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Cleanaway Operations Pty Ltd

# Melbourne Energy and Resource Centre

## Hydrology and Flood Risk Technical Report

Reference: MERC-ARU-MEL-ENHY-RPT-0001

01 | 1 December 2023



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# Abbreviations and glossary

| Abbreviations | Definition |
|---|---|
| **AEP** | Annual Exceedance Probability (AEP) refers to the probability of a flood event occurring in any year |
| **AHD** | Australian Height Datum |
| **ARF** | Aerial Reduction Factor |
| **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 |
| **DEM** | Digital Elevation Model |
| **IBA** | Incinerator Bottom Ash |
| **IL/CL** | Initial Loss/Continuing Loss |
| **IPCC** | United Nations International Panel for Climate Change (IPCC) |
| **LGA** | Local Government Area |
| **MERC** | Melbourne Energy and Resource Centre |
| **MSP** | Municipal Solid Waste |
| **OSD** | On-site detention |
| **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 |
| **RCP** | Representative Concentration Pathway (RCP) is a greenhouse gas concentration trajectory adopted by the IPCC |
| **WtE** | Waste-to-energy |

# Executive Summary

Cleanaway Operations Pty Ltd (Cleanaway) is an Australian waste management, recycling, and industrial services company. Cleanaway is developing a waste-to-energy (WtE) facility in Victoria known as the Melbourne Energy and Resource Centre (MERC) herein referred to as 'the Proposal'.

The EPA VIC Guideline: Energy from Waste stipulates that *'Proponents of EfW proposals…will be expected to demonstrate that the siting, design, construction and operation of EfW facilities will incorporate best practice measures for the protection of the land, water and air environments as well as for energy efficiency and greenhouse gas emissions management. Facilities should be able to provide evidence of how they minimise and manage emissions (including pollutants, odour, dust, litter, noise and residual waste) in accordance with relevant statutory requirements.*'

The purpose of this specialist assessment is to demonstrate compliance with the various authority requirements.

This report provides information relevant to the existing site hydrology and flood risk across the Proposal area, details of the flood modelling undertaken and documents the potential changes in flood risk due to the proposed development activities.

The proposed site is located at 510 Summerhill Road in Wollert, Victoria which is in the City of Whittlesea local government area (LGA). The site has an area of approximately 82 hectares and sits within the Yarra River basin and Merri Creek catchment.

The Proposal area interacts with the catchments for Curly Sedge Creek and a tributary of Curly Sedge Creek (Tributary 4545) along with a small farm dam. As the Proposal area is largely greenfield, there is no formal pit and pipe network present within the Proposal area.

The fluvial geomorphological assessment of the Proposal area (510 Summerhill Rd Waterway Assessment, Streamology, 2022) concluded that:

- *"The waterway mapped as Tributary 4545 is a very poorly defined, discontinuous channel"*
- *"No geomorphic values are associated with Tributary 4545, located within the study site and there are limited habitat values (e.g. large wood, riparian vegetation) along the waterway"*
- *"Considering only the geomorphic values, form and trajectory of Tributary 4545, the waterway is a good candidate for realignment as a constructed waterway."*



## Surface water management

The over-arching surface water design intent is to maintain existing catchments within the Proposal area and to minimise the change to the magnitude and quality of flows leaving the site.

The surface water management strategy has been devised in accordance with relevant Whittlesea Council, Melbourne Water and Victoria Planning Provisions requirements. In accordance with Council requirements, the system will be required to attenuate stormwater discharge and provide water quality measures.

To demonstrate compliance with the Best Practice Environmental Management (BPEM) Guideline objectives, MUSIC (Model for Urban Stormwater Conceptualisation) computer software was used.

DRAINS was used to determine the minimum storage volumes of attenuation basins based on the developed footprint of the Proposal area. Concept stormwater pipe sizing was completed using the drainage design module in in 12-D.

The concept stormwater drainage design includes a minor network of inlet pits and pipes. The Proposal area drainage network has been split into two primary catchment areas consistent with the existing site conditions.

On-site detention for site runoff will be provided in two open basins, upstream of the two site stormwater discharge points. Each basin will include a bioretention portion of the basins to maximise water quality treatment.

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

## Flood risk

Hydrologic and hydraulic modelling has been completed to assess the risk of flooding within the Proposal area in accordance with Australian Rainfall and Runoff 2019 (ARR 2019) guidelines and Melbourne Water's AM STA 6200 Flood Mapping Projects Specification (2021).

Hydrologic modelling was undertaken using RORB and a 2D hydraulic model was developed in TUFLOW. The TUFLOW HPC solver was utilised after validating results against TUFLOW classic solver results.

The hydraulic model extent encompasses the Proposal area, capturing all upstream sub-catchments and extending approximately 500m south of Summerhill Road. A 5m model grid size has been adopted for both the critical duration analysis and design simulations of the Proposal.

The proposed design was tested in the TUFLOW model with the key design elements related to the hydraulic modelling summarised below:

- Internal site structures, consisting of the waste-to-energy (WtE) facility (waste reception hall, waste bunker, boilers, flue gas treatment & stack, and steam power plant), IBA treatment area, substation, truck shed, visitor centre and noise wall;
- Stormwater attenuation and treatment basins;
- Internal roads and paved areas.

The TUFLOW model was used to simulate the full ensemble of storms for both existing and design durations for overland flows are within the order of 20 minutes to 30 minutes.

- In the 1% AEP event, peak flood depths within the mapped waterways are shallow and less than 500mm.
- In the 1% AEP event, peak flood flows are generally within mapped waterways, with the exception of an area of overland flow in the north-east corner of the Proposal area.

Key observations for the **design scenario** flood conditions in the 1% AEP event are:

- In all flood events up to and including the 1% AEP event, flooding is not observed within the footprint of the design, with the exception of some minor ponding along both western and eastern access due to overland flow from external catchments, this will be managed by the proposed development road drainage design;
- In all flood events up to and including the 1% AEP event, the hazard remains similar to the existing scenario with the exception of an area of low hazard (H2) within the western overland flow path where flows are slightly deeper than existing due to the proposed earthworks;
- In all flood events up to and including the 1% AEP event, no adverse impacts to flood levels or flows are predicted outside the Proposal area;
- Critical design elements remain outside the 1% AEP flood extents and above the PMF flood level;
- Buildings are designed to be raised at least 600mm above the 1% AEP peak flood level.

# 1. Proposal overview

Cleanaway Operations Pty Ltd (Cleanaway) is an Australian waste management, recycling, and industrial services company. Cleanaway is developing a waste-to-energy (WtE) facility in Victoria known as the Melbourne Energy and Resource Centre (MERC) (the Proposal).

The MERC has been designed to thermally treat a design capacity of 380,000 tonnes per annum (tpa) of waste feedstock, consisting of residual Municipal Solid Waste (MSW) and residual commercial waste, which is waste that would otherwise be sent to landfill. Waste feedstock processed by the MERC will be subject to a Waste Acceptance Protocol to determine eligibility and suitability for processing both prior to arrival and upon arrival on-site. The Proposal will also incorporate maturation and processing of bottom ash to recover recyclable metals, with the intent to utilise the remaining ash as an aggregate in construction.

Residual waste is waste that is left over from recycling and resource recovery operations and waste from source separated collections. Source separation involves separating waste into common material streams or categories for separate collection. Waste processed at the site will be subject to a Waste Acceptance Protocol to ensure only appropriate waste is used as feedstock.

The WtE process would generate approximately 46.3MW gross of electricity, 4.7MW of which would be used to power the facility itself and the associated on-site by-product and residue handling processes, with 41.6MW (328,700MWh/year) exported to the grid as base load electricity. In addition to supplying electricity to the grid, there is also potential to supply energy in the form of heat and/or process steam to local industrial users.

Some residual materials are produced because of the WtE process, including Incinerator Bottom Ash (IBA), boiler ash and flue gas treatment residue. The boiler ash and flue gas treatment residue are typically combined and together are referred to as Air Pollution Control residue (APCr). Overall, the WtE process typically leads to about 90% reduction in the volume, or 80% reduction in mass (tonnes), of waste that would otherwise go to landfill. If IBA is reused as an alternative construction product to virgin materials, this percentage increases further to approximately 95% reduction in volume and mass of waste that would otherwise go to landfill. The final volume of waste diverted from landfill is dependent on the classification and market for the residues and by-products generated by the WtE facility.

The Proposal includes the construction and operation of an IBA maturation and processing facility on site. The purpose of this facility is to store the IBA to mature (stabilise) it, before mechanically processing IBA from the WtE facility into an aggregate for reuse. As part of this process, both ferrous and non-ferrous metals will be recovered from the IBA for recycling and sale to market.

The Proposal also includes a stabilisation facility for APCr, a necessary treatment step to immobilise leachable components of the APCr prior to removal from site by vehicle and disposal at an appropriately licenced landfill.

The Proposal will use best available techniques and technologies in the engineering design, operation, maintenance and monitoring activities associated with the MERC.

Moving grate technology has been chosen as the means to thermally treat incoming waste to recover energy and other resources. Current international best-practice techniques, including automated combustion controls and advanced flue gas treatment technology will be applied so that air emissions meet stringent emission. The moving grate combustion system is a common form of thermal WtE technology in which the waste is fed through the combustion chamber on a travelling grate. This enables efficient and complete combustion of the waste, with primary combustion air introduced from below the grate and secondary combustion air introduced directly into the combustion zone above the grate. Moving grate technology has been used globally for over 100 years, and in that time the technology has been subject to continual improvement responding to regulatory, industry and public demands. There are approximately 500 similar operational examples across Europe alone, the majority of which use the moving grate-type technology being proposed for the MERC.

The Proposal involves the building of all onsite infrastructure required to support the WtE facility, including site utilities, internal roads, weighbridges, parking and hardstand areas, stormwater infrastructure, fencing and landscaping. The Proposal will also include a visitor and education centre to help educate and inform the community on the circular economy, recycling, resource recovery, the benefits of landfill diversion and the WtE process. The intent behind this education is to drive a shift in community thinking and actions around waste management.

The Victorian Waste to Energy Framework (2021) recognises the role of WtE to divert waste from landfills, helping Victoria transition to a circular economy. *Recycling Victoria* recognises a role for WtE investment and supports WtE facilities where they meet best-practice environment protection requirements. This includes reducing waste to landfill, supporting waste avoidance, reusing and recycling, and demonstrating social license with affected communities. The Victorian Environment Protection Authority (EPA) Energy from Waste Guideline (Publication 1559, 1 July 2017) also notes that efficient recovery of energy from the thermal processing of waste is considered a resource recovery as opposed to a waste disposal option.

The EPA VIC Guideline: Energy from Waste stipulates that *'Proponents of EfW proposals…will be expected to demonstrate that the siting, design, construction and operation of EfW facilities will incorporate best practice measures for the protection of the land, water and air environments as well as for energy efficiency and greenhouse gas emissions management. Facilities should be able to provide evidence of how they minimise and manage emissions (including pollutants, odour, dust, litter, noise and residual waste) in accordance with relevant statutory requirements.*'

The WtE facility has been designed to meet the European Industrial Emissions Directive (IED) (2010) and the associated Best Available Techniques Reference (BREF) Document published December 2019, for Waste Incineration which sets the European Union environmental standards for waste incineration. The facility will also comply with the technical criteria set out in the EPA Victoria Guideline: Energy from Waste publication 1559.1.

The purpose of this specialist assessment is to demonstrate compliance with the various authority requirements, develop community support and social license.

The proposed site is located at 510 Summerhill Road in Wollert, Victoria which is in the City of Whittlesea local government area (LGA).

This report provides information relevant to the existing site hydrology and flood risk across the study area, details of the flood modelling undertaken and documents the potential changes in flood risk due to the proposed development activities.

# 2. Regulatory context and state of knowledge

## 2.1 Relevant legislation, policy and guidelines

This section sets out the Hydrology and Flood Risk legislation, policy and guidelines applicable to MERC. Together, these documents form the current 'state of knowledge' for Hydrology and Flood Risk in relation to the Proposal.

**Table 1: Regulatory context**

| Jurisdiction | Title | Relevance |
|---|---|---|
| **Federal** | Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia (AIDR, 2017) | Developed with consideration of the National Strategy for Disaster Resilience (COAG, 2011) and intended to provide broad guidance on all aspects of managing flood risk. |
| | Australian Rainfall and Runoff (ARR) (Ball, et al., 2019) | National guideline for design flood estimation. |
| **State** | Planning and Environment Act 1987 (State Government of Victoria, 2022) | Enables planning schemes to *'regulate or prohibit any use or development in hazardous areas, or areas likely to become hazardous'*. As a result, planning schemes contain State planning policy for floodplain management requiring, among other things, that flood risk be considered in the preparation of planning schemes and in land use decisions. |
| | *Water Act 1989* (State Government of Victoria, 2022) | Identifies Melbourne Water as the authority responsible for the administration of the Planning Scheme which aims to regulate or prohibit development in hazard areas and enable flood risk to be managed. |
| | Victorian Floodplain Management Strategy (State of Victoria Department of Environment, Land, Water and Planning, 2016) | Provides the technical basis for assessing flood risk, and provides a framework to prioritise flood mitigation activities. |
| | Guidelines for Development in Flood Affected Areas (Department of Environment, Land, Water and Planning (DELWP), 2019) | Provides an assessment framework and method to assist decisions on development in flood affected areas. |
| | Victorian Planning Policy Framework (PPF) (2021) | Aligns state and local policy and directs towards the use of local planning schemes (e.g. Whittlesea Planning Scheme). |
| | Victoria Planning Provisions (VPP) Amendment VC154 (Department of Environment, Land, Water and Planning (DELWP), 2018) | Provides stormwater management provisions for urban developments under Victoria planning schemes, including requirement to meet Best Practice Environmental Management (BPEM) Guidelines |
| | Best Practice Environmental Management (BPEM) Guidelines (Victorian Stormwater Committee, 1999) | Provides design guidance for designers and planners to meet required environmental targets (e.g. stormwater pollutant reduction targets). |
| | *Environment Protection Act 2017* (State Government of Victoria, 2022) | Outlines the principals for environmental protection from pollution or waste via General Environmental Duties (GED). |
| **Local** | AM STA 6200 Flood Mapping Projects Specification (Melbourne Water, 2021) | Provides technical guidance for the delivery of a flood assessment. |
| | Melbourne Water standards for infrastructure projects in flood-prone areas (Melbourne Water, 2019) | Provides minimum requirements for projects that have the potential to impact on flood-prone areas. |
| | Flood Risk Assessment Framework: How flood impacts are assessed in the Port Phillip and Westernport Region (Melbourne Water, 2010) | Outlines a framework for undertaking a flood risk assessment. |
| | Whittlesea Planning Scheme (Department of Environment, Land, Water and Planning (DELWP), 2022). | Outlines key planning strategies, including floodplain management. Notes that community facilities must be located outside the 1% Annual Exceedance Probability (AEP) flood extents, and where possible above the height of the probable maximum flood (PMF). Notes developments involving the storage and disposal of environmentally hazardous waste and other dangerous goods must be outside floodplains unless potential contact between such substances and floodwaters is prevented without affecting flood carrying and storage functions of the floodplain. Melbourne Water defines floodplains as land subject to inundation by floods up to and including the PMF. |
| | Guidelines for Urban Development (City of Whittlesea, 2015) | Provides the minimum Council requirements for the design and construction of infrastructure. |

## 2.2 Flood assessment criteria summary

The key flooding requirements for the Proposal are:

1. Developments involving the storage and disposal of environmentally hazardous waste and other dangerous goods must be outside floodplains unless potential contact between such substances and floodwaters is prevented without affecting flood carrying and storage functions of the floodplain, where floodplains are defined as land subject to inundation by floods up to and including the largest probable flood event. Other community facilities must be located outside the 1% AEP flood extents and above the Probable Maximum Flood (PMF) level where possible (The State of Victoria Department of Environment, Land, Water and Planning, 2022)
2. The development must be located outside the flood extent (1% AEP) and setback 10m – 20m[1] from the 'top of bank' of waterways (Melbourne Water, 2022)
3. Work must not affect floodwater flow capacity or reduce floodplain storage (Melbourne Water, 2022)
4. Works must meet minimum floor level height (600mm above 1% AEP flood level) relevant to development location (freeboard) (Melbourne Water, 2022)
5. Works must not occur where the depth and flow of floodwaters would create a hazard (Melbourne Water, 2022)
6. Works must not occur in circumstances where the depth and flow of floodwater affecting access to the property is hazardous (Melbourne Water, 2017)
7. There should be no detrimental impacts to nearby properties, particularly properties downstream (Melbourne Water, 2022)
8. Development should preserve, and if possible, enhance, the social and environmental values and benefits of floodplains and waterways (State of Victoria Department of Environment, Land, Water and Planning, 2019).

## 2.3 Stormwater management criteria summary

The key stormwater management requirements for the Proposal are:

1. Minor pit and pipe site drainage network are to be designed to accommodate a 10% AEP event (Guidelines for Urban Development, Dec 2015, City of Whittlesea)
2. On-site detention (OSD) basin to be sized based on (Guidelines for Urban Development, Dec 2015, City of Whittlesea):
   a. Permissible Site Discharge (PSD) is equal to the 5-year ARI (20% AEP) pre-developed site peak flows
   b. Site Storage Requirement (SSR) will be designed to limit flows in the 10-year ARI (10% AEP) to the PSD (20% AEP)
3. Site stormwater shall be treated to meet the following targets (Best Practice Environmental Management (BPEM) Guidelines, Victorian Stormwater Committee, 1999):
   a. Total suspended solids: 80% retention of the typical urban annual load
   b. Total phosphorus: 45% retention of the typical urban annual load
   c. Total nitrogen: 45% retention of the typical urban annual load
   d. Urban litter (gross pollutants): 70% reduction of typical urban annual load



[1] Note that the setback distance is not specifically defined in Melbourne Water guidelines, however a 10-20m buffer width for each bank is cited as a recommended minimum in several studies within the Melbourne Water Waterway Corridors Greenfield Development Guide, Melbourne Water 2013

4. Site stormwater discharge in small events shall maintain flow to the 1.5-year Annual Recurrence Interval (ARI) pre-developed site peak flows (Best Practice Environmental Management (BPEM) Guidelines, Victorian Stormwater Committee, 1999)

## 2.4 Melbourne Water stakeholder engagement

As a key stakeholder for this Proposal, Melbourne Water has been engaged to identify constraints and opportunities within the Proposal area.

Key outcomes of the initial stakeholder engagement with Melbourne Water are summarised below and the full response is included in Appendix I:

1. The Proposal area is subject to flooding from Curly Sedge Creek and its tributaries
2. The development is required to follow the Guidelines for Development in Flood Affected Areas (DEPWP, 2019)
3. A hydraulic assessment is required to be completed using an acceptable hydraulic modelling software to demonstrate that the development does not adversely affect flood behaviour
4. Work must not affect floodwater flow capacity or reduce floodplain storage
5. Works must meet minimum floor level height (600mm above 1% AEP flood level) relevant to development location (freeboard)
6. New fencing across a floodplain should also be of an open style of construction
7. A detailed Drainage and Stormwater Management Strategy must be prepared which demonstrates how stormwater runoff from the development will achieve flood protection standards and State Environment Protection Policy (Waters of Victoria) objectives for the environmental management of stormwater
8. The property contains two waterways Curly Sedge Creek and Tributary 4545
9. The development must be located outside the flood extent and setback from the 'top of bank' of both waterways to the satisfaction of Melbourne Water to ensure adequate protection of water quality and river health. An appropriate interface and landscaping between the waterways and the development will be required to buffer the waterway corridor from the development.

# 3. Existing conditions

This section provides information relevant to the existing Hydrology and Flood Risk environment broadly across the study area and details the methodology used to define the existing conditions.

## 3.1 Site location

The Proposal area is located at 510 Summerhill Road, Wollert, which is within the City of Whittlesea Local Government Area and Melbourne Water's jurisdiction.

The site has an area of approximately 82 hectares and sits within the Yarra River basin and Merri Creek catchment. Curly Sedge Creek and its tributaries interact with the Proposal area, as shown in Figure 1, before draining into the Merri Creek further south.

The Proposal area drains from north to south, with an elevation range of approximately 203mAHD to 230mAHD, as shown in Figure 1.

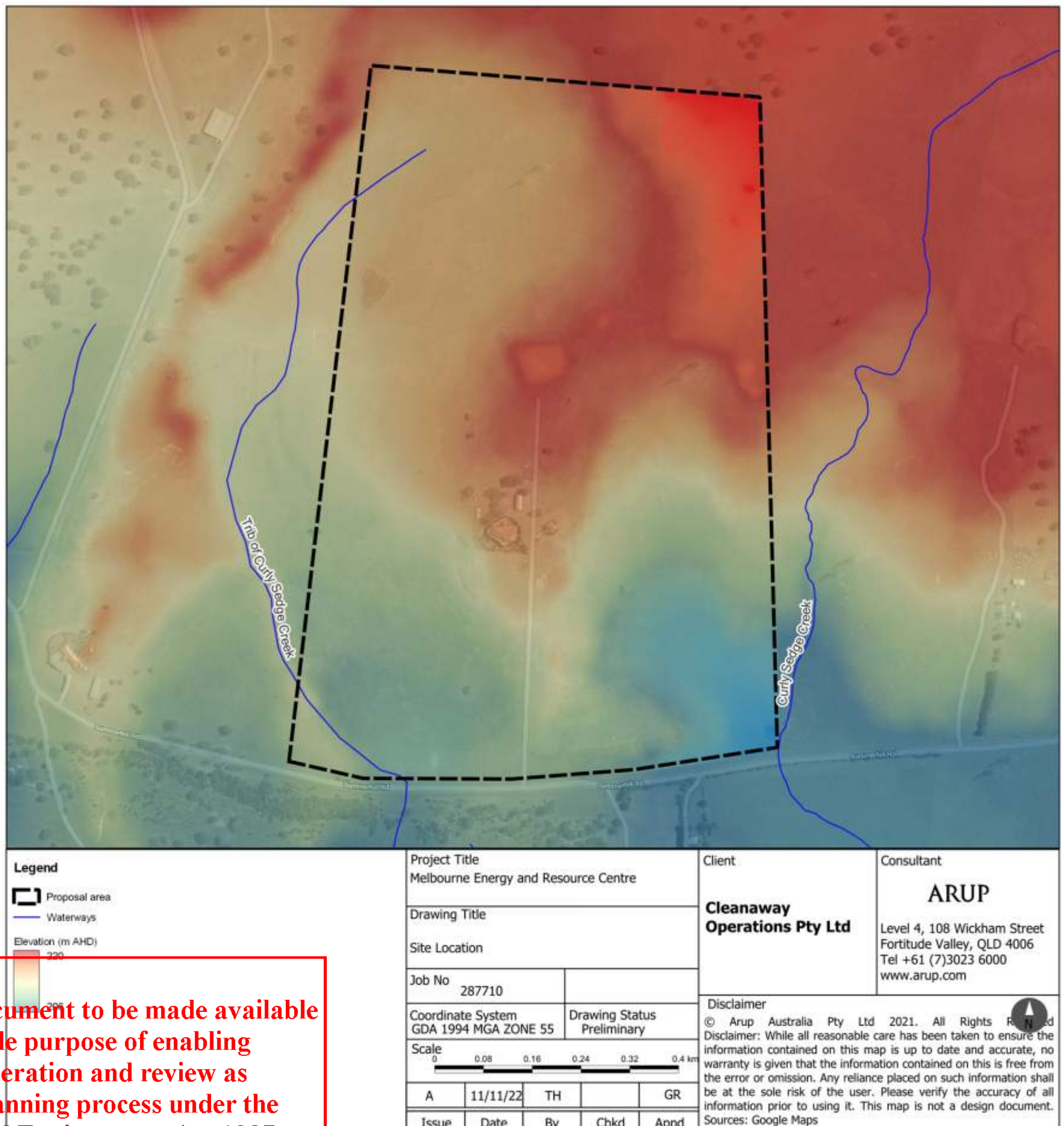



Figure 1: Proposal area

## 3.2 Catchment delineation

The Proposal area interacts with the catchments for Curly Sedge Creek and a tributary of Curly Sedge Creek (Tributary 4545), as shown in Figure 1.

The catchment area contributing to the Proposal was delineated using Vicmap Elevation DEM 10m LiDAR data obtained via the ELVIS platform. The sub-catchment delineation for the Proposal is shown in Figure 2.

