	62.3 (1.525)	76.5 (1.589)	90.1 (1.624)	80.1 (1.223)	72.7 (0.988)
120 (2.0)	40.7 (1.215)	83.4 (1.869)	111.6 (2.125)	138.7 (2.290)	123.9 (1.728)	112.8 (1.398)
180 (3.0)	69.4 (1.804)	89.3 (1.748)	102.4 (1.703)	115.0 (1.656)	122.5 (1.486)	128.2 (1.377)
360 (6.0)	51.0 (1.019)	81.8 (1.224)	102.2 (1.292)	121.8 (1.326)	133.4 (1.215)	142.1 (1.142)
720 (12.0)	48.4 (0.722)	73.2 (0.799)	89.6 (0.818)	105.3 (0.821)	119.4 (0.773)	129.9 (0.741)
1080 (18.0)	51.1 (0.642)	65.6 (0.591)	75.1 (0.561)	84.3 (0.533)	102.9 (0.540)	116.8 (0.540)
1440 (24.0)	35.5 (0.395)	46.8 (0.369)	54.4 (0.352)	61.6 (0.336)	75.8 (0.343)	86.4 (0.345)
2160 (36.0)	33.8 (0.322)	42.2 (0.279)	47.8 (0.257)	53.1 (0.239)	72.3 (0.270)	86.6 (0.286)
2880 (48.0)	16.0 (0.138)	17.5 (0.104)	18.5 (0.089)	19.5 (0.078)	53.3 (0.177)	78.6 (0.231)
4320 (72.0)	16.4 (0.126)	25.2 (0.131)	31.0 (0.130)	36.6 (0.127)	40.1 (0.116)	42.6 (0.110)

Layer Info

Time Accessed	21 February 2020 02:13PM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

Interim Climate Change Factors

	RCP 4.5	RCP6	**RCP 8.5**
2030	**0.869 (4.3%)**	0.783 (3.9%)	**0.983 (4.9%)**
2040	**1.057 (5.3%)**	1.014 (5.1%)	**1.349 (6.8%)**
2050	**1.272 (6.4%)**	1.236 (6.2%)	**1.773 (9.0%)**
2060	**1.488 (7.5%)**	1.458 (7.4%)	**2.237 (11.5%)**
2070	**1.676 (8.5%)**	1.691 (8.6%)	**2.722 (14.2%)**
2080	**1.810 (9.2%)**	1.944 (9.9%)	**3.209 (16.9%)**
2090	**1.862 (9.5%)**	2.227 (11.5%)	**3.679 (19.7%)**

Layer Info

Time Accessed	21 February 2020 02:13PM
Version	2019_v1
Note	ARR recommends the use of RCP4.5 and RCP 8.5 values. These have been updated to the values that can be found on the climate change in Australia website.

Probability Neutral Burst Initial Loss

min (h)\AEP(%)	**50**	**20**	**10**	**5**	**2**	**1**
60 (1.0)	26.7	15.6	14.3	14.4	12.3	10.2
90 (1.5)	30.3	16.7	14.6	14.2	12.7	11.6
120 (2.0)	31.1	16.3	13.5	12.7	12.0	9.0
180 (3.0)	26.1	14.1	12.4	12.2	11.2	9.6
360 (6.0)	27.1	15.9	13.5	12.7	10.1	6.9
720 (12.0)	28.3	19.6	18.4	17.2	14.4	8.0
1080 (18.0)	29.4	21.7	21.1	19.7	17.7	9.7
1440 (24.0)	33.2	25.3	24.7	23.6	22.9	13.9
2160 (36.0)	36.0	28.8	28.7	28.0	24.4	12.3
2880 (48.0)	40.5	35.2	35.8	40.1	30.7	15.9
4320 (72.0)	41.3	35.6	35.3	42.1	34.5	20.4

Layer Info

Time Accessed	21 February 2020 02:13PM
Version	2018_v1
Note	As this point is in NSW the advice provided on losses and pre-burst on the NSW Specific Tab of the ARR Data Hub (./nsw_specific) is to be considered. In NSW losses are derived considering a hierarchy of approaches depending on the available loss information. Probability neutral burst initial loss values for NSW are to be used in place of the standard initial loss and pre-burst as per the losses hierarchy.

Baseflow Factors

Downstream	10098
Area (km2)	618.695552
Catchment Number	10155
Volume Factor	0.296375
Peak Factor	0.04368

Layer Info

Time Accessed	21 February 2020 02:13PM
Version	2016_v1

Download TXT (downloads/8a365f3e-eb9b-41a6-a423-daa0c2185805.txt)

Download JSON (downloads/02cc32f4-b8a1-4a97-9ffb-aea934d2e455.json)

Generating PDF... (downloads/ae180b04-0302-4ccd-bb9a-8169d206e3fe.pdf)

Appendix B

Preliminary Sediment and Erosion Control Plan

NOTE

1. FOR GENERAL NOTES AND LEGEND REFER TO DRAWING No's ARU-SYD-CICW-DRG-0002 AND ARU-SYD-CICW-DRG-0003.
2. EROSION AND SEDIMENT CONTROL MEASURES ARE INDICATIVE ONLY. DETAILED PLANS, INCLUDING CONSTRUCTION STAGING ARE TO BE PREPARED BY THE CONTRACTOR.

NOT FOR CONSTRUCTION

Scales
0 10 20m
A1 / A3
1:500 / 1:1000

Filename (Full Drawing No)
WSERRC-ARU-SYD-CICW-DRG-0101
Design Model Version

Issue	Date	By	Chkd	Appd

Issue	Date	By	Chkd	Appd

Issue	Date	By	Chkd	Appd
0	22/05/20	HNA	AC	EM
FOR PLANNING APPROVAL				

Client
CLEANAWAY
Making a sustainable future possible
MACQUARIE

Engineering Certification (CEng)
Name: ....
Signature: .... Date: ....

Job Title
WESTERN SYDNEY ENERGY AND RESOURCE RECOVERY CENTRE

Scale at A1 1:500m
Discipline Civil

ARUP
Arup, Barrack Place, Level 5, 151 Clarence St
Sydney, NSW, 2000
Tel +61 (02) 9320 9320 Fax +61 (02) 9320 9321
www.arup.com

CONSULT AUSTRALIA
Member Firm
Arup Pty Ltd
ABN 18 000 966 165

Drawing Title
EROSION AND SEDIMENT CONTROL PLAN
SHEET 1 OF 2

Drawing Status
Preliminary Issue

Job No	Drawing No	Issue
264039-00	ARU-SYD-CICW-DRG-0101	0

Do not scale

DRAWING COLOUR CODED - PRINT ALL COPIES IN COLOUR

ADJOINS DRG No. ARU-SYD-CICW-DRG-0101

NOTE

1. FOR GENERAL NOTES AND LEGEND REFER TO DRAWING No's ARU-SYD-CICW-DRG-0002 AND ARU-SYD-CICW-DRG-0003.
2. EROSION AND SEDIMENT CONTROL MEASURES ARE INDICATIVE ONLY. DETAILED PLANS, INCLUDING CONSTRUCTION STAGING ARE TO BE PREPARED BY THE CONTRACTOR.

NOT FOR CONSTRUCTION

Scales

NOT TO SCALE

Filename (Full Drawing No)
WSERRC-ARU-SYD-CICW-DRG-0102
Design Model Version

Issue	Date	By	Chkd	Appd
0	22/05/20	HNA	AC	EM
FOR PLANNING APPROVAL				

Client
CLEANAWAY
Making a sustainable future possible
MACQUARIE

Engineering Certification (CEng)
Name: ....
Signature: .... Date: ....

Job Title
WESTERN SYDNEY ENERGY AND RESOURCE RECOVERY CENTRE

Scale at A1 1:500m

Discipline Civil

ARUP

Arup, Barrack Place, Level 5, 151 Clarence St
Sydney, NSW, 2000
Tel +61 (02) 9320 9320 Fax +61 (02) 9320 9321
www.arup.com

CONSULT AUSTRALIA
Member Firm
Arup Pty Ltd
ABN 18 000 966 165

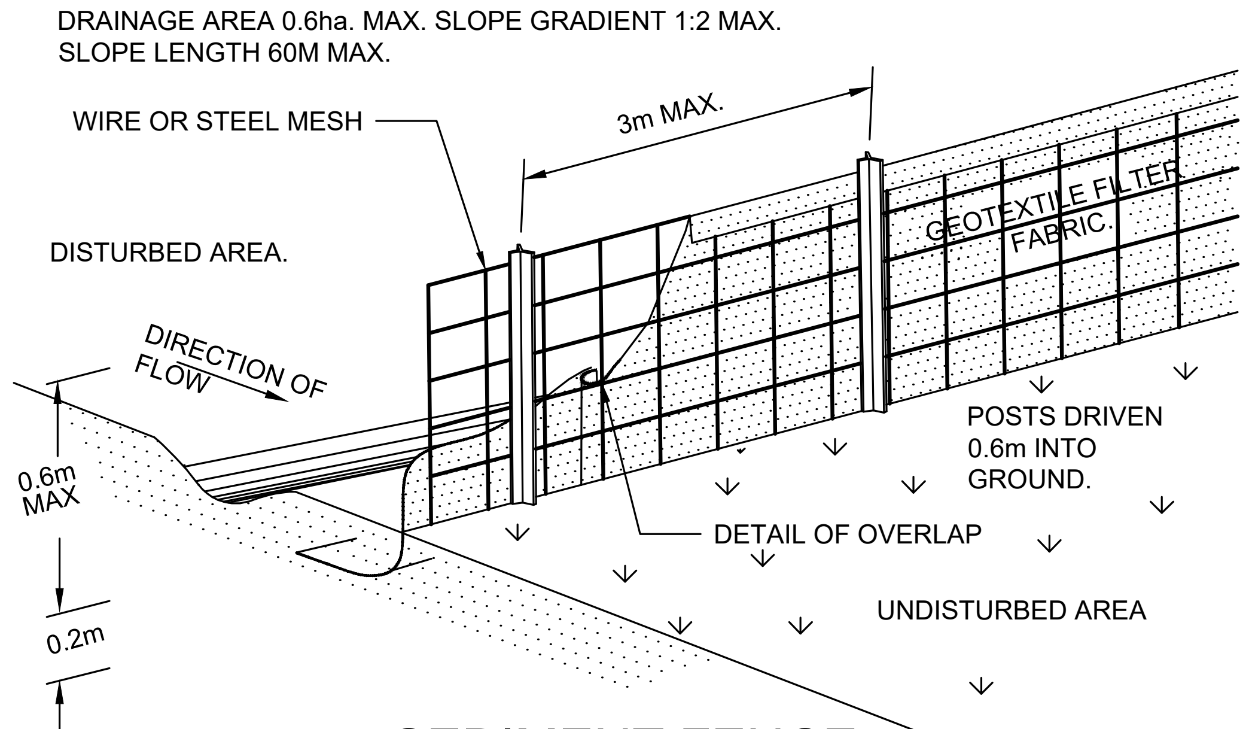
Drawing Title
EROSION AND SEDIMENT CONTROL PLAN
SHEET 2 OF 2

Drawing Status
Preliminary Issue

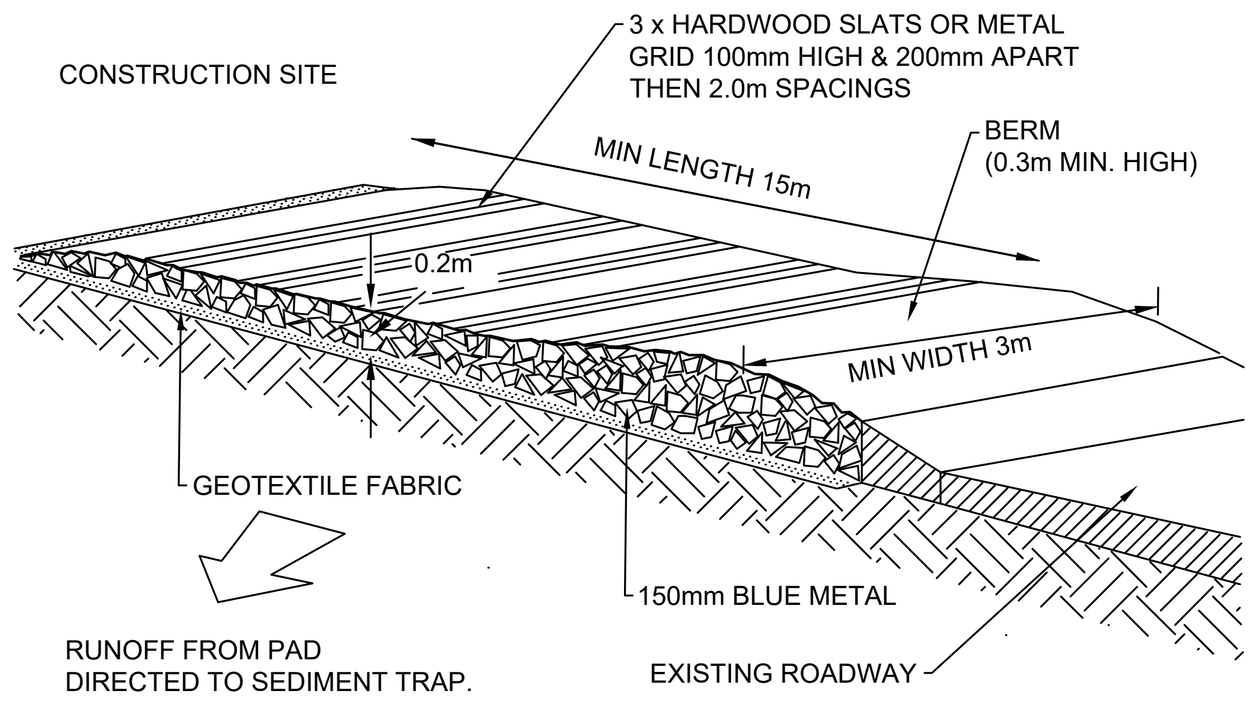
Job No	Drawing No	Issue
264039-00	ARU-SYD-CICW-DRG-0102	0

Do not scale

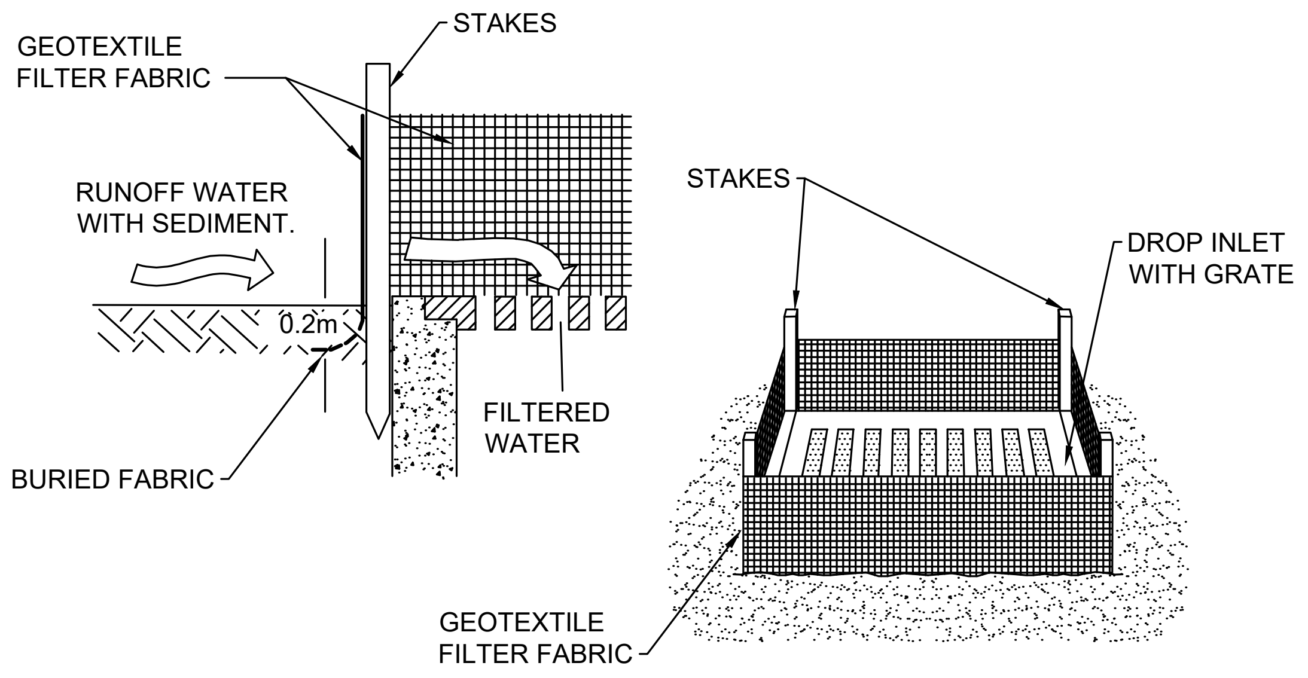
DRAWING COLOUR CODED - PRINT ALL COPIES IN COLOUR



