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KYNETON COMMERCIAL ESTATE FLOOD RISK ASSESSMENT

MAY 2020

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PREPARED FOR

Select Architects

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1 INTRODUCTION

Select Architects have engaged Water Modelling Solutions to prepare a flood risk assessment for the proposed Kyneton Commercial Estate to determine the 1% AEP flood extent. As part of the approval process with Macedon Ranges Shire Council, a request for information has been requested which detailed a number of specific requirements which needed to be addressed to comply with Clause 53.18 of the Planning Scheme. The following item has been addressed within this flood risk assessment:

- "Detention basin outlets are not subject to backwater effect from Post Office Creek" – **The 1% AEP flood extent for the study area has been determined, which has informed the design of the development layout including ensuring the required detention basins are located outside of the 1% AEP flood extent and not subject to backwater effects.**

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2 SITE OVERVIEW

The flood risk assessment is for the proposed commercial estate located in Kyneton to the north of the Calder Freeway. The site, shown in Figure 2-1 is bordered by Edgecombe Road to the west and Baynton Road to the south. The site currently consists predominantly of pastured and agricultural land. It is noted that Post Office Creek traverses the southern end of the site with an approximate upstream catchment area of 8.7 km^2.

The proposed Kyneton Commercial Estate consists of mixed use with 27 commercial and 18 residential lots as shown in Figure 2-2. The Estate includes a proposed service station, hardware store and subdivision of rural residential lots. The majority of the proposed site is situated on the northern side of Post Office Creek with 3 lots on the southern side. Pipers Creek divides the proposed site into two main precincts. The precinct to the south of Pipers Creek Road consists of commercial use including the petrol station and the northern precinct is split between commercial and rural residential uses.