At the southern end of the Proposal area, the upstream contributing area for the Curly Sedge Creek and Tributary 4545 catchments are 2.0km$^2$ and 2.6km$^2$ respectively.

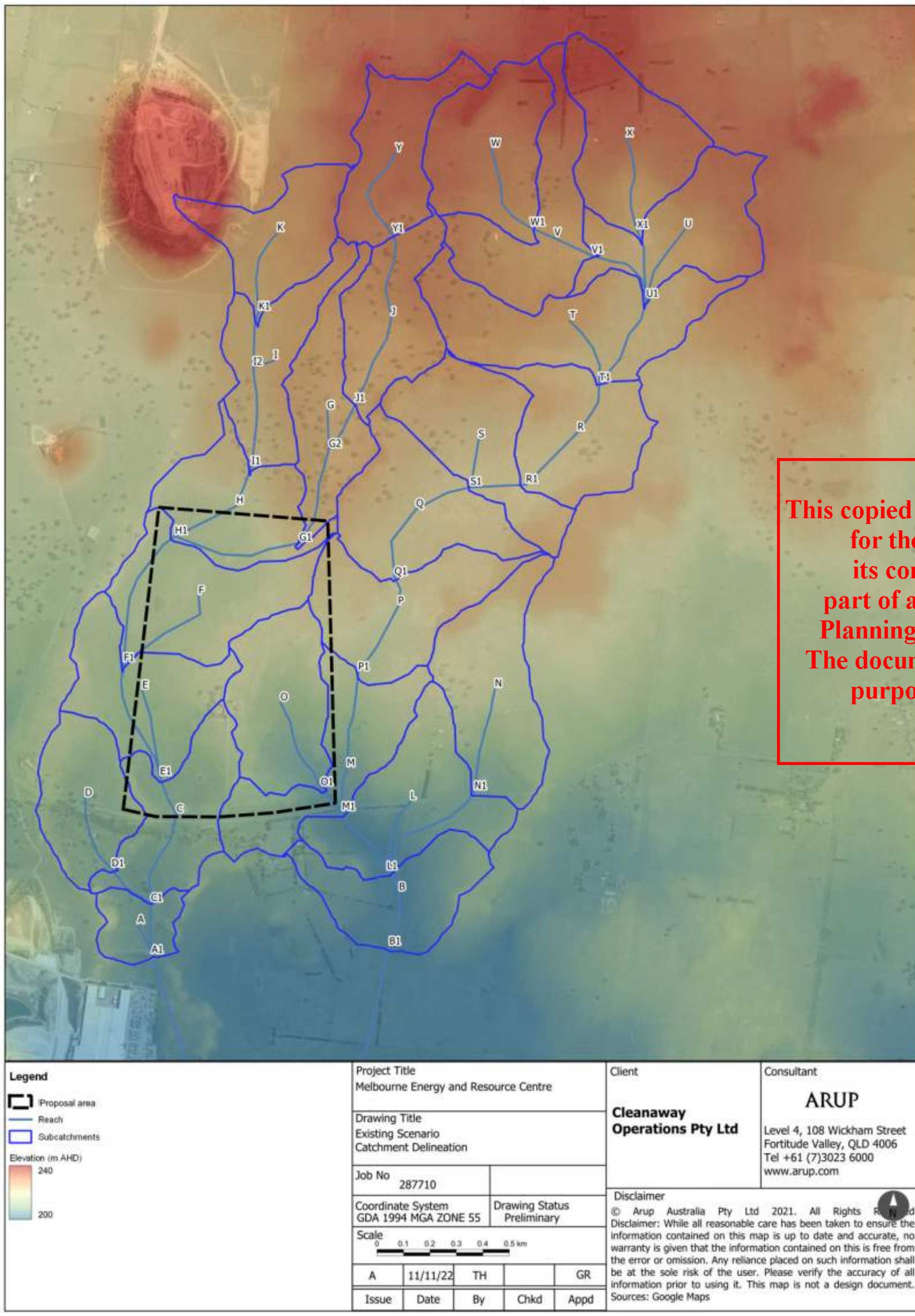



**Figure 2: Catchment delineation for the Proposal**

## 3.3 Existing stormwater management

The Proposal area generally falls from north to south and includes a ridge-line that runs from the north-east boundary of the site through the centre of the site in a north-south direction to the centre of the site at the southern boundary. This creates two primary stormwater catchment areas; an eastern and western which flow south beyond Summerhill Road and ultimately to Merri Creek. Along the southern boundary of the Proposal area, adjacent to Summerhill Road, existing levels vary from the central high point at RL 209.2mAHD to low points RL 207.6mAHD to the west and RL 203.4mAHD to the east.

The existing site stormwater networks includes two mapped waterways, Curly Sedge Creek and its Tributary 4545 along with a small farm dam.

Two small culverts are present beneath Summerhill Road which conveys flows from both Curly Sedge Creek and Tributary 4545. The two cross drains running below Summerhill Road are estimated to be DN 225 / DN 300 in size.

As the Proposal area is largely greenfield, there is no formal pit and pipe network present within the Proposal area. The existing site consists mainly of open farmland and does not contain any existing water quality infrastructure. There is also no formal stormwater road drainage serving Summerhill Road to the south, which comprises an unbound gravel surface.

### 3.3.1 Curly Sedge Creek and Curly Sedge Creek Tributary 4545 watercourse delineation

Stakeholder engagement with Melbourne Water (summarised in Section 2.4) identified Curly Sedge Creek and Curly Sedge Creek Tributary 4545 as the two watercourses located within the study area as shown in Figure 1.

A combination of GIS, site survey and an independent geomorphologic assessment have been utilised to identify the location of both watercourses within the study area to ensure the Melbourne Water setback requirements are achieved: "*setback from the 'top of bank' of both waterways to the satisfaction of Melbourne Water to ensure adequate protection of water quality and river health*" (Melbourne Water, 2022).

The location of Curly Sedge Creek was found to be clearly defined in available topographical data and distant from any potential design activities, whilst the location of Curly Sedge Creek Tributary 4545 was undefined and required additional investigations.

To identify the location and assess the potential value of Curly Sedge Creek Tributary 4545, Cleanaway commissioned a detailed topographical site survey in addition to an independent assessment by a fluvial geomorphologist.

The detailed topographical site survey, completed by Melbourne Land Surveyors, could not find any evidence of a defined watercourse.

The fluvial geomorphological assessment (510 Summerhill Rd Waterway Assessment, Streamology, 2022) concluded that:

- *"The waterway mapped as Tributary 4545 is a very poorly defined, discontinuous channel"*
- *"No geomorphic values are associated with Tributary 4545, located within the study site and there are limited habitat values (e.g. large wood, riparian vegetation) along the waterway"*
- *"Considering only the geomorphic values, form and trajectory of Tributary 4545, the waterway is a good candidate for realignment as a constructed waterway."*

For reference, the full report from Melbourne Land Surveyors and Streamology are included in Appendix 65 and 66 respectively.

## 3.4 Flood risk assessment methodology

Hydrologic and hydraulic modelling has been completed to assess the risk of flooding within the Proposal area. A summary of the hydrological and hydraulic modelling methodologies is provided in this section. Detailed information covering model setup and parameters is provided in Appendix B.

### 3.4.1 Hydrologic modelling

Hydrologic modelling was undertaken in RORB (version 6.45) for the purpose of providing inflows to the TUFLOW hydraulic model.

The Australian Rainfall and Runoff 2019 (ARR 2019) guidelines and Bureau of Metrology (BoM) ARR 2019 Intensity-Frequency-Duration (IFD) rainfall inputs were adopted for the hydrologic modelling. Raw data outputs of the ARR 2019 Data Hub Summary and the BoM IFD Data can be found in Appendix C.

A RORB model was built based on upstream catchment areas for the project sub-catchments, as shown in Figure 3. The model has been developed based on guidance presented in ARR 2019 and Melbourne Water's AM STA 6200 Flood Mapping Projects Specification (2021).

A validation exercise was undertaken to demonstrate that flows predicted by the RORB model are suitable for use in the hydraulic modelling.

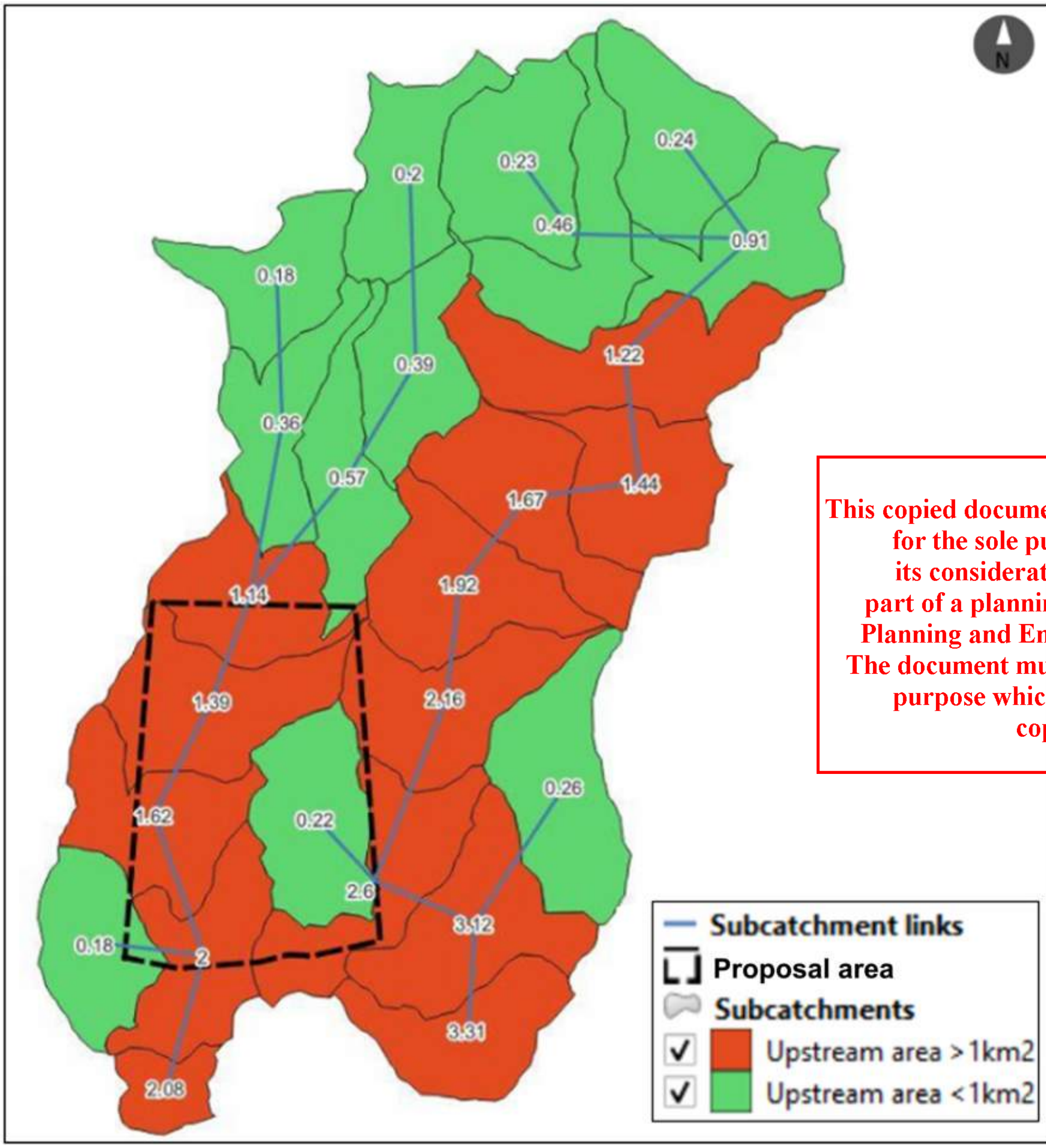





Figure 3: Upstream catchment areas (km$^2$)

### 3.4.2 Hydraulic modelling

The hydraulic modelling was undertaken using TUFLOW (version 2020-10-AD), a two-dimensional (2D) hydraulic modelling software. As no existing model that captured the Proposal area was available, a new TUFLOW model has been developed.

Generally, the model has been set up as per Melbourne Water preferred methodology, noting that the purpose of the model is to inform a feasibility assessment only. As a result, the modelling methodology has been simplified and will require review and update during later design stages. In addition to this, TUFLOW's HPC solver has been utilised. TUFLOW's Classic solver has been used to validate the HPC results for critical events as per the Melbourne Water Flood Modelling: HPC Guidance Note (2020). The validation exercise demonstrated that both solvers are producing similar results, the TUFLOW HPC solver is an appropriate solver to use in further modelling.

The TUFLOW model was used to simulate the full ensemble of storms shown in Figure 4.

**Table 2: Hydraulic simulations**

| Event | Storm durations | Temporal patterns (TP) |
|---|---|---|
| **20% AEP** | 15 min, 20 min, 25 min, 30 min, 45 min, 1 hr, 1.5 hr, 2 hr, 3 hr, 4.5 hr, 6 hr | Frequent temporal patterns TP1 to TP10 |
| **20% AEP under future climate conditions (2100)** | | |
| **10% AEP to 5% AEP** | | Intermediate temporal patterns TP11 to TP20 |
| **10% AEP under future climate conditions (2100)** | | |
| **2% AEP to 1% AEP** | | Rare temporal patterns TP21 to TP30 |
| **1% AEP under future climate conditions (2100)** | | |
| **PMF** | 15 min, 30 min, 45 min, 1 hr, 1.5 hr, 2 hr, 2.5 hr, 3 hr, 4 hr, 5 hr | PMP temporal pattern |

The hydraulic model extent, shown in Figure 4 captures all upstream sub-catchments and extents approximately 500m south of the southern extent of the Proposal area.

A 5m grid size has been adopted for both the critical duration analysis and design simulations of the Proposal.

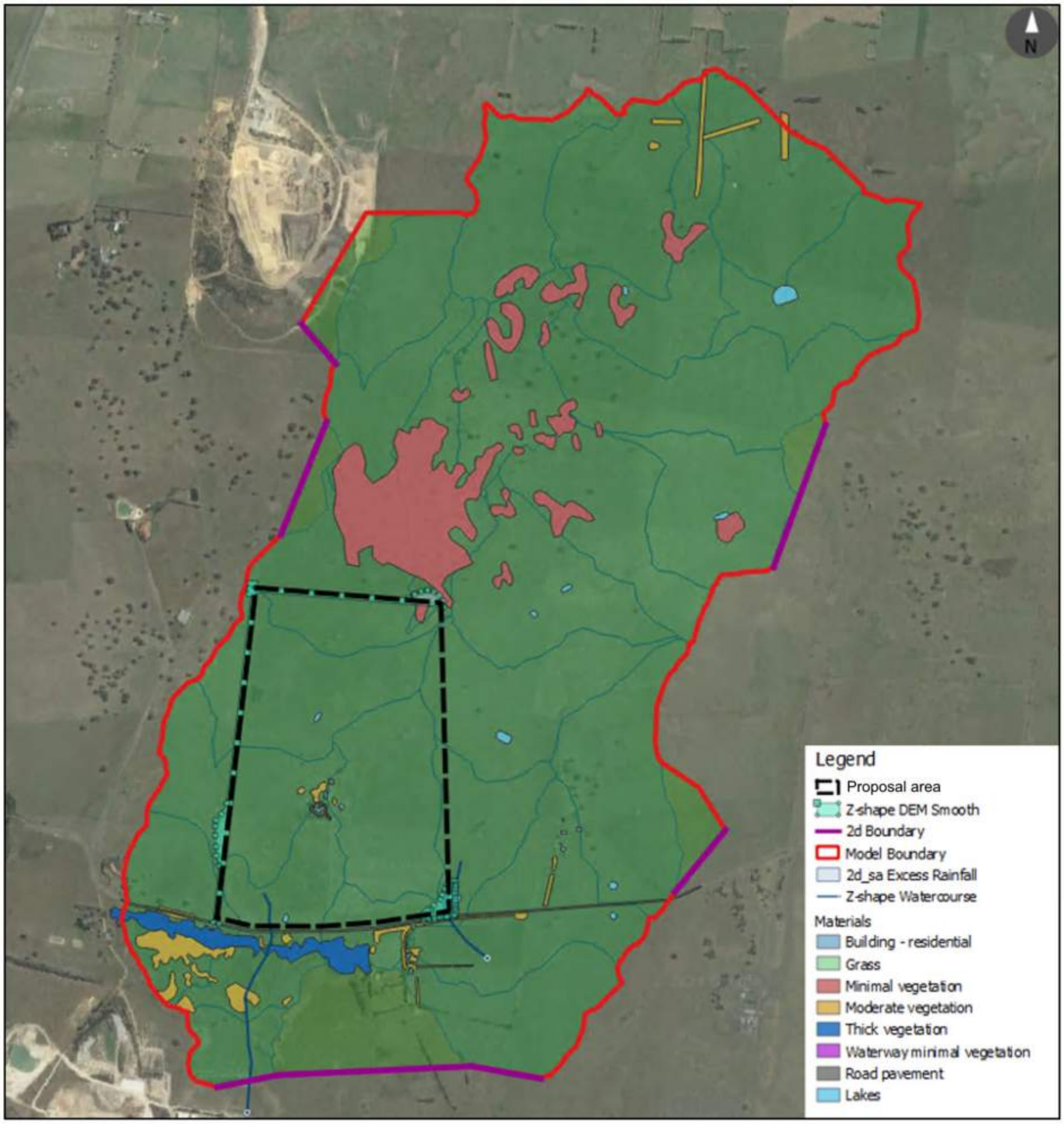



Figure 4: Hydraulic model configuration

### 3.4.3 Representation of Proposed Design

The proposed design layout is presented in Figure 5 and discussed further in Section 4. The key design elements related to the hydraulic modelling are summarised below:

- Internal site structures consisting of the waste-to-energy (WtE) facility (waste reception hall, waste bunker, boilers, flue gas treatment & stack, and steam power plant), IBA treatment area, substation, truck shed, visitor centre and noise wall;
- Stormwater attenuation and treatment basins;
- Internal roads and paved areas.

The following elements were incorporated into the hydraulic model to represent the design scenario:

- Site bulk earthworks: Proposed roads, basins and building pads were represented using the earthworks 3D design surface;

- Buildings and raised storage areas: Proposed buildings and raised storage areas (such as the visitor centre and IBA sorting building) were represented by manual modifications to the topography. These areas will be raised above the flood levels and so were represented in the flood model by 'Z Shapes' increasing the ground level by 10m. The footprints of proposed fill areas are shown in Figure 5;
- Changes in land use: Proposed changes in surface roughness associated with the development of buildings, roads and carparks were incorporated into the model by modifications to the surface material delineation. The Manning's *n* values adopted for the different land use types are shown in Figure 5. The delineation of land-use types is shown in Figure 5;
- Changes to the site's imperviousness associated with the proposed buildings and roads has not been incorporated into the hydrological modelling for this stage of design. That is, the existing scenario hydrology has been adopted for the design scenario. This is considered an appropriate approach as rainfall excess is directly applied to the design surface. Therefore, the hydrological processes which would normally be calculated in the hydrology model package are largely calculated within the hydraulic model.


**Figure 5: Design model setup**



## 3.5 Water quality methodology

To demonstrate compliance with the Best Practice Environmental Management (BPEM) Guideline objectives, MUSIC (Model for Urban Stormwater Conceptualisation) computer software (version 6) was used.

MUSIC is a conceptual model and applies typical pollutant generation rates to the Proposal catchments to inform of the type and size of stormwater treatment devices required.

## 3.6 Surface water management methodology

The stormwater management strategy has been devised in accordance with relevant Whittlesea Council, Melbourne Water and Victoria Planning Provisions requirements. In accordance with Council requirements, the system will be required to attenuate stormwater discharge and provide water quality measures.

The required storage volumes for the attenuation basins were determined using the Whittlesea Council on-site detention permissible site discharge (PSD) and site storage requirement (SSD) set out in Guidelines for Urban Development, Dec 2015, City of Whittlesea.

Assessment of existing stormwater discharge was determined in DRAINS software assuming a 95% pervious surface, reflective of the present-day agricultural nature of the Proposal area.

DRAINS was used to determine the minimum storage volumes of attenuation basins based on the developed footprint of the Proposal area. The concept stormwater drainage design will include a minor network of inlet pits and pipes with a capacity to convey the 10% AEP event. The site drainage network will be split into two primary catchment areas consistent with the existing site conditions.

Concept stormwater pipe sizing was completed using the drainage design module in in 12-D version 14.

## 3.7 Existing land-use and imperviousness

The Whittlesea Planning Scheme presented in Figure 6 shows that the existing catchment is primarily farming and rural zones. The footprint of the impervious elements (road, driveway, buildings) is insignificant in comparison to the catchment and, therefore, the existing catchment is considered to be 100% pervious.

Adopted rainfall losses for the catchment are described in Appendix B.

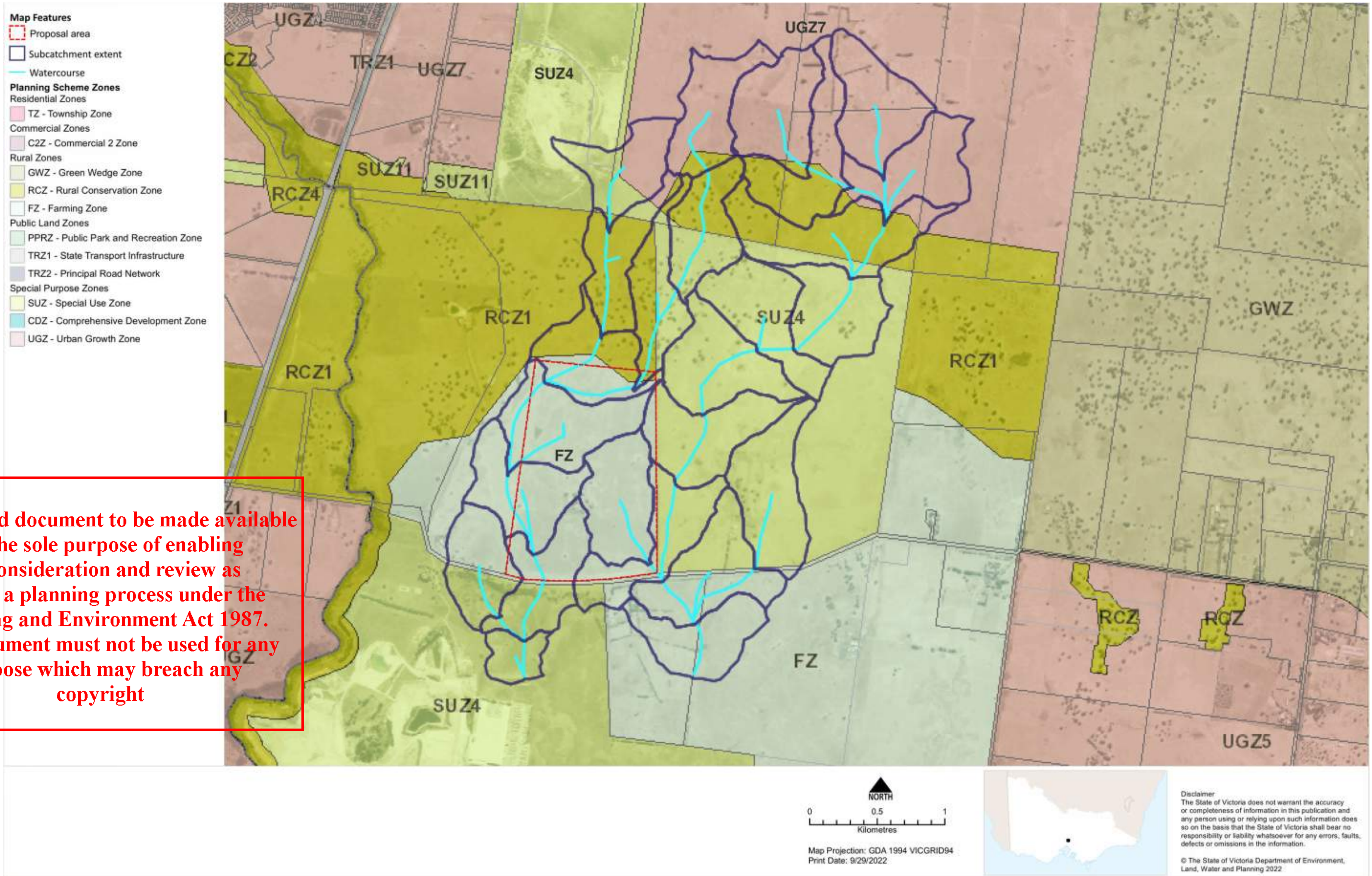





**Figure 6: Whittlesea Planning Scheme Landuse map (Source: VicPlan, 2022)**

## 3.8 Existing flood behaviour

The flood model has been simulated for the existing case scenario for the events listed in Table 2. The purpose of this modelling is to understand the existing flood behaviour and inform initial site layout and design considerations.