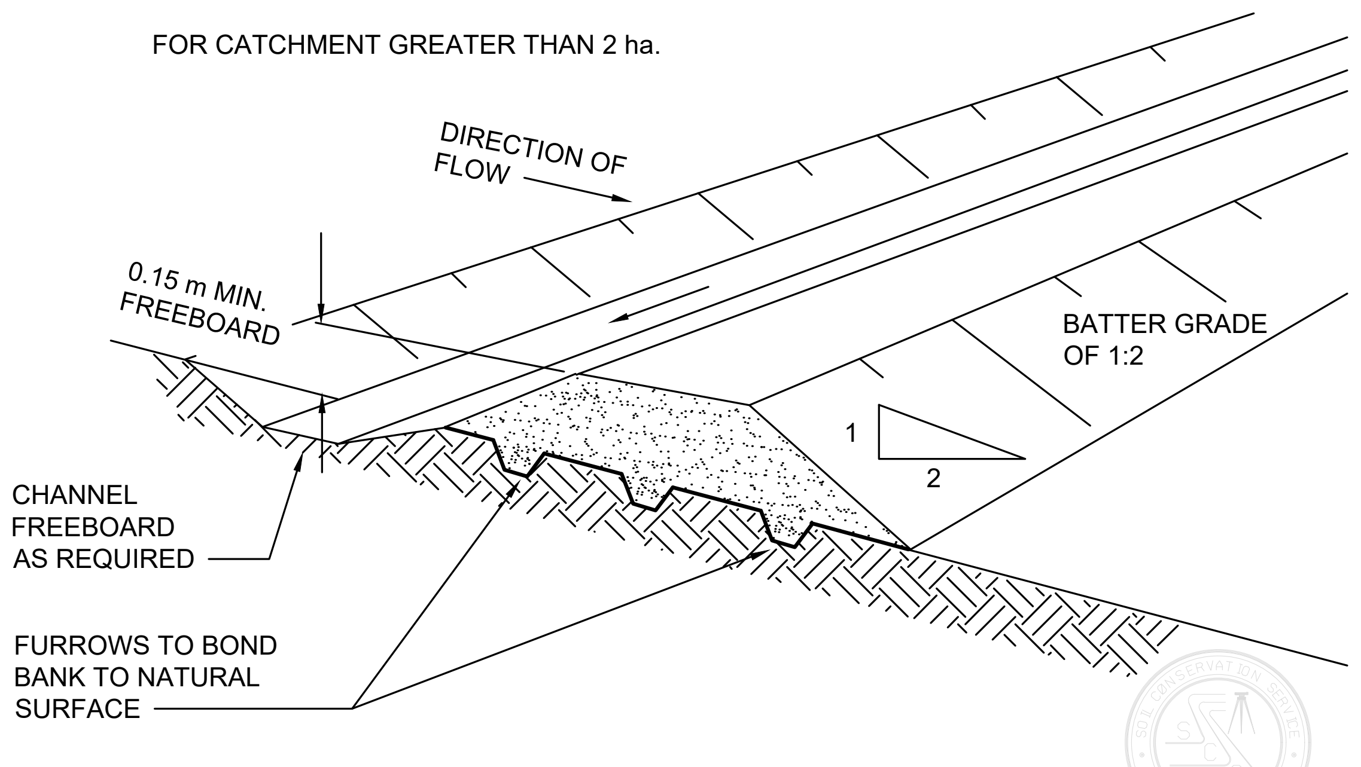
SEDIMENT FENCE



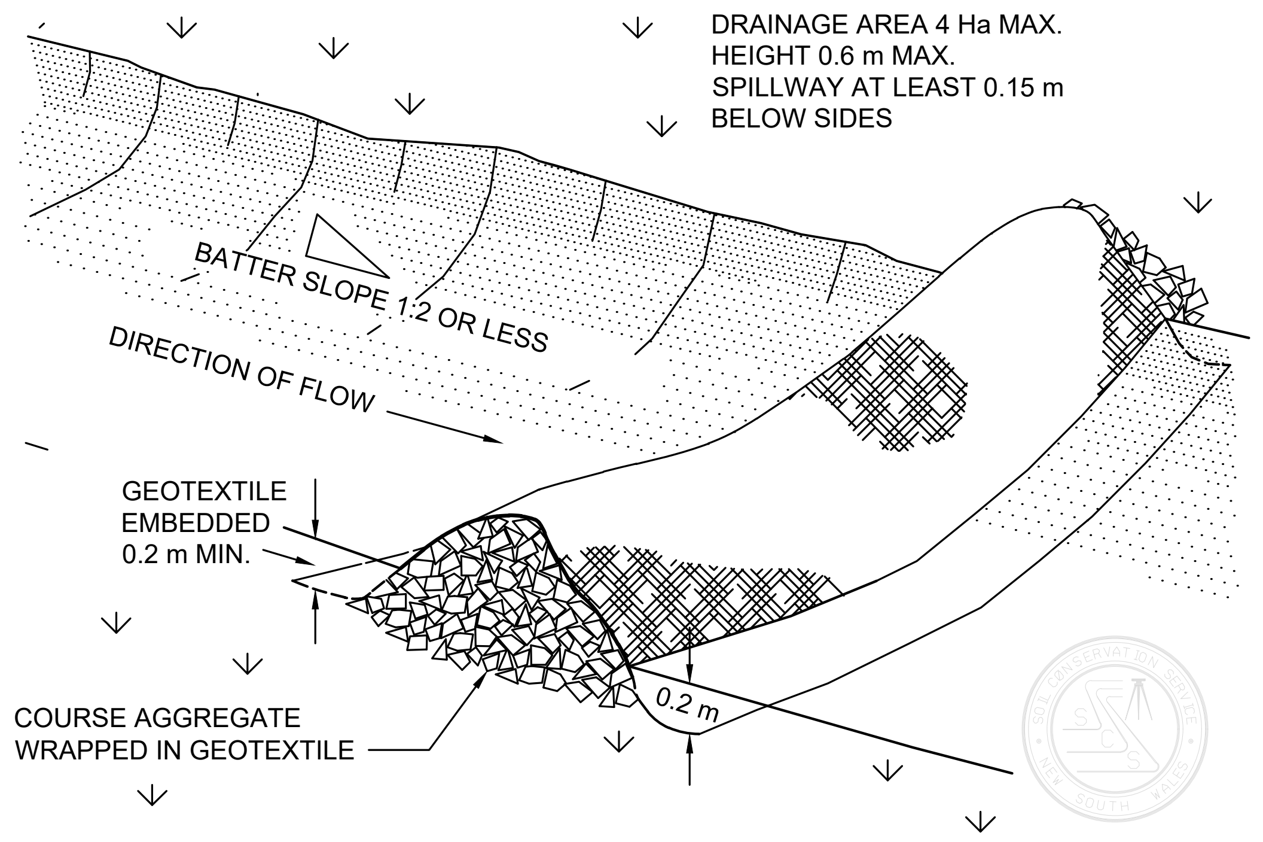
TEMPORARY CONSTRUCTION EXIT



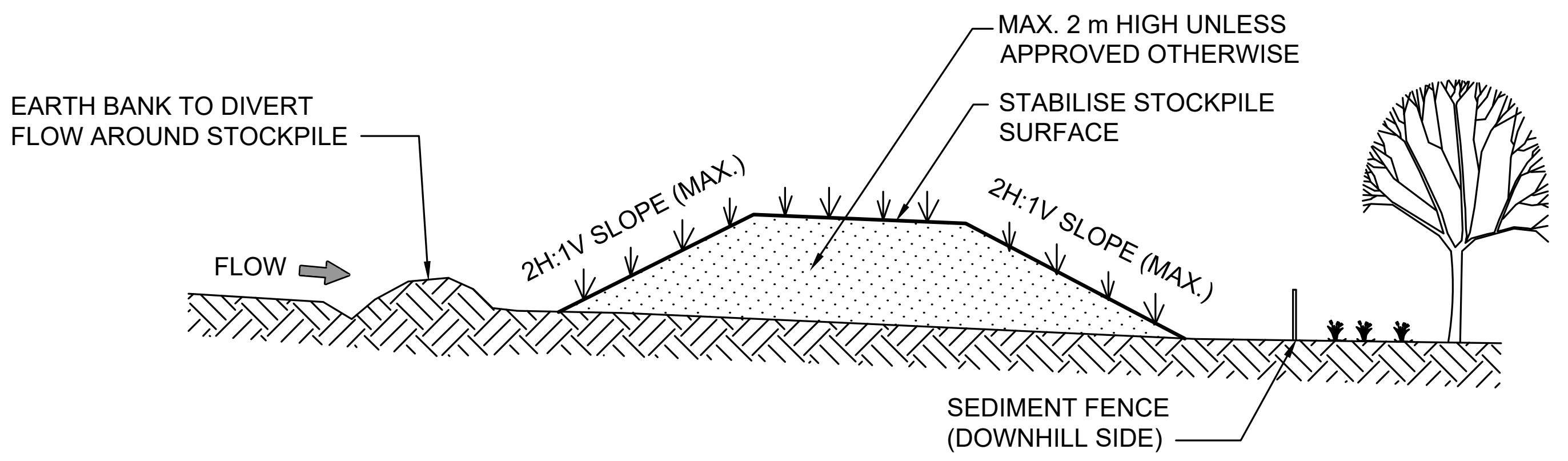
GEOTEXTILE FILTER FABRIC DROP INLET SEDIMENT TRAP



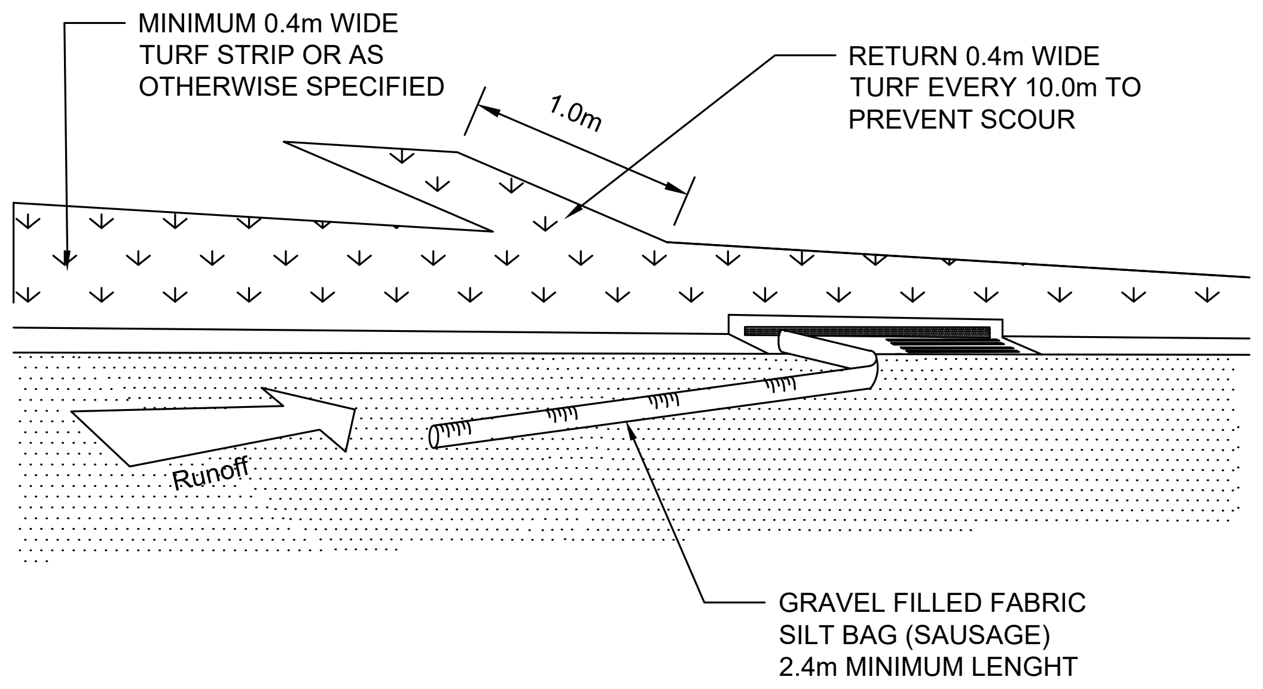
DIVERSION BANK AND CHANNEL



ROCK CHECK DAM



STOCKPILE



FABRIC STOCKING
KERB INLET SEDIMENT TRAP

NOT FOR CONSTRUCTION

Scales

Filename (Full Drawing No)
WSERRC-ARU-SYD-CICW-DRG-0191
Design Model Version

Issue	Date	By	Chkd	Appd
0	22/05/20	HNA	AC	EM
FOR PLANNING APPROVAL				

Client
CLEANAWAY
Making a sustainable future possible
MACQUARIE

Engineering Certification (CEng)
Name: ....
Signature: .... Date: ....

Job Title
WESTERN SYDNEY ENERGY AND RESOURCE RECOVERY CENTRE

Scale at A1

Discipline
Civil

ARUP
Arup, Barrack Place, Level 5, 151 Clarence St
Sydney, NSW, 2000
Tel +61 (02) 9320 9320 Fax +61 (02) 9320 9321
www.arup.com

CONSULT AUSTRALIA
Member Firm
Arup Pty Ltd
ABN 18 000 966 165

Drawing Title
EROSION AND SEDIMENT CONTROL DETAILS

Drawing Status
Preliminary Issue

Job No	Drawing No	Issue
264039-00	ARU-SYD-CICW-DRG-0191	0

Do not scale

DRAWING COLOUR CODED - PRINT ALL COPIES IN COLOUR

Appendix C

Preliminary Stormwater Drainage Design Drawings

NOTE

1. FOR GENERAL NOTES AND LEGEND REFER TO DRAWING No's ARU-SYD-CICW-DRG-0002 AND ARU-SYD-CICW-DRG-0003.
2. PIT AND HEADWALL SIZES ARE SHOWN INDICATIVELY FOR PRESENTATION PURPOSES.

ADJOINS DRG No. ARU-SYD-CICW-DRG-0602

NOT FOR CONSTRUCTION

Scales
0 10 20m
A1 / A3
1:500 / 1:1000

Filename (Full Drawing No)
WSERRC-ARU-SYD-CICW-DRG-0601
Design Model Version

Issue	Date	By	Chkd	Appd
0	22/05/20	HNA	AC	EM

FOR PLANNING APPROVAL

Client
CLEANAWAY
Making a sustainable future possible
MACQUARIE

Engineering Certification (CEng)
Name: ....
Signature: .... Date: ....

Job Title
WESTERN SYDNEY ENERGY AND
RESOURCE RECOVERY CENTRE

Scale at A1 1:500m
Discipline Civil

ARUP
Arup, Barrack Place, Level 5, 151 Clarence St
Sydney, NSW, 2000
Tel +61 (02) 9320 9320 Fax +61 (02) 9320 9321
www.arup.com

CONSULT AUSTRALIA
Member Firm
Arup Pty Ltd
ABN 18 000 966 165

Drawing Title
STORMWATER
PLAN
SHEET 1 OF 2

Drawing Status
Preliminary Issue

Job No **264039-00**
Drawing No **ARU-SYD-CICW-DRG-0601**
Issue **0**

Do not scale

DRAWING COLOUR CODED - PRINT ALL COPIES IN COLOUR

ADJOINS DRG No. ARU-SYD-CICW-DRG-0601

NOTE

1. FOR GENERAL NOTES AND LEGEND REFER TO DRAWING No's ARU-SYD-CICW-DRG-0002 AND ARU-SYD-CICW-DRG-0003.
2. PIT AND HEADWALL SIZES ARE SHOWN INDICATIVELY FOR PRESENTATION PURPOSES.