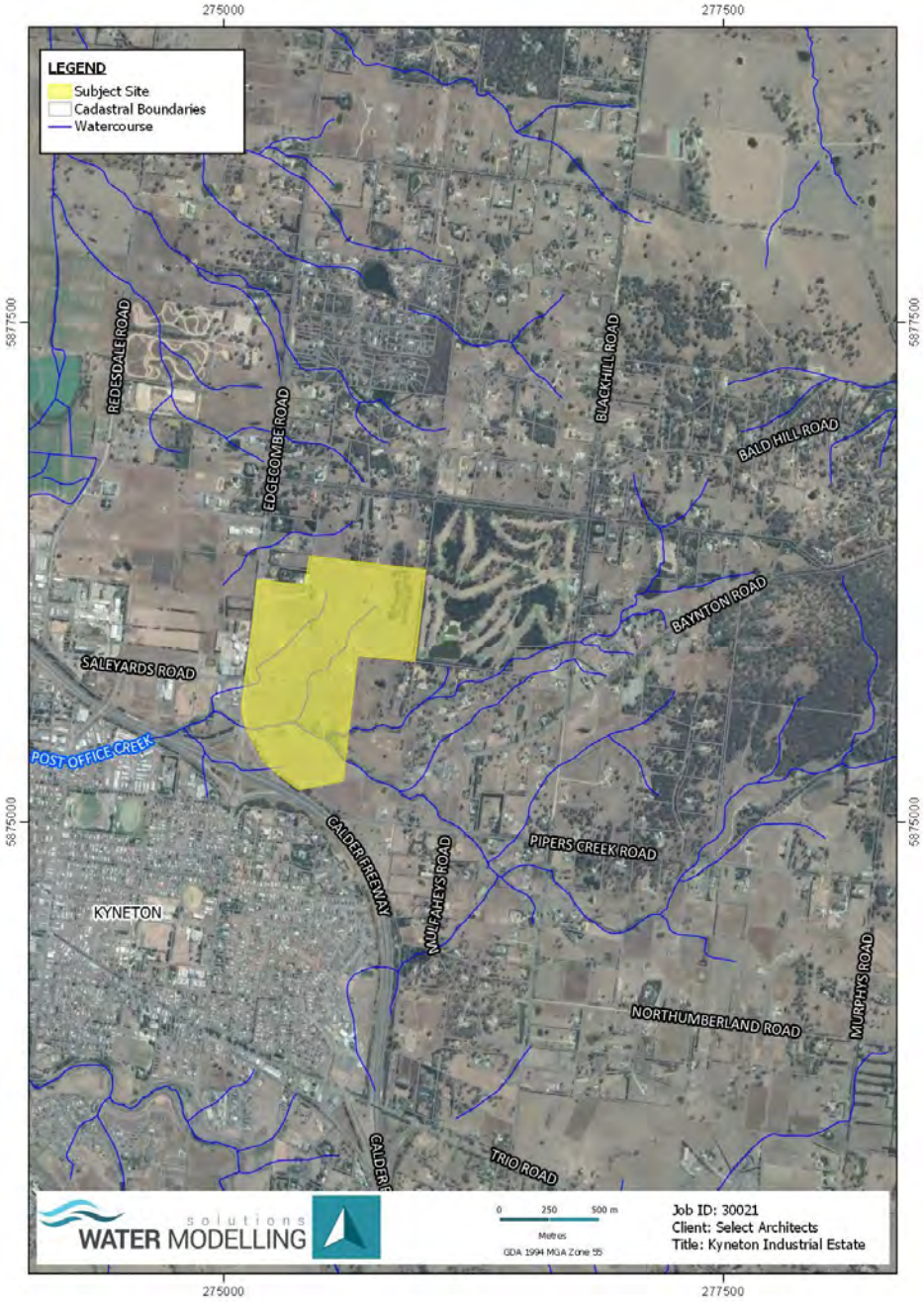

Figure 2-1 Study Area

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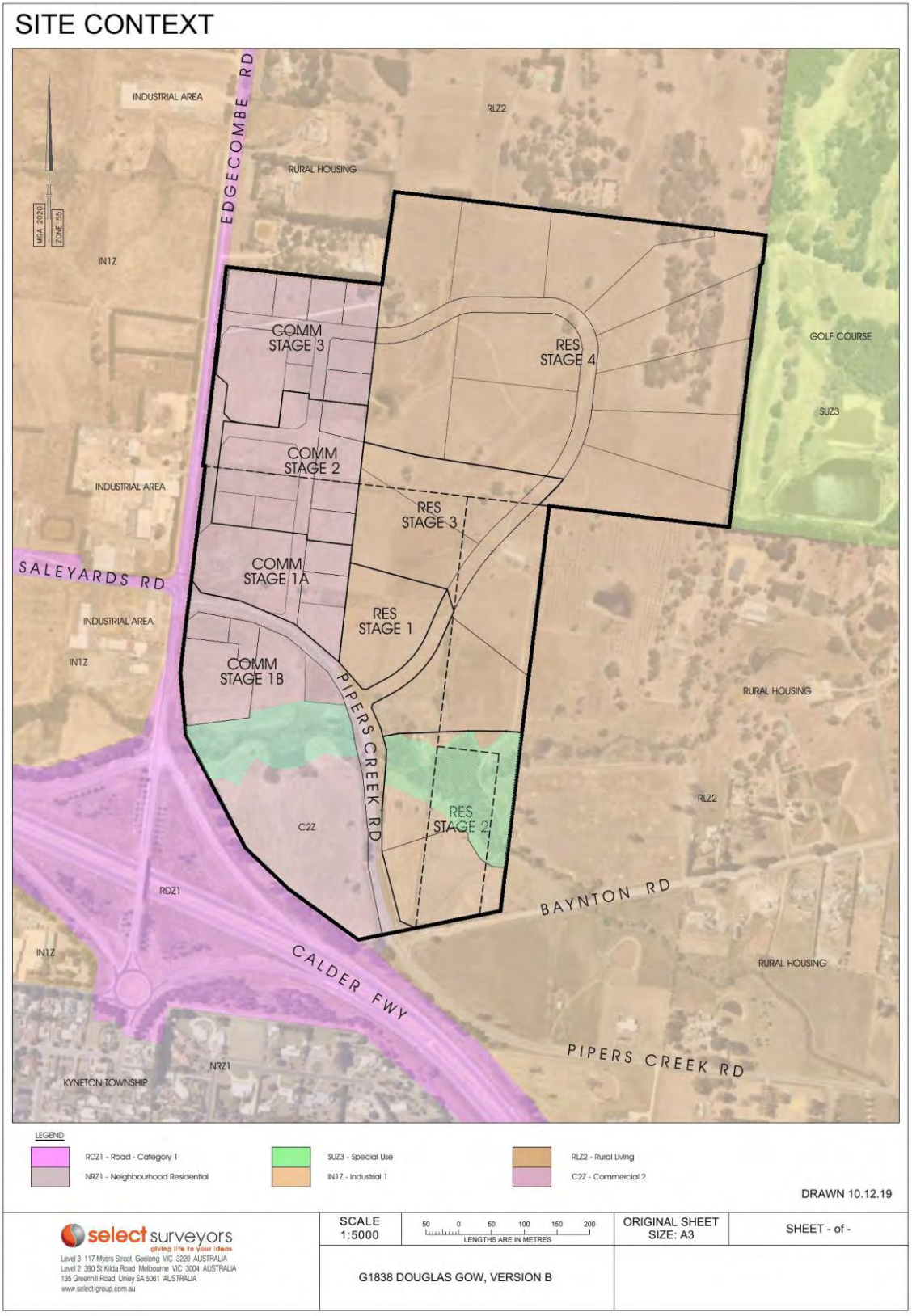

Figure 2-2 Kyneton Commercial Estate Proposed Layout Plan

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3 MODEL DEVELOPMENT

3.1 HYDROLOGY

A hydrological RORB model has been constructed to determine design flows for the site. The modelling also allowed the critical duration and temporal pattern for the 1% AEP storm event to be determined. The Post Office Creek catchment delineation was undertaken using CatchmentSIM GIS software. SRTM-based 1 second digital elevation model sourced from Vicmap was used as the topographic data to delineate and sub-divide the Post Office Creek catchment. Based on the SRTM data, the total catchment area to be modelled is approximately 8.7 km^2.

Sub-catchment delineation is shown in Figure 3-1 below. 'Print' nodes were inserted downstream of sub-catchments 23 and 28 at the approximate location of the hydraulic model boundary. *This enabled hydrographs to be extracted from the RORB model at these locations to determine design flows for input into the hydraulic model.*

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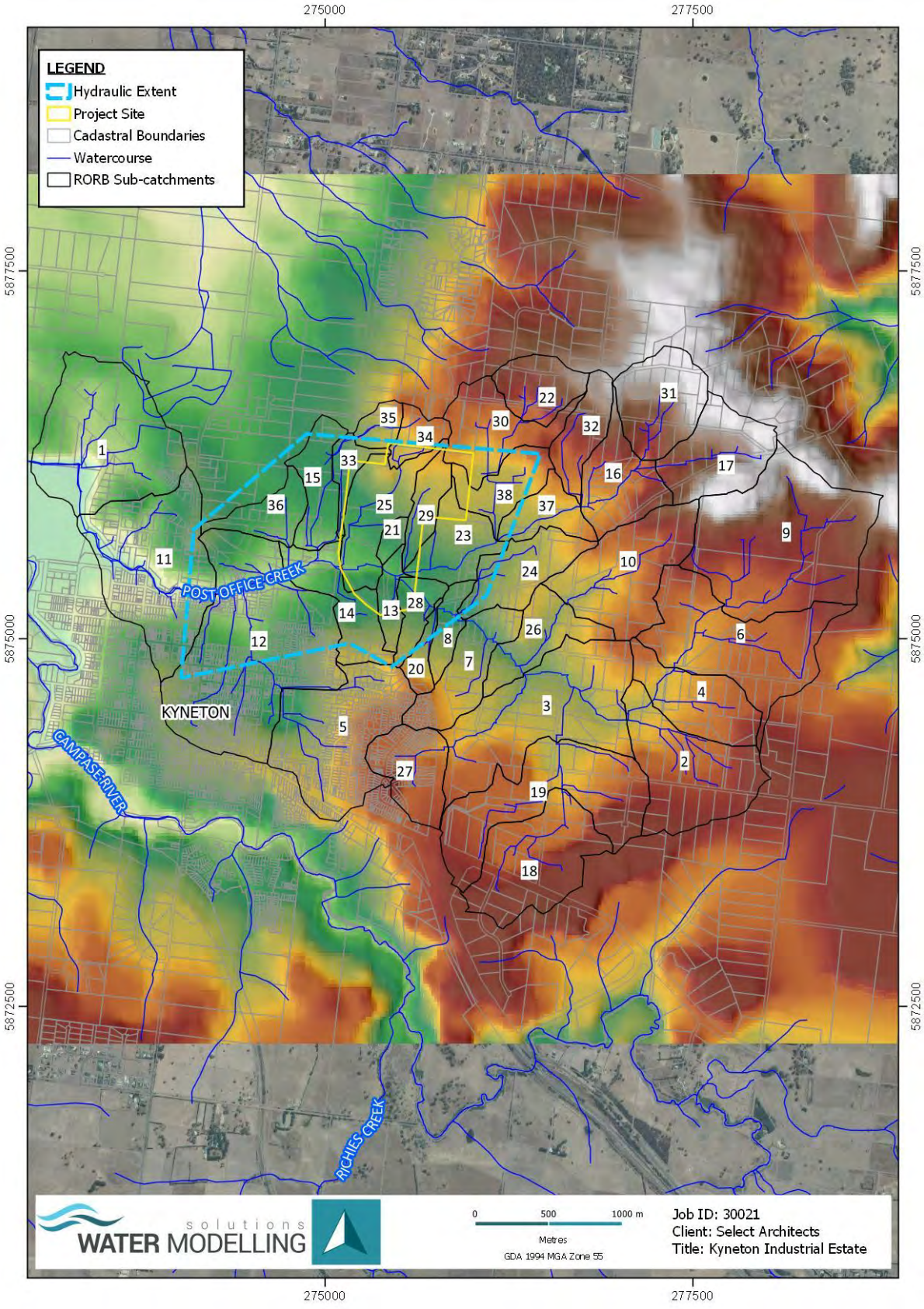