Peak flood level and depth results for the 50% AEP, 1% AEP and PMF events are presented in Figure 8, Figure 9 and Figure 10 respectively. Peak flood hazard results for the 1% AEP and PMF events are presented in Figure 11 and Figure 12 respectively.

Hazard categories are described in Figure 7. Focus has been on the 1% AEP event and the PMF event due to the requirements for the proposed development.

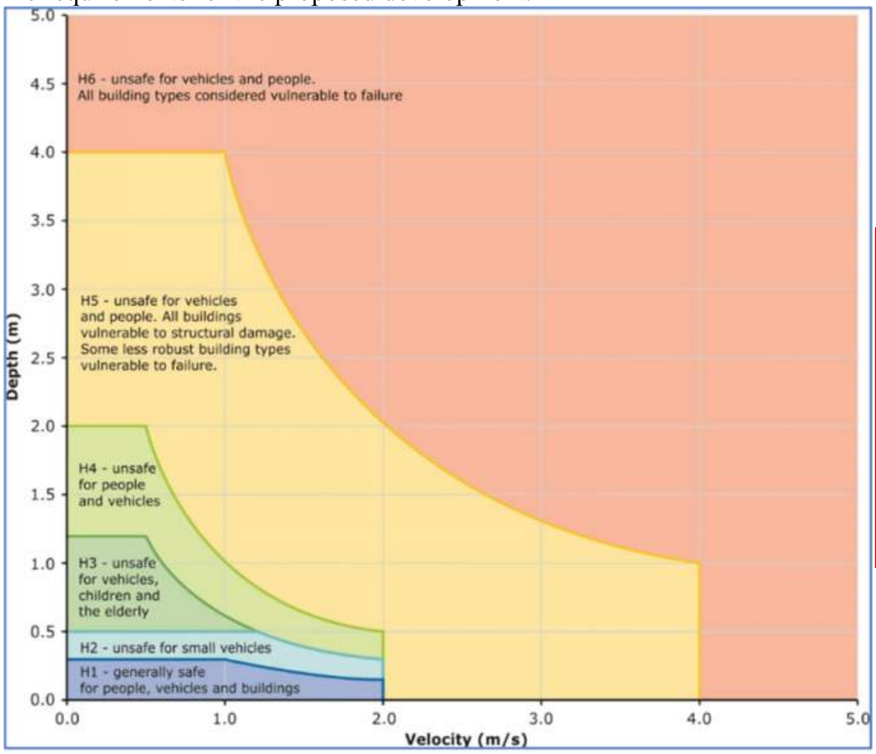
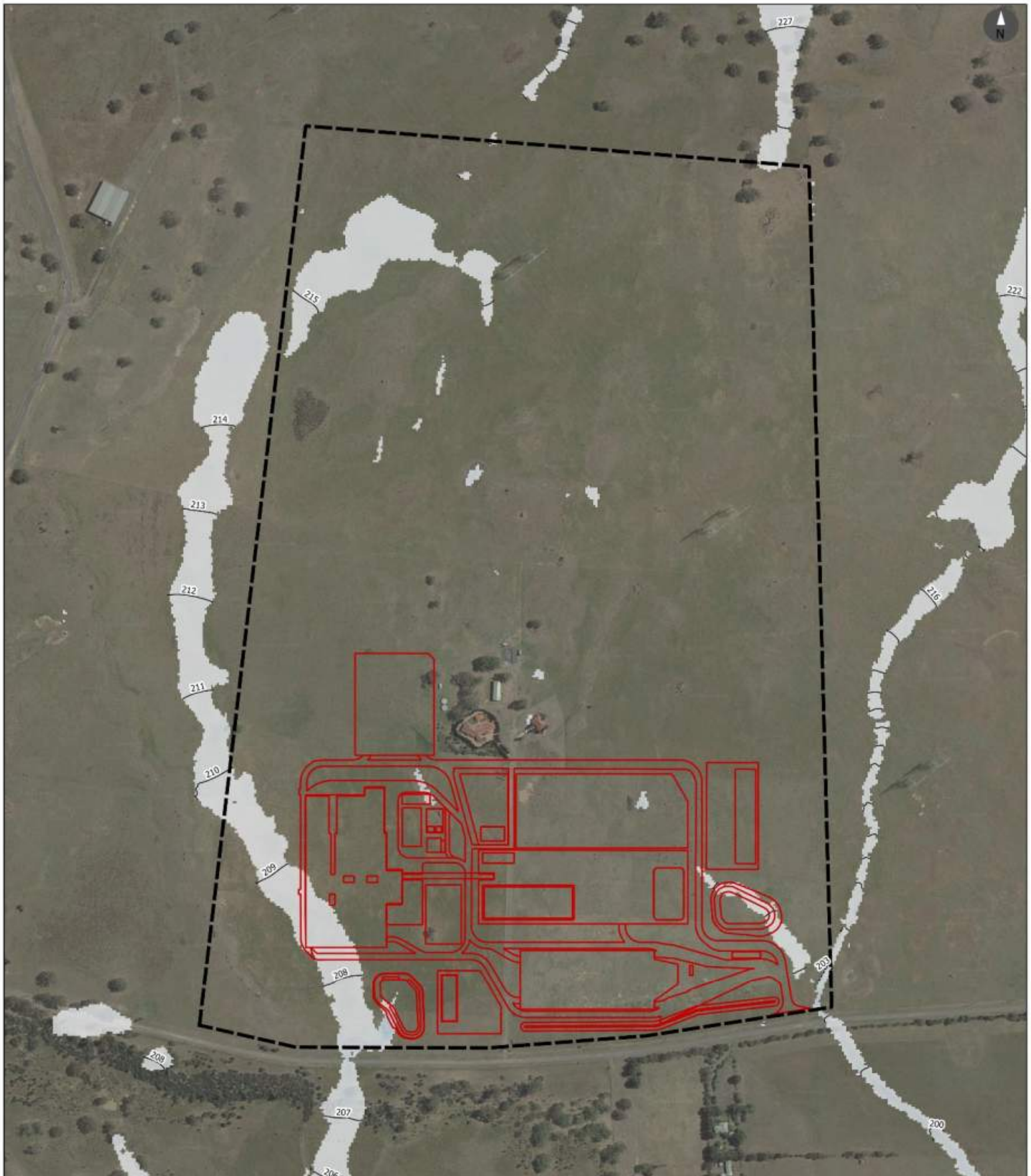





**Figure 7: Flood hazard curves (Smith, et.al., 2014)**

Key observations for the existing scenario flood conditions in the 1% AEP and PMF events are:

- Critical storm durations within waterways (Curly Sedge Creek and the tributary of Curly Sedge Creek) at the site are in the order of 1 hour to 3 hours. Critical storm durations for overland flows are within the order of 20 minutes to 30 minutes
- In the 1% AEP event, peak flood depths within the watercourses are shallow and less than 500mm
- In the 1% AEP event, peak flood flows are generally within waterways, with the exception of an area of overland flow in the north-east corner of the Proposal area. Note that flood depths less than 50mm are not shown on the figures below (due to the nature of the inflows in which all cells receive some flow depth due to the rain-on-grid approach adopted)
- In the PMF event:
  - Peak flood depths are less than 2m
  - The extent of overland flood flows is significantly greater (when compared to the 1% AEP event) with a majority of the Proposal area experiencing overland flow inundation
  - The peak flood hazard (depth-velocity product) for the PMF event (shown in Figure 11 and Figure 12) further indicates areas of the Proposal area less suitable for development without changes to the watercourse alignment and terrain.




Legend
- Project area
- Design Layout
- Peak Flood Level Contours (m AHD)

Peak Flood Depth (m)
2.2
0.05

| | | | | |
|---|---|---|---|---|
| Project Title<br>Melbourne Energy and Resource Centre | | | | |
| Drawing Title<br>Existing scenario<br>50% AEP peak flood levels and depths | | | | |
| Job No 287710 | | | | |
| Coordinate System<br>GDA 1994 MGA ZONE 55 | | | Drawing Status<br>Preliminary | |
| Scale 0 0.06 0.12 0.18 0.24 0.3 km | | | | |
| A | 20/11/23 | TH | | GR |
| Issue | Date | By | Chkd | Appd |

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Figure 8: 50% AEP peak flood levels and depths – existing scenario

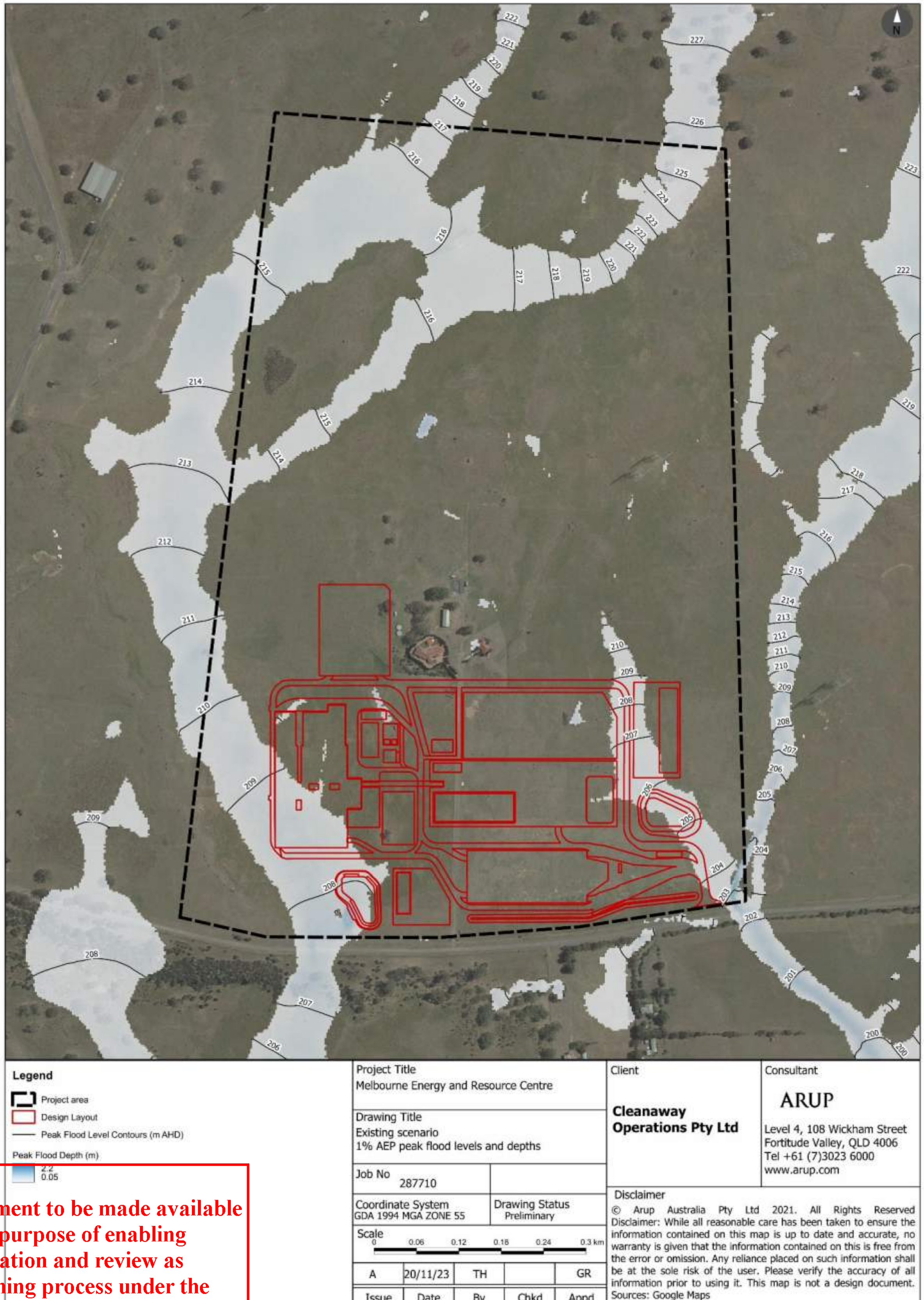


Figure 9: 1% AEP peak flood levels and depths – existing scenario

Legend
- Project area
- Design Layout
- Peak Flood Level Contours (m AHD)

Peak Flood Depth (m)
2.2
0.05

| | | | | |
|---|---|---|---|---|
| Project Title<br>Melbourne Energy and Resource Centre | | | | |
| Drawing Title<br>Existing scenario<br>PMF peak flood levels and depths | | | | |
| Job No<br>287710 | | | | |
| Coordinate System<br>GDA 1994 MGA ZONE 55 | | Drawing Status<br>Preliminary | | |
| Scale 0 0.06 0.12 0.18 0.24 0.3 km | | | | |
| A | 20/11/23 | TH | | GR |
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Sources: Google Maps



Figure 10: PMF peak flood levels and depths – existing scenario

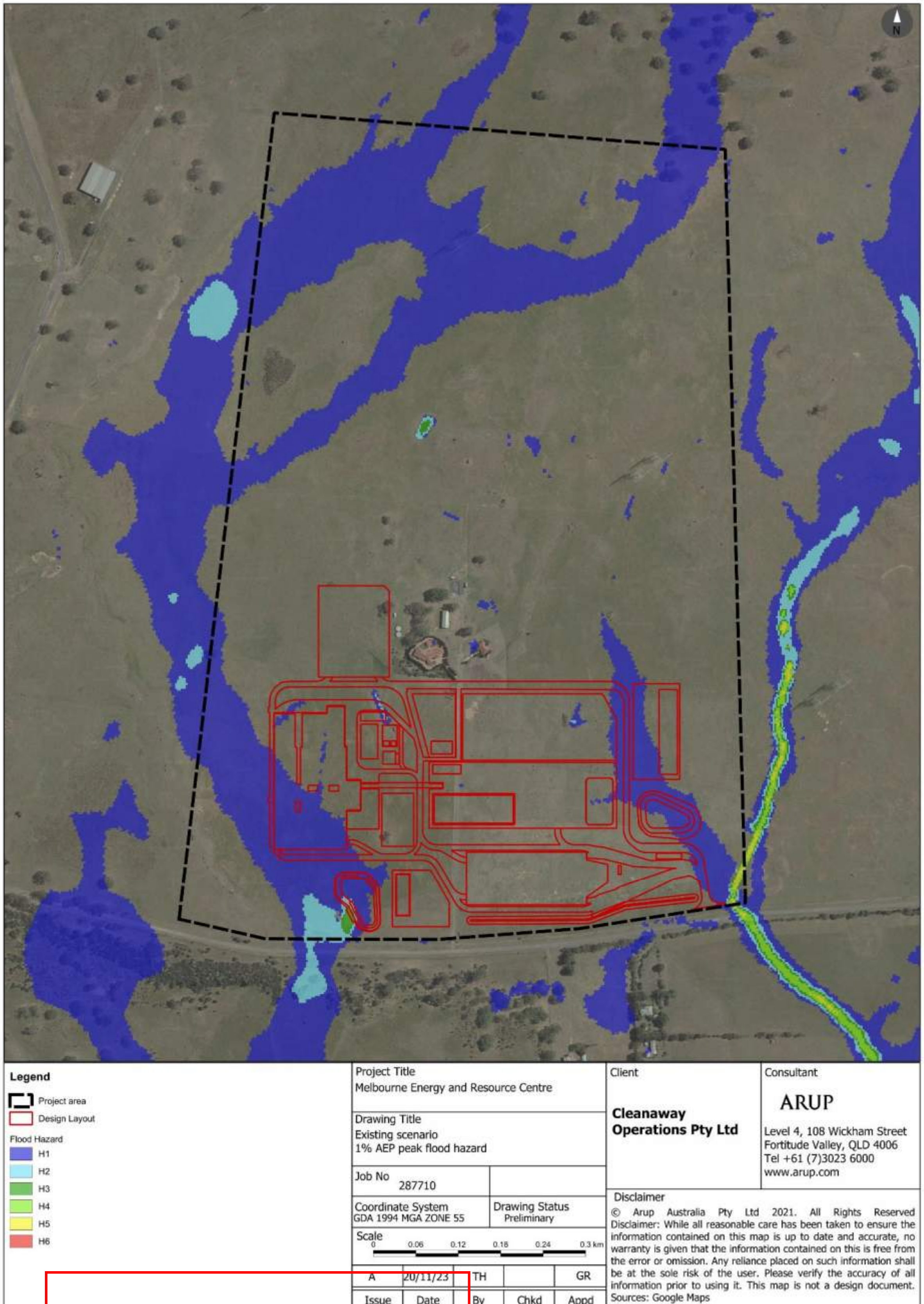



Figure 11: 1% AEP peak flood hazard – existing scenario

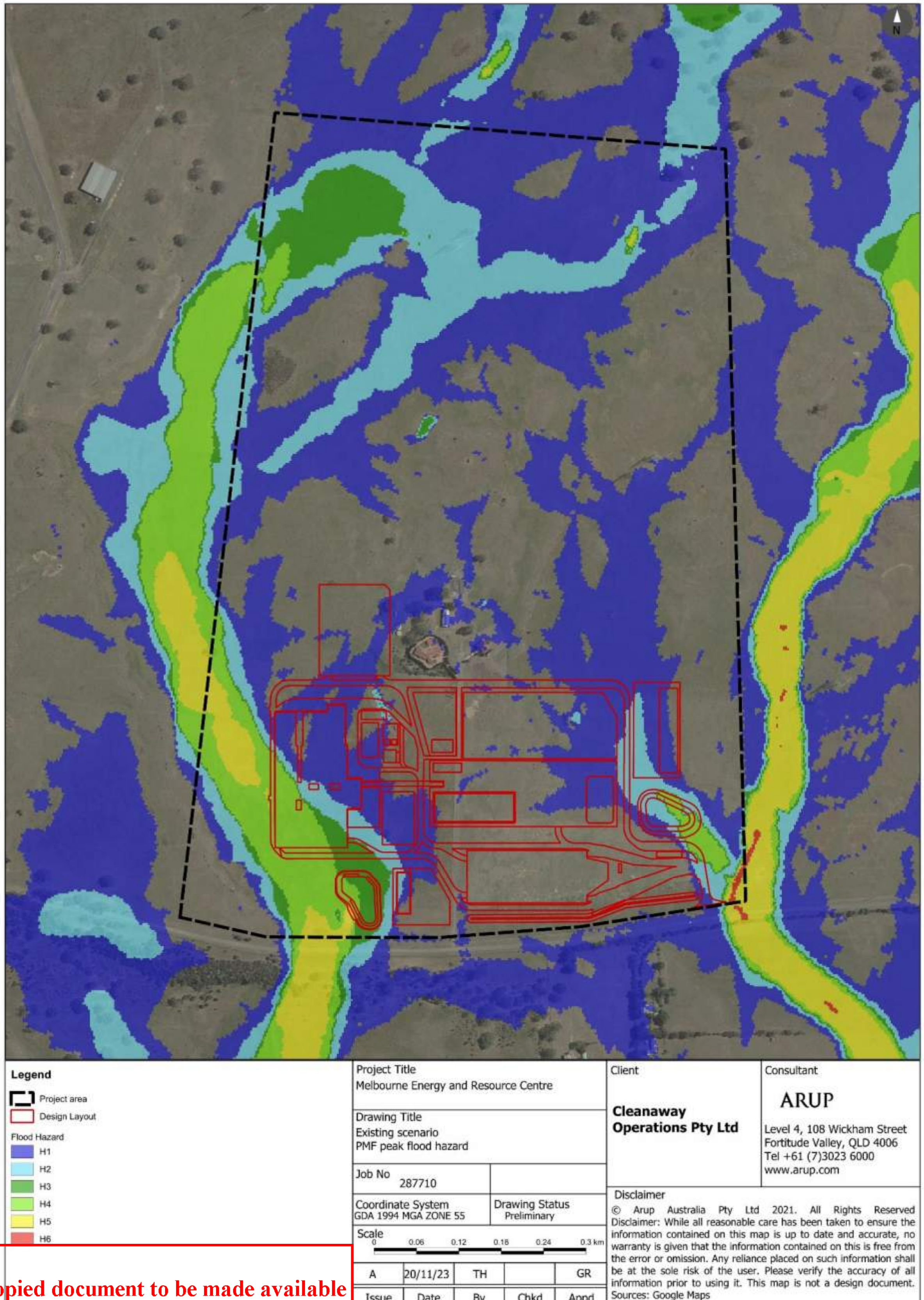



**Figure 12: PMF peak flood hazard – existing scenario**

# 4. Proposed surface water features and management

## 4.1 Site levels and grading

The over-arching design intent is to maintain existing catchments within the Proposal area. The primary circulatory access road around the WtE building has been set to largely follow the existing topography, including high points corresponding with the existing ridge-line through the site. This maintains a distinct eastern and western catchment within the developed site. Longitudinal gradients on primary site access roads typically range between 0.8% and 4.0%.

Levels within the western catchment, which includes the WtE building and circulatory road have generally been set above existing ground to mitigate impact from the existing overland flow path which runs near the western boundary of the Proposal area.

Hardstand surfaces typically fall away from the building perimeter to the outer kerbline at 2% to 3% crossfall. To encourage overland flows and prevent ponding outside the WtE building, the longitudinal gradient on both sides of the building falls to the south.

Sag points in the road network are positioned adjacent to proposed attenuation basins to maximise capture of stormwater runoff in the basins prior to site discharge. Within the western portion of the Proposal area, the sag point is positioned to the south of the tipping hall which permits a natural overland flow away from the building, towards the attenuation basin, in the extreme event of the stormwater system failing.

## 4.2 Proposed stormwater drainage

The concept stormwater drainage design includes a minor network of inlet pits and pipes. The developed footprint of the Proposal's drainage network has been split into two primary catchment areas consistent with the existing site conditions.

The western portion of the Proposal area will drain to the proposed attenuation basin at the south-west of the site. The proposed in-ground drainage network includes trunk lines on either side of the building and following the site access roads. These lines run from north to south consistent with the proposed site grading. The visitor centre building will also drain to the proposed basin. A portion of the visitor car park will bypass the attenuation basin and discharge directly to the overland flow path on the north side of Summerhill Road.

The eastern portion of the Proposal area will drain to the proposed attenuation basin at the south-east of the site. The proposed in-ground drainage network includes trunk lines following the road network. These lines run from west to east and north to south consistent with the proposed site grading. Drainage stubs have been provided for large hardstand areas such as the articulated truck parking, truck shed and A-double decoupling areas. Internal drainage for these areas will be developed during future design stages. A portion of the site access roads at the south-east of the site at the access from Summerhill Road will bypass the attenuation basins due to site levels and discharge directly to the overland flow path at the south-east of the site.

Runoff from the IBA treatment area will be separated from other site runoff and stored and treated in a lined retention basin at the west of this area. In order to minimise catchment redistribution, clean runoff from the IBA building will discharge to the east and ultimately drain to the south-east attenuation basin. For the purposes of sizing the eastern basin, hydraulic modelling has assumed a worst case scenario where no leachate generating activities occur and catchments 9A-1 and 8B-1 discharge to the stormwater system.

On-site detention for site runoff will be provided in two open basins, upstream of the two site stormwater discharge points. The basin at the south-west of the site will manage stormwater runoff from the western portion of the site before discharging to the overland flow path. The basin at the south-east of the site will treat runoff from the eastern portion of the site. Both basins will receive site flows from the trunk stormwater network, with inflows directed to the bioretention portion of the basins to maximise water quality treatment. Discharge from the basins will be through an outlet discharge pit and orifice in the side of the basin embankments.

The basins include emergency overflow spillways, positioned to allow 300mm freeboard above the estimated 10-year ARI (10% AEP) storage level.

The south-west basin has been designed with a storage capacity of approximately 2100m$^3$, with a maximum level of 208.1mAHD in the 10-year ARI (10% AEP) event.