NOT FOR CONSTRUCTION

Scales
0 10 20m
A1 / A3
1:500 / 1:1000

Filename (Full Drawing No)
WSERRC-ARU-SYD-CICW-DRG-0602
Design Model Version

Issue	Date	By	Chkd	Appd
0	22/05/20	HNA	AC	EM
FOR PLANNING APPROVAL				

Client
CLEANAWAY
Making a sustainable future possible
MACQUARIE

Engineering Certification (CEng)
Name: ....
Signature: .... Date: ....

Job Title
WESTERN SYDNEY ENERGY AND RESOURCE RECOVERY CENTRE

Scale at A1 1:500m

Discipline Civil

ARUP

Arup, Barrack Place, Level 5, 151 Clarence St
Sydney, NSW, 2000
Tel +61 (02) 9320 9320 Fax +61 (02) 9320 9321
www.arup.com

CONSULT AUSTRALIA
Member Firm
Arup Pty Ltd
ABN 18 000 966 165

Drawing Title
STORMWATER
PLAN
SHEET 2 OF 2

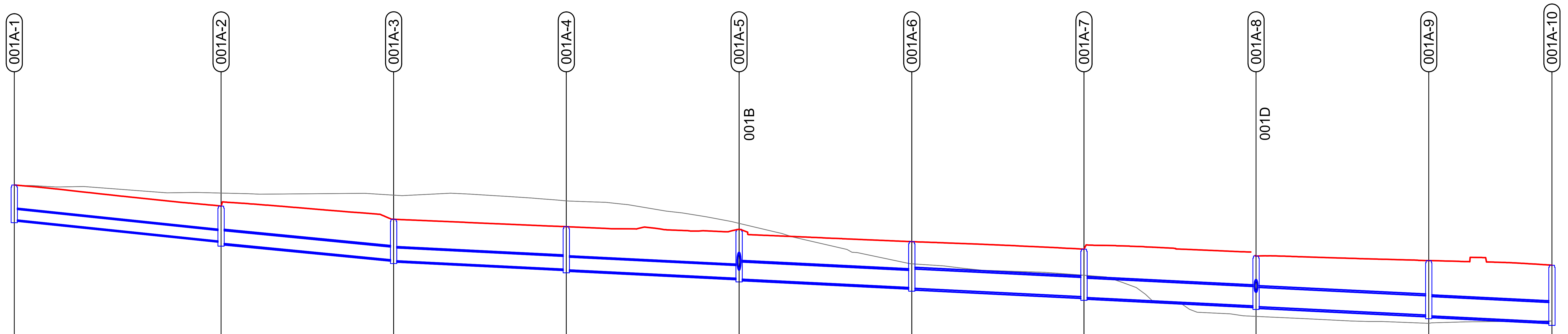
Drawing Status
Preliminary Issue

Job No **264039-00**
Drawing No **ARU-SYD-CICW-DRG-0602**
Issue **0**

Do not scale

DRAWING COLOUR CODED - PRINT ALL COPIES IN COLOUR

NOTE
1. ALL STORMWATER PIPES CLASS 4 RUBBER RING JOINT REINFORCED CONCRETE



PIPE DIAMETER (mm)		∅375		∅450		∅450		∅450		∅600		∅675		∅675		∅675		∅675	
PIPE TYPE & CLASS		CLASS 4		CLASS 4		CLASS 4		CLASS 4		CLASS 4		CLASS 4		CLASS 4		CLASS 4		CLASS 4	
PIPE GRADE (%)		2.09%		1.95%		1.00%		1.00%		1.00%		1.00%		1.00%		1.00%		1.00%	
DATUM R.L. 45.00																			
INVERT LEVEL	59.85		59.10 59.04		58.45 58.43		58.13 58.11		57.81 57.79		57.49 57.47		57.17 57.15		56.85 56.83		56.53 56.51		56.30
DESIGN LEVEL	61.06		60.33		59.87		59.61		59.53		59.09		58.83		58.59		58.43		58.27
EXISTING LEVEL	61.06		60.33		59.87		59.61		59.53		59.09		58.83		58.59		58.43		58.27
PIPE CHAINAGE	0.00	35.92	35.92	29.96	65.88	30.00	95.88	30.00	125.88	30.00	155.88	29.91	185.79	29.88	215.67	30.00	245.67	21.39	267.06

LINE.001A

NOT FOR CONSTRUCTION

Scales
0 10 20m A1 / A3
1:500 / 1:1000
Scale H1:500
0 2.5 5m A1 / A3
1:100 / 1:200
Scale V1:100

Filename (Full Drawing No)
WSERRC-ARU-SYD-CICW-DRG-0641
Design Model Version

Issue	Date	By	Chkd	Appd
0	22/05/20	HNA	AC	EM
FOR PLANNING APPROVAL				

Client
CLEANAWAY
Making a sustainable future possible
MACQUARIE

Engineering Certification (CEng)
Name: ....
Signature: .... Date: ....

Job Title
WESTERN SYDNEY ENERGY AND RESOURCE RECOVERY CENTRE

Scale at A1

Discipline
Civil

ARUP
Arup, Barrack Place, Level 5, 151 Clarence St
Sydney, NSW, 2000
Tel +61 (02) 9320 9320 Fax +61 (02) 9320 9321
www.arup.com

CONSULT AUSTRALIA
Member Firm
Arup Pty Ltd
ABN 18 000 966 165

Drawing Title
STORMWATER
LONGITUDINAL SECTIONS
SHEET 1 OF 6

Drawing Status
Preliminary Issue

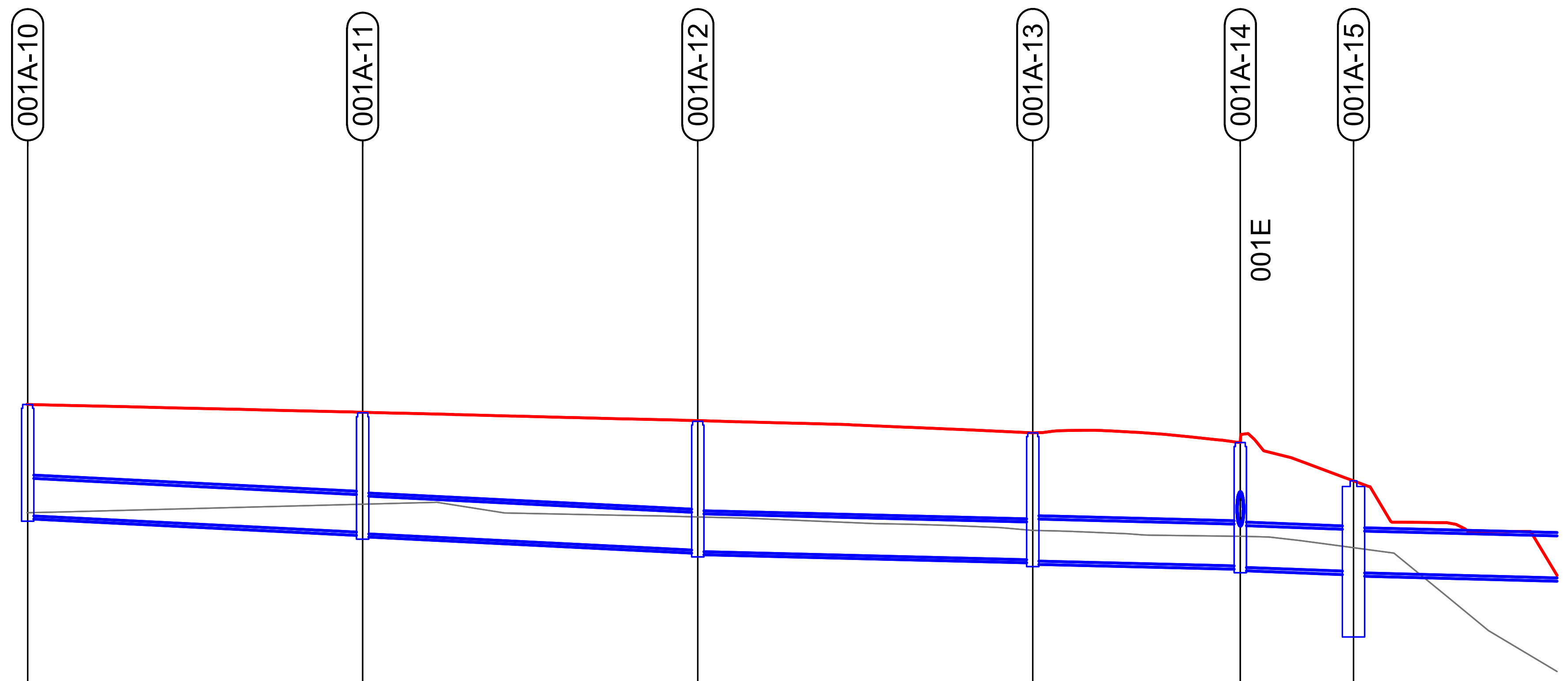
Job No
264039-00
Drawing No
ARU-SYD-CICW-DRG-0641
Issue
0

Do not scale

DRAWING COLOUR CODED - PRINT ALL COPIES IN COLOUR

A1

NOTE
1. ALL STORMWATER PIPES CLASS 4 RUBBER RING JOINT REINFORCED CONCRETE



PIPE DIAMETER (mm)		∅675		∅675		∅675		∅750		∅750		∅750	
PIPE TYPE & CLASS		CLASS 4		CLASS 4		CLASS 4		CLASS 4		CLASS 4		CLASS 4	
PIPE GRADE (%)		1.00%		1.00%		0.50%		0.50%		0.77%		0.50%	
DATUM R.L. 45.00													
INVERT LEVEL	56.28		55.98 55.96		55.66 55.64		55.49 55.47		55.38 55.36		55.28 55.26		55.16
DESIGN LEVEL	58.27		58.12		57.97		57.77		57.59		56.91		
EXISTING LEVEL	58.27		58.13		57.98		57.77		57.59		56.91		
PIPE CHAINAGE	267.06	30.00	297.06	30.00	327.06	30.00	357.06	18.58	375.64	10.13	385.78	18.86	404.64

LINE.001A

NOT FOR CONSTRUCTION

Scales
0 10 20m A1 / A3
1:500 / 1:1000
Scale H1:500
0 2.5 5m A1 / A3
1:100 / 1:200
Scale V1:100

Filename (Full Drawing No)
WSERRC-ARU-SYD-CICW-DRG-0642
Design Model Version

Issue	Date	By	Chkd	Appd
0	22/05/20	HNA	AC	EM
FOR PLANNING APPROVAL				

Client
CLEANAWAY
Making a sustainable future possible
MACQUARIE

Engineering Certification (CEng)
Name: ....
Signature: .... Date: ....

Job Title
WESTERN SYDNEY ENERGY AND RESOURCE RECOVERY CENTRE

Scale at A1

Discipline Civil

ARUP

Arup, Level 5, 151 Clarence St
Sydney, NSW, 2000
Tel +61 (02) 9320 9320 Fax +61 (02) 9320 9321
www.arup.com

CONSULT AUSTRALIA
Member Firm
Arup Pty Ltd
ABN 18 000 966 165

Drawing Title
STORMWATER
LONGITUDINAL SECTIONS
SHEET 2 OF 6

Drawing Status
Preliminary Issue

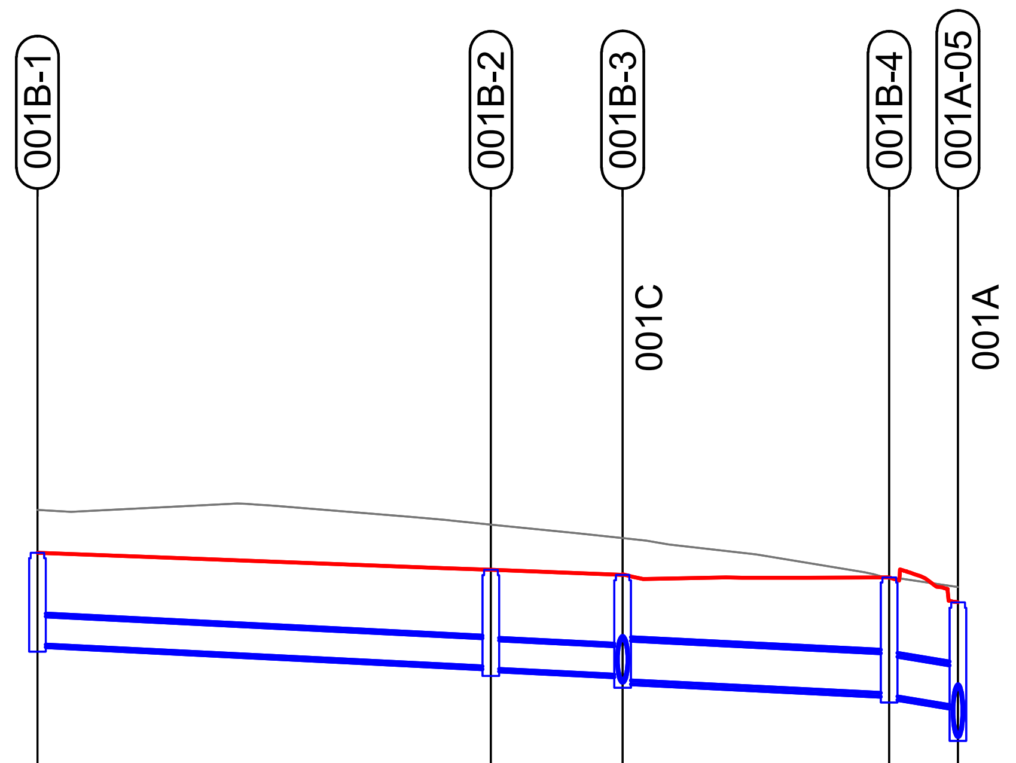
Job No **264039-00**
Drawing No **ARU-SYD-CICW-DRG-0642**
Issue **0**

Do not scale

DRAWING COLOUR CODED - PRINT ALL COPIES IN COLOUR

NOTE

1. ALL STORMWATER PIPES CLASS 4 RUBBER RING JOINT REINFORCED CONCRETE



DATUM R.L. 50.00

PIPE DIAMETER (mm)		∅375		∅375		∅525		∅525	
PIPE TYPE & CLASS		CLASS 4		CLASS 4		CLASS 4		CLASS 4	
PIPE GRADE (%)		1.00%		1.00%		1.00%		3.29%	
INVERT LEVEL	58.97		58.67 58.65		58.57 58.50		58.32 58.30		58.15
DESIGN LEVEL	60.18		59.96		59.89		59.86		59.53
EXISTING LEVEL	60.18		59.96		59.89		59.86		59.53
PIPE CHAINAGE	0.00	30.00	30.00	8.71	38.71	17.64	56.35	4.55	60.90

LINE.001B

NOT FOR CONSTRUCTION

Scales
0 10 20m A1 / A3 1:500 / 1:1000
Scale H1:500
0 2.5 5m A1 / A3 1:100 / 1:200
Scale V1:100

Filename (Full Drawing No)
WSERRC-ARU-SYD-CICW-DRG-0643
Design Model Version

Issue	Date	By	Chkd	Appd
0	22/05/20	HNA	AC	EM
FOR PLANNING APPROVAL				

Client
CLEANAWAY Making a sustainable future possible
MACQUARIE

Engineering Certification (CEng)
Name: ....
Signature: .... Date: ....