Figure 3-1 RORB Model Sub-catchment Delineation

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A Monte Carlo simulation was run ion RORB to determine the critical duration and peak flow of the catchment for the 1% AEP event. The Monte Carlo simulation simulated 50 rainfall division with 20 samples per division providing a broad range of storms that may cause the design flood. The peak flow and critical duration from the Monte Carlo simulation were used to select an ARR 2019 temporal pattern that best matched the target discharge. This methodology is in line with Australian Rainfall and Runoff (ARR) 2019 best practice.

IFD data was sourced from the Bureau of Meteorology (BoM) IFD generation tool for Australian Rainfall and Runoff (ARR) 2016, and was based on the site coordinates upstream catchment centroid (37.2441S, 144.4812E). Spatial variation of IFD data was not investigated due to the small catchment size.

The input parameters that were used in the RORB model are shown in Table 3-1, and results are shown in Table 3-2.

Table 3-1 Adopted RORB Input Parameters

Parameter	Value	Derivation
Fraction Impervious	Varying	Determined using land use planning zones and values sourced from Melbourne Water Music Guidelines.
Initial Loss	23 mm	Adopted from Kyneton Flood Study completed in 2019 (North Central CMA, 2019).
Continuing Loss	1 mm/hr	Adopted from Kyneton Flood Study completed in 2019 (North Central CMA, 2019).
Routing Coefficient (K_c)	3.29	Derived from the Kyneton Flood Study Post Office Creek RORB model based on a K_c/d_{av} ratio of 1.276.
Average Stream Length (d_{av})	2.58 km	Derived from the WMS built Post Office Creek RORB model, based on delineated catchments.
Non-Linearity exponent (m)	0.80	Adopted from Kyneton Flood Study completed in 2019 (North Central CMA, 2019).

Table 3-2 RORB Model 1% AEP Flows

RORB Print Node Location	Simulation Type	1 % AEP Peak Flow (m^3/s)	1% AEP Storm Duration
Downstream of sub-catchment 23	Monte Carlo	21.6	2-hour
	ARR 2019 Ensemble (design storm)	22.5	1.5-hour, temporal pattern 27
Downstream of sub-catchment 28	Monte Carlo	54.4	2-hour
	ARR 2019 Ensemble design storm)	55.8	1.5-hour, temporal pattern 27

3.2 HYDRAULICS

A 2d hydraulic model was developed to simulate existing 1% AEP flood conditions within the site. Hydrographs for both sub-catchment 23 and sub-catchment 28 were exported from RORB for input into the 2d hydraulic TUFLOW model, and are shown below in Figure 3-2. Key aspects of the existing conditions are mentioned below.

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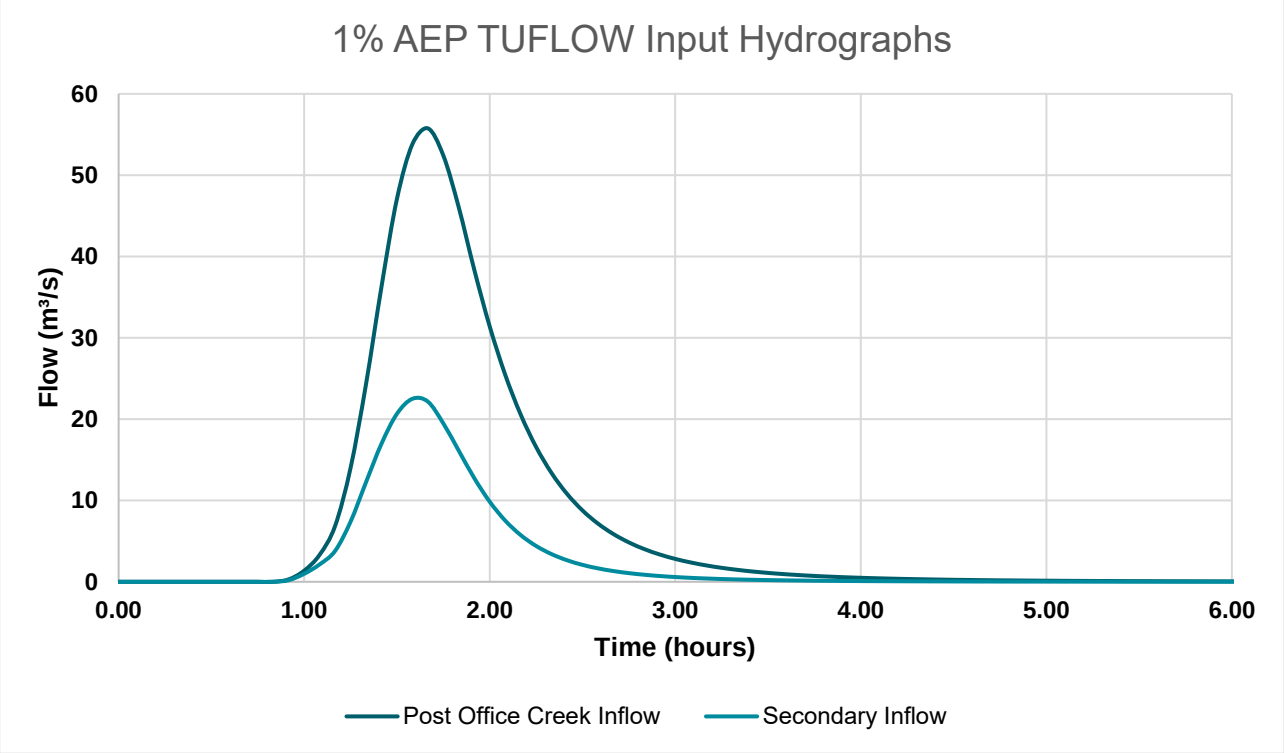

Figure 3-2 TUFLOW input hydrographs

3.2.1 Key Parameters

The model extends approximately 450m upstream of the site to the east within Post Office Creek, and crosses underneath Calder Freeway to approximately 600m downstream. The site borders the model extent on the northern end which extends up a ridge of the catchment.