The south-east basin has been designed with a storage capacity of approximately 1700m$^3$, with a maximum level of 204.3mAHD in the 10-year ARI (10% AEP) event.

The required storage volumes for the two basins have been determined using the Whittlesea Council on-site detention permissible site discharge (PSD) and site storage requirement (OSD) set out in the Guidelines for Urban Development, Dec 2015, City of Whittlesea.

Cut-off drains are proposed along the northern perimeter of the proposed development to separate "clean" water from the developed hardstands.

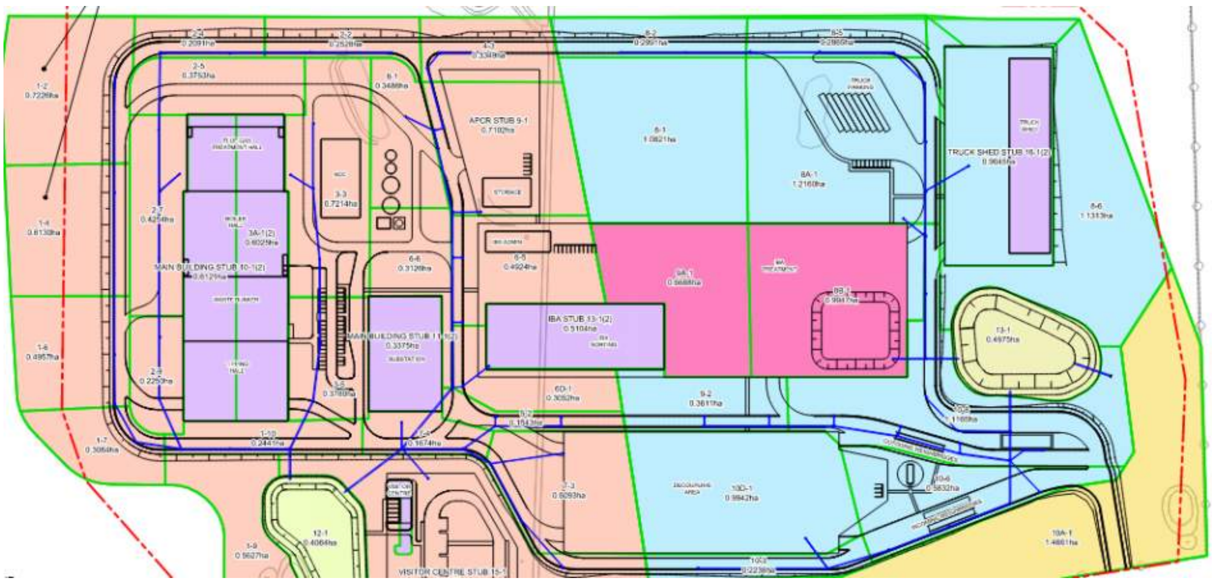


Figure 13: Proposed site stormwater drainage network

Each basin will include a bioretention portion of the basins to maximise water quality treatment. Discharge from the basins will be through an outlet discharge pit and orifice in the side of the basin embankments. Table 3 summarises the site discharge rates which are below the allowable PSD.

Table 3: Permissible Site Discharge

| Sub-catchment | Allowable PSD (5-yr ARI) | Post Development Discharge (ls) |
|---|---|---|
| **Western Outfall** | 0.788 | 0.641 |
| **Eastern Outfall** | 0.773 | 0.737 |

Concept stormwater design plans are presented in Appendix D.

## 4.3 Proposed water quality

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 4.

MUSIC modelling was completed based on the developed status of the Proposal area. Un-developed areas which are being retained as existing (i.e. 95% pervious) have been excluded from this assessment.



Table 4: MUSIC model sub-catchments

| Sub-catchment | % Impervious | Area (ha) |
|---|---|---|

| | | |
|---|---|---|
| Catchments Draining to South-Western Basin | | |
| **Main Building Roof West** | 100% | 0.612 |
| **Main Building Roof East** | 100% | 0.602 |
| **Visitor Centre Roof** | 100% | 0.120 |
| **IBA Roof** | 100% | 0.510 |
| **Substation Roof** | 100% | 0.338 |
| **Access Roads West** | 100% | 3.098 |
| **Western Hardstand** | 95% | 5.163 |
| **Western Vegetated Area** | 0% | 2.065 |
| **Bioretention/OSD Basin Direct Rainfall** | 100% | 0.404 |
| **Total – to South-Western Basin** | | 13.412 |
| Catchments Draining to South-Eastern Basin | | |
| **Truck Shed Roof** | 100% | 0.905 |
| **Access Roads East** | 100% | 2.725 |
| **Eastern Hardstand** | 95% | 4.542 |
| **Eastern Vegetated Area** | 0% | 1.817 |
| **Bioretention/OSD Basin Direct Rainfall** | 100% | 0.498 |
| **Total – to South-Eastern Basin** | | 12.901 |
| **Eastern Bypass Area** | | 2.010 |
| **TOTAL** | | **24.409** |

The stormwater network comprises the following elements:

- Four roof rainwater harvesting tanks for the main WtE building (2No), IBA building and visitor centre
- Stormwater pit and pipe networks which conveys flows towards the two bio-retention and on-site detention basins.
- A bioretention basin with a 700m$^2$ base filter area within the south-west attenuation basin
- A bioretention basin with a 600m$^2$ base filter area within the south-east attenuation basin
- Gross Pollutant Traps (GPT's) are provided upstream of inlets to each bio-retention basin.

Bio-retention basins have been modelled to feature an impermeable liner and 500mm thick filter media layer which promotes the removal of particulate and soluble contaminants that may be present in the stormwater runoff. A typical section through the combined bio-retention and on-site detention basin is contained within Figure 14.

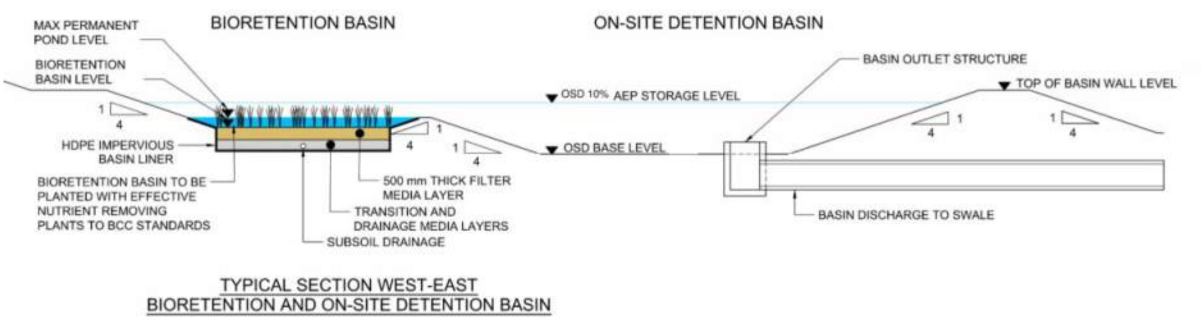



**Figure 14: Concept Design of Bio-Retention and on-site detention basin.**

The water demand to support the processes in the WtE building and IBA building far exceeds the volume of water that will be collected from the roof collection. For example, the boiler hall requires a continuous flow of approximately 7L/s to support the incineration process.

The southeast corner of the Proposal area is the lowest part of the site. This area can't be positively drained to either of the attenuation basins and has been assumed to bypass treatment measures.

Runoff from sensitive areas, where there is a risk of spills of chemicals or hydrocarbons, will be bunded to prevent an 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:

- Diesel refuelling area
- Electrical substation.

Runoff from the IBA treatment hardstand areas is also considered sensitive due to the potential for transportation of pollutants. Therefore, it is proposed to include a lined retention basin to contain stormwater runoff from this area and re-use within the maturation process. Management procedures will be implemented by the operator to minimise the catchment area draining to this retention basin.

The schematisation of the MUSIC water quality model is shown in Figure 15.

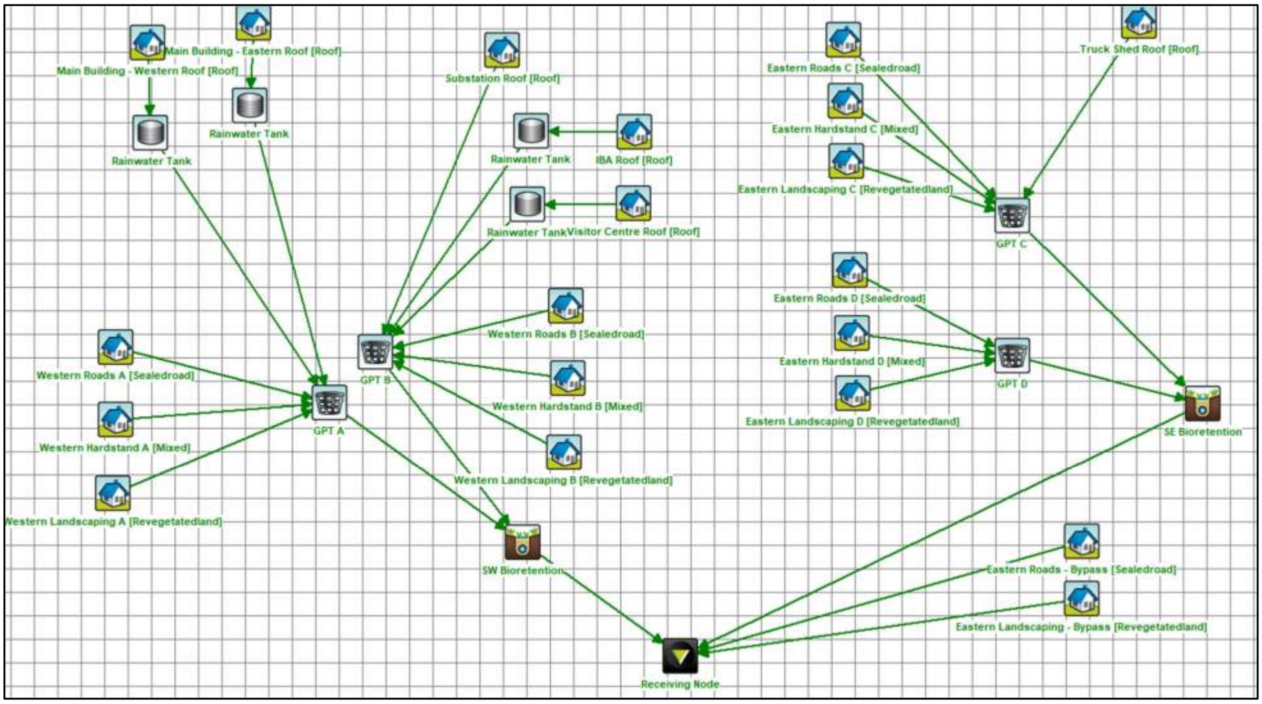



**Figure 15: MUSIC model schematisation**

The pollutant reduction results from the MUSIC model are summarised in Table 5. These results demonstrate compliance with BPEM requirements.

**Table 5: Summary of MUSIC model results**

| Pollutant | Source load (kg/yr) | Residual Load (kg/yr) | Reduction | Target Reduction | Target Achieved (Yes/No) |
|---|---|---|---|---|---|
| **Total Suspended Solids** | 16300 | 1470 | 91.0% | 80% | Yes |
| **Total Phosphorus** | 25.7 | 13.1 | 49.0% | 45% | Yes |
| **Total Nitrogen** | 313 | 86.6 | 72.3% | 45% | Yes |
| **Gross Pollutants** | 3940 | 221 | 94.4% | 70% | Yes |

# 5. Assessment of surface water risks

This chapter details the Hydrology and Flood Risk assessment in relation to both construction and operational phases.

## 5.1 Construction phase risks

### 5.1.1 Sediment and erosion control

A preliminary site geotechnical investigation found that basalt bedrock controls were present at depths between 0.3 m and 2.9 m with an average depth of 1 m with basalt rock outcrops identified throughout the Proposal area (Douglas & Partners, 2022). This indicates that there is limited risk of erosion.

Whilst erosion risk is limited, careful planning with regard to the phasing of clearing, excavation, stockpiling, and filling stages across the Proposal area 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 detailed Soil and Water Management Plan is to be developed for the construction stage, with reference to relevant guidelines.

Potential strategies to control sediment and erosion during the construction phase include:

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



Concept sediment and erosion control measures are shown in the engineering plans contained in Appendix D. The final design, sizing and location of these measures will be determined by the Contractor based on the proposed phasing of site works.

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 Proposal area, including at the site discharge point will also be undertaken throughout construction. To comply with requirements of City of Whittlesea Council's Site Environmental Management Plan, water discharged from Proposal area shall meet EPA Victoria water quality requirements.

### 5.1.2 Flood risk management

All construction compounds and main construction access tracks are to be located outside of the existing 1% AEP flood extent. The establishment of temporary drainage on site as outlined in Section 5.1.1 will be important to safely manage site stormwater runoff and minimise the risk of flooding during constriction.



## 5.2 Operation phase risks

### 5.2.1 Stormwater management

Peak stormwater flows, up to and including the 10-year ARI (10% AEP) event will be equal to or lower than pre-development conditions. The trunk stormwater system, pipes and attenuation basins have been designed to consider flows from the 10-year ARI (10% AEP) event as per Whittlesea Council's guidelines.

### 5.2.2 Stormwater quality

MUSIC modelling has been completed which demonstrates that no additional on-site water quality treatments measures are required. The site includes gross pollutant traps and rainwater harvesting tanks for water cycle management, which will further improve the quality of stormwater discharge. Oil and water separators are proposed to serve connections from the HV switching station.

### 5.2.3 Flood risk

As with the existing flood behaviour outlined in Section 3.8, the design case flood risk has been determined by simulating the TUFLOW model for the events listed in Table 2. Representation of the design scenario is described in Section 3.4.3.

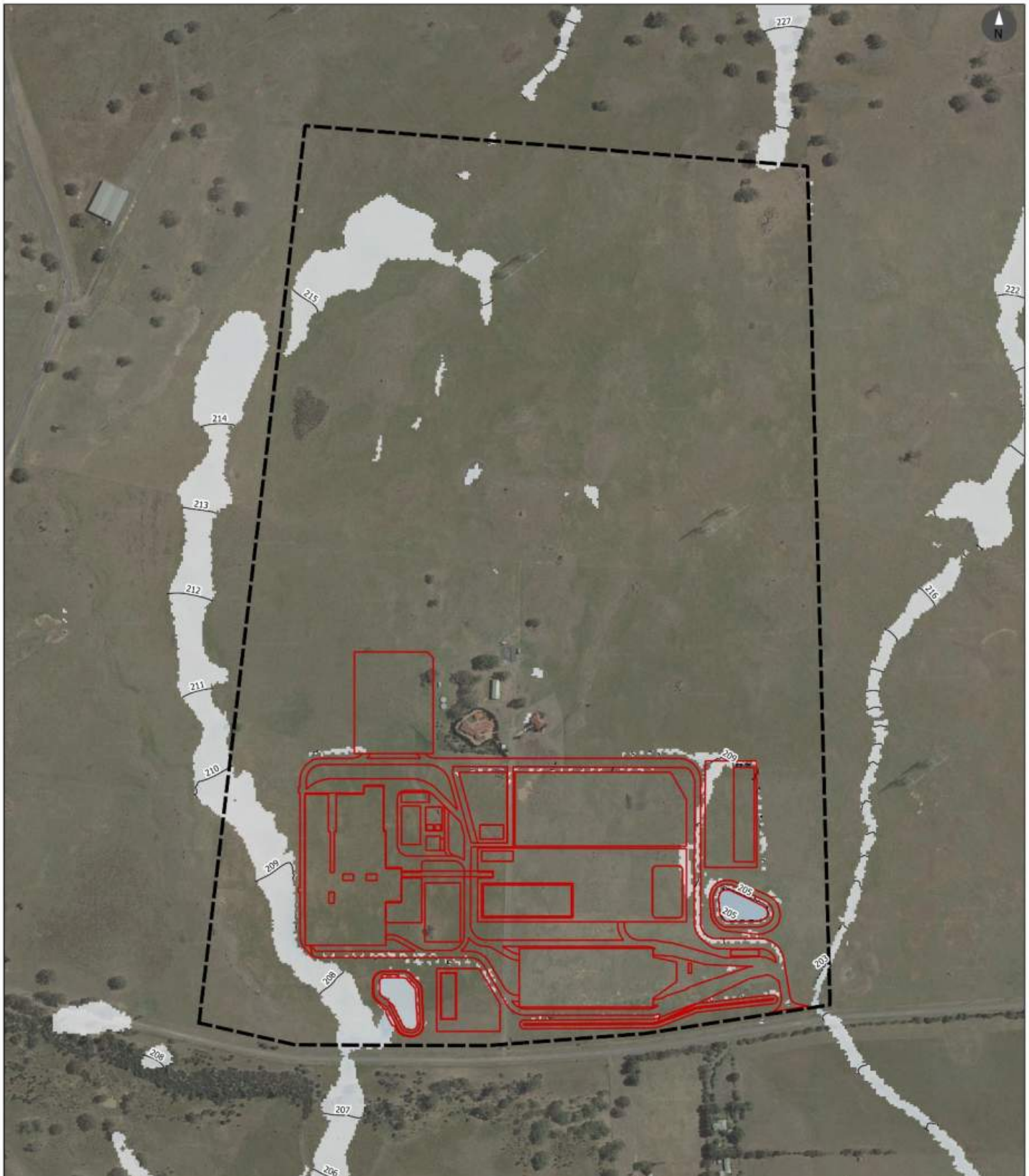
Peak flood level and depth results for the 50% AEP, 1% AEP and PMF events are presented in Figure 16, Figure 17 and Figure 18 respectively.

Peak flood hazard results for the 1% AEP and PMF events are presented in Figure 19 and Figure 20 respectively. Hazard categories are described in Figure 7.

The peak flood level impacts for the 50% AEP and 1% AEP event are presented in Figure 21 and Figure 22.

Key observations for the design scenario flood conditions in the 1% AEP and PMF events are:

- In the 1% AEP event, flooding is not observed within the Proposal area, with the exception of some minor ponding along both western and eastern access due to overland flow from external catchments, this will be managed by the proposed development road drainage design
- In the 1% AEP event, the hazard remains similar to the existing scenario with the exception of an area of low hazard (H2) within the western overland flow path where flows are slightly deeper than existing due to the proposed earthworks
- In the 50% AEP event, a minor reduction of up to 18mm in the peak flood level is observed downstream of the western attenuation basin due to the basin effectively attenuating flows
- In the 1% AEP event, no adverse impacts are predicted outside the Proposal area
- In the PMF event, peak flood depths are less than 2m within the Proposal area. Depths to the west of the site are generally less than 1.8m whilst to the east of the site, depths are less than 1.5m
- In the PMF event, the western access road and a portion of the eastern access road is affected by high hazard (H4 and H5).




Legend
Project area
Design Layout
Peak Flood Level Contours (m AHD)
Peak Flood Depth (m)
2.2
0.05

Project Title
Melbourne Energy and Resource Centre

Drawing Title
Design scenario
50% AEP peak flood levels and depths

Job No 287710

Coordinate System GDA 1994 MGA ZONE 55

Drawing Status Preliminary

Scale 0 0.06 0.12 0.18 0.24 0.3 km

| Issue | Date | By | Chkd | Appd |
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Sources: Google Maps

Figure 16: 50% AEP peak flood levels and depths – design scenario


Legend
Project area
Design Layout
Peak Flood Level Contours (m AHD)
Peak Flood Depth (m)
2.2
0.05

| | | | |
|---|---|---|---|
| Project Title: Melbourne Energy and Resource Centre | | Client: **Cleanaway Operations Pty Ltd** | Consultant: ARUP, Level 4, 108 Wickham Street, Fortitude Valley, QLD 4006, Tel +61 (7)3023 6000, www.arup.com |
| Drawing Title: Design scenario 1% AEP peak flood levels and depths | | | |
| Job No 287710 | | Disclaimer | |
| Coordinate System GDA 1994 MGA ZONE 55 | Drawing Status Preliminary | | |

Scale 0 0.06 0.12 0.18 0.24 0.3 km

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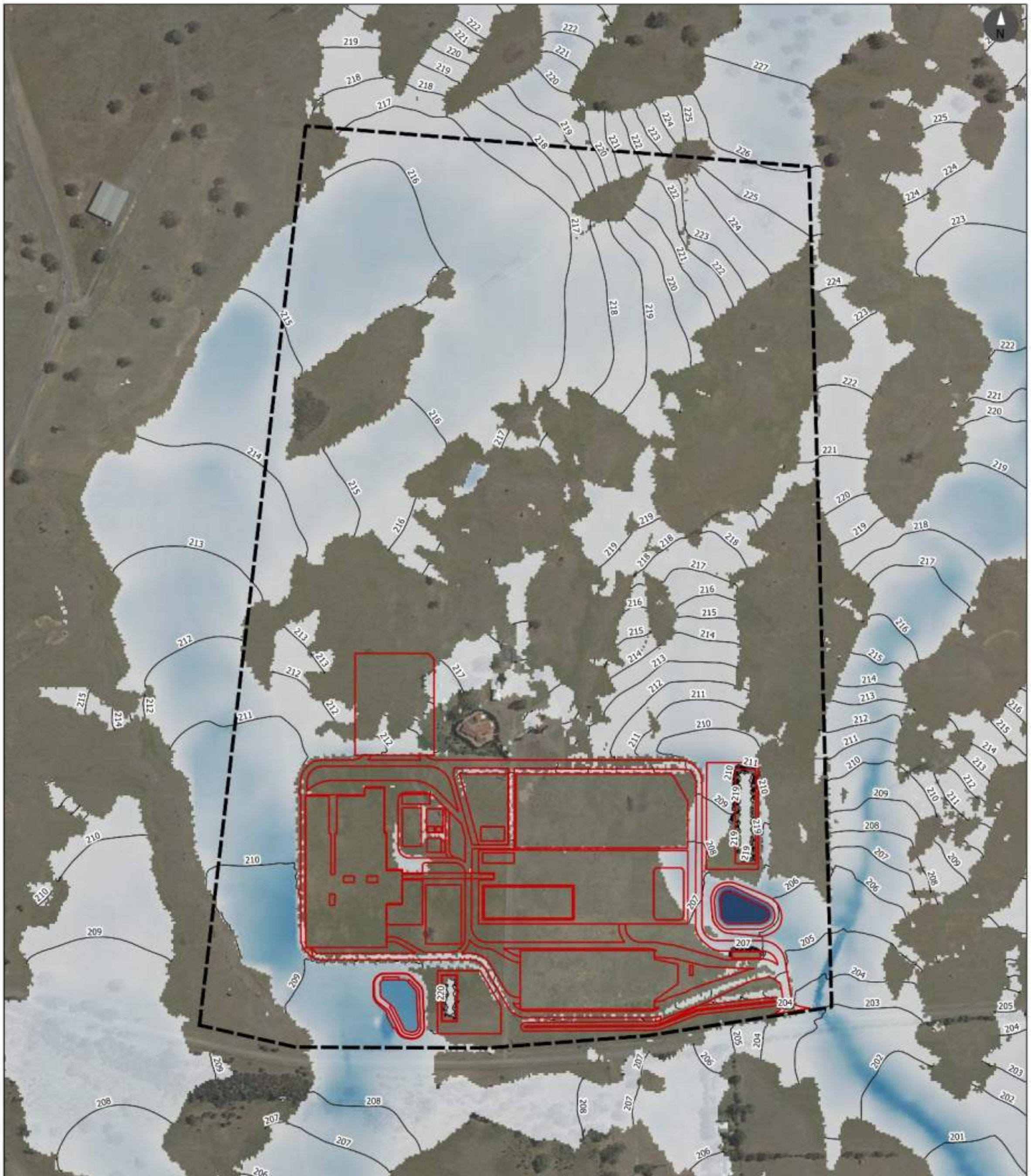
**Figure 17: 1% AEP peak flood levels and depths – design scenario**



Legend
- Project area
- Design Layout
- Peak Flood Level Contours (m AHD)

Peak Flood Depth (m)
2.2
0.05

| | |
|---|---|
| Project Title | Melbourne Energy and Resource Centre |
| Drawing Title | Design scenario<br>PMF peak flood levels and depths |
| Job No | 287710 |
| Coordinate System | GDA 1994 MGA ZONE 55 |
| Drawing Status | Preliminary |
| Scale | 0 – 0.06 – 0.12 – 0.18 – 0.24 – 0.3 km |

| Issue | Date | By | Chkd | Appd |
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Figure 18 PMF peak flood levels and depths - design scenario