Job Title
WESTERN SYDNEY ENERGY AND RESOURCE RECOVERY CENTRE

Scale at A1

Discipline
Civil

ARUP
Arup, Level 5, 151 Clarence St
Sydney, NSW, 2000
Tel +61 (02) 9320 9320 Fax +61 (02) 9320 9321
www.arup.com

CONSULT AUSTRALIA
Member Firm
Arup Pty Ltd
ABN 18 000 966 165

Drawing Title
STORMWATER
LONGITUDINAL SECTIONS
SHEET 3 OF 6

Drawing Status
Preliminary Issue

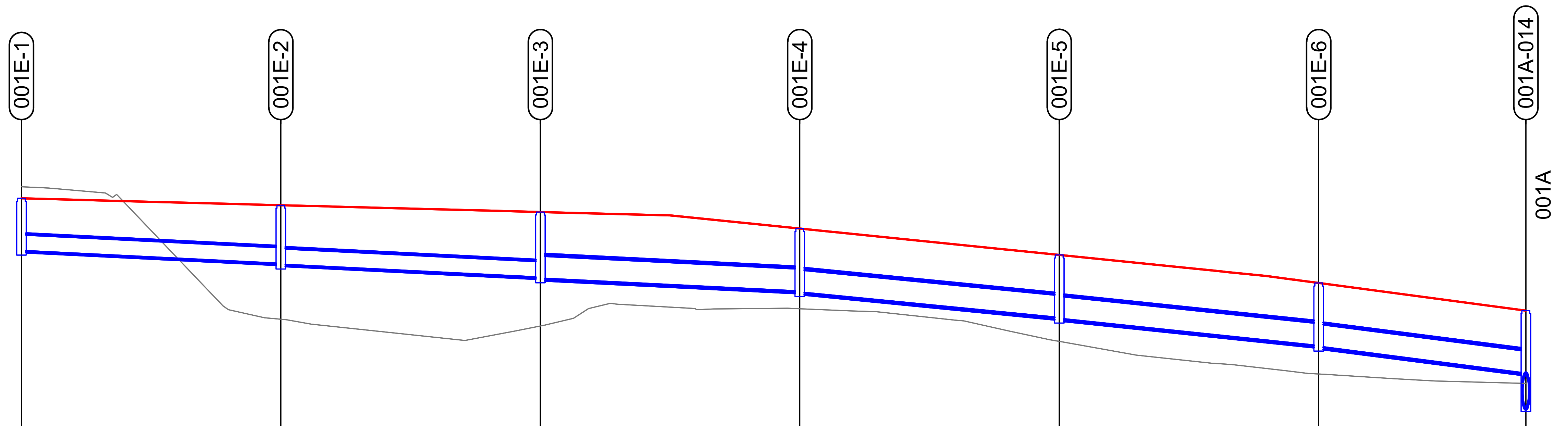
Job No	Drawing No	Issue
264039-00	**ARU-SYD-CICW-DRG-0643**	**0**

Do not scale

DRAWING COLOUR CODED - PRINT ALL COPIES IN COLOUR

NOTE

1. ALL STORMWATER PIPES CLASS 4 RUBBER RING JOINT REINFORCED CONCRETE



PIPE DIAMETER (mm)		Ø375		Ø375		Ø525		Ø525		Ø525		Ø525	
PIPE TYPE & CLASS		CLASS 4		CLASS 4		CLASS 4		CLASS 4		CLASS 4		CLASS 4	
PIPE GRADE (%)		1.00%		1.00%		1.00%		1.97%		2.09%		2.58%	

DATUM R.L. 45.00

INVERT LEVEL	58.97		58.67 58.65		58.35 58.33		58.03 58.01		57.42 57.40		56.78 56.76		56.14
DESIGN LEVEL	60.18		60.03		59.87		59.49		58.88		58.23		57.59
EXISTING LEVEL	60.18		60.03		59.87		59.49		58.88		58.23		57.59
PIPE CHAINAGE	0.00	30.00	30.00	30.00	60.00	30.00	90.00	30.00	120.00	30.00	150.00	23.95	173.95

LINE.001E

NOT FOR CONSTRUCTION

Scales
0 10 20m A1 / A3
1:500 / 1:1000
Scale H1:500
0 2.5 5m A1 / A3
1:100 / 1:200
Scale V1:100

Filename (Full Drawing No)
WSERRC-ARU-SYD-CICW-DRG-0644
Design Model Version

Issue	Date	By	Chkd	Appd
0	22/05/20	HNA	AC	EM
FOR PLANNING APPROVAL				

Client
CLEANAWAY
Making a sustainable future possible
MACQUARIE

Engineering Certification (CEng)
Name: ....
Signature: .... Date: ....

Job Title
WESTERN SYDNEY ENERGY AND RESOURCE RECOVERY CENTRE

Scale at A1

Discipline
Civil

ARUP

Arup, Level 5, 151 Clarence St
Sydney, NSW, 2000
Tel +61 (02) 9320 9320 Fax +61 (02) 9320 9321
www.arup.com

CONSULT AUSTRALIA
Member Firm
Arup Pty Ltd
ABN 18 000 966 165

Drawing Title
STORMWATER
LONGITUDINAL SECTIONS
SHEET 4 OF 6

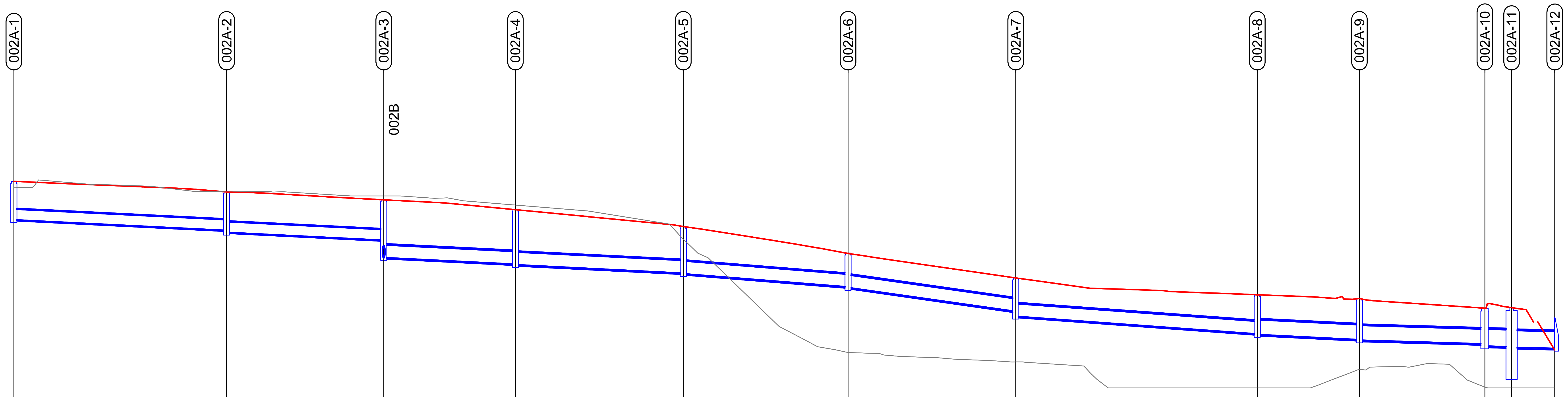
Drawing Status
Preliminary Issue

Job No	Drawing No	Issue
264039-00	ARU-SYD-CICW-DRG-0644	0

Do not scale

DRAWING COLOUR CODED - PRINT ALL COPIES IN COLOUR

NOTE
1. ALL STORMWATER PIPES CLASS 4 RUBBER RING JOINT REINFORCED CONCRETE



PIPE DIAMETER (mm)	∅375	∅375	∅450	∅450	∅450	∅450	∅450	∅525	∅525	∅600	∅600
PIPE TYPE & CLASS	CLASS 4	CLASS 4	CLASS 4	CLASS 4	CLASS 4	CLASS 4	CLASS 4	CLASS 4	CLASS 4	CLASS 4	CLASS 4
PIPE GRADE (%)	1.00%	1.00%	1.00%	1.00%	1.61%	2.85%	1.46%	1.00%	0.59%	0.50%	0.50%

DATUM R.L. 45.00

INVERT LEVEL	59.65		59.27 59.20		58.92 58.30		58.06 58.04		57.74 57.72		57.25 57.23		56.38 56.20		55.57 55.55		55.37 55.35		55.22 55.14		55.12 55.10		55.06
DESIGN LEVEL	61.02		60.66		60.36		60.01		59.41		58.46		57.57		56.98		56.84		56.49		56.51		56.16
EXISTING LEVEL	61.02		60.66		60.36		60.01		59.41		58.46		57.57		56.98		56.84		56.49		56.51		55.00
PIPE CHAINAGE	0.00	38.02	38.02	28.08	66.09	23.53	89.63	30.00	119.63	29.44	149.07	29.98	179.04	43.15	222.20	18.25	240.45	22.42	262.86	4.78	267.64	7.71	275.36

LINE.002A

NOT FOR CONSTRUCTION

Scales
0 10 20m A1 / A3
1:500 / 1:1000
Scale H1:500
0 2.5 5m A1 / A3
1:100 / 1:200
Scale V1:100

Filename (Full Drawing No)
WSERRC-ARU-SYD-CICW-DRG-0645
Design Model Version

Issue	Date	By	Chkd	Appd
0	22/05/20	HNA	AC	EM
FOR PLANNING APPROVAL				

Client
CLEANAWAY
MACQUARIE

Engineering Certification (CEng)
Name: ....
Signature: .... Date: ....

Job Title
WESTERN SYDNEY ENERGY AND RESOURCE RECOVERY CENTRE

Scale at A1

Discipline
Civil

ARUP

Arup, Level 5, 151 Clarence St
Sydney, NSW, 2000
Tel +61 (02) 9320 9320 Fax +61 (02) 9320 9321
www.arup.com

CONSULT AUSTRALIA
Member Firm
Arup Pty Ltd
ABN 18 000 966 165

Drawing Title
STORMWATER
LONGITUDINAL SECTIONS
SHEET 5 OF 6

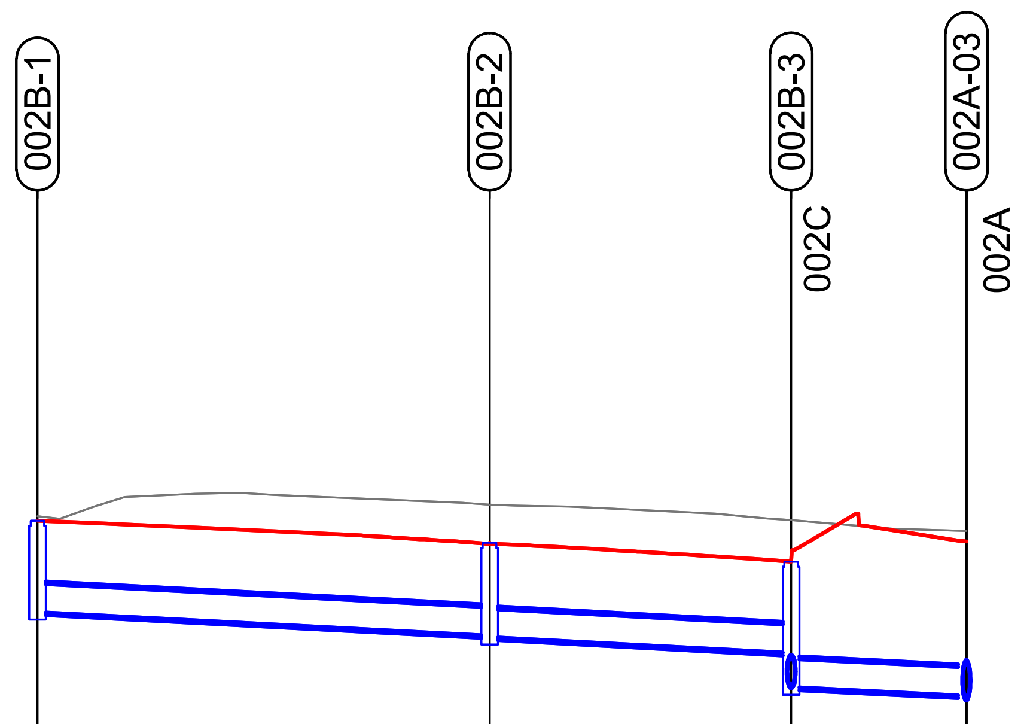
Drawing Status
Preliminary Issue

Job No **264039-00**
Drawing No **ARU-SYD-CICW-DRG-0645**
Issue **0**

Do not scale

DRAWING COLOUR CODED - PRINT ALL COPIES IN COLOUR

NOTE
1. ALL STORMWATER PIPES CLASS 4 RUBBER RING JOINT REINFORCED CONCRETE



PIPE DIAMETER (mm)		∅375		∅375		∅375	
PIPE TYPE & CLASS		CLASS 4		CLASS 4		CLASS 4	
PIPE GRADE (%)		1.04%		1.06%		1.00%	
DATUM R.L. 50.00							
INVERT LEVEL	59.43		59.12 59.10		58.88 58.44		58.32
DESIGN LEVEL	60.64		60.34		60.10		60.36
EXISTING LEVEL	60.64		60.34		60.10		60.36
PIPE CHAINAGE	0.00	29.90	29.90	19.95	49.85	11.58	61.44

LINE.002B

NOT FOR CONSTRUCTION

Scales
Scale H1:500 — A1 / A3 1:500 / 1:1000
Scale V1:100 — A1 / A3 1:100 / 1:200

Filename (Full Drawing No)
WSERRC-ARU-SYD-CICW-DRG-0646
Design Model Version

Issue	Date	By	Chkd	Appd
0	22/05/20	HNA	AC	EM
FOR PLANNING APPROVAL				

Client
CLEANAWAY
Making a sustainable future possible
MACQUARIE

Engineering Certification (CEng)
Name: ....
Signature: .... Date: ....

Job Title
WESTERN SYDNEY ENERGY AND RESOURCE RECOVERY CENTRE

Scale at A1

Discipline
Civil

ARUP

Arup, Level 5, 151 Clarence St
Sydney, NSW, 2000
Tel +61 (02) 9320 9320 Fax +61 (02) 9320 9321
www.arup.com

CONSULT AUSTRALIA
Member Firm
Arup Pty Ltd
ABN 18 000 966 165

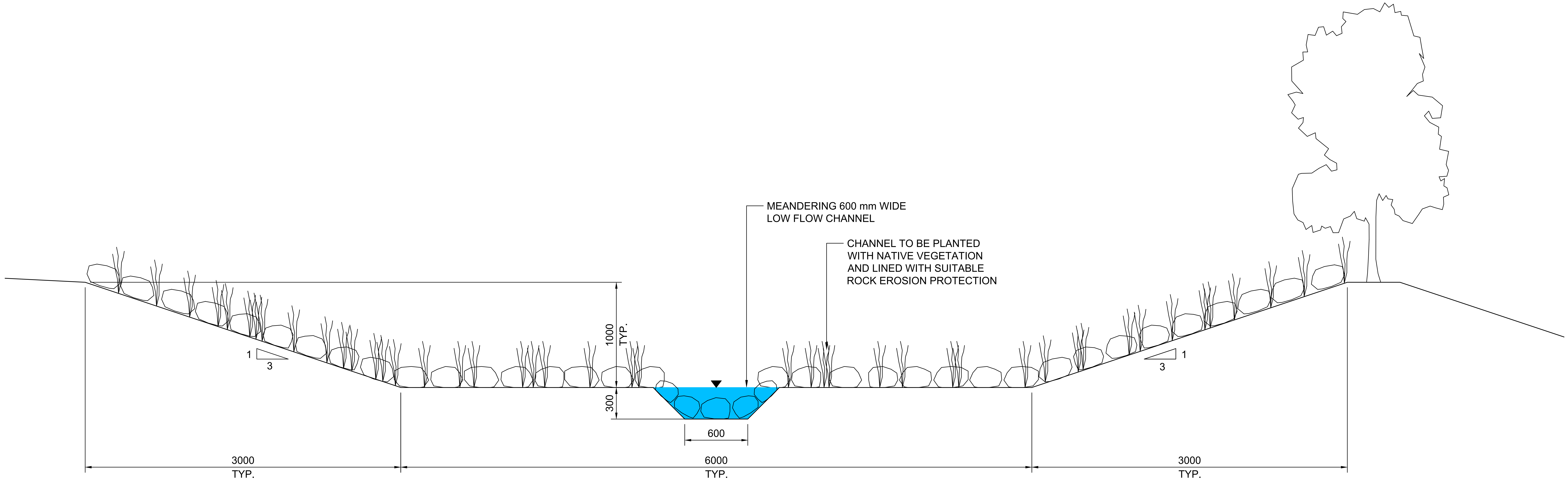
Drawing Title
STORMWATER
LONGITUDINAL SECTIONS
SHEET 6 OF 6