- The model topography utilised a one metre cell size, and was based on DELWP LiDAR flown in February 2012.
- Inflows were applied as source-area boundaries at the upstream locations for Post Office Creek and a tributary of Post Office Creek. Site runoff was not explicitly modelled, and is being assessed as part of the Stormwater Management Plan for the site.
- Significant culverts in the study area were modelled as one-dimensional structures connected to the two-dimensional domain. A site visit was conducted and culverts were measured where accessible. Where culverts were not accessible, culvert sizes were assumed base on sizes of the upstream and downstream culverts. Culvert lengths and inverts were estimated using LiDAR and Google Earth aerial imagery. Details of culverts within the TUFLOW model are summarised in Table 3-4.
- The model schematisation, including topography, boundaries, and culvert locations, is shown in Figure 3-3.
- Hydraulic roughness (Manning's 'n') values used throughout the model are listed below in Table 3-3 and the spatial delineation of roughness is shown in Figure 3-4.

Table 3-3 Manning's 'n' Roughness Values

Land use Description	Manning's 'n' Roughness Value
Open pervious areas, minimal vegetation (grassed, pasture)	0.05
Open pervious areas, moderate vegetation (shrubs, long grass)	0.06
Open pervious areas, thick vegetation (trees)	0.1
Residential - low density	0.1

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Land use Description	Manning's 'n' Roughness Value
Residential - moderate density	0.15
Industrial/commercial	0.3
Roads	0.02
Waterway with moderate vegetation	0.08

Table 3-4 Structure Information

ID	Location	Length (m)	Dimensions	Upstream Invert (mAHD)	Downstream Invert (mAHD)	Blockage (%)
A	Calder Highway Bridge	78	Three cells of 3 m W x 2.4 m H box culverts	500.17	500.13	0
B	Edgecombe Road	43	Three cells of 3 m W x 2.01 m H box culverts*	503.64	503.50	0
C	Pipers Creek Road	21	Three cells of 3 m W x 2.01 m H box culverts	505.74	505.36	0
D	Driveway Access	8.0	One 0.9 m diameter culvert	507.10	506.98	0
F	Baynton Road	8.5	One 0.9 m diameter culvert	507.57	507.41	0
G	Driveway Access	9.5	One 0.9 m diameter culvert	510.81	510.74	0
I	Driveway Access	7.5	One 0.9 m diameter culvert	514.46	514.35	0
J	Edgecombe Road	14.5	One 0.9 m diameter culvert	512.59	512.41	30*
K	Driveway Access	9.5	One 0.9 m diameter culvert	514.65	514.50	0
L	Driveway Access	7.5	One 0.9 m diameter culvert	520.86	520.77	0
m	Mollison Street	13	One 0.9 m diameter culvert	496.89	496.85	0

*Blockage was based on site visit inspection.

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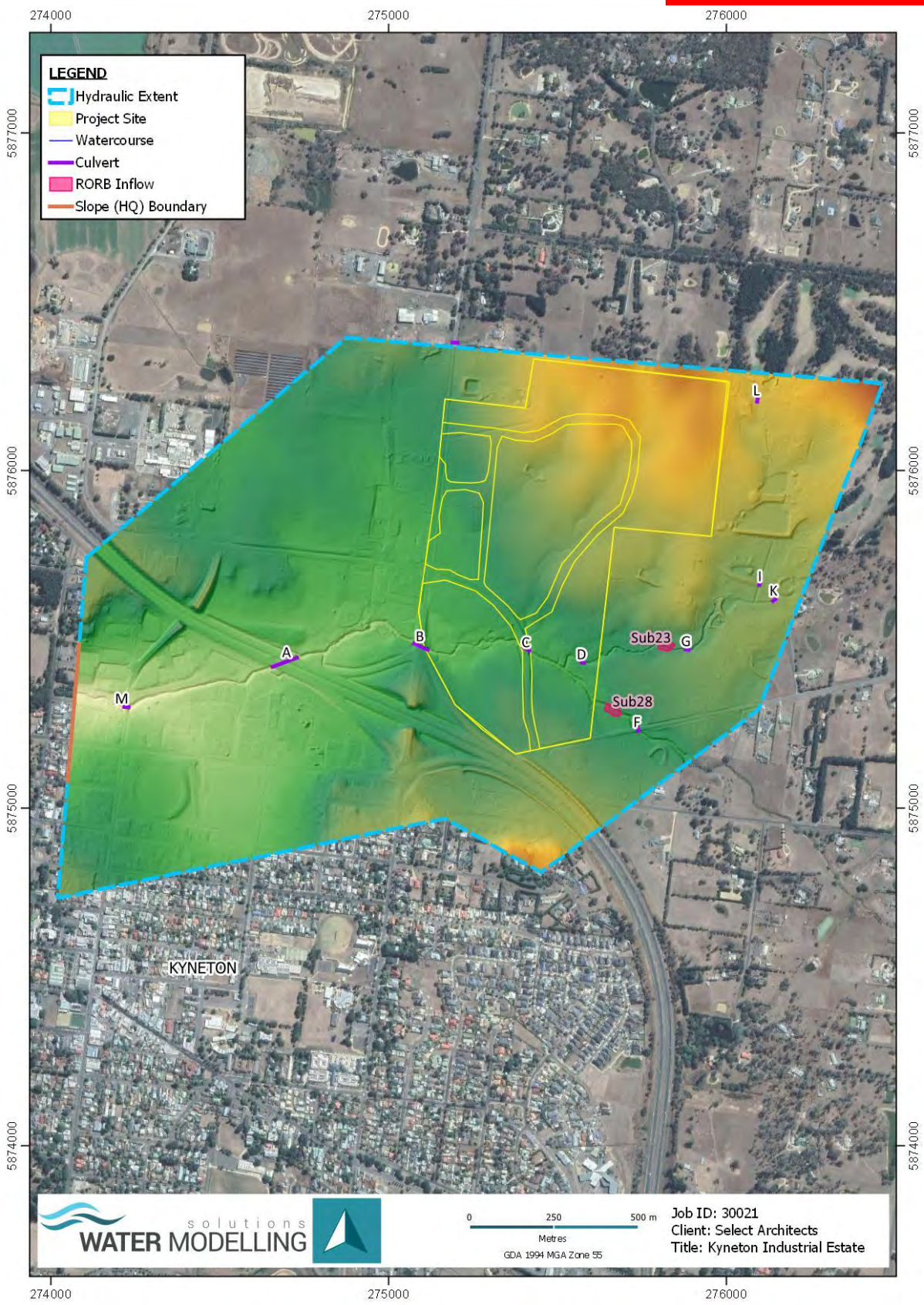