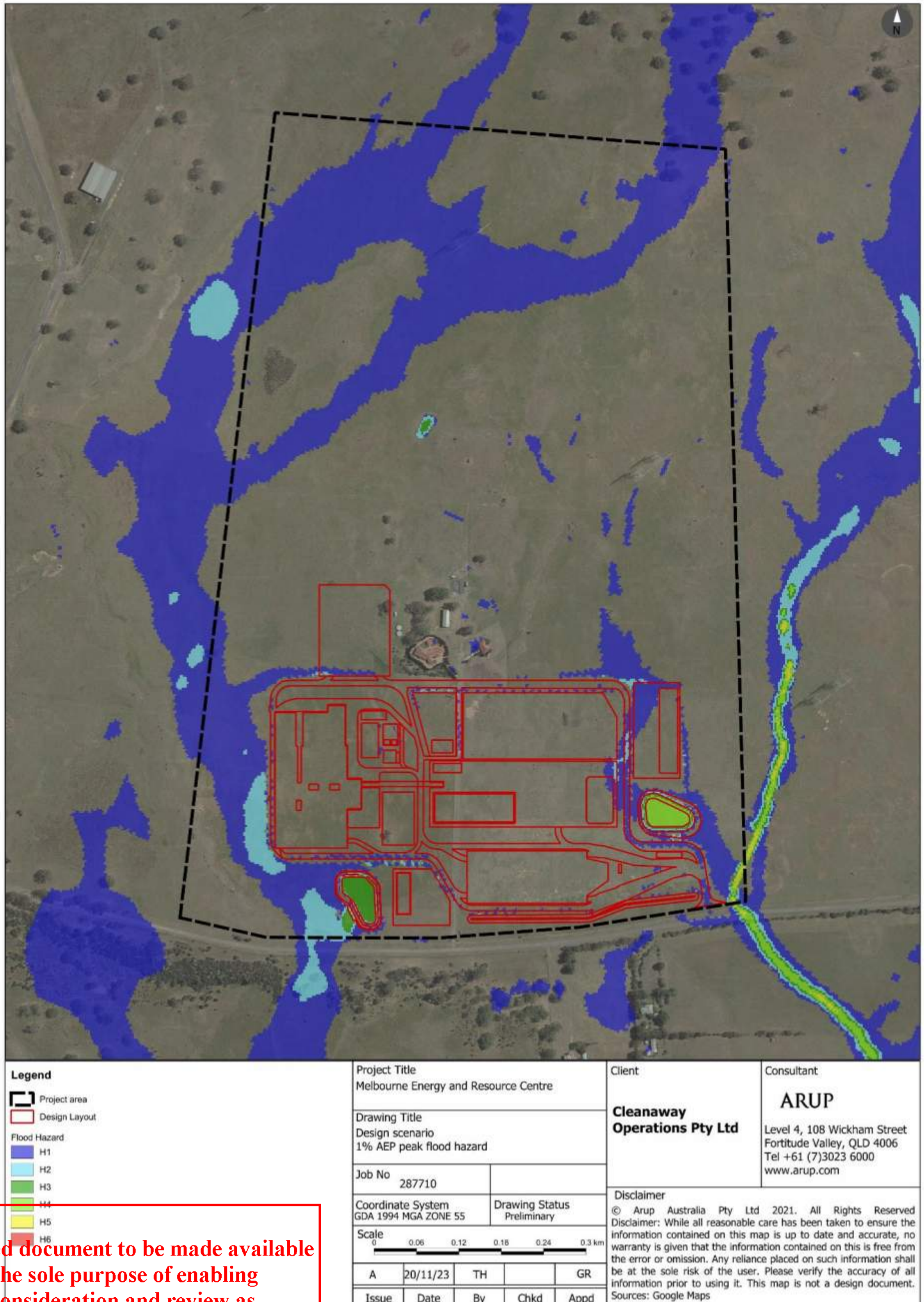



Figure 19: 1% AEP peak flood hazard – design scenario

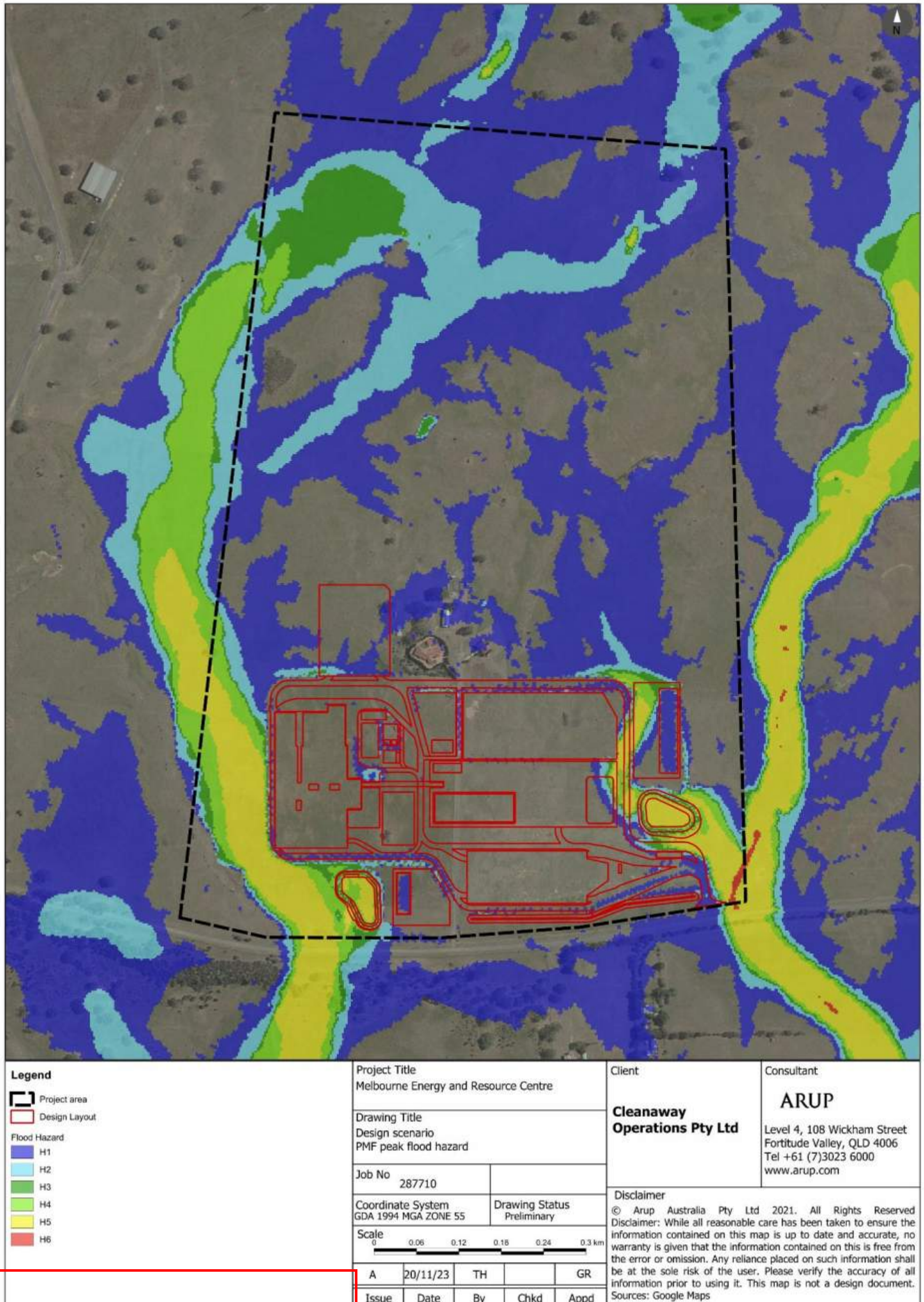



Figure 20: PMF peak flood hazard – design scenario

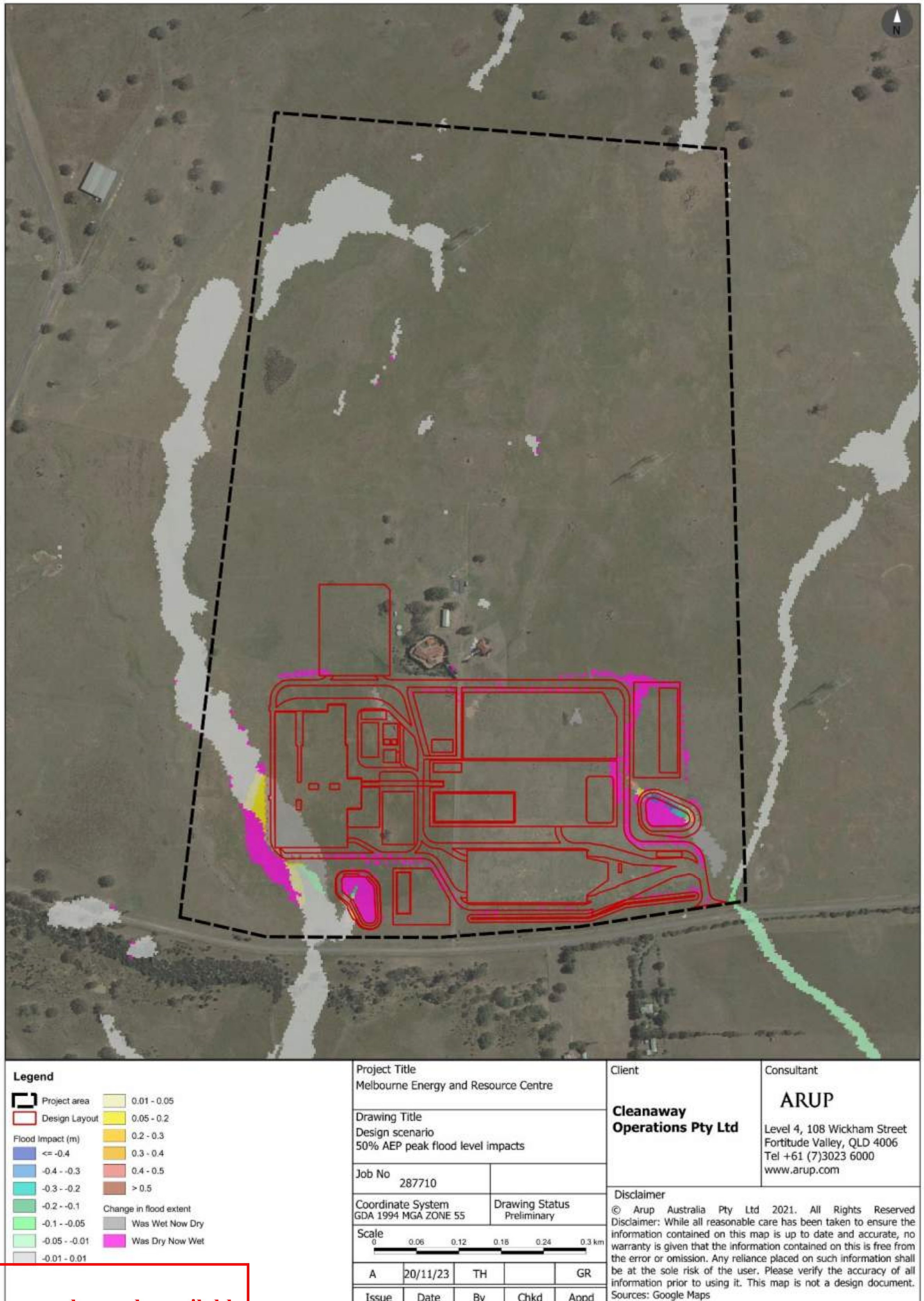



Figure 21: 50% AEP peak flood level impacts – design scenario

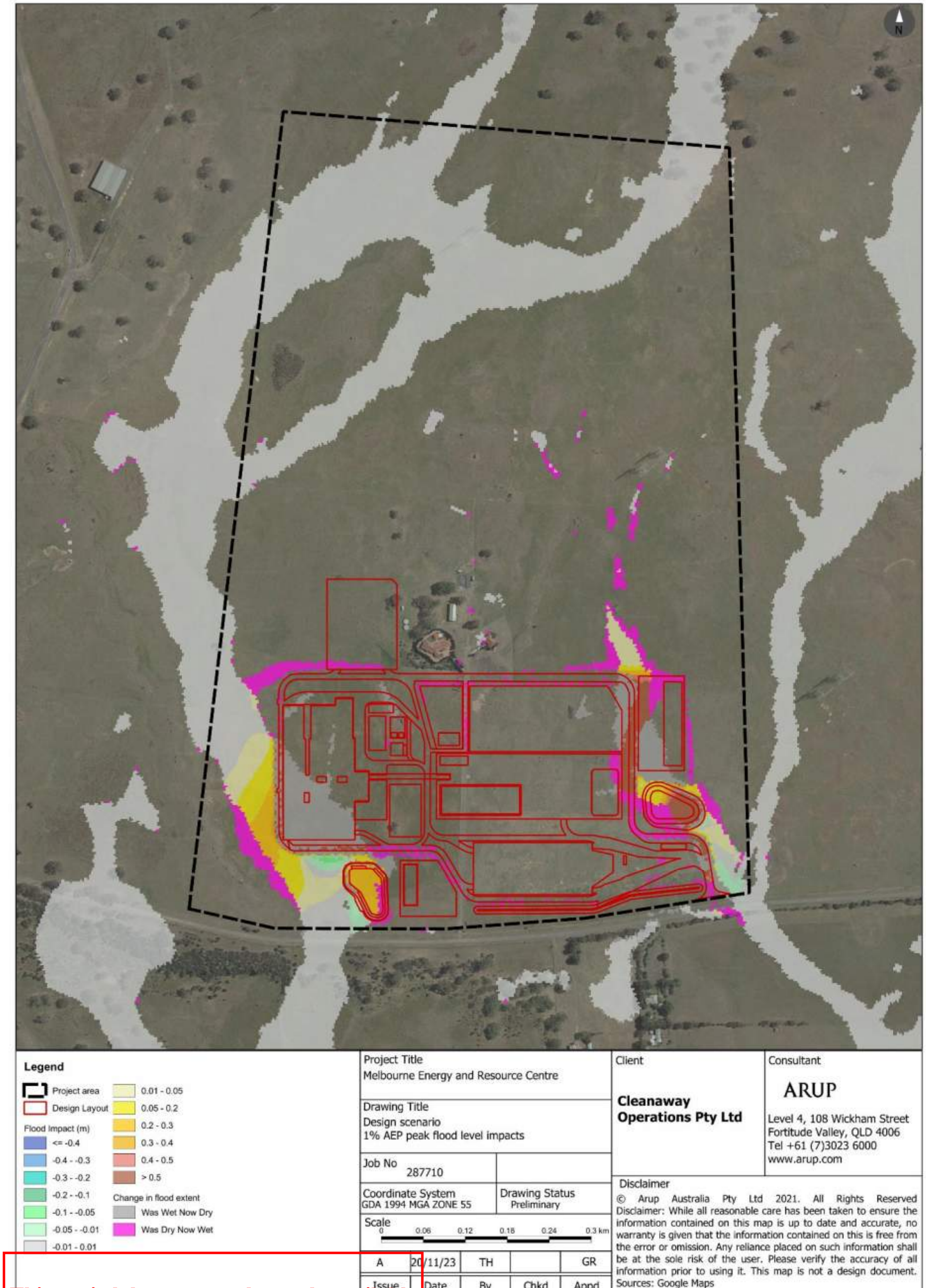



Figure 22: 1% AEP peak flood level impacts – design scenario

# 6. Proposed mitigation of risks

This section outlines proposed mitigation and management measures that have been developed to mitigate the potential Hydrology and Flood Risks of the Proposal during construction and operation phases.

## 6.1 Construction phase

During the construction phase, impacts on the environment will be mitigated by adopting the mitigation measures presented in Table 6.

**Table 6: Construction phase mitigation measures for Hydrology and Flood Risk**

| ID | Mitigation measure | Timing |
|---|---|---|
| **HYD1** | Implement a Soil and Water Management Plan comprising suitable erosion and sediment control measures such as 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. | Construction |
| **HYD2** | Reuse stormwater collected in sediment basins for dust suppression. | Construction |
| **HYD3** | The water quality of stormwater discharged from the site will be monitored by the contractor to ensure water quality objectives are met. | Construction |
| **HYD4** | 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. | Construction |

## 6.2 Operation phase

The design for the Proposal includes numerous features that will act to mitigate hydrology, surface water and flooding impacts. These are summarised in Table 7.

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 have 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.

**Table 7: Operation phase mitigation measures for Hydrology and Flood Risk**

| ID | Mitigation measure | Timing |
|---|---|---|
| **HYD101** | The design includes two on-site detention basins which have been sized to meet the City of Whittlesea Permissible Site Discharge rates and maintain flow to the 1.5 Year ARI pre-developed peak flow as required by BPEM Guidelines. | Operation |
| **HYD102** | The design incorporates water sensitive urban design elements which enable the proposal to meet BPEM pollutant reduction targets, including Rainwater harvesting system to collect runoff from the main building and reuse it for the WtE process, gross pollutant traps and bioretention basins. | Operation |
| **HYD103** | The design elements involving the storage or processing of potentially hazardous waste have been located outside the 1% AEP flood extents and above the PMF flood level to comply with DELWP regulations. | Operation |
| **HYD104** | Design earthworks have avoided impacting Curly Sedge Creek Tributary 4545 and remain at least 10m from the waterway ‘top of bank’. | Operation |
| **HYD105** | Potential downstream flood impacts are mitigated by the inclusion of two on-site detention basins | Operation |
| **HYD106** | The buildings within the development are proposed to be raised to a minimum floor level of 210.00mAHD to meet the minimum floor height requirement (600mm above the 1% AEP flood level). | Operation |

# 7. Conclusions

The Hydrology and Flood Risk assessment has been completed for the Proposal. The existing site conditions have been investigated and potential risks identified through the methodology presented.

The relevant environmental and planning regulations have been considered and addressed throughout the design development.

Risks have been assessed throughout the construction and operation stages with appropriate mitigation measures identified.

This assessment has concluded that:

- The two watercourses that pass through the Proposal area (Curly Sedge Creek and Curly Sedge Creek Tributary 4545) are not impacted by the proposed activity
- Flood modelling has demonstrated that the flood assessment criteria are met, including:
  - Critical design elements remain outside the 1% AEP flood extents and above the PMF flood level
  - Buildings are designed to be raised at least 600mm above the 1% AEP peak flood level
  - The proposed design does not result in impact outside the Proposal area
- The stormwater design has been developed to ensure that:
  - Match and maintain pre-development catchment boundaries
  - Flows are detained using on-site detention basins to meet the permissible site discharge requirements
  - Stormwater is treated to ensure the BPEM targets are met.

# 8. References

AM STA 6200 Flood Mapping Projects Specification (Melbourne Water, 2021)

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

Best Practice Environmental Management (BPEM) Guidelines (Victorian Stormwater Committee, 1999)

Environment Protection Act 2017 (State Government of Victoria, 2022)

Flood Risk Assessment Framework: How flood impacts are assessed in the Port Phillip and Westernport Region (Melbourne Water, 2010)

Guidelines for Development in Flood Affected Areas (Department of Environment, Land, Water and Planning (DELWP), 2019)

Guidelines for Urban Development (City of Whittlesea, 2015)

Melbourne Water standards for infrastructure projects in flood-prone areas (Melbourne Water, 2019)

Planning and Environment Act 1987 (State Government of Victoria, 2022)

Victoria Planning Provisions (VPP) Amendment VC154 (Department of Environment, Land, Water and Planning (DELWP), 2018)

Victorian Floodplain Management Strategy (State of Victoria Department of Environment, Land, Water and Planning, 2016)

Victorian Planning Policy Framework (PPF) (2021)

Water Act 1989 (State Government of Victoria, 2022)

Whittlesea Planning Scheme (Department of Environment, Land, Water and Planning (DELWP), 2022).

# Appendix A

## A.1 Reliance Statement

The sole purpose of this report, flood models and the associated services performed by Arup is inform the development license application of the proposed Waste to Energy facility in accordance with the scope of services set out in the contract between Arup and Cleanaway. In preparing this report, Arup has relied upon, and presumed accurate, information (or confirmation of the absence thereof) provided by Cleanaway and/or from other sources. Except as otherwise stated in the report, Arup has not attempted to verify the accuracy or completeness of any such information. 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.

Arup derived the data from information sourced from Cleanaway and/or available in the public domain at the time or times outlined in the report.

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 and is subject to, and issued in accordance with, the provisions of the contract between Arup and Cleanaway. Arup accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report by any third party.

# Appendix B

## B.1 Hydrologic modelling methodology

The methodology used to develop the hydrologic modelling undertaken in RORB for the purpose of providing inflows to the TUFLOW hydraulic model is summarised in this section.

### B.1.1 Design Rainfall

ARR 2019 (Book 2, Chapter 3) recommends that the updated BoM 2019 IFD is adopted for events up to the 0.05% AEP. These rainfall depths have been derived using a broad-scale national approach. Design rainfall depths were obtained from the BoM for the frequent, intermediate, and rare AEPs for each standard design storm duration outlined in BoM and ARR 2019.

Future climate conditions were incorporated into the modelling by increasing the BoM 2019 IFD rainfall intensities to be appropriate for the year 2100 using a Representative Concentration Pathway (RCP) 8.5 scenario. This RCP results in a rainfall intensity increase of 18.5% for the year 2100. As there is only future data available for up to the year 2090, extrapolation was used. This approach is consistent with the guidance in Melbourne Water's AM STA 6200 Flood Mapping Projects Specification (2021).

As described in Section 3.3, two catchments flow through the Proposal area, Curly Sedge Creek and Tributary 4545 (a tributary of Curly Sedge Creek). As the Proposal area is predominately within the catchment of Tributary 4545, the characteristics of Tributary 4545's catchment have been used to determine the Probable Maximum Precipitation (PMP). Due to the location of the Proposal and the short duration flooding, the GSDM methodology has been adopted to determine rainfall. The calculation sheet to determine rainfall is shown in Appendix E. A summary of the rainfall for each event duration is also shown in Table 8.

**Table 8: PMP rainfall intensities**

| Duration (hours) | 0.25 | 0.5 | 0.75 | 1.0 | 1.5 | 2.0 | 2.5 | 3.0 | 4.0 | 5.0 | 6.0 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Rainfall (mm)** | 130 | 190 | 240 | 280 | 320 | 350 | 380 | 400 | 430 | 460 | 490 |

### B.1.2 Areal Reductions Factors

Chapter 4 of Book 2 of ARR 2019 recommends that Areal Reduction Factors (ARFs) are applied when deriving hydrological estimates. To calculate ARFs for AEPs up to and including the 0.05% event, ARR 2019 provides an updated set of equations and coefficients. The catchment area and critical duration at points of interest in the catchment dictate what equation is used to calculate an ARF.

Where the catchment area upstream of a point of interest is less than $1km^2$ an ARF of 1.0 (i.e., no change in rainfall) should be applied.

The upstream catchment areas for the Proposal sub-catchments are shown in Figure 23. Red sub-catchments indicate sub-catchments with contributing area of greater than $1km^2$. As shown in Figure 23, the range of contributing areas for sub-catchments in the vicinity of the Proposal area is between 0.18 to $2.6km^2$, where the largest contributing area ($2.6km^2$, in the south-east corner of the site) would be the most influenced by application of ARFs.

To understand the significance of this influence, ARFs were calculated for a $2.6km^2$ contributing area at the Proposal area. These ARF values are shown in Table 9 which highlights that for all design storm events with duration between 30 minutes and 12 hours, the ARF value is 0.95 or greater. This indicates that there would be negligible difference in flows if ARFs were incorporated into the design rainfall.

As the incorporation of ARFs adds significant complexity to the logistics involved in simulating storm events and would likely result in negligible change to the peak flows, they have not been incorporated into the design hydrology. This is a suitable approach as it will result in slightly conservative peak flows.