Drawing Status
Preliminary Issue

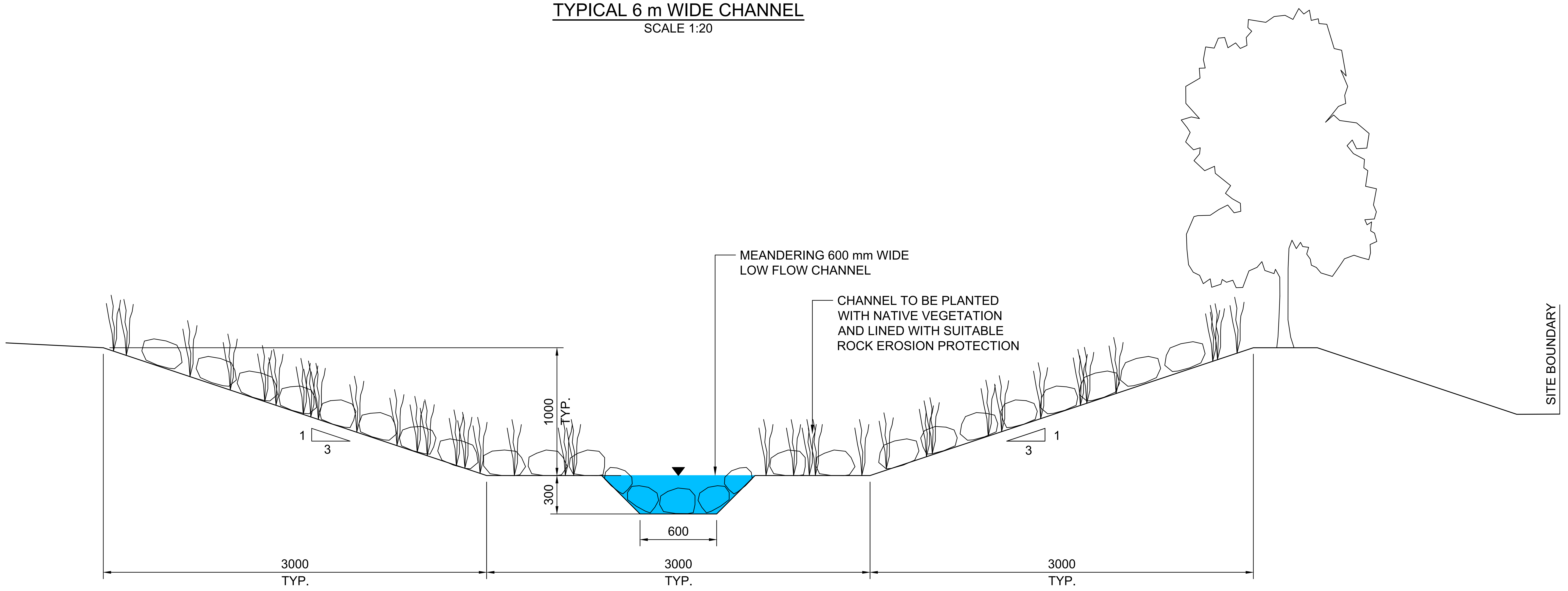
Job No	Drawing No	Issue
264039-00	ARU-SYD-CICW-DRG-0646	0

Do not scale

DRAWING COLOUR CODED - PRINT ALL COPIES IN COLOUR



TYPICAL 6 m WIDE CHANNEL
SCALE 1:20



TYPICAL 3 m WIDE CHANNEL
SCALE 1:20

Scales
0 500 1000mm A1 / A3
1:20 / 1:40

Filename (Full Drawing No)
WSERRC-ARU-SYD-CICW-DRG-0691
Design Model Version

Issue	Date	By	Chkd	Appd
0	22/05/20	HNA	AC	EM
FOR PLANNING APPROVAL				

Client
CLEANAWAY
Making a sustainable future possible
MACQUARIE

Engineering Certification (CEng)
Name: ....
Signature: .... Date: ....

Job Title
WESTERN SYDNEY ENERGY AND
RESOURCE RECOVERY CENTRE

Scale at A1 1:20mm
Discipline Civil

ARUP

Arup, Barrack Place, Level 5, 151 Clarence St
Sydney, NSW, 2000
Tel +61 (02) 9320 9320 Fax +61 (02) 9320 9321
www.arup.com

CONSULT AUSTRALIA
Member Firm
Arup Pty Ltd
ABN 18 000 966 165

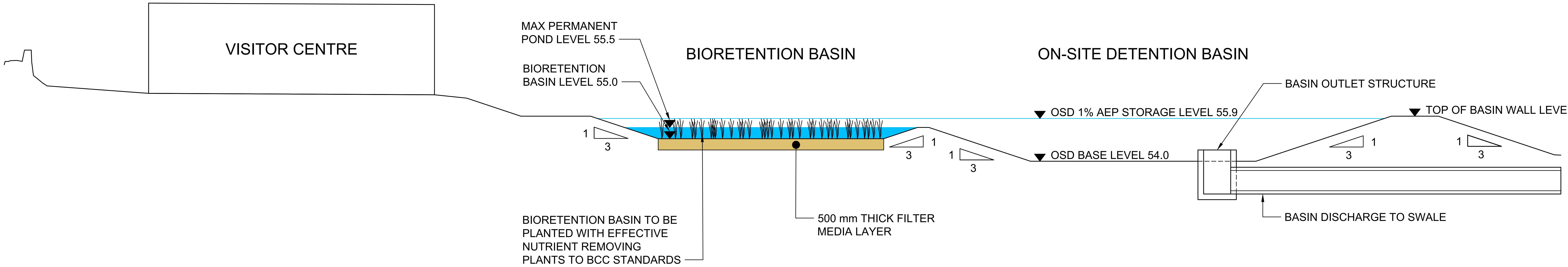
Drawing Title
STORMWATER
GRASS CHANNEL
TYPICAL SECTION

Drawing Status
Preliminary Issue

Job No **264039-00**
Drawing No **ARU-SYD-CICW-DRG-0691**
Issue **0**

Do not scale

DRAWING COLOUR CODED - PRINT ALL COPIES IN COLOUR



TYPICAL SECTION WEST-EAST BIORETENTION AND ON-SITE DETENTION BASIN

SECTION 7/0301
SCALE 1:100

Scales
0 2500 5000mm A1 / A3
1:100 / 1:200

Filename (Full Drawing No)
WSERRC-ARU-SYD-CICW-DRG-0692
Design Model Version

Issue	Date	By	Chkd	Appd
0	22/05/20	HNA	AC	EM
FOR PLANNING APPROVAL				

Client
CLEANAWAY
Making a sustainable future possible
MACQUARIE

Engineering Certification (CEng)
Name: ....
Signature: .... Date: ....

Job Title
WESTERN SYDNEY ENERGY AND RESOURCE RECOVERY CENTRE

Scale at A1 1:100mm
Discipline Civil

ARUP

Arup, Level 5, 151 Clarence St
Sydney, NSW, 2000
Tel +61 (02) 9320 9320 Fax +61 (02) 9320 9321
www.arup.com

CONSULT AUSTRALIA
Member Firm
Arup Pty Ltd
ABN 18 000 966 165

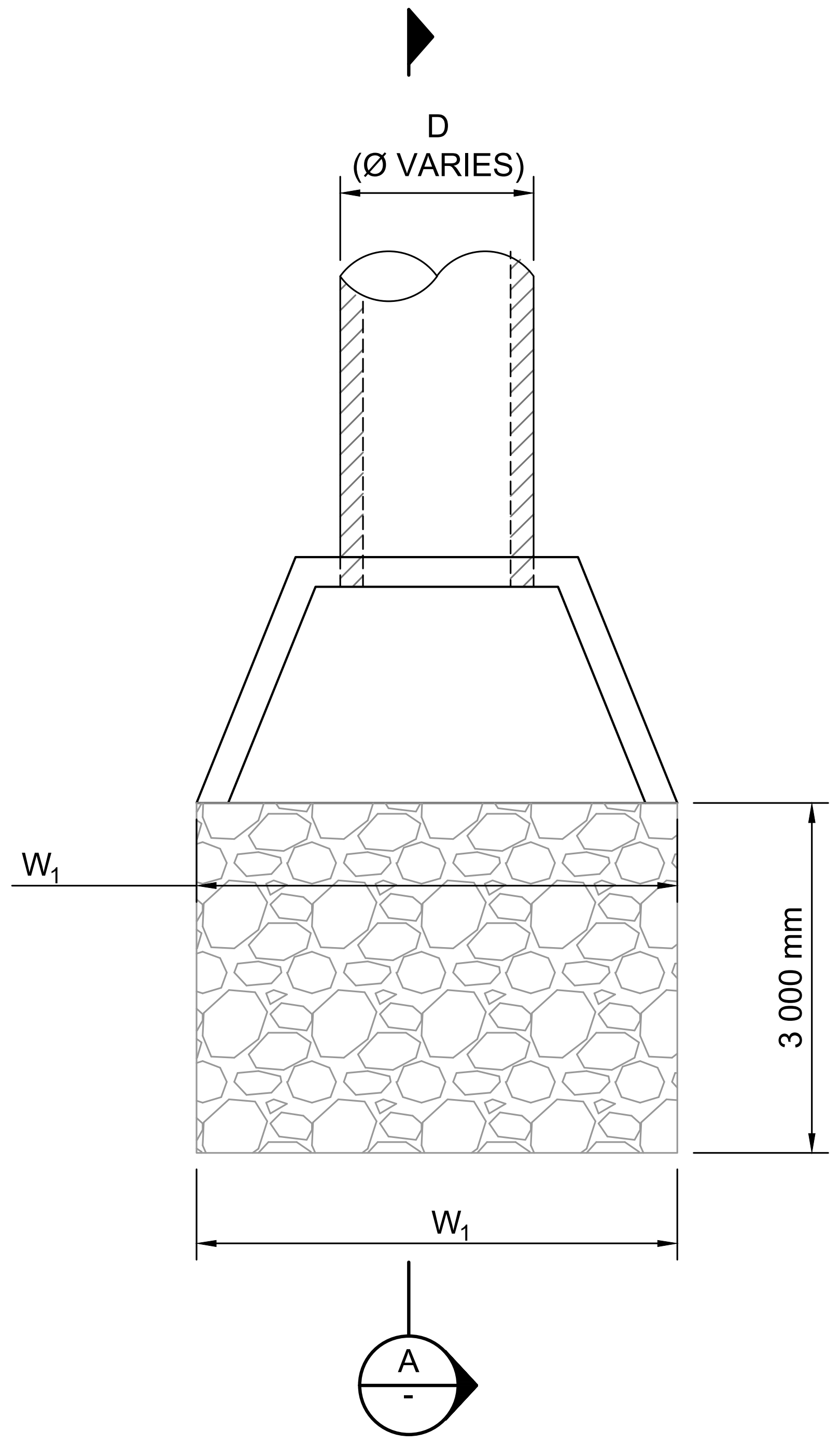
Drawing Title
STORMWATER
BIORETENTION & OSD BASIN
TYPICAL SECTION