Figure 3-3 TUFLOW Existing Case Model Setup

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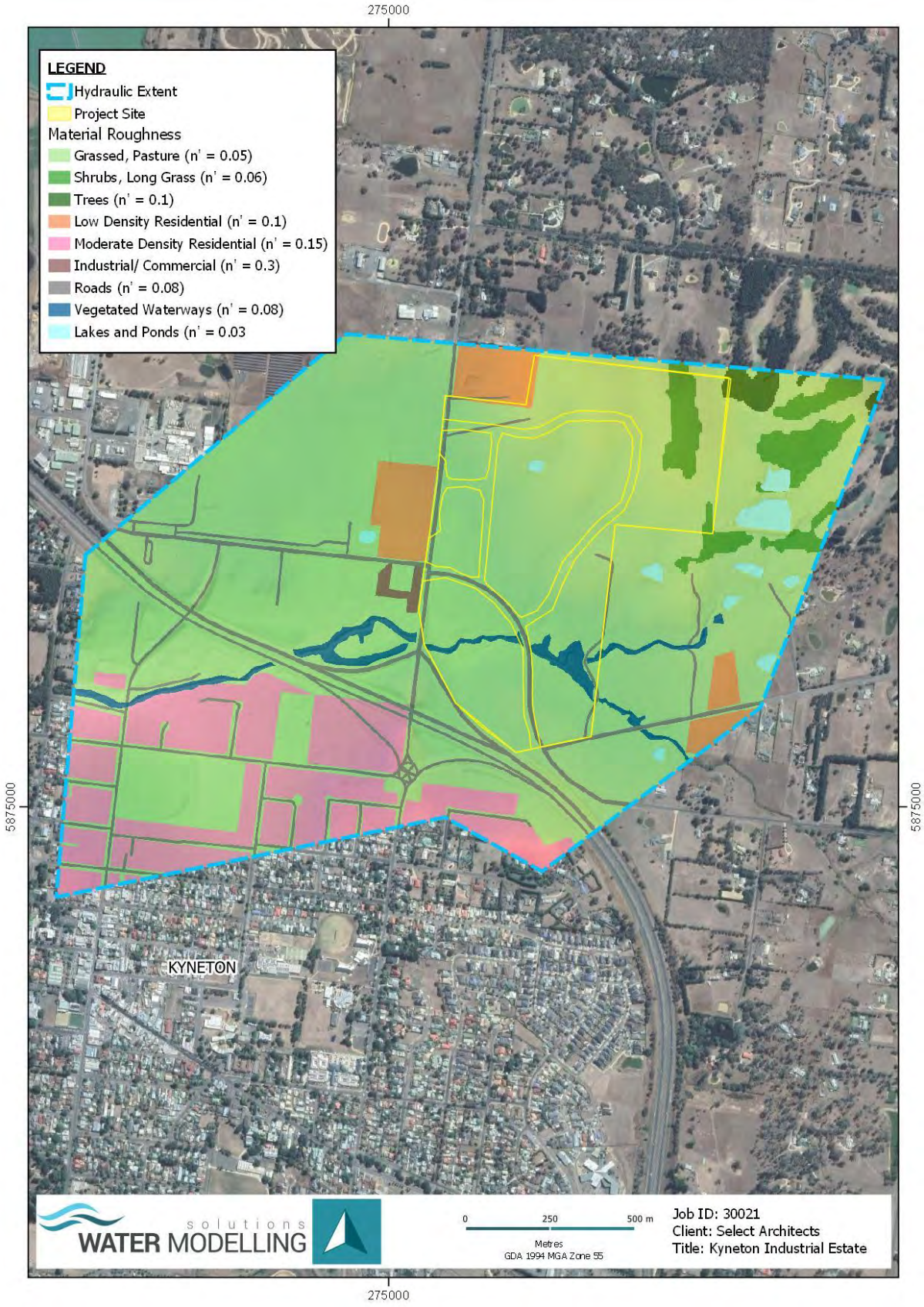

Figure 3-4 TUFLOW Existing Case Model Roughness Delineation

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4 RESULTS

4.1 EXISTING CONDITIONS

Mapping of the existing depth and velocity existing flood results for the 1% AEP event are presented in Appendix A. Figure 4-1 below shows the 1% AEP flood depths with the development layout plan overlaid.

The results show that under existing conditions:

- Pipers Creek Road within the proposed site is overtopped with a depth of approximately 260 mm and velocities of up to 2.4 m/s.
- Edgecombe Road, situated on the western border of the site, currently overtops with depths of up to 750 mm across the road. The overtopping occurs within a small localised area within a short 1.5-hour critical storm duration for the 1% AEP event.
- Due to the overtopping of Edgecombe Road, the adjacent industrial area to the west is impacted. Depths of up to 900 mm and peak velocities up to 0.8 m/s were experienced to the west of initial overtopping location of Edgecombe Road.
- For the proposed site, results under the 1% AEP existing conditions are shown below in Figure 4-1 with the proposed land use masterplan presented underneath the flood depths. The main impacts are shown to the south-west corner of Lot 104 and to a lesser extent Lots 103, 110 and 264.
- It is noted that approximately 40% of Lot 104 is subject to deeper, hazardous flooding and that there is safe access into Lot 104 via Edgecombe Road. It is noted that any development on Lot 104 is proposed on the higher portion of the Lot, outside of the hazardous area of flooding.
- Some of the proposed residential lots have hazardous flooding in the lower portions but the proposed dwelling locations are not impacted and they all have safe access during a 1% AEP flood event.