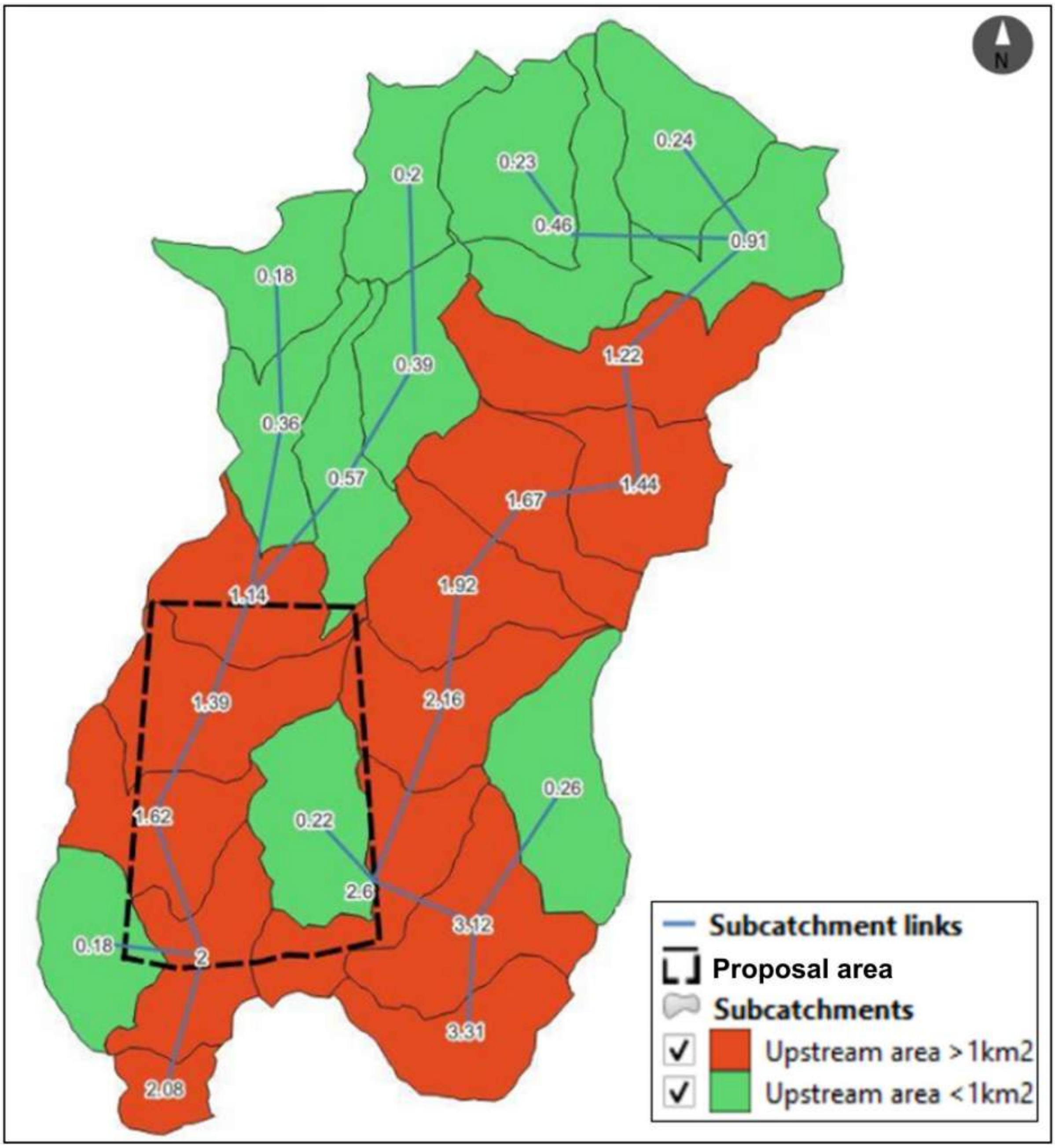



Figure 23: Upstream catchment areas (km$^2$)

Table 9: ARF values for a 2.6km$^2$ contributing catchment area

| Duration | 50% AEP | 20% AEP | 10% AEP | 5% AEP | 2% AEP | 1% AEP | 0.5% AEP | 0.2% AEP | 0.1% AEP | 0.05% AEP |
|---|---|---|---|---|---|---|---|---|---|---|
| **30 min** | 0.97 | 0.97 | 0.97 | 0.96 | 0.96 | 0.96 | 0.96 | 0.96 | 0.96 | 0.95 |
| **45 min** | 0.98 | 0.97 | 0.97 | 0.97 | 0.97 | 0.97 | 0.96 | 0.96 | 0.96 | 0.96 |
| **1 hour** | 0.98 | 0.98 | 0.97 | 0.97 | 0.97 | 0.97 | 0.97 | 0.96 | 0.96 | 0.96 |
| **1.5 hours** | 0.98 | 0.98 | 0.98 | 0.98 | 0.97 | 0.97 | 0.97 | 0.96 | 0.96 | 0.96 |
| **2 hours** | 0.99 | 0.98 | 0.98 | 0.98 | 0.97 | 0.97 | 0.97 | 0.97 | 0.96 | 0.96 |
| **3 hours** | 0.99 | 0.98 | 0.98 | 0.98 | 0.98 | 0.97 | 0.97 | 0.97 | 0.96 | 0.96 |
| **4.5 hours** | 0.99 | 0.99 | 0.99 | 0.98 | 0.98 | 0.98 | 0.98 | 0.97 | 0.97 | 0.97 |
| **6 hours** | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 |
| **9 hours** | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 |
| **12 hours** | 1 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 |

### B.1.3 Rainfall losses

The Initial Loss – Continuing Loss (IL/CL) model was adopted for determining rainfall losses as per the guidance provided in Melbourne Water’s AM STA 6200 Flood Mapping Projects Specification (2021).

The existing catchment is 100% pervious. Melbourne Water’s AM STA 6200 Flood Mapping Projects Specification (2021) notes that where insufficient local information is available, initial losses may be obtained from the Australian Rainfall and Runoff Data Hub. The rural losses (prior to applying pre-burst rainfall) were obtained from Data Hub and are shown in Table 10 below for pervious areas.

Table 10: Summary of pervious area loss types

| Item | Value |
|---|---|
| **Initial Loss** | 16.0mm |
| **Continuing Loss** | 2.6mm/h |

ARR 2019 Book 5, Section 3.7.3 notes that the effect of timestep on the estimation of Continuing Loss (CL) should be considered. In Section 3.7.3.1 it goes on to state that for rural catchments, the regional CL values obtained through Data Hub are derived from a 1-hour timestep and that storm durations with timestep less than 1-hour should be adjusted to increase the CL in order to maintain the same volume of rainfall excess. In RORB this would require modification of all storms with duration less than 24 hours. This process would result in different CLs for all AEP and duration events and would significantly complicate the hydrologic modelling process. As a result, adjustment of CLs for storm durations with less than 1-hour has been excluded. This is considered reasonable as it results in a conservative rainfall excess.

### B.1.4 Spatial patterns

ARR 2019 (Book 2, Chapter 6) recommends that a single uniform spatial pattern is adopted for catchments smaller than 20km$^2$. Catchment areas upstream of the Proposal area are less than 20km$^2$ and as a result, a single uniform spatial pattern has been adopted for the Proposal.

### B.1.5 Pre-burst

Benchmarking ARR2019 for Victoria (Melbourne Water, 2020) outlines six potential methods for loss estimation within the Loss Region 3 (as per Figure ES-1 of the Benchmarking ARR2019 for Victoria report). As the Proposal catchments are within Loss Region 3, the potential methods were assessed in order of priority in the hierarchy. Approaches one to five for loss estimation were inappropriate for the catchment type and as a result, approach six was adopted. Approach six involves adopting the 75th percentile pre-burst rainfall in combination with unmodified Data Hub values of Initial Loss (IL) and CL.

As shown in Table 11, the majority of storms have a pre-burst depth less than IL (16.0mm). However, there are still several storms with pre-burst depth greater than IL (shown in red in Table 11). As a result, pre-burst depth has been included in the RORB model as a percentage of the burst depth in conjunction with ILs. As shown in Table 11, pre-burst information for storm durations less than 1-hour were not available. For these storms, the pre-burst ratio and temporal patterns for the 1-hour storm has been adopted.

**Table 11: 75th percentile pre-burst depths**

| Minutes (hour) | 50% AEP | 20% AEP | 10% AEP | 5% AEP | 2% AEP | 1% AEP |
|---|---|---|---|---|---|---|
| **60 (1.0)** | 10.3 (0.649) | 12.2 (0.542) | 13.4 (0.487) | 14.6 (0.441) | 11.7 (0.283) | 9.5 (0.196) |
| **90 (1.5)** | 10.1 (0.550) | 12.0 (0.468) | 13.4 (0.424) | 14.6 (0.387) | 14.2 (0.301) | 13.9 (0.251) |
| **120 (2.0)** | 13.8 (0.680) | 14.3 (0.504) | 14.7 (0.422) | 15.0 (0.360) | 16.0 (0.308) | 16.8 (0.275) |
| **180 (3.0)** | 13.5 (0.577) | 14.3 (0.437) | 14.8 (0.370) | 15.3 (0.319) | 19.7 (0.328) | 23.0 (0.327) |
| **360 (6.0)** | 6.2 (0.203) | 12.4 (0.290) | 16.5 (0.315) | 20.4 (0.326) | 25.5 (0.327) | 29.3 (0.322) |
| **720 (12.0)** | 4.4 (0.111) | 9.7 (0.173) | 13.2 (0.192) | 16.5 (0.201) | 24.0 (0.236) | 29.6 (0.251) |
| **1080 (18.0)** | 4.7 (0.101) | 8.6 (0.132) | 11.2 (0.140) | 13.8 (0.143) | 16.9 (0.143) | 19.2 (0.142) |
| **1440 (24.0)** | 2.3 (0.046) | 6.1 (0.084) | 8.6 (0.097) | 11.1 (0.104) | 14.3 (0.110) | 16.6 (0.112) |
| **2160 (36.0)** | 0.3 (0.005) | 2.8 (0.034) | 4.4 (0.044) | 6.0 (0.050) | 11.5 (0.079) | 15.6 (0.095) |
| **2880 (48.0)** | 0.0 (0.000) | 0.6 (0.006) | 1.0 (0.009) | 1.3 (0.010) | 3.3 (0.021) | 4.8 (0.028) |
| **4320 (72.0)** | 0.0 (0.000) | 0.0 (0.000) | 0.0 (0.000) | 0.0 (0.000) | 0.5 (0.003) | 0.8 (0.004) |

As per the Melbourne Water's AM STA 6200 Flood Mapping Projects Specification (2021), temporal patterns developed for Probable Maximum Precipitation (PMP) were used as pre-burst temporal patterns and automatically specified within RORB. For this site, GSAM and Jordan et al., default pre-burst temporal patterns were applied.



### B.1.6 Temporal patterns

According to Chapter 5 of Book 2 in ARR 2019, point temporal patterns should be used for catchments less than 75km$^2$. In addition to this, Chapter 5 of Book 2 in ARR 2019 recommends the use of an ensemble of 10 temporal patterns to represent variability in observed patterns.

As the catchments are less than 75km$^2$, point temporal patterns have been applied. The Southern Slopes (mainland) temporal patterns have been downloaded from Datahub and adopted for the Proposal catchments. Frequent, intermediate and rare temporal pattern bins were available and have been applied to the relevant events as shown in Table 12.

**Table 12: Applied temporal pattern bins**

| Event | Temporal Pattern Bin |
|---|---|
| **Up to 20% AEP** | Frequent |
| **10% to 5% AEP** | Intermediate |
| **2% AEP – 0.05% AEP** | Rare |
| **1% AEP under future climate conditions** | Rare |
| **PMP** | NA |



### B.1.7 Baseflow

A preliminary assessment of baseflow was undertaken in accordance with Chapter 4 of Book 5 ARR 2019. Note that this assessment is based on Figure 5.4.3 in ARR 2019 which identifies the relative magnitude of baseflow compared to surface runoff for catchments across Australia. No additional streamflow data was available at the time of this assessment. The Proposal catchments are within the area shown to have a baseflow peak factor of 0.05 to 0.3 (i.e. 5% and 30%). In addition to this, the area has a baseflow peak factor of 5.8% according to the ARR 2019 Data Hub output.

For catchments with a baseflow factor between 5% and 30%, ARR 2019 recommends a direct analysis procedure where recorded streamflow data is available. In the absence of suitable streamflow data, ARR 2019 recommends adopting regional procedures to estimate unregulated baseflow in the absence of streamflow data. This regional procedure involves utilising the factors from ARR Datahub to estimate baseflow.

However, ARR 2019 also notes that the baseflow guidance is for the main stem of the river. It is unlikely that small catchments away from the main stem of river catchments will have a tangible baseflow effect. As a result, baseflow has been excluded from the flood modelling for the Proposal.

### B.1.8 RORB model validation

The RORB catchments are entirely contained within the hydraulic model area. These catchments are applied as rainfall excess in the hydraulic model and therefore, all flow routing will be undertaken in the hydraulic modelling. As a result, the RORB catchment routing parameter (kc) value applied in RORB does not require validation.



To validate peak flows at the downstream extent of the hydrologic model, the following methods were compared for both Tributary 4545 and Curly Sedge Creek:

- Regional Flood Frequency Estimation (RFFE)
- Rational Method calculations for a suite of AEP events
- Rule of thumb calculations from Melbourne Water guidelines. For ‘typical’ rural catchment the discharge estimation is $3m^3/s$ per $1km^2$ of catchment.

Results for the comparison are shown in Table 13 and Table 14 respectively. The comparison highlighted the following:

- RORB outputs are within the confidence limits of the RFFE flows
- The RFFE method estimated peak flows lower than the RORB outputs. This is likely due to the limited applicability of the RFFE to small catchments
- RORB output flows exceed flows estimated by Melbourne Water’s ‘rule of thumb’.

Based on the above observations, flows are considered suitable for incorporation in the modelling and if anything, are likely to result in conservative design decisions.

Table 13: RORB validation for Tributary 4545 – summary of flows compared with other estimates

| AEP (%) | RORB | RFFE | | | Rational Method | Melbourne Water Rule of Thumb |
|---|---|---|---|---|---|---|
| | Discharge ($m^3/s$) | Discharge ($m^3/s$) | Lower Confidence Limit (5%) ($m^3/s$) | Upper Confidence Limit (95%) ($m^3/s$) | Discharge ($m^3/s$) | Discharge ($m^3/s$) |
| 50 | 2.81 | 1.11 | 0.38 | 3.23 | 2.5 | |
| 20 | 4.92 | 1.97 | 0.72 | 5.43 | 3.9 | |
| 10 | 6.65 | 2.67 | 0.97 | 7.37 | 5.1 | |
| 5 | 8.70 | 3.45 | 1.23 | 9.76 | 6.4 | |
| 2 | 11.97 | 4.61 | 1.6 | 13.5 | 8.8 | |
| 1 | 15.03 | 5.61 | 1.88 | 16.9 | 10.7 | 6.24 |

Table 14: RORB validation for Curly Sedge Creek – summary of flows compared with other estimates

| AEP (%) | RORB | RFFE | | | Rational Method | Melbourne Water Rule of Thumb |
|---|---|---|---|---|---|---|
| | Discharge ($m^3/s$) | Discharge ($m^3/s$) | Lower Confidence Limit (5%) ($m^3/s$) | Upper Confidence Limit (95%) ($m^3/s$) | Discharge ($m^3/s$) | Discharge ($m^3/s$) |
| **50** | 3.53 | 1.57 | 0.54 | 4.54 | 4.0 | |
| **20** | 6.31 | 2.77 | 1.01 | 7.64 | 6.3 | |
| **10** | 8.75 | 3.76 | 1.37 | 10.4 | 8.1 | |
| **5** | 11.32 | 4.86 | 1.74 | 13.7 | 10.2 | |
| **2** | 16.07 | 6.5 | 2.25 | 19.1 | 14.0 | |
| **1** | 20.28 | 7.9 | 2.66 | 23.9 | 17.1 | 9.93 |

# B.2 Hydraulic modelling methodology

The hydraulic modelling was undertaken using TUFLOW, a two-dimensional (2D) hydraulic modelling software. As no existing model that captured the Proposal area was available, a new TUFLOW model has been developed. This section presents the methodology used to develop the TUFLOW model for the Proposal.

The general TUFLOW hydraulic model parameters are summarised in Table 2.

Table 15: General model parameters

| Parameter | Value |
|---|---|
| **TUFLOW Release** | 2020-10-AD |
| **Solver** | HPC |
| **Inflow approach** | RORBwin hydrological inflows<br>(applied using SA ALL function in TUFLOW) |
| **Grid resolution** | 5m |
| **Model code size** | 5.68km$^2$ |

## B.2.1 Model extent and grid size

The hydraulic model extent, shown in Figure 4 captures all upstream sub-catchments and extents approximately 500m south of the southern Proposal area. This allows for all sub-catchment flow routing to be done in the hydraulic model.

A 5m grid size has been adopted for both the critical duration analysis and design simulations of the Proposal.

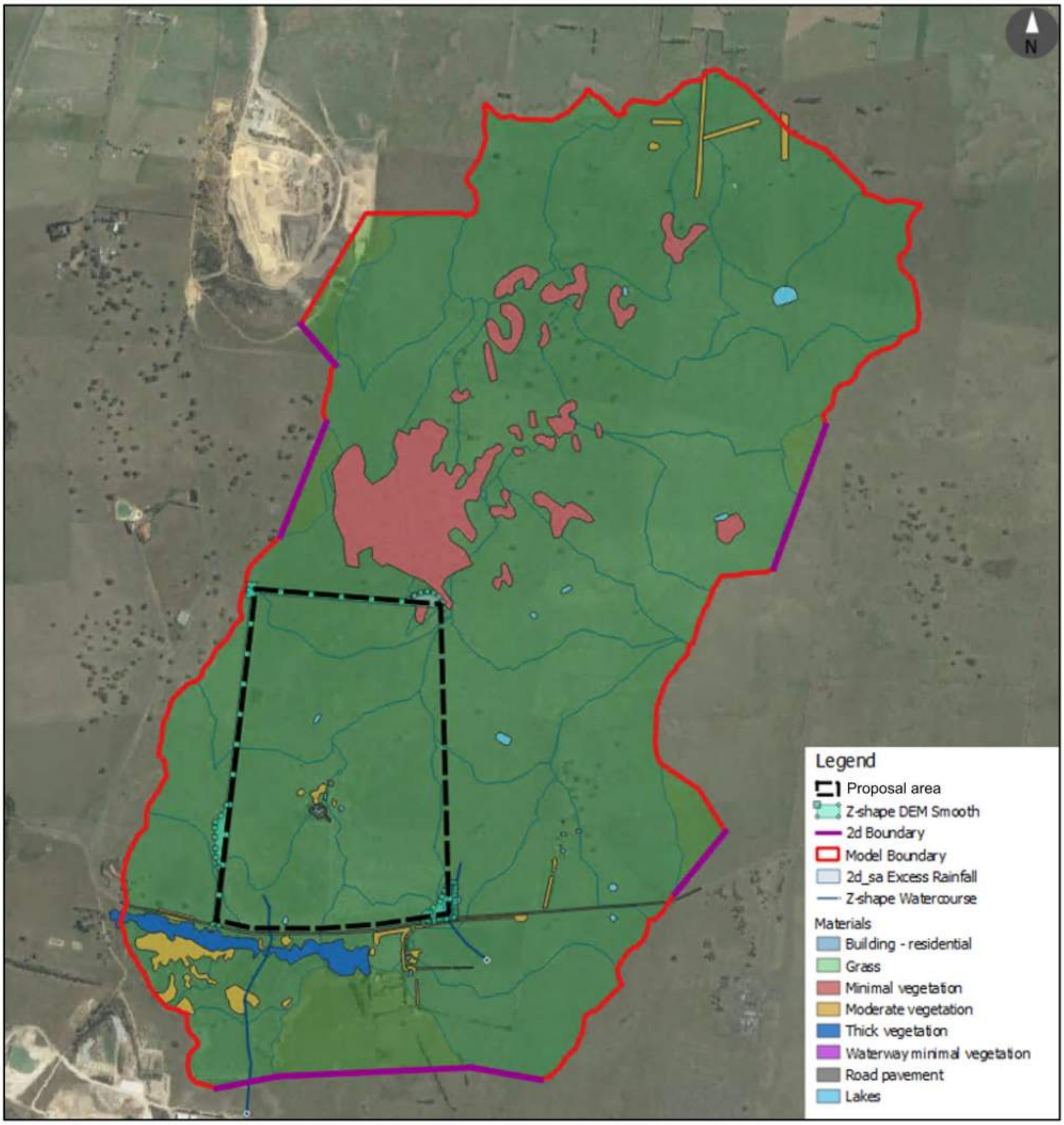



**Figure 24: Hydraulic model configuration**

## B.2.2 Inflows

Local rainfall inflows (developed using RORB) have been applied directly to the TUFLOW model domain via 25 2D SA direct rainfall polygons. The direct rainfall method allows for rainfall to be distributed equally to all cells within the polygon such that local flow paths are identified within the Proposal area.

All outflow boundaries are stage-discharge (HQ) boundaries based on automatically generated slopes.

## B.2.3 Downstream boundary conditions

As shown in Figure 4, the model incorporates seven outflow HQ type boundaries.

Three of the seven boundaries are located at the southern-most extent of the model boundary and are the primary outflow boundaries. The additional four outflow boundaries ensure that flows that break out in larger flood events, and travel away from the Proposal area, are not trapped within the model.

### B.2.4 Roughness

Aerial imagery has been used to delineate land use types within the model extent, as shown in Figure 4 Manning's n values have been assigned for each individual land use and are listed in Table 16. Only land uses within the model extent have been shown in Table 16.

**Table 16: Land use type and adopted Manning's n values**

| Material ID | Description of land use | Manning's n |
|---|---|---|
| **3** | Commercial – proposed building footprint only | 0.50 |
| **7** | Open pervious areas, grassed | 0.04 |
| **8** | Open pervious areas, minimal vegetation (grassed with sparse shrubs) | 0.05 |
| **9** | Open pervious areas, moderate vegetation (shrubs) | 0.06 |
| **10** | Open pervious areas, thick vegetation (trees) | 0.09 |
| **11** | Waterways/channels, minimal vegetation | 0.03 |
| **14** | Paved roads/carparks/driveways | 0.025 |
| **15** | Lakes (no emergent vegetation) | 0.025 |

### B.2.5 Hydraulic Structures

The southern extent of the Proposal area borders Summerhill Road which has two existing culvert structures passing beneath the road at the crossing of Curly Sedge Creek and Tributary 4545. The existing structures are less than 0.3m in diameter. Due to the small size of these structures, they have not been incorporated in the hydraulic flood model.

Existing cross drainage infrastructure has not been observed or identified by the detailed survey within the extents of the Proposal area. That is, no drainage structures have been incorporated into the existing scenario flood modelling.

Aerial imagery indicates several small farm ponds and dams are within the model extent. These were generally not captured in the available LiDAR information. As detailed survey of the Proposal area was made available, the location of these small farm dams was confirmed.

The TUFLOW materials file was used to delineate the dams (as shown in Figure 4) and a representative surface type was allocated. This is described further in Section B.2.4. All dams have been modelled as 'full' using an initial water level equivalent to the top of the dam. This assumption is considered conservative.

### B.2.6 Critical Duration Assessment

Following the simulation of the storms shown in Table 17, median temporal patterns were determined for each storm duration and event combination as per Melbourne Water's AM STA 6200 Flood Mapping Projects Specification (2021), using TUFLOW post-processing tools. Critical storm durations were then determined based on the mean temporal pattern results (using TUFLOW post-processing tools).

The resultant critical durations within the vicinity of the Proposal area for each event are shown in Table 17. Critical duration maps are shown in Appendix F.

**Table 17: Critical storms at the Proposal area**

| Event | Critical durations within the Proposal area |
|---|---|
| **50% AEP** | 1hr, 2hr |
| **1% AEP** | 20min, 1hr, 2hr, 3hr |
| **PMF** | 15min, 30min, 1hr |

### B.2.7 TUFLOW Classic Validation

The TUFLOW model has been simulated in the HPC solver. To ensure the model is robust, additional validation using the Classic solver has been undertaken.

The existing case TUFLOW model has been simulated using both HPC and Classic solvers for a critical 1% AEP events (1 hour duration) to determine whether both solvers produce similar results. A comparison in peak flood level is presented in Figure 25.

Results from the validation exercise demonstrate that peak flood levels are largely within ±10mm throughout the modelled domain and in the vicinity of the Proposal area.

In a select few locations, there is up to 20mm change in peak water level (e.g., along the southern boundary of the Proposal area and in the southeast corner of the Proposal area).