Drawing Status
Preliminary Issue

Job No **264039-00**
Drawing No **ARU-SYD-CICW-DRG-0692**
Issue **0**

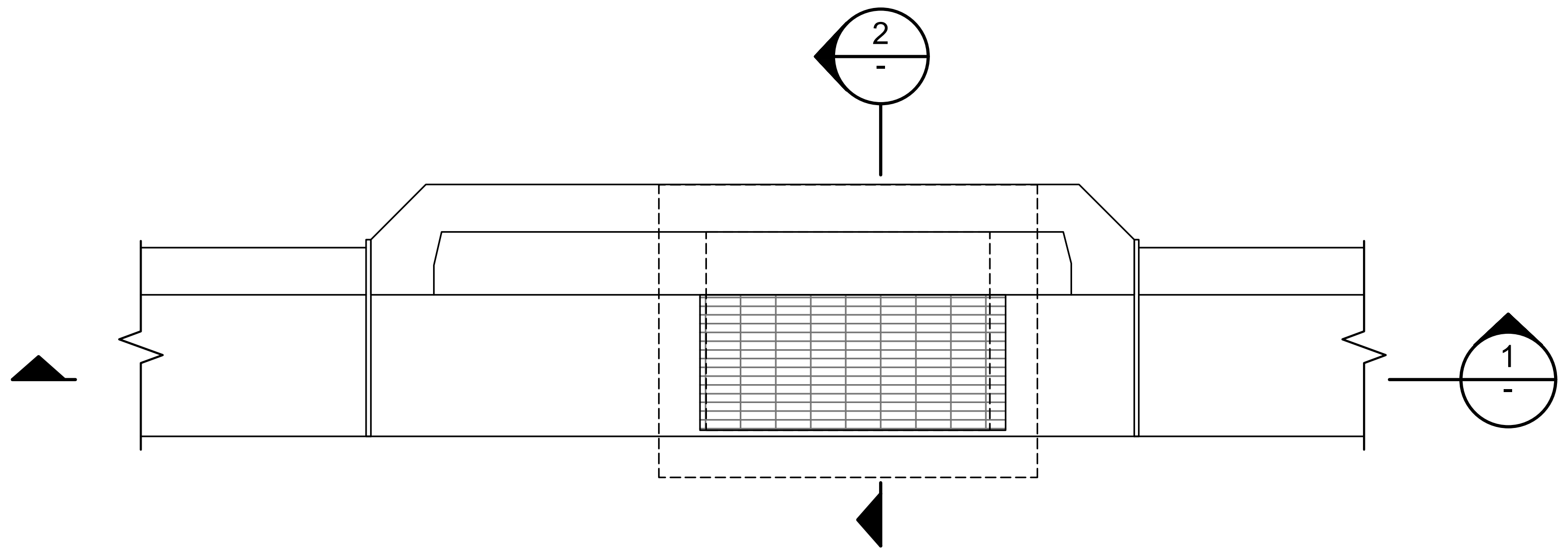
Do not scale

DRAWING COLOUR CODED - PRINT ALL COPIES IN COLOUR

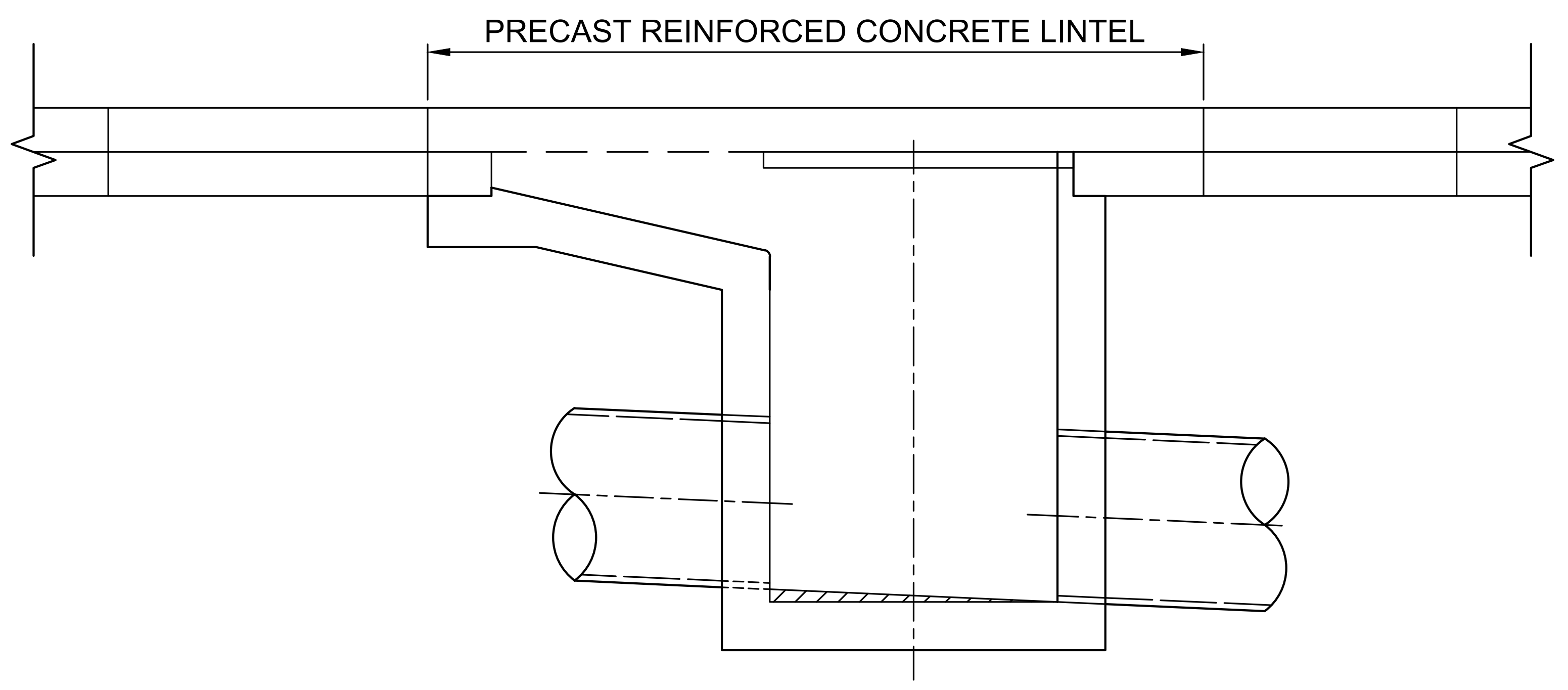


PLAN
TYPICAL CONCRETE HEADWALL - SINGLE CELL
NTS

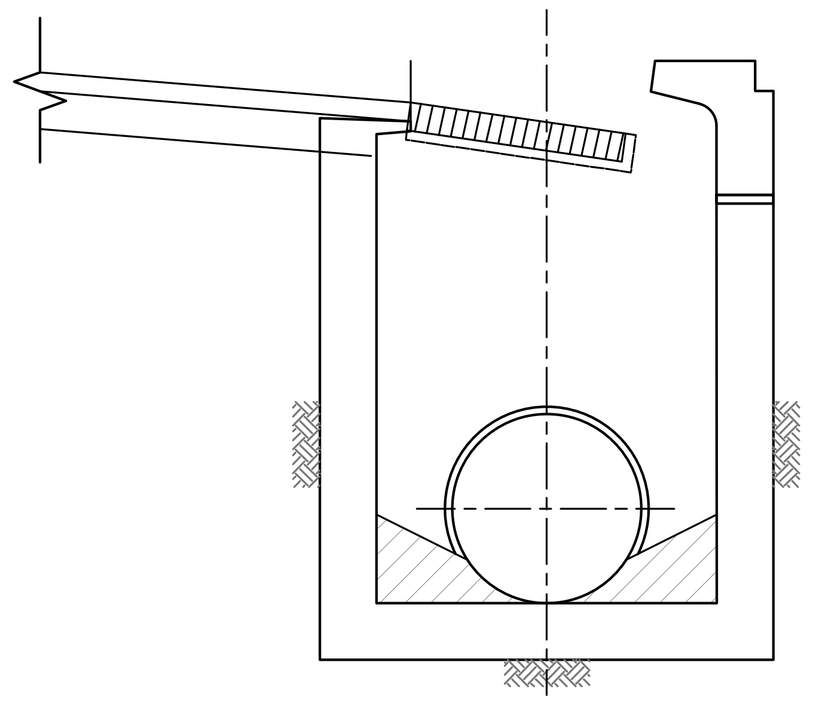
TYPICAL KERB INLET PIT DETAIL



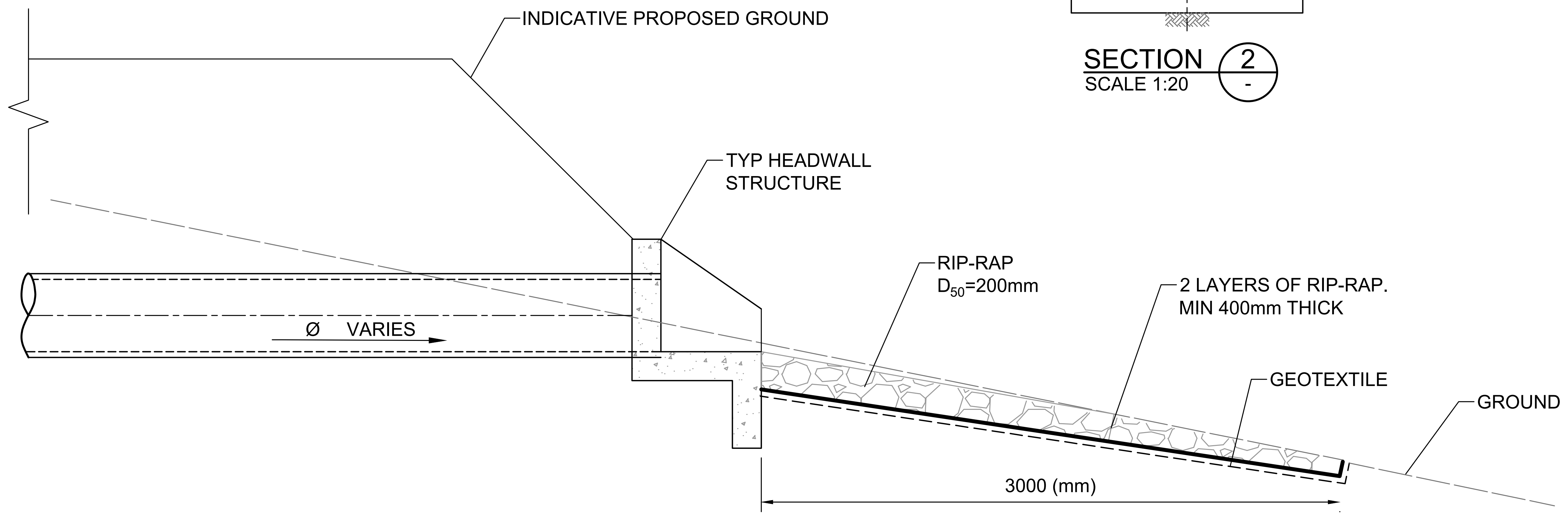
PLAN
SCALE 1:20



SECTION 1 -
SCALE 1:20



SECTION 2 -
SCALE 1:20



SECTION A -
SCALE 1:20

NOTES

1. FOR GENERAL NOTES AND LEGEND REFER TO TO DRAWING No's ARU-SYD-CICW-DRG-002 AND ARU-SYD-CICW-DRG-003.
2. HEADWALLS TO BE PRECAST TO SUIT DIAMETER OF DISCHARGE PIPE. EROSION PROTECTION SHOWN IS INDICATIVE AND SUBJECT TO DETAIL DESIGN.
3. APPROVED STEP IRONS TO BE PROVIDED WHERE THE PIT EXCEEDS 1200mm IN DEPTH. STEP IRONS TO AS1657 AND EN13101 ARRANGED IN A SINGLE WIDTH TREAD FORMATION (MIN LENGTH 350mm) OR A SINGLE COLUMN, DOUBLE WIDTH TREAD (MIN LENGTH 150mm) STAGGERED DOUBLE COLUMN.

Scales
0 0.5 1m
A1 / A3
1:20 / 1:40

Filename (Full Drawing No)
WSERRC-ARU-SYD-CICW-DRG-0695
Design Model Version

Issue	Date	By	Chkd	Appd
0	22/05/20	HNA	AC	EM
	FOR PLANNING APPROVAL			

Client
CLEANAWAY
MACQUARIE

Engineering Certification (CEng)
Name: ....
Signature: .... Date: ....

Job Title
WESTERN SYDNEY ENERGY AND RESOURCE RECOVERY CENTRE

Scale at A1 1:20m
Discipline Civil

ARUP
Arup, Level 5, 151 Clarence St
Sydney, NSW, 2000
Tel +61 (02) 9320 9320 Fax +61 (02) 9320 9321
www.arup.com