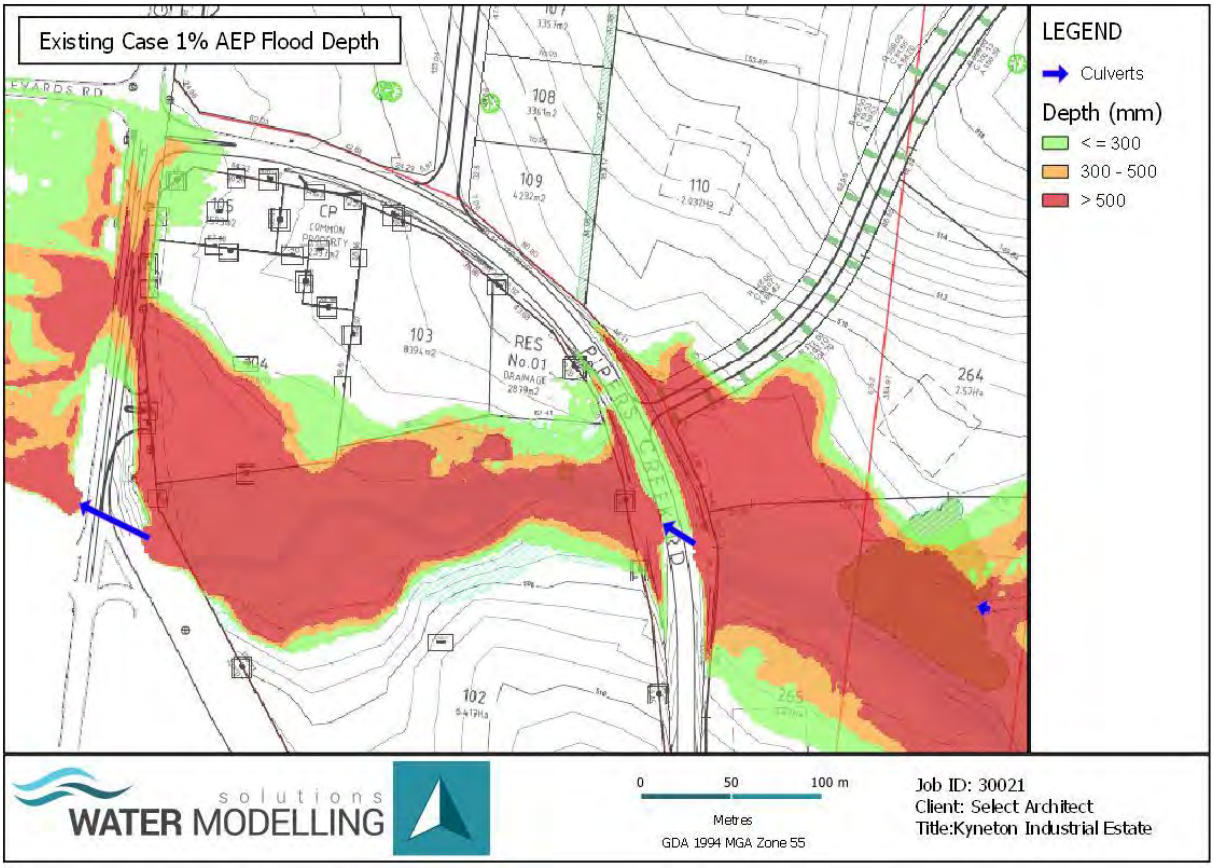

Figure 4-1 1% AEP Flood Depths with Development Layout Plan Overlaid

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4.2 FLOOD IMPACTS TO LOT 104 (SERVICE STATION DEVELOPMENT)

A service station is proposed for Lot 104 and the current layout has been overlaid over the 1% AEP flood depths in in Figure 4-2. It can be seen that the proposed development within Lot 104 is not impacted by deeper flooding (red areas). All development on Lot 104 is either outside of the 1% AEP flood extent or within the flood fringe where flood depths are less than 300mm. The following actions are recommended as part of the development design:

- The development must ensure no fill within the floodplain where 1% depths are more than 300mm (red areas).
- Any fill within the flood fringe (green areas) where depths are less than 300mm will be compensated by an equivalent volume cut within the 1% flood extent on Lot 104 to ensure no net loss of flood storage.
- The finished floor level of the service station shop must be a minimum of 300mm above the applicable 1% AEP flood level.
- 1% AEP flood-free access must be available onto Pipers Creek Road via the common lot to north-east of the service station.