Two locations are observed where the Classic simulation is showing an increased flood extent (see magenta patch at the bottom of Figure 25). This is occurring in areas of very shallow overland flow (approximately 5mm in depth), this is not considered to impact the overall model behaviour and is located approximately 250m from the Proposal area.

Based on the validation exercise which demonstrated that both solvers are producing similar results, the TUFLOW HPC solver is an appropriate solver to use in further modelling.

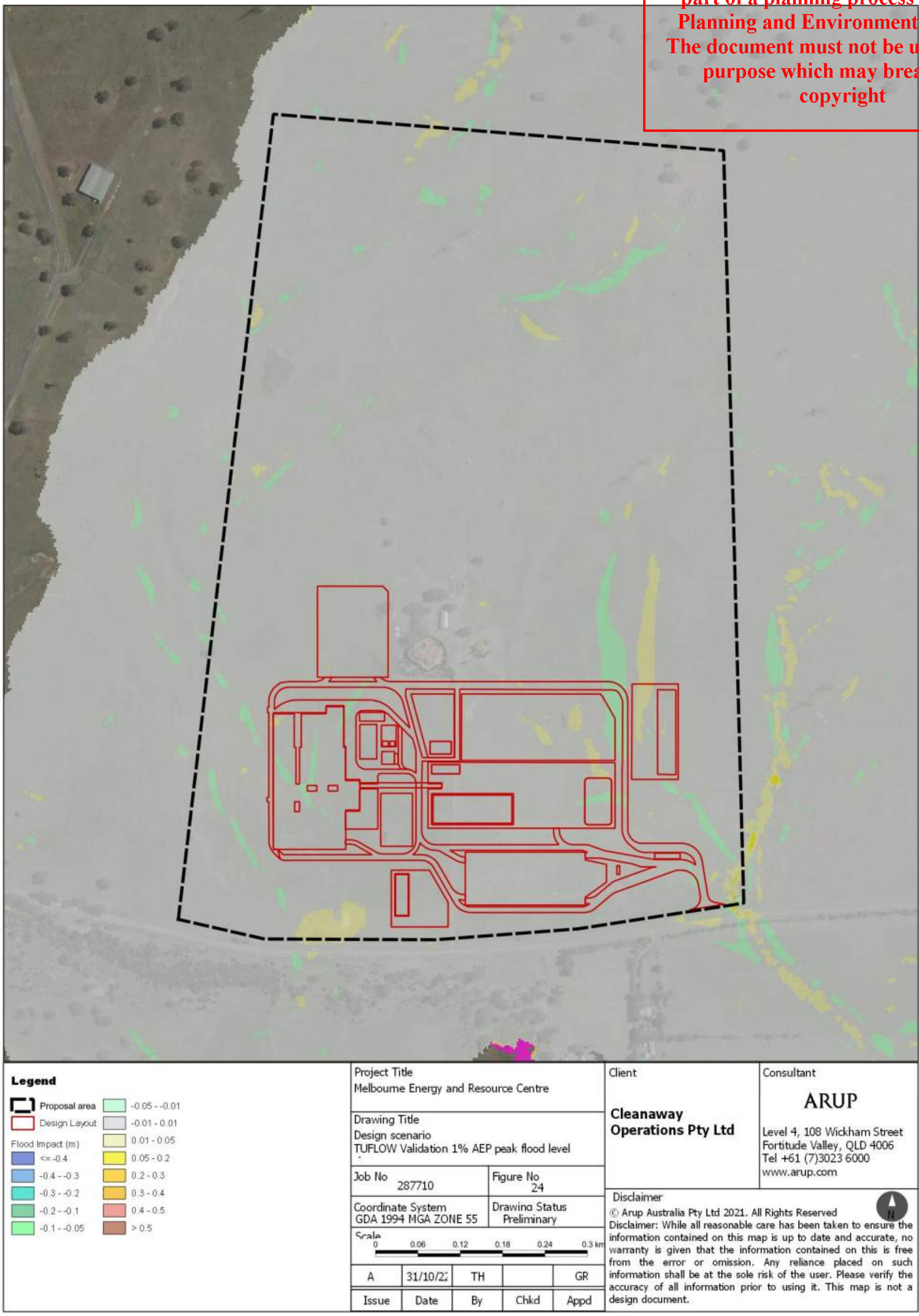



**Figure 25: TUFLOW Validation - 1% AEP Event comparison between HPC and Classic solvers**

# Appendix C

## C.1 Datahub Output

Results - ARR Data Hub

[STARTTXT]

Input Data Information

[INPUTDATA]

Latitude,-37.570951

Longitude,144.977846

[END_INPUTDATA]

River Region

[RIVREG]

Division,South East Coast (Victoria)

River Number,6

River Name,Yarra River

[RIVREG_META]

Time Accessed,15 June 2022 10:59AM

Version,2016_v1

[END_RIVREG]

ARF Parameters

[LONGARF]

Zone,Southern Temperate

a,0.158

b,0.276

c,0.372

d,0.315

e,0.000141

f,0.41

g,0.15

h,0.01

i,-0.0027

[LONGARF_META]

Time Accessed,15 June 2022 10:59AM

Version,2016_v1

[END_LONGARF]

Storm Losses

[LOSSES]

Storm Initial Losses (mm),16.0

Storm Continuing Losses (mm/h),2.6

[LOSSES_META]

Time Accessed,15 June 2022 10:59AM

Version,2016_v1

[END_LOSSES]

Temporal Patterns

[TP]

code,SSmainland

Label,Southern Slopes (Vic/NSW)

[TP_META]

Time Accessed,15 June 2022 10:59AM

Version,2016_v2

[END_TP]

Areal Temporal Patterns

[ATP]

code,SSmainland

arealabel,Southern Slopes (Vic/NSW)

[ATP_META]

Time Accessed,15 June 2022 10:59AM

Version,2016_v2

[END_ATP]

Median Preburst Depths and Ratios

[PREBURST]

min (h)\AEP(%),50,20,10,5,2,1

60 (1.0),2.7 (0.172),2.3 (0.102),2.0 (0.073),1.7 (0.052),1.3 (0.032),1.0 (0.021)

90 (1.5),2.4 (0.130),2.0 (0.079),1.8 (0.057),1.6 (0.042),0.9 (0.019),0.4 (0.007)

120 (2.0),3.8 (0.187),3.0 (0.105),2.4 (0.070),1.9 (0.046),1.0 (0.020),0.4 (0.006)

180 (3.0),2.7 (0.114),2.8 (0.086),2.9 (0.072),3.0 (0.062),5.7 (0.094),7.7 (0.109)

360 (6.0),0.6 (0.019),1.1 (0.026),1.4 (0.028),1.8 (0.028),5.1 (0.066),7.6 (0.084)

720 (12.0),0.1 (0.003),2.3 (0.042),3.8 (0.055),5.2 (0.063),7.4 (0.073),9.1 (0.077)

1080 (18.0),0.0 (0.000),0.9 (0.014),1.5 (0.018),2.1 (0.021),3.2 (0.027),4.0 (0.030)

1440 (24.0),0.0 (0.000),0.5 (0.007),0.8 (0.010),1.2 (0.011),2.9 (0.023),4.2 (0.028)

2160 (36.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.9 (0.006),1.6 (0.010)

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)

[PREBURST_META]

Time Accessed,15 June 2022 10:59AM

Version,2018_v1

Note,Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

[END_PREBURST]From preburst class



10% Preburst Depths

[PREBURST10]

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)

[PREBURST10_META]

Time Accessed,15 June 2022 10:59AM

Version,2018_v1

Note,Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

[END_PREBURST10]From preburst class



25% Preburst Depths

[PREBURST25]

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)

[PREBURST25_META]

Time Accessed,15 June 2022 10:59AM

Version,2018_v1

Note,Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

[END_PREBURST25]From preburst class

75% Preburst Depths

[PREBURST75]

min (h)\AEP(%),50,20,10,5,2,1

60 (1.0),10.3 (0.649),12.2 (0.542),13.4 (0.487),14.6 (0.441),11.7 (0.283),9.5 (0.196)

90 (1.5),10.1 (0.550),12.0 (0.468),13.4 (0.424),14.6 (0.387),14.2 (0.301),13.9 (0.251)

120 (2.0),13.8 (0.680),14.3 (0.504),14.7 (0.422),15.0 (0.360),16.0 (0.308),16.8 (0.275)

180 (3.0),13.5 (0.577),14.3 (0.437),14.8 (0.370),15.3 (0.319),19.7 (0.328),23.0 (0.327)

360 (6.0),6.2 (0.203),12.4 (0.290),16.5 (0.315),20.4 (0.326),25.5 (0.327),29.3 (0.322)

720 (12.0),4.4 (0.111),9.7 (0.173),13.2 (0.192),16.5 (0.201),24.0 (0.236),29.6 (0.251)

1080 (18.0),4.7 (0.101),8.6 (0.132),11.2 (0.140),13.8 (0.143),16.9 (0.143),19.2 (0.142)

1440 (24.0),2.3 (0.046),6.1 (0.084),8.6 (0.097),11.1 (0.104),14.3 (0.110),16.6 (0.112)

2160 (36.0),0.3 (0.005),2.8 (0.034),4.4 (0.044),6.0 (0.050),11.5 (0.079),15.6 (0.095)

2880 (48.0),0.0 (0.000),0.6 (0.006),1.0 (0.009),1.3 (0.010),3.3 (0.021),4.8 (0.028)

4320 (72.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.5 (0.003),0.8 (0.004)

[PREBURST75_META]

Time Accessed,15 June 2022 10:59AM

Version,2018_v1

Note,Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

[END_PREBURST75]From preburst class



90% Preburst Depths

[PREBURST90]

min (h)\AEP(%),50,20,10,5,2,1

60 (1.0),22.7 (1.430),26.2 (1.167),28.5 (1.035),30.7 (0.929),27.7 (0.671),25.5 (0.526)

90 (1.5),23.5 (1.285),24.6 (0.955),25.2 (0.801),25.9 (0.685),27.9 (0.590),29.3 (0.530)

120 (2.0),24.3 (1.197),28.1 (0.989),30.6 (0.882),33.0 (0.794),38.4 (0.736),42.3 (0.693)

180 (3.0),23.5 (1.003),27.6 (0.843),30.4 (0.757),33.0 (0.686),44.4 (0.739),53.0 (0.751)

360 (6.0),18.2 (0.598),28.8 (0.675),35.9 (0.687),42.6 (0.681),52.1 (0.669),59.2 (0.650)

720 (12.0),21.8 (0.549),28.3 (0.504),32.5 (0.473),36.6 (0.445),55.8 (0.549),70.1 (0.595)

1080 (18.0),17.2 (0.372),21.0 (0.320),23.5 (0.293),25.9 (0.270),33.6 (0.286),39.4 (0.291)

1440 (24.0),15.0 (0.294),19.4 (0.267),22.3 (0.251),25.1 (0.237),32.6 (0.252),38.3 (0.258)

2160 (36.0),6.5 (0.111),13.7 (0.166),18.6 (0.183),23.2 (0.193),31.5 (0.217),37.8 (0.229)

2880 (48.0),5.1 (0.081),9.7 (0.109),12.8 (0.117),15.8 (0.122),24.0 (0.155),30.2 (0.173)

4320 (72.0),1.0 (0.015),9.9 (0.101),15.8 (0.133),21.5 (0.153),21.5 (0.129),21.5 (0.116)

[PREBURST90_META]

Time Accessed,15 June 2022 10:59AM

Version,2018_v1

Note,Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

[END_PREBURST90]From preburst class

Interim Climate Change Factors

[CCF]

,RCP 4.5,RCP6,RCP 8.5

2030,0.648 (3.2%),0.687 (3.4%),0.811 (4.0%)

2040,0.878 (4.4%),0.827 (4.1%),1.084 (5.4%)

2050,1.081 (5.4%),1.013 (5.1%),1.446 (7.3%)

2060,1.251 (6.3%),1.229 (6.2%),1.862 (9.5%)

2070,1.381 (7.0%),1.460 (7.4%),2.298 (11.9%)

2080,1.465 (7.4%),1.691 (8.6%),2.719 (14.2%)

2090,1.496 (7.6%),1.906 (9.7%),3.090 (16.3%)

[CCF_META]

Time Accessed,15 June 2022 10:59AM

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.

[END_CCF]

Baseflow Factors

[BASEFLOW]

Downstream,11203

Area (km2),6192.737856

Catchment Number,11147

Volume Factor,0.309605



Peak Factor,0.058074

[BASEFLOW_META]

Time Accessed,15 June 2022 10:59AM

Version,2016_v1

[END_BASEFLOW]

[ENDTXT]

# Appendix D

## D.1 Civil Design Drawings

# Appendix E

## E.1 GSDM Calculation Sheet

# Appendix 1

## GSDM CALCULATION SHEET

**LOCATION INFORMATION**

Catchment Curly Sedge Creek Area 2.08 km² Fig 2: Intermediate Zone

State Vic Duration Limit 5 hours hrs

Latitude -37.56576 ° S Longitude 144.97844 ° E

Portion of Area Considered:

Smooth , S = 1.0 (0.0 - 1.0) Rough , **R** = 0.9 (0.0 - 1.0)

**ELEVATION ADJUSTMENT FACTOR (EAF)**

Mean Elevation 220 m

Adjustment for Elevation (-0.05 per 300m above 1500m) 0

**EAF** = 1.0 (0.85 - 1.00)

**MOISTURE ADJUSTMENT FACTOR (MAF)**

**MAF** = 0.55 (0.40 - 1.00)



**PMP VALUES (mm)**

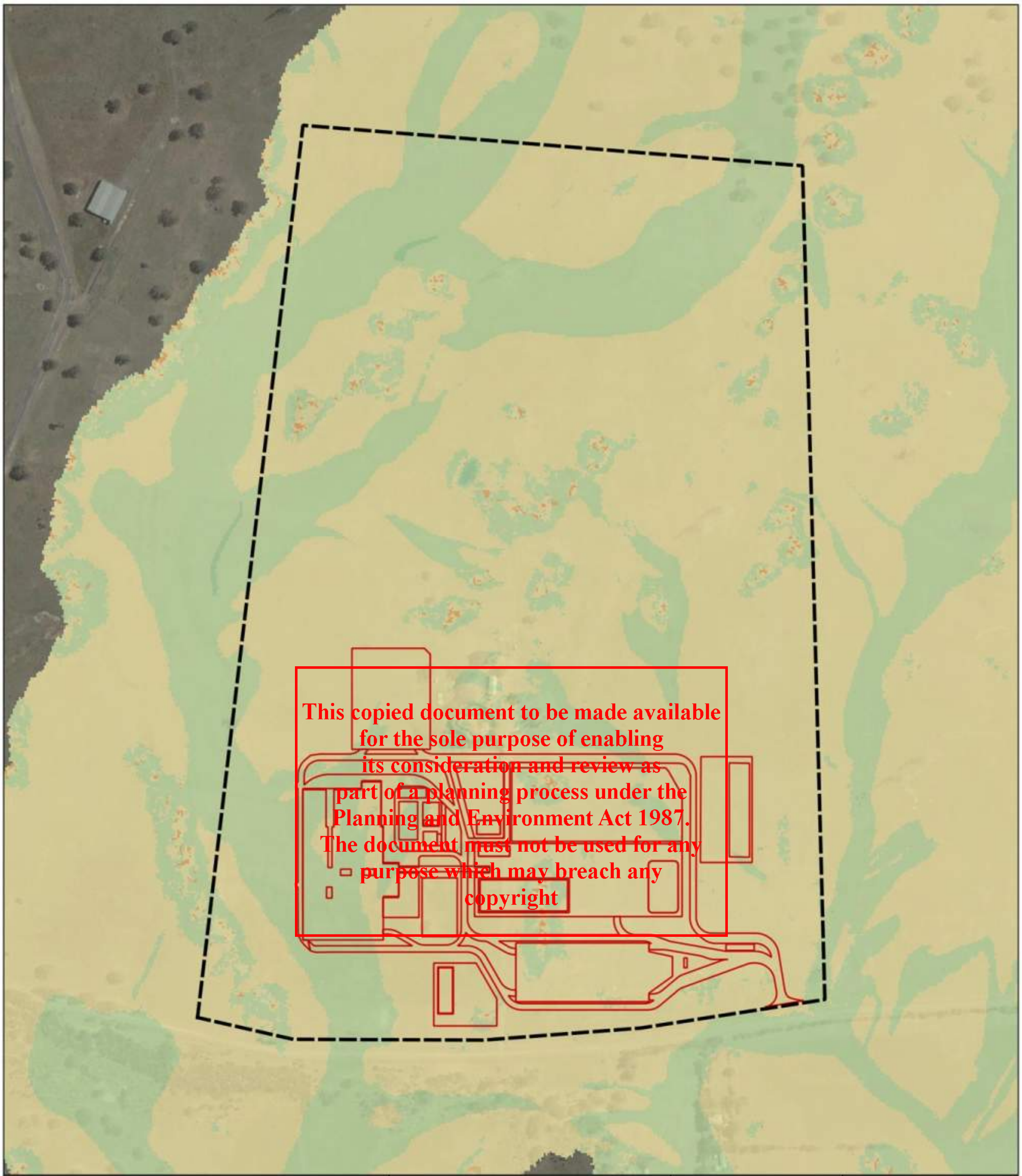
| Duration (hours) | Initial Depth - Smooth ($D_S$) | Initial Depth - Rough ($D_R$) | PMP Estimate = ($D_S \times S + D_R \times R$) × MAF × EAF | Rounded PMP Estimate (nearest 10 mm) |
|---|---|---|---|---|
| 0.25 | 235 | | | 130 |
| 0.50 | 340 | | | 190 |
| 0.75 | 430 | | | 240 |
| 1.0 | 500 | | | 280 |
| 1.5 | 570 | | | 320 |
| 2.0 | 635 | | | 350 |
| 2.5 | 675 | | | 380 |
| 3.0 | 710 | | | 400 |
| 4.0 | 775 | | | 430 |
| 5.0 | 835 | | | 460 |
| 6.0 | 885 | | | 490 |

Prepared by Chelsea Matthews Date 27/06/22

Checked by ........................ Date ......../......../........

# Appendix F

## F.1 Critical Duration Maps





**Legend**

Indicative site extents

Design Layout

Critical Duration: 15min, 20min, 25min, 30min, 45min, 1hr, 1.5hr, 2hr, 3hr, 4.5hr, 6hr

| | |
|---|---|
| Project Title | Melbourne Energy and Resource Centre |
| Drawing Title | Existing scenario 50% AEP critical duration |
| Job No | 287710 |
| Figure No | 21 |
| Coordinate System | GDA 1994 MGA ZONE 55 |
| Drawing Status | Preliminary |
| Scale | 0 – 0.06 – 0.12 – 0.18 – 0.24 – 0.3 km |

| Issue | Date | By | Chkd | Appd |
|---|---|---|---|---|
| A | 31/10/2? | TH | | GR |

Client

**Cleanaway Operations Pty Ltd**

Consultant

ARUP

Level 4, 108 Wickham Street
Fortitude Valley, QLD 4006
Tel +61 (7)3023 6000
www.arup.com

Disclaimer



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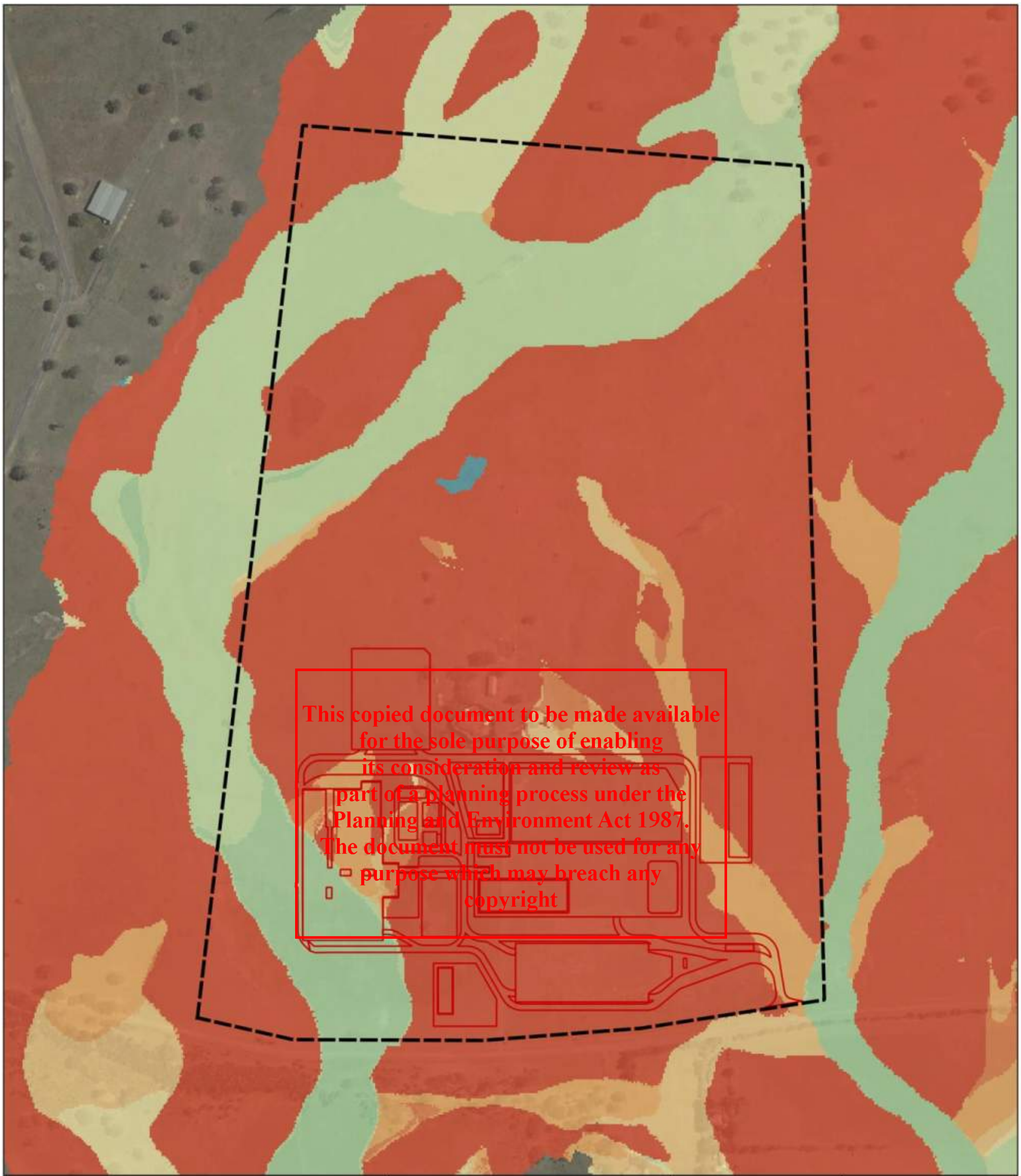



**Legend**

- Indicative site extents
- Design Layout

Critical Duration: 15min, 20min, 25min, 30min, 45min, 1hr, 1.5hr, 2hr, 3hr, 4.5hr, 6hr

Project Title: Melbourne Energy and Resource Centre

Drawing Title: Existing scenario 1% AEP critical duration

Job No: 287710

Figure No: 22

Coordinate System: GDA 1994 MGA ZONE 55

Drawing Status: Preliminary

Scale: 0 0.06 0.12 0.18 0.24 0.3 km

| Issue | Date | By | Chkd | Appd |
|---|---|---|---|---|
| A | 31/10/2? | TH | | GR |

Client: **Cleanaway Operations Pty Ltd**

Consultant: ARUP

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**Legend**

Indicative site extents

Design Layout

Critical Duration

15min
20min
25min
30min
45min
1hr
1.5hr
2hr
3hr
4.5hr
6hr

| | | | | |
|---|---|---|---|---|
| Project Title<br>Melbourne Energy and Resource Centre | | | | |
| Drawing Title<br>Existing scenario<br>PMF critical duration | | | | |
| Job No 287710 | | Figure No 23 | | |
| Coordinate System GDA 1994 MGA ZONE 55 | | Drawing Status Preliminary | | |
| Scale 0 0.06 0.12 0.18 0.24 0.3 km | | | | |
| A | 31/10/22 | TH | | GR |
| Issue | Date | By | Chkd | Appd |

Client

**Cleanaway Operations Pty Ltd**

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# Appendix G

## G.1 Melbourne Land Surveyors Report

melbourne LAND SURVEYORS

28-8-22

Dear Sir/Madam,

**Re: 510 Summerhill Road Wollert**

When we first surveyed the above site on the 10-3-22 we did not notice any evidence of a creek along the western boundary at the north or south or did we notice a creek in the south east corner of the site.
We revisited the site on the 28-9-22 and took the photos below which indicate no creek on site either.