CONSULT AUSTRALIA
Member Firm
Arup Pty Ltd
ABN 18 000 966 165

Drawing Title
STORMWATER
DETAILS
SHEET 1 OF 2

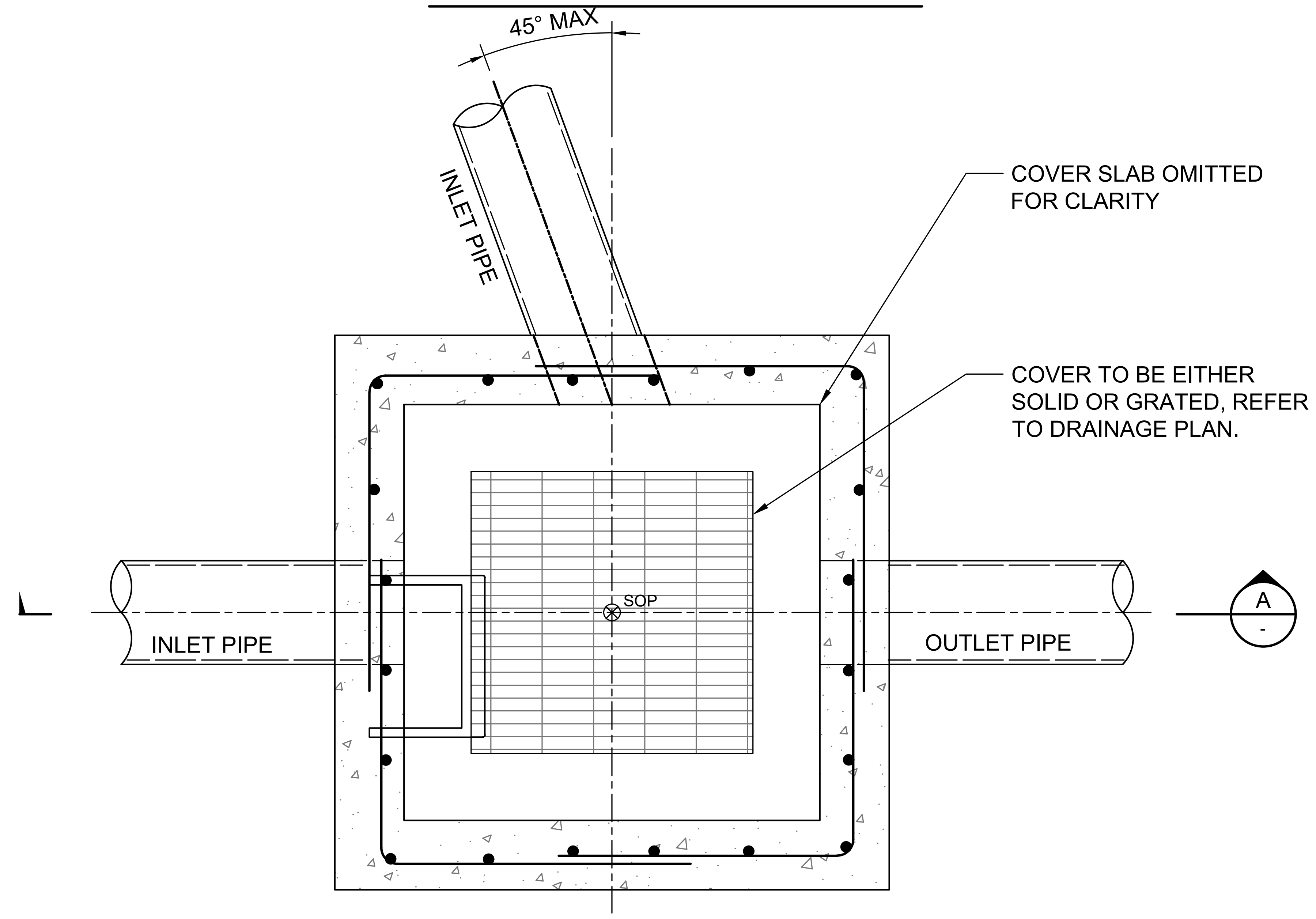
Drawing Status
Preliminary Issue

Job No	Drawing No	Issue
264039-00	ARU-SYD-CICW-DRG-0695	0

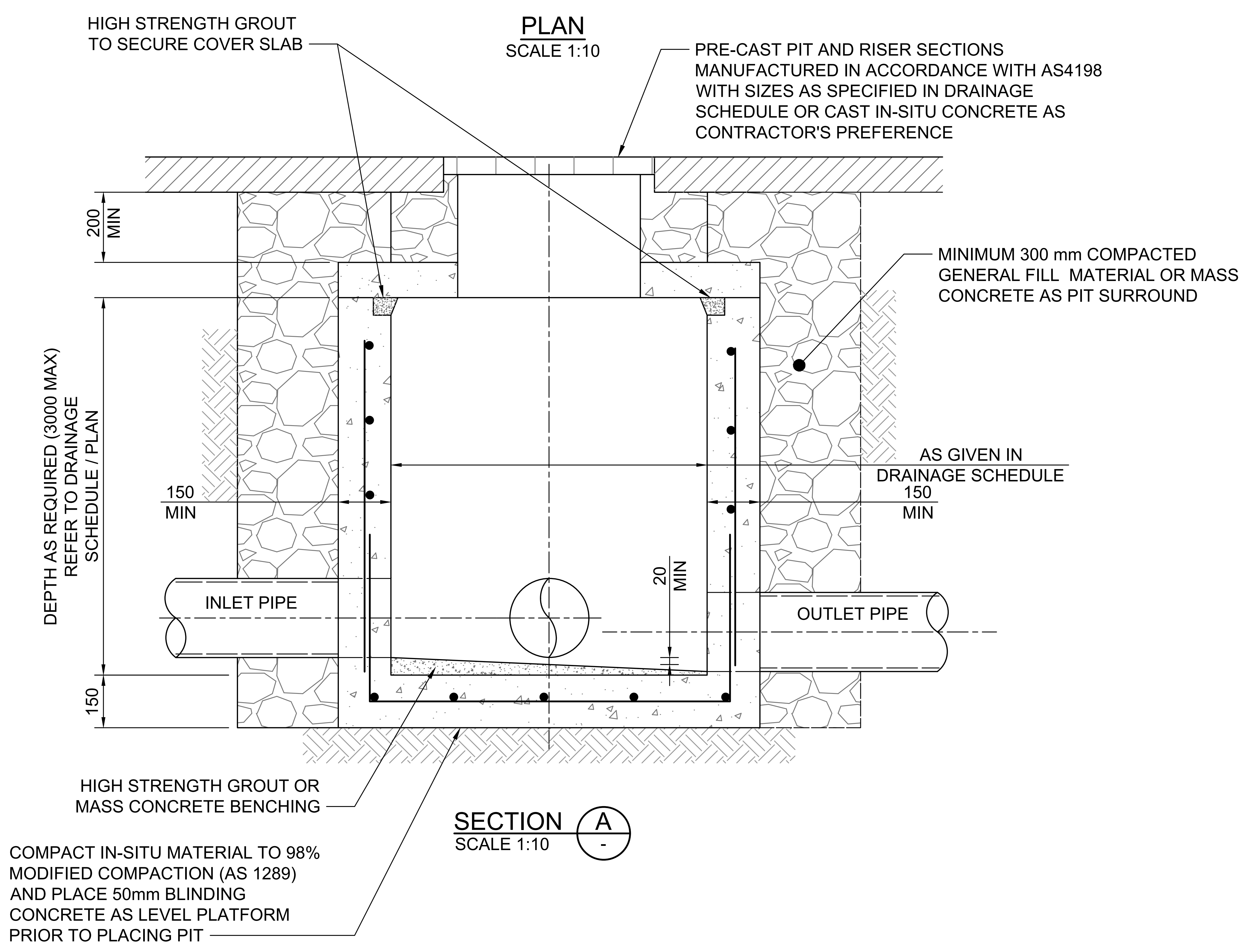
Do not scale

DRAWING COLOUR CODED - PRINT ALL COPIES IN COLOUR

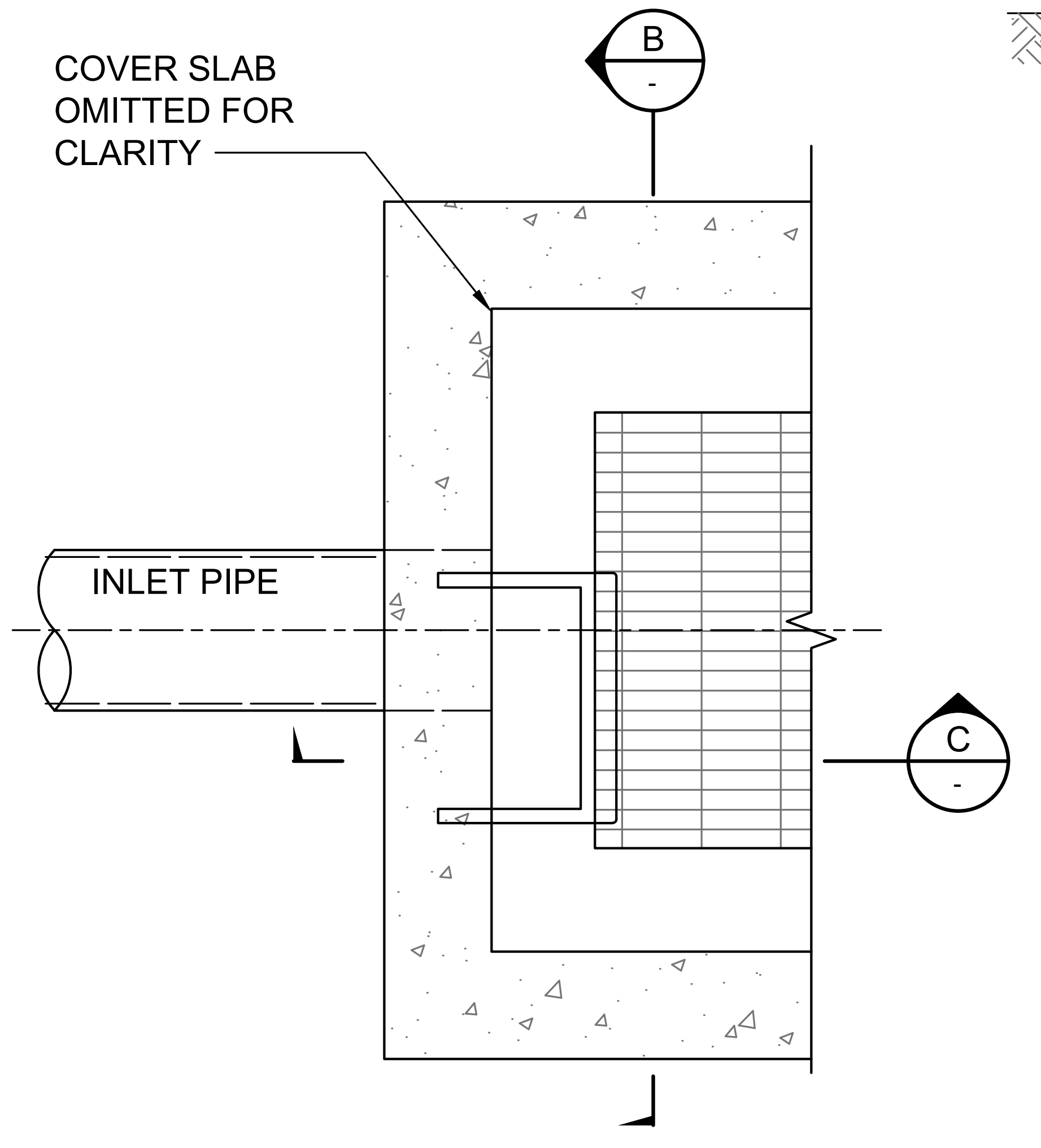
TYPICAL DRAINAGE PIT DETAIL



PLAN
SCALE 1:10



SECTION A -
SCALE 1:10

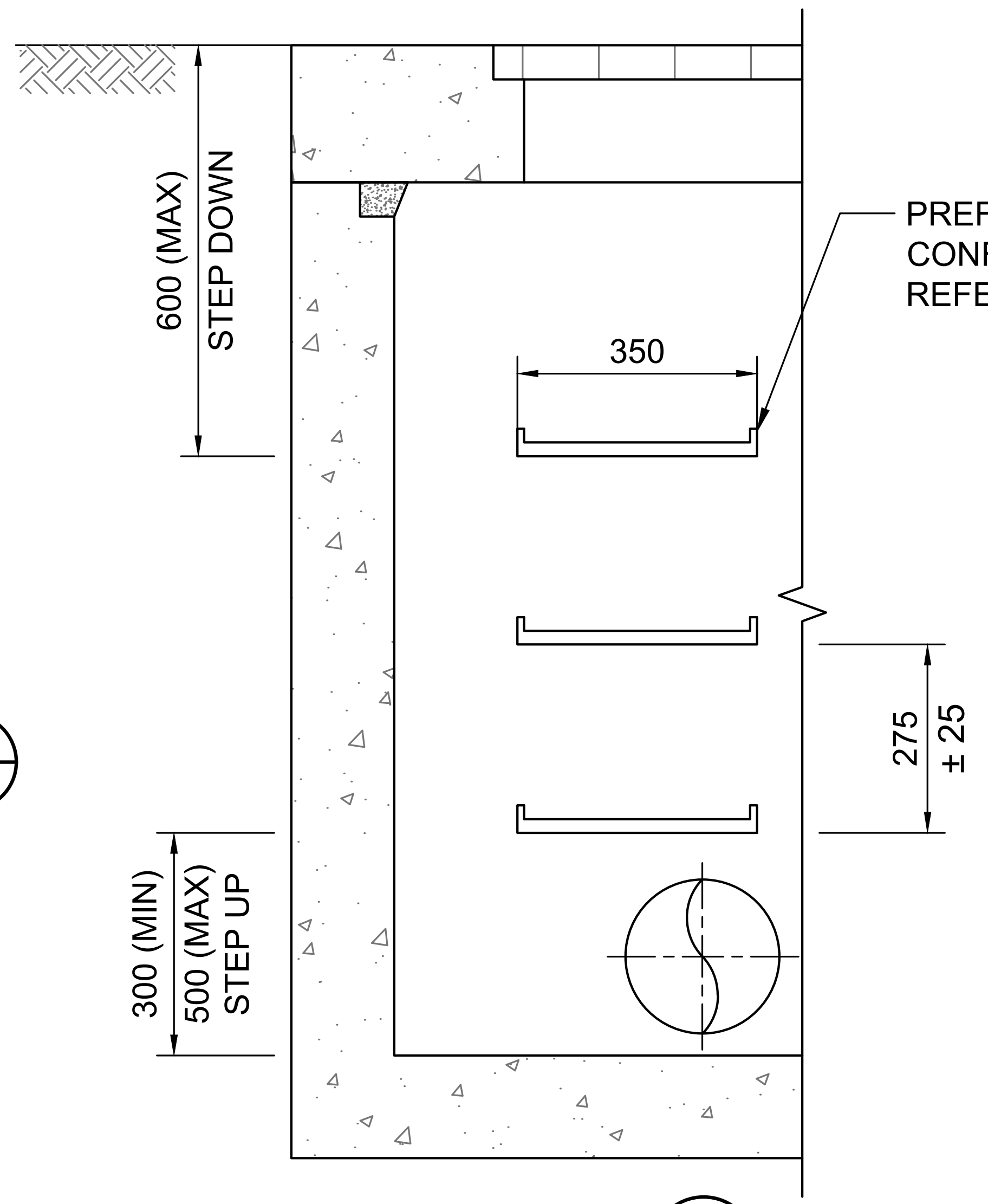


PLAN
SCALE 1:10

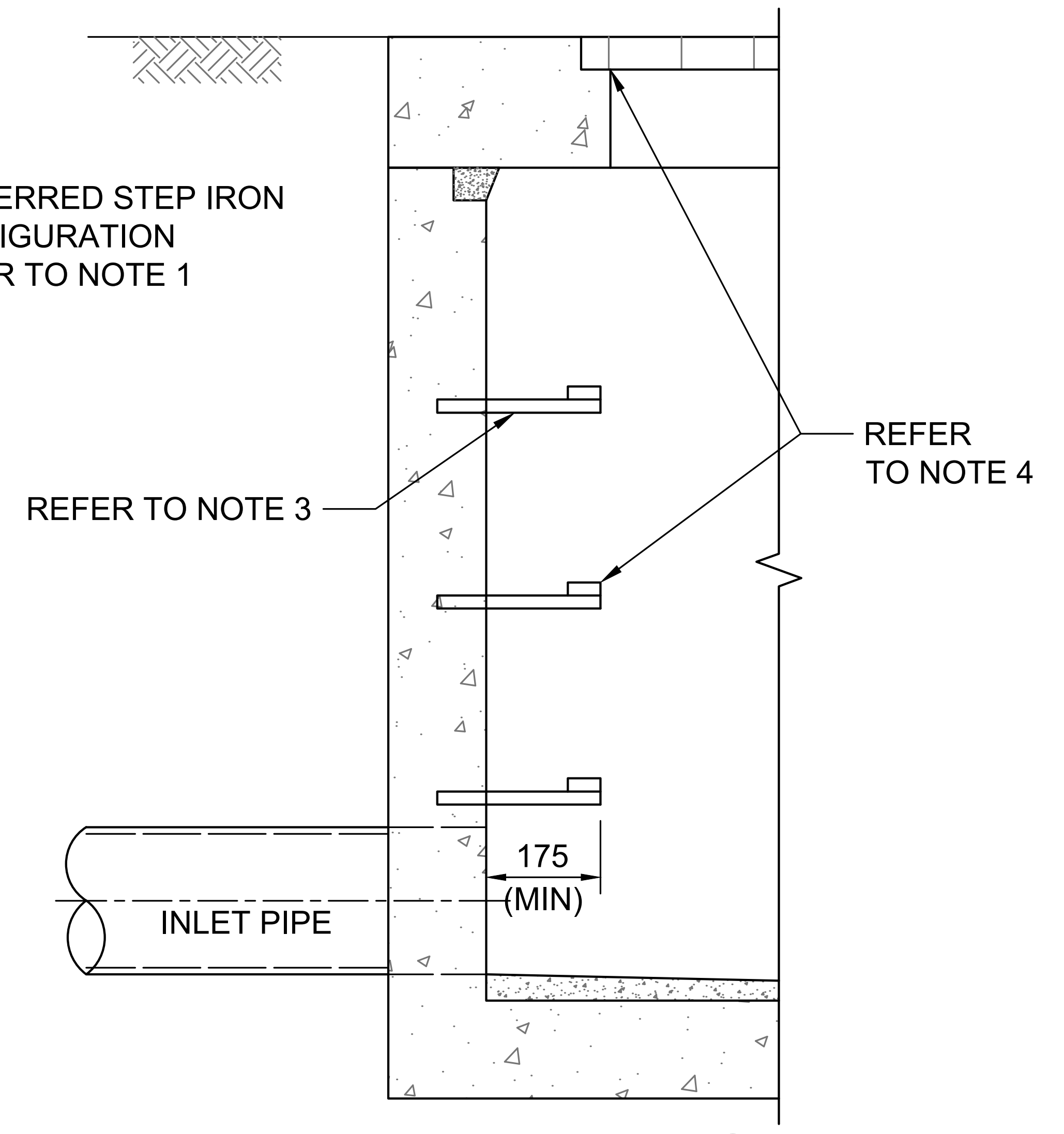
NOTES

1. FOR GENERAL NOTES AND LEGEND REFER TO TO DRAWING No's ARU-SYD-CICW-DRG-002 AND ARU-SYD-CICW-DRG-003.
2. HEADWALLS TO BE PRECAST TO SUIT DIAMETER OF DISCHARGE PIPE. EROSION PROTECTION SHOWN IS INDICATIVE AND SUBJECT TO DETAIL DESIGN.
3. APPROVED STEP IRONS TO BE PROVIDED WHERE THE PIT EXCEEDS 1200mm IN DEPTH. STEP IRONS TO AS1657 AND EN13101 ARRANGED IN A SINGLE WIDTH TREAD FORMATION (MIN LENGTH 350mm) OR A SINGLE COLUMN, DOUBLE WIDTH TREAD (MIN LENGTH 150mm) STAGGERED DOUBLE COLUMN.

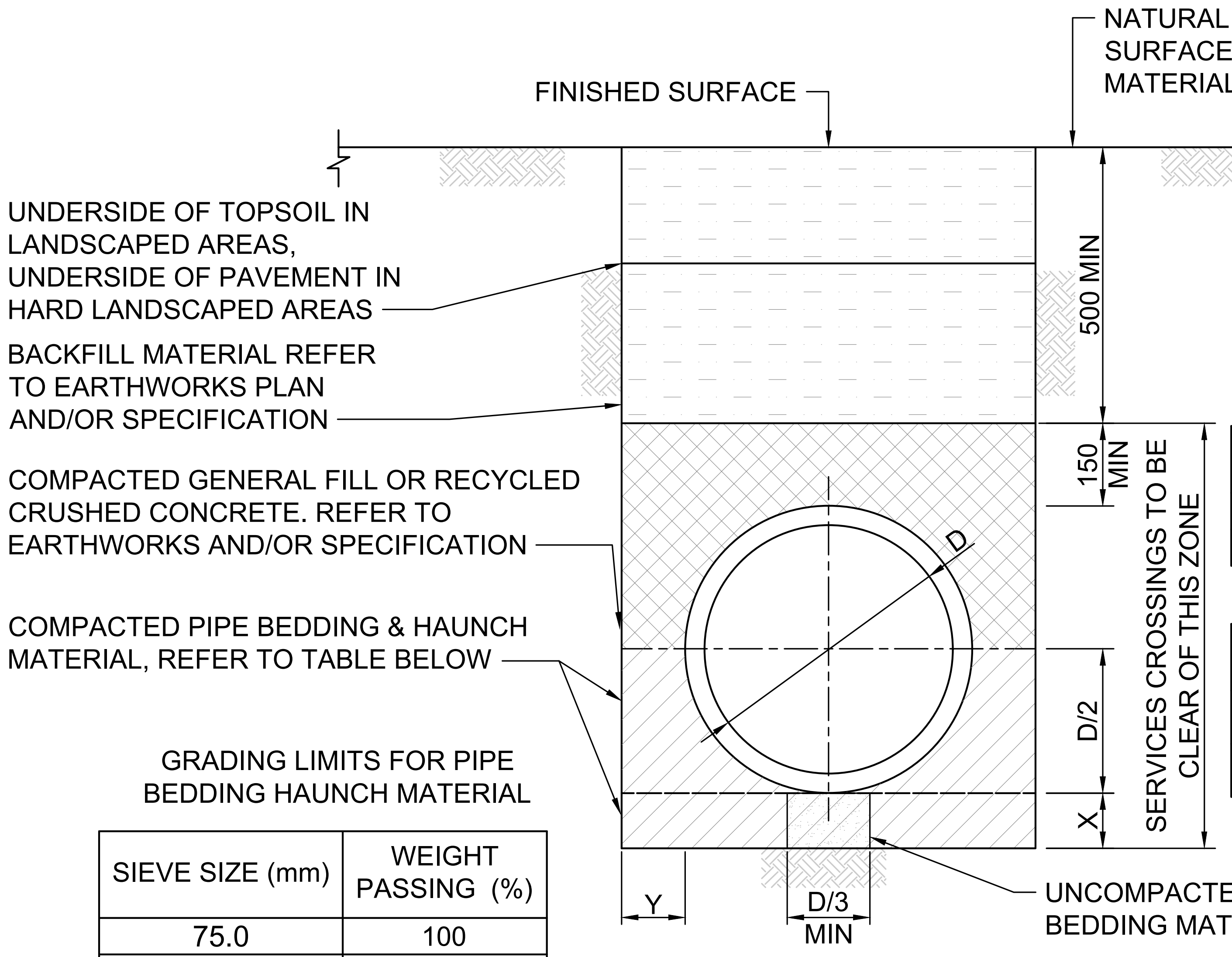
STANDARD STEP IRON DETAILS



SECTION B -
SCALE 1:10



SECTION C -
SCALE 1:10



D	Y (mm)
≤900	150
>900	D/6

D	X (mm)
≤1500	100 (MIN)
>1500	150 (MIN)

GRADING LIMITS FOR PIPE BEDDING HAUNCH MATERIAL

SIEVE SIZE (mm)	WEIGHT PASSING (%)
75.0	100
9.5	100-50
2.36	100-30
0.60	50-15
0.075	25-0

GRANULAR BACK FILL TYPICAL SECTION

SCALE 1:10

PIPE BEDDING & HAUNCH MATERIAL COMPACTION REQUIREMENTS

TYPE	MIN STD COMPACTION
COHESIVE	50%^{*1}
COHENSIONLESS	85%^{*2}

^{*1} IN ACCORDANCE WITH AS3725-2007

Scales

Filename (Full Drawing No)
WSERRC-ARU-SYD-CICW-DRG-0696
Design Model Version

Issue	Date	By	Chkd	Appd
0	22/05/20	HNA	AC	EM
FOR PLANNING APPROVAL				

Client
CLEANAWAY
Making a sustainable future possible
MACQUARIE

Engineering Certification (CEng)
Name: ....
Signature: .... Date: ....