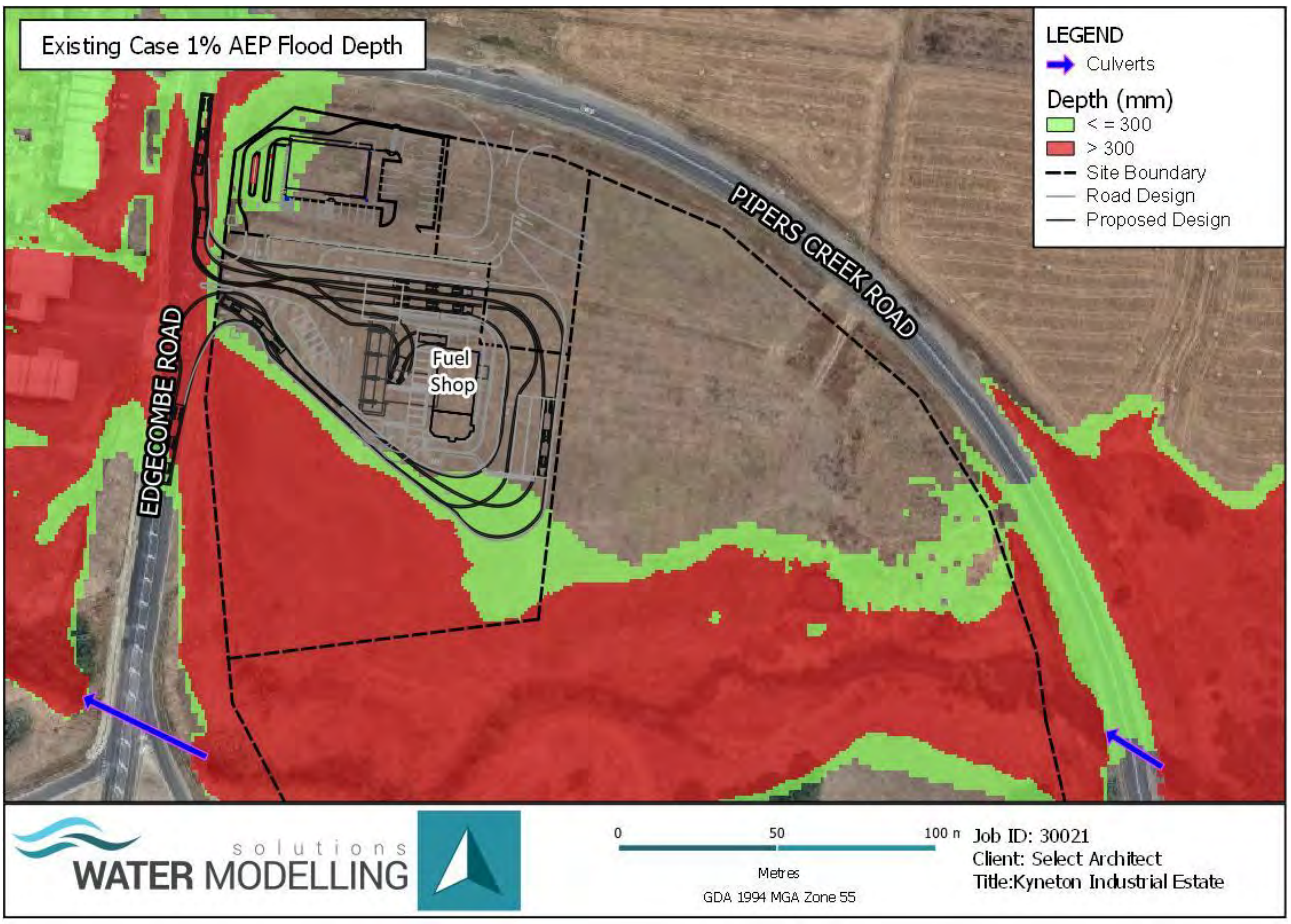

Figure 4-2 1% AEP Existing Flood Extent with Service Station Development

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5 ASSUMPTIONS AND LIMITATIONS

The modelling and results described in this report are subject to the following assumptions and limitations:

- It was assumed that the Campaspe River does not impact the site in a 1% AEP event. Elevations around the site are at least 3 metres in elevation above the confluence of Campaspe River and Campsite Creek;
- No additional stormwater pits and pipes were incorporated into the model other than the drains and culverts described. Any additional minor drainage features within Kyneton township would have a negligible on modelling results for the 1% AEP event;
- Culvert sizes were assumed base on surrounding structures for those not able to be measured during site visit. Culvert inverts and lengths were estimated based on measured depth of cover and on LiDAR and aerial imagery (as opposed to surveyed); and
- The hydrological catchments have been delineated based on low-resolution SRTM topographical data, and hydraulic modelling has been based on the available high-resolution LiDAR.

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6 CONCLUSIONS AND RECOMMENDATIONS

The key findings of the flood risk assessment are:

- There is no hazardous flooding, with depths of more than 300mm, on any proposed commercial lots other than Lot 104 (proposed service station) where development is only proposed on the higher portions of the lot.
- Some of the proposed residential lots have hazardous flooding in the lower portions but the proposed dwelling locations are not impacted and they all have safe access during a 1% AEP flood event.
- All lots have safe egress with depths of less than 300mm to access the site.
- It is recommended that the floor levels of all residential and commercial buildings must be raised a minimum of 300mm above the applicable flood level. This will likely be achieved anyway given the natural topography across the development site.

With regards to the proposed service station on Lot 104 it is recommended that:

- The development must ensure no fill within the floodplain where 1% depths are more than 300mm (red areas).
- Any fill within the flood fringe (green areas), where flood depths are less than 300mm, will be compensated by an equivalent volume cut within the 1% flood extent on Lot 104 to ensure no net loss of flood storage.
- 1% AEP flood-free access must be available onto Pipers Creek via the common lot to north-east of the service station.

The recommendations described above ensure compliance with the Guidelines for Development in Flood Affected Areas (DELWP 2019).

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APPENDIX A

EXISTING 1% AEP FLOOD MAPS

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WATER MODELLING solutions

Kyneton Industrial Estate - Flood Risk Assessment

LEGEND

- Hydraulic Model Extent
- Culverts
- Downstream Boundary

Depth (m)

- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.5 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

1% AEP Depth - Existing

A3 Scale: 1:7500
GDA 1994 / MGA Zone 55

0 100 200 300 m

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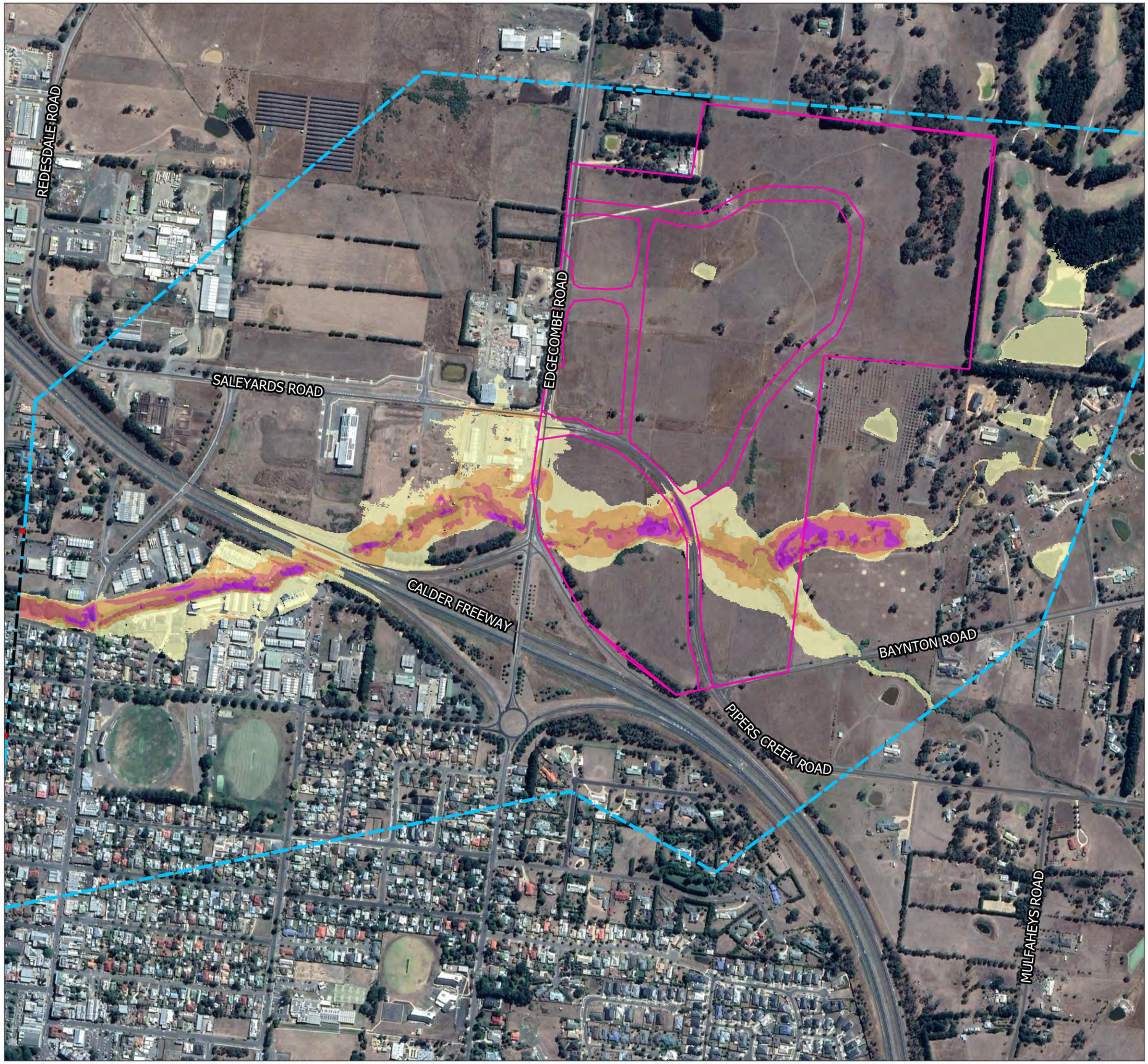
Kyneton Industrial Estate - Flood Risk Assessment