Photo 1: South East corner of site

Photo 2: South West Corner of site (this bank is shown on our Feature Survey)

Photo 3: North West of site

Photo 4: North West of site

Clearly, from the attached photos and a couple of visits we could not clearly see any evidence of a creek.

Yours sincerely,

***Ben Couch***
*Licensed Surveyor*

# Appendix H

## H.1 Streamology Report

October 6 2022

**Project:** 510 Summerhill Rd Waterway Assessment
**To:** James Pearce, Cleanaway Waste Management
**Prepared by:** Kira Woods, Streamology

# 1 Background

Cleanaway Waste Management (Cleanaway) engaged Streamology Pty Ltd. (Streamology) to undertake a waterway assessment at 510 Summerhill Rd, Wollert and provide advice regarding appropriate management of the waterway in relation to future development occurring at the site. The scope of the project was to undertake a desktop and field assessment of the geomorphic features, condition and likely trajectory of waterways across the site to inform the next steps required to progress the development of the site.

## 1.1 Site location

The study area is located approximately 25 km north of the CBD at 510 Summerhill Rd, Wollert (Figure 1).

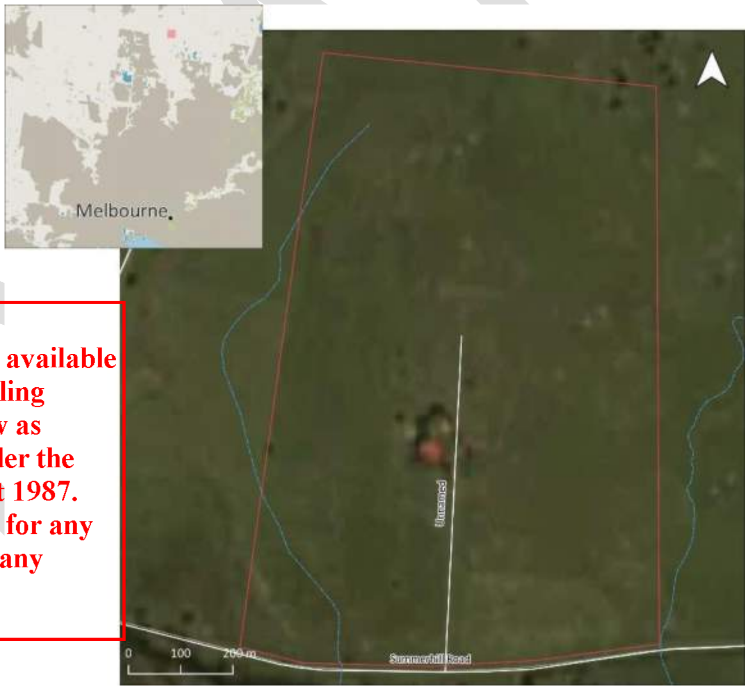





Figure 1. Location of the study area at 510 Summerhill Rd, Wollert

The property is currently an agricultural property which covers approximately 80 ha to the north of Summerhill Rd and is located within the Northern Quarries Precinct Structure Plan (PSP) which has not been added to the VPA plan of works as yet. There are two mapped waterways within the property boundary, Curly Sedge Creek which intersects the property boundary in the south east corner of the site, and Tributary 4545 which originates in the north west corner of the property, flows in a southerly direction into the adjacent property before re-entering the study area in the southwest corner of the study area.

## 2 Desktop assessment

A desktop assessment of the key characteristics that influence waterway form and processes was undertaken using publicly available, state-wide datasets.

### Soils

The dominant soil type within study area according to the state-wide soil data set is a Brown Sodosol. Sodosols are soils that have a strong texture contrast between the A and B horizons with the upper 0.2 m of the B2 horizon being sodic (CSIRO, 2016). Sodosols are likely to posses a bleached A2 horizon and are associated with soil issues such as tunnelling and dispersion (Ford et al., 1993). State-wide mapping also indicated that there are areas across the site where Vertosols exist. Vertosols are shrink-swell clay soils that exhibit strong cracking when dry. Vertosols have a field texture of 35% or more clay throughout the solum (CSIRO, 2016).

### Geology

The geology across the study area is uniform and comprises Quaternary aged basalt lava flows of the Newer Volcanic Group.

### Geomorphological management units

Geomorphological management units provide a classification of diverse information about the landscape, geology, stratigraphy and geomorphology. The study site falls within the Western Plains; Volcanic plains; Stony rises management unit. This management unit is formed by lava flows of the Newer Volcanics and is characterised by rocky and undulating landscapes. This unit is known for poor soil development and drainage development (VRO, 2007).

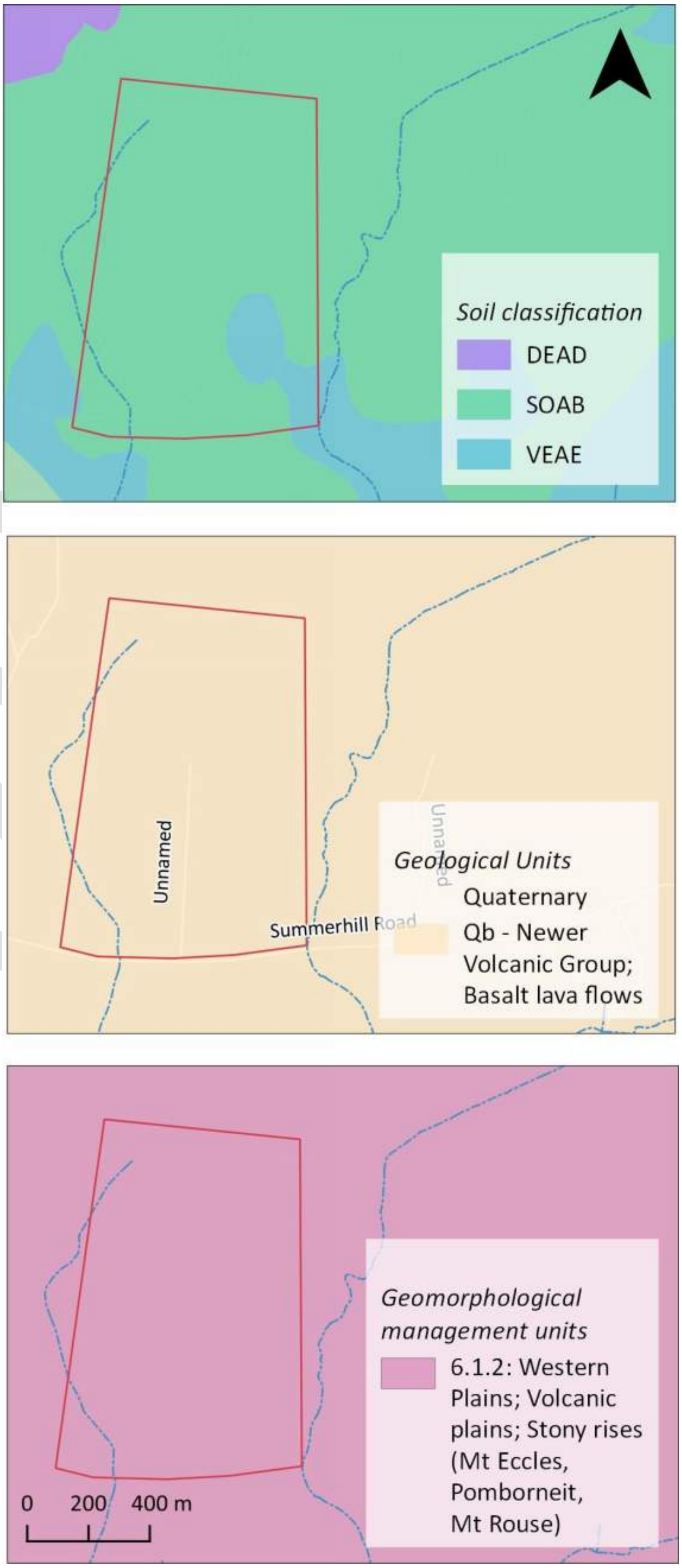


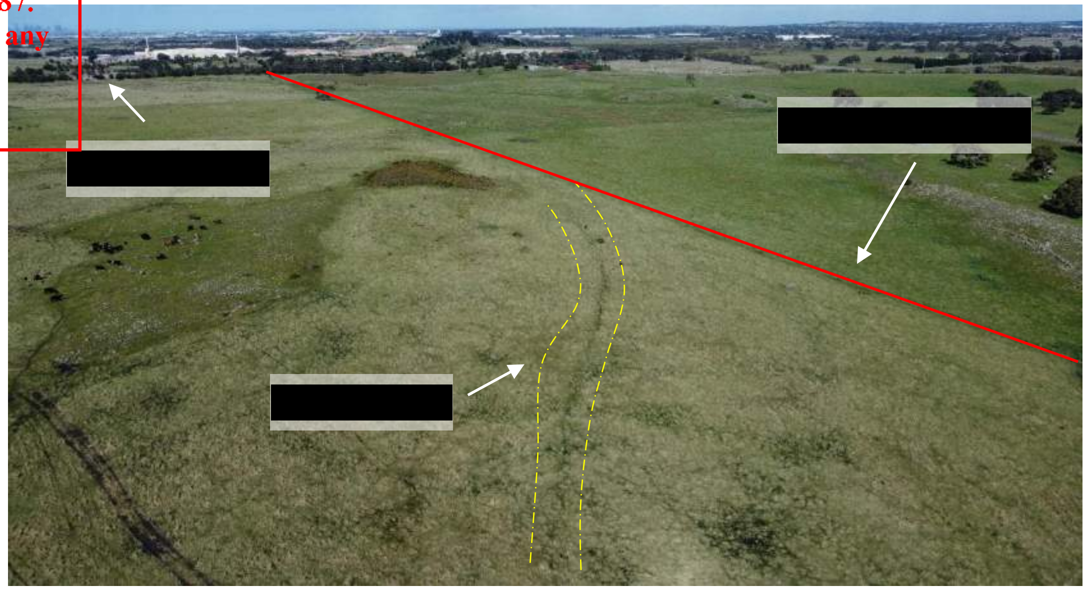

Figure 2. Soil mapping (top), geology mapping (middle) and geomorphological management unit mapping (bottom) across the study site.

# 3 Site assessment

## 3.1 Key observations

A site assessment was undertaken by Kira Woods and Thom Gower from Streamology on 16th September 2022. Key observations are outlined in the table below.

| Parameter | Partly confined, basalt-controlled channel |
|---|---|
| Channel | Single, discontinuous channel |
| Bank/valley sides | Poorly defined drainage line with little to no bank definition apparent on ground. |
| Bed | Bed of the waterway is well vegetated with grasses and sedges. Bed material brown, silty clay. |
| Planform | Discontinuous, poorly defined channel. |
| Geology | Quaternary basalt lava flows. Basalt floaters present across the study area. |
| Land use | Cleared agricultural land currently used for grazing. |
| Soil type | Dark brown silty clay |
| Sediment load | Low – water present was not turbid. |
| Floodplain connectivity | Poorly defined waterway. Subsequently there is high degree of connection to the surrounding floodplain. |
| Riparian vegetation | Cleared riparian zone. Floodplain area consists mostly of exotic grasses. Some rushes present along the primary drainage line. |
| In stream vegetation | Mostly exotic grasses. Some rushes along the primary drainage line. |
| Habitat value | No habitat values present. |





## 3.2 Key issues

### Waterway condition and trajectory

The waterway mapped as Tributary 4545 is a very poorly defined, discontinuous channel. While the waterway is poorly defined, it is partly confined by basalt controls present on the adjacent floodplain. This waterway type is common on the basalt plains of greater Melbourne. Along most of the mapped waterway, the presence of a drainage line is only indicated by slight changes in vegetation type or the presence of standing water (Figure 3). Rather than a defined waterway, flow through the drainage line is dispersed across a large expanse of the lower relief sections of the floodplain as indicated by the width of the 50-year AEP flood extent which includes a 20 m buffer (what would be considered a typical riparian zone).



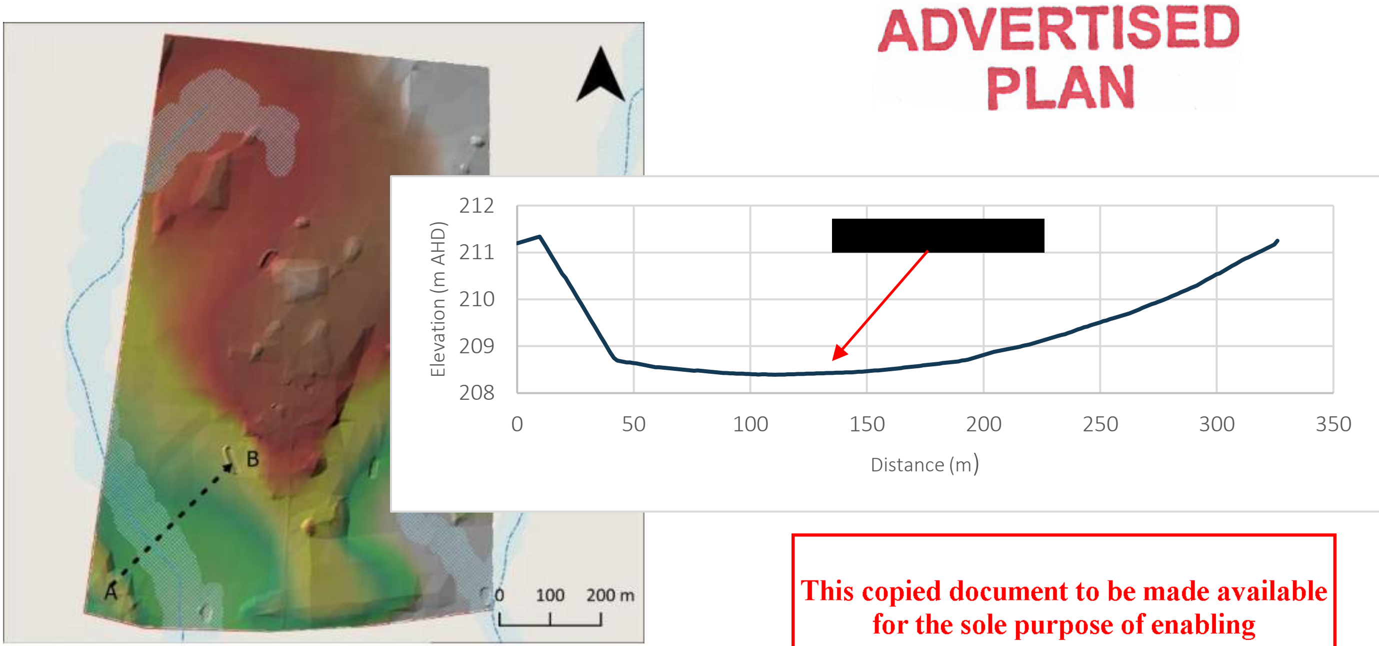





Figure 3. Digital elevation model of the study site mapped with waterway centrelines, 50 AEP flood extent. A cross section has been derived from the DEM which shows the lack of definition of Tributary 4545. The location of the cross section has also been mapped.

The presence of basalt floaters and outcrops within and adjacent to the study area, indicate that there is a limited risk of erosion. A preliminary geotechnical investigation at the site also indicated that basalt bedrock controls were present at depths between 0.3 m and 2.9 m with an average depth of 1 m (Douglas & Partners, 2022) which limits the scale of any potential waterway incision or gully development.

Observations from the site visit did not reveal any indications of erosion issues either from overland flows or as a result of dispersive subsoils, further indicating that erosion risk is likely to be low across the study area.

### Sodic soil

State-wide soil mapping showed that the study area was dominated by Sodosols according to the Australian Soil Classification. These soils are soils that have strong texture contrast between the A and B horizons and are identifiable through their high levels of sodium (greater than 6% ESP) as well as a bleached A2 horizon which is commonly present. Common issues arising with sodic soils include dispersion, tunnelling, gullying and low productivity.

A land capability assessment of the Mitchell Shire, just to the north of the study area, was undertaken in the mid-1990s and looked at sodic soil associated with the Newer Volcanic basalt deposits in the region. The study found that compared with sodic soils associated with alluvial floodplain deposits, the soil associated with the Newer Volcanics had low levels of dispersibility (Jones et al., 1996). These findings appear to be supported by field observations at the study site where no indication of dispersive subsoils was present. Additionally, a preliminary geotechnical investigation at the site did not list soil dispersibility as a key geotechnical issue at the site (Douglas & Partners, 2022).

# 4 Conclusions

No geomorphic values are associated with Tributary 4545, located within the study site and there are limited habitat values (e.g. large wood, riparian vegetation) along the waterway. Considering only the geomorphic values, form and trajectory of Tributary 4545, the waterway is a good candidate for realignment as a constructed waterway. A new constructed waterway at the site would need to be designed and constructed in line with Melbourne Water's Constructed Waterway Design Manual and appropriate riparian buffer widths for new constructed waterways can be found in Melbourne Water's Waterway Corridors Guidelines.

## 4.1 Limitations

This assessment has focused on the geomorphic form, condition and trajectory of the waterway within the study area. It has not assessed soil conditions or vegetation.

As mentioned, the soil across the study area has been mapped as a Sodosol. While there has been no indication of issues associated with dispersive subsoils at the site, the risk associated with this soil type should be considered as development progresses. Additional soil sampling to examine the soil properties at the site, specifically those which relate to dispersibility could be advantageous.

Vegetation values across the site have not been assessed as a part of this project. The appropriateness of realigning the current waterway is based on an assessment of geomorphic characteristics only. Seasonal Herbaceous Wetlands (SHW) are known to occur across the Volcanic Plain. They are characterised by shallow inundation across seasonally waterlogged soils which dry out through warmer, drier months. They can be difficult to detect and as a result much of the former extent of SHW has been lost. It is recommended that an assessment of vegetation values be undertaken across the site to determine the appropriateness of realigning the waterway considering vegetation values.

## 5 References

CSIRO (2016). The Australian Soil Classification, https://www.clw.csiro.au/aclep/asc_re_on_line_V2/soilhome.htm, accessed 19/9/2022.

Douglas and Partners (2022). Report on Geotechnical and Preliminary Soil Contamination Investigation (DRAFT). Report prepared for Macquarie Group.

Ford, G., Martin, J., Rengasamy, P., Boucher, S. & Ellington A. (1993). 'Soil sodicity in Victoria', Australian Journal of Soil Research, vol. 31, pp.869 – 909.

Jones E., Boyle G., Baxter N. & Bluml M. (1996) A land capability study of the shire of Mitchell. Centre for Land Protection Research. Technical Report No. 35.

VRO (2007). Victorian Geomorphological Framework, http://vro.agriculture.vic.gov.au/dpi/vro/vrosite.nsf/pages/landform_geomorphological_framework, accessed 19/9/2022.

# Appendix I

## I.1 Melbourne Water Stakeholder Engagement Letter

ADVERTISED PLAN

Melbourne Water



17 August 2022

Chelsea Matthews
Arup
4/108 Wickham Street
Fortitude Valley QLD 4006

Dear Chelsea,

Proposal: Proposed Development
Site location: 510 SUMMERHILL ROAD WOLLERT 3750

Melbourne Water reference: MWA-1260072
Date referred: 20/07/2022

Thank you for your application for pre-development information for the abovementioned property.

Melbourne Water provides the following information to assist you in understanding the impact flooding and associated infrastructure assets may have on the potential to develop a site, and to inform your design response.

| | |
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| Flood Level Information | The property is subject to flooding from Curly Sedge Creek<br><br>The applicable 1% Annual Exceedance Probability (AEP) flood level for the property, being the 1% probability in any one calendar year, is 215.30 metres to Australian Height Datum (AHD) (maximum) and 203.40 metres to AHD (minimum). |
| Guideline Requirements for Development in Floodprone Areas | The property is not located within the Special Building Overlay or Land Subject to Inundation Overlay under the applicable Council Planning Scheme. Please refer to the local Planning Scheme and applicable Planning Policy Framework provisions relating to floodplains, coastal inundation, waterways, erosion and drainage for policy guidelines.<br><br>Melbourne Water assesses development applications in accordance with the Guidelines for Development in Flood Affected Areas (DELWP, 2019). Development in or adjacent to a floodplain will only be acceptable where the new development is protected from flooding (flood levels |

VICTORIA State Government



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| | are constructed to the identified Nominal Flood Protection Level; has safe access to and around the development (in considering site specific flood depths and velocities); and does not interfere with the passage and storage of floodwaters.<br><br>Developments in areas affected by flooding must not obstruct the passage of flood flows or reduce floodplain storage as this may cause flood levels and velocities to increase and adversely impact surrounding properties. Due to the nature of this development a hydraulic engineer should be engaged to ensure that the development does not increase flood levels to the neighbouring properties. A Comparative Flood Model and associated report must be prepared showing a minimum of two scenarios, existing and developed conditions. The acceptable models to use for hydrology and hydraulic assessment are RORB, HECRAS and TUFLOW.<br><br>Freeboard is the difference between the floor level of a building and the 100-year flood level. Freeboard requirements are designed to ensure that valuable buildings, their contents and the people in them are safely above the 100-year flood level. The development must be constructed with finished floor levels set no lower than 600mm above the identified flood level.<br><br>New fencing across a floodplain should also be of an open style of construction (50 per cent permeable/open) to maintain conveyance of flows through floodplains. |
| Drainage and Stormwater Management Strategy | A detailed Drainage and Stormwater Management Strategy must be prepared which demonstrates how stormwater runoff from the development will achieve flood protection standards and State Environment Protection Policy (Waters of Victoria) objectives for the environmental management of stormwater. The strategy must also consider flows from external catchment areas when determining how the development will achieve flood protections standards. The strategy should also include information regarding the future ownership and maintenance requirements of any proposed assets. |
| Waterway Information | The property contains two waterways Curly Sedge Creek and Tributary 4545.<br><br>The impacts of development can include erosion, altered flood behaviour, loss of habitat, a reduction in water quality and a reduction in species diversity. Site disturbance can create conditions that lead to native vegetation being displaced with weeds and woody debris, such as willows, which choke the waterways.<br><br>All new development should preserve, and enhance, the |

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| | social and environmental values and benefits of floodplains and waterways and should be sensitively designed and sited to maintain and enhance environmental assets, significant views and landscapes along river corridors and waterways. The development must be located outside the flood extent and setback from the 'top of bank' of both waterways to the satisfaction of Melbourne Water to ensure adequate protection of water quality and river health. An appropriate interface and landscaping between the waterways and the development will be required to buffer the waterway corridor from the development.<br><br>See the Waterway Corridors Guidelines for general setback guidance, along with any applicable specific local planning provisions.<br><br>A Vegetation assessment must be prepared for the waterway corridors to identify any remnant values for protection.<br><br>A landscape plan must be prepared for the waterway corridors to improve the vegetation condition and buffer the waterway from the development. The plan must be to Melbourne Waters satisfaction. |

Any plans submitted with your application have not been assessed for compliance and the information provided in this letter does not constitute approval. Melbourne Water may not support development that does not satisfy the relevant criteria within our guidelines and the relevant planning provisions.

This is a non-statutory, free service which provides high level, preliminary advice prior to formal applications for planning and building approval. Melbourne Water does not offer a consultancy service, and recommends that applicants seek their own expert advice from a planning consultant or hydraulic engineer in relation to flooding matters prior to making an application to the Responsible Authority.

Next Steps

Melbourne Water is not able to consider requests to vary or review this pre-development advice.

Melbourne Water will formally review, assess and respond to your complete application at Planning/Building Permit stage, and as such recommends that the Responsible Authority's pre-application service is also used to understand the risks associated with any proposal as a whole.

This information provided above is valid on the day of issue and is only preliminary in nature. It forms no contractual agreement between your company and Melbourne Water. Melbourne Water reserves the right to alter any or all of this information at any time.

If you have any enquiries, please contact me on 131 722 or email devconnect@melbournewater.com.au, quoting Melbourne Water's reference number in the subject line.

Regards,

Louise Ripper
Development Planning Services