Job Title
WESTERN SYDNEY ENERGY AND RESOURCE RECOVERY CENTRE

Scale at A1 1:10m
Discipline Civil

ARUP
Arup, Level 5, 151 Clarence St
Sydney, NSW, 2000
Tel +61 (02) 9320 9320 Fax +61 (02) 9320 9321
www.arup.com

CONSULT AUSTRALIA
Member Firm
Arup Pty Ltd
ABN 18 000 966 165

Drawing Title
STORMWATER
DETAILS
SHEET 2 OF 2

Drawing Status
Preliminary Issue

Job No	Drawing No	Issue
264039-00	**ARU-SYD-CICW-DRG-0696**	**0**

Do not scale

DRAWING COLOUR CODED - PRINT ALL COPIES IN COLOUR

Appendix D

Site Water Balance Calculations

WSERRC Water Balance - Summary of Assumptions

Date	24-04-20
Prepared by	Andrew Crouch and Emann-Ray Aroyo (Arup)
Project	Western Sydney Resource Recovery Centre (WSERRC) Site Water Balance
Description	This spreadsheet shows the balance between the water inflow and outflow at the proposed Cleanaway Energy from Waste facility at 339 Wallgrove Road, Eastern Creek
Key assumptions	- Rainfall at the site is the same as the rainfall at the weather station - Rainfall data of the last 20 years (2000 - 2019) is a close indicator of the future rainfall - Rain falls at a constant rate equally throughout the site - Impervious area runoff coefficient is 1 - Pervious area runoff coefficient is 0.1 - Water to steam/ash conversion coefficient is 1 - i.e. all process water is lost and is not discharged to sewer - Rainfall on the visitor centre admin building, substation and ACC do not contribute to the amount of rainwater harvested - Energy process demand is 32.4 m3/hr - Site process demand is 1 m3/day - Municipal demand is 16 m3/day - Incinerators run for 8000 hours per year - Initial volume of tank storage is 0 - There are 2 tank storages with a capacity of 100 m3 each - 100% of roof drains to rainwater tanks - Rainfall in the tank storage can only be reused for the energy process demand - Sydney Water potable water is used for the energy process demand shortage, site process demand and municipal demand - Sewer discharge is the outflow of the site process and municipal demands
Data sources	- U 000 DRAINAGE Model - Catchments.pdf - BoM daily rainfall data for Prospect Reservoir Meteorological station - 2020 03 11 WSERRC Mass and Energy Balance Figure Request (Ramboll 2020-03-23).xlsx

Water Balance Annual totals

Year	Rainfall Volume on Site (kL)	Sydney Water Potable Water Consumption (kL)	Rainfall Harvested and Reused (kL)	Rainfall Discharge from Site to Creek due to Site Runoff (Excl. Roof) and Tank Overflow (kL)	Sewer Discharge (kL)	Rainfall Lost on Pervious Area (kL)	Energy Process Water Lost to Steam/Ash (kL)	Site Annual Water Balance Check (kL)
2000	48350	281974	12143	30393	9516	5814	284602	0
2001	52213	281701	11613	34322	9490	6278	283824	0
2002	36781	284105	9209	23149	9490	4423	283824	0
2003	45639	281665	11649	28502	9490	5488	283824	0
2004	43689	282966	11152	27284	9516	5253	284602	0
2005	38793	283412	9902	24226	9490	4665	283824	0
2006	36156	284263	9051	22757	9490	4347	283824	0
2007	64512	277305	16009	40746	9490	7757	283824	0
2008	56781	279882	14235	35718	9516	6827	284602	0
2009	42241	282532	10782	26380	9490	5079	283824	0
2010	53841	279571	13743	33624	9490	6474	283824	0
2011	53704	279606	13708	33539	9490	6458	283824	0
2012	60018	279542	14576	38226	9516	7217	284602	0
2013	55376	280167	13147	35570	9490	6659	283824	0
2014	54744	279754	13560	34602	9490	6583	283824	0
2015	70492	276774	16540	45476	9490	8476	283824	0
2016	63509	280126	13991	41881	9516	7637	284602	0
2017	52200	280517	12797	33127	9490	6277	283824	0
2018	38384	283919	9395	24374	9490	4615	283824	0
2019	43640	282433	10881	27511	9490	5247	283824	0

Water Balance - Annual Average Totals

Water Source/Demand	Average annual total (kL)	
	In	Out
Rainfall on site	50000	
Rainwater used for process		12000
Stormwater discharge from site		32000
Stormwater infiltration and evapotranspiration on pervious areas		6000
Potable water supply	281000	
Potable water used for process		272000
Discharge to sewer		9000

Results Validation - Water Balance Using Rainfall Data from BoM Whitlam Centre Station - 1967 - 1976

Water Source/Demand	Average annual total (kL)	
	In	Out
Rainfall on site	55000	
Rainwater used for process		13000
Stormwater discharge from site		35000
Stormwater infiltration and evapotranspiration on pervious areas		7000
Potable water supply	280000	
Potable water used for process		271000
Discharge to sewer		9000

Results Validation - MUSIC Model

Water Source/Demand	Average annual total (kL)	
	In	Out
Rainfall on site	53000	
Rainwater used for process		10000
Stormwater discharge from site		24000
Stormwater infiltration and evapotranspiration on pervious areas		19000
Potable water supply	N/A	
Potable water used for process		N/A
Discharge to sewer		N/A

Appendix E

MUSIC Stormwater Quality Model Outputs

MUSIC-*link* Report

Project Details

Project:	339 Wallgrove Road - Western Sydney Energy and Resource Recovery Centre
Report Export Date:	03-Jun-20
Catchment Name:	W2E Site WQ Model
Catchment Area:	6.19ha
Impervious Area*:	74.81%
Rainfall Station:	67035 LIVERPOOL(WHITLAM
Modelling Time-step:	6 Minutes
Modelling Period:	1-01-1967 - 31-12-1976 11:54:00 PM
Mean Annual Rainfall:	857mm
Evapotranspiration:	1261mm
MUSIC Version:	6.2.1
MUSIC-link data Version:	6.22
Study Area:	Blacktown
Scenario:	Blacktown Development

Company Details

Company:	Arup
Contact:	Andrew Crouch
Address:	Level 5 151 Clarence St Sydney NSW
Phone:	93209151
Email:	andrew.crouch@arup.com

* takes into account area from all source nodes that link to the chosen reporting node, excluding Import Data Nodes

Treatment Train Effectiveness

Node: Receiving Node	Reduction
Flow	38.2%
TSS	87.4%
TP	72%
TN	46.9%
GP	100%

Treatment Nodes

Node Type	Number
Rain Water Tank Node	2
Bio Retention Node	1
Swale Node	1
Detention Basin Node	1
GPT Node	2

Source Nodes

Node Type	Number
Urban Source Node	7

Comments

The model has been prepared following Blacktown City Council and NSW MUSIC Modelling guidelines.

Passing Parameters

Node Type	Node Name	Parameter	Min	Max	Actual
Bio	Bioretention basin	Hi-flow bypass rate (cum/sec)	None	None	2
Bio	Bioretention basin	PET Scaling Factor	2.1	2.1	2.1
Detention	Detention Basin	% Reuse Demand Met	None	None	0
GPT	East Catchment - CDS 0708M	Hi-flow bypass rate (cum/sec)	None	None	0.054
GPT	West Catchment - CDS 0708M	Hi-flow bypass rate (cum/sec)	None	None	0.054
Receiving	Receiving Node	% Load Reduction	None	None	38.2
Receiving	Receiving Node	GP % Load Reduction	90	None	100
Receiving	Receiving Node	TN % Load Reduction	45	None	46.9
Receiving	Receiving Node	TP % Load Reduction	65	None	72
Receiving	Receiving Node	TSS % Load Reduction	85	None	87.4
Swale	Revegetated swale	Bed slope	0	0.05	0.005
Urban	Bioretention/OSD Basin Direct Rainfall	Area Impervious (ha)	None	None	0.056
Urban	Bioretention/OSD Basin Direct Rainfall	Area Pervious (ha)	None	None	0.357
Urban	Bioretention/OSD Basin Direct Rainfall	Total Area (ha)	None	None	0.414
Urban	East Road Catchment - BCC Road Areas	Area Impervious (ha)	None	None	1.344
Urban	East Road Catchment - BCC Road Areas	Area Pervious (ha)	None	None	0.145
Urban	East Road Catchment - BCC Road Areas	Total Area (ha)	None	None	1.49
Urban	Overland Flow Channel - BCC Pervious Areas	Area Impervious (ha)	None	None	0
Urban	Overland Flow Channel - BCC Pervious Areas	Area Pervious (ha)	None	None	0.811
Urban	Overland Flow Channel - BCC Pervious Areas	Total Area (ha)	None	None	0.811
Urban	Roof East - BCC Roof Area	Area Impervious (ha)	None	None	0.825
Urban	Roof East - BCC Roof Area	Area Pervious (ha)	None	None	0
Urban	Roof East - BCC Roof Area	Total Area (ha)	None	None	0.825
Urban	Roof Visitor Centre - BCC Roof Area	Area Impervious (ha)	None	None	0.093
Urban	Roof Visitor Centre - BCC Roof Area	Area Pervious (ha)	None	None	0
Urban	Roof Visitor Centre - BCC Roof Area	Total Area (ha)	None	None	0.093
Urban	Roof West - BCC Roof Area	Area Impervious (ha)	None	None	0.753
Urban	Roof West - BCC Roof Area	Area Pervious (ha)	None	None	0
Urban	Roof West - BCC Roof Area	Total Area (ha)	None	None	0.753
Urban	West Road Catchment - BCC Road Areas	Area Impervious (ha)	None	None	1.559
Urban	West Road Catchment - BCC Road Areas	Area Pervious (ha)	None	None	0.244
Urban	West Road Catchment - BCC Road Areas	Total Area (ha)	None	None	1.804

Only certain parameters are reported when they pass validation

Failing Parameters

Node Type	Node Name	Parameter	Min	Max	Actual
Bio	Bioretention basin	Exfiltration Rate (mm/hr)	0	0	0.2
Bio	Bioretention basin	Extended detention depth (m)	None	0.4	0.5
Detention	Detention Basin	Exfiltration Rate (mm/hr)	0	0	0.2
Rain	East tank	% Reuse Demand Met	80	None	3.516
Rain	West tank	% Reuse Demand Met	80	None	3.296
Swale	Revegetated swale	Exfiltration Rate (mm/hr)	0	0	0.2
Urban	Roof East - BCC Roof Area	Baseflow Total Nitrogen Mean (log mg/L)	0.32	0.32	0.11
Urban	Roof East - BCC Roof Area	Baseflow Total Phosphorus Mean (log mg/L)	-0.82	-0.82	-0.85
Urban	Roof East - BCC Roof Area	Baseflow Total Suspended Solids Mean (log mg/L)	1.1	1.1	1.2
Urban	Roof Visitor Centre - BCC Roof Area	Baseflow Total Nitrogen Mean (log mg/L)	0.32	0.32	0.11
Urban	Roof Visitor Centre - BCC Roof Area	Baseflow Total Phosphorus Mean (log mg/L)	-0.82	-0.82	-0.85
Urban	Roof Visitor Centre - BCC Roof Area	Baseflow Total Suspended Solids Mean (log mg/L)	1.1	1.1	1.2
Urban	Roof West - BCC Roof Area	Baseflow Total Nitrogen Mean (log mg/L)	0.32	0.32	0.11
Urban	Roof West - BCC Roof Area	Baseflow Total Phosphorus Mean (log mg/L)	-0.82	-0.82	-0.85
Urban	Roof West - BCC Roof Area	Baseflow Total Suspended Solids Mean (log mg/L)	1.1	1.1	1.2

Only certain parameters are reported when they pass validation

Appendix F

OSD Volume Calculation Sheet

Blacktown City Council - On-site Detention Deemed to Comply Tool

Select project to Load or Delete:

v1.9

Project Details:

Project Title	WSERRC
Address	339 Wallgrove Rd, Eastern Cree
Reference Number	

General Site Data:

Site Area (m^2)	61900 m^2
Area Draining to OSD (m^2)	53790 m^2

On-Site Detention Data:

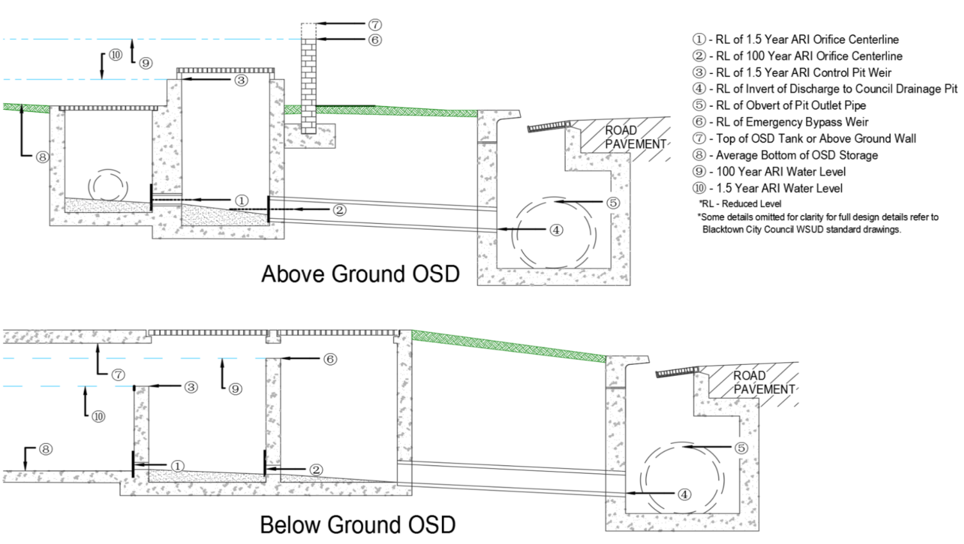
OSD Location	Above Ground
OSD Discharge Location	Council Drainage Pit
RL of Bottom of OSD Storage Area	54.000
RL of Top of OSD Storage Area	56.000
Length of Emergency Overflow Weir (m)	4.00 m

Filter Cartridges:

Will filter cartridges be used to manage water quality?	No

Discharge Data:

RL of 1.5 Year ARI Orifice Centreline	53.000
Number of Orifices	1
RL of 100 Year ARI Orifice Centreline	53.100
Number of Orifices	1
RL of Invert of Discharge to Council Drainage Pit	53.000
RL of obvert of Pit outlet pipe	53.450



Above Ground OSD Summary with calculated values

Site:	
Site Area	61900 m^2
Site Area NOT Draining to OSD	8110 m^2
Reduced Levels (AHD):	
RL of Top of Tank	56
RL of Bottom of OSD Tank	54
RL of 1.5 Year ARI Overflow Weir	54.985
RL of Emergency Overflow Weir	55.495
RL of 1.5 Year ARI Orifice Centerline	53
RL of 100 Year ARI Orifice Centreline	53.1
RL of Invert of Discharge to Council Drainage Pit	53
RL of obvert of Pit outlet pipe	53.45
Minium RL of Garage Floor	56.09
Minium RL of House Floor	56.19
OSD Volume:	
Required Storage BELOW 1.5 Year ARI Overflow Weir	1957.3 m^3
Required Storage BELOW Emergency Overflow Weir	2968.5 m^3
Discharge Details:	
Using Filter Cartridges to Manage Water Quality	No
Discharge Location	Council Drainage Pit
Length of Emergency Overflow Weir	4.00 m
Maximum 1.5 Year ARI Site Discharge	198.94 L/s
1.5 Year ARI Orifice Discharge	198.94 L/s
Maximum 100 Year ARI Site Discharge	721.94 L/s
100 Year ARI Orifice Discharge	721.94 L/s
Orifice Details:	
Number of 1.5 Year ARI Orifices	1
Number of 100 Year ARI Orifices	1
1.5 Year ARI Orifice Size (mm)	258.0 mm
100 Year ARI Orifice Size (mm)	469.0 mm

Notifications:

Due to the Outlet Orifice being drowned by 17.2% during 100 ARI event an extra 5.4% of Storage volume has been added.