LEGEND

- Main Roads
- Proposed Development
- Hydraulic Model Extent

Velocity (m/s)

- <= 0.5
- 0.5 - 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.5
- > 2.5

1% AEP Velocity - Existing

A3 Scale: 1:7500
GDA 1994 / MGA Zone 55
0 100 200 300 m

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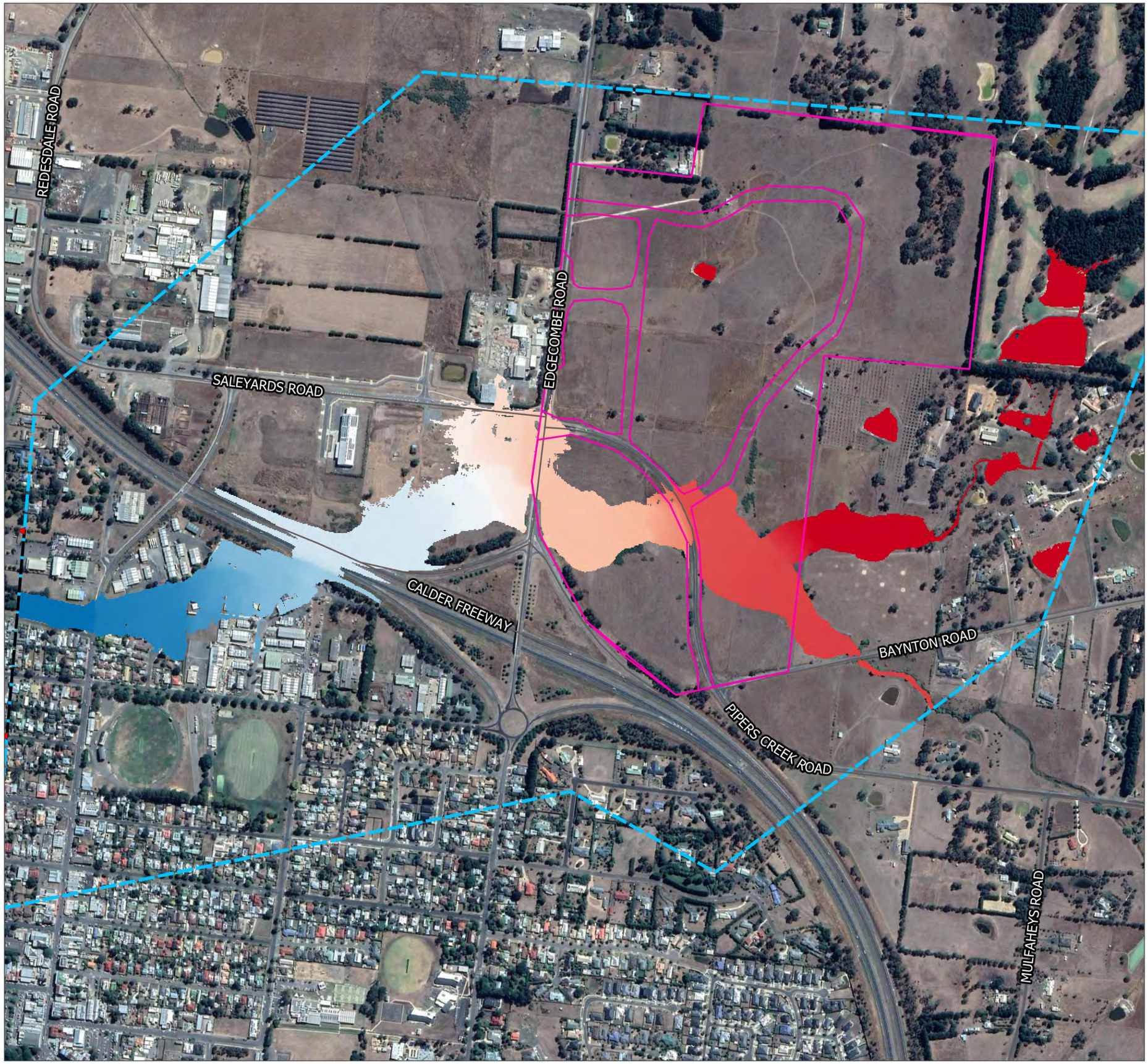
Kyneton Industrial Estate - Flood Risk Assessment



LEGEND

- Main Roads
- Proposed Development
- Hydraulic Model Extent

WSL (m AHD)

- 500
- 501
- 502
- 503
- 504
- 505
- 506
- 507
- 508
- 509
- 510

1% AEP WSL - Existing

A3 Scale: 1:7500
GDA 1994 / MGA Zone 55
0 100 200 300 m

Job No: 30021
Date: 18/03/2020