Hanson Construction Materials

Yannathan Quarry Extension

Surface Water Management Plan

September 2022

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Signatures						

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Contents

Appendices

List of Tables

List of Figures

GLOSSARY

12d Model – Civil Engineering and Surveying Software Package is used to undertake terrain modelling

AEP – Annual Exceedance Probability. For example, a 1 % AEP storm event has a 1 % chance of occurring, or being exceeded, in any one year.

ARI – Average Recurrence Interval. It is the average or expected value of periods between exceedances of a given rainfall over a given duration.

ARR 2019 – Australian Rainfall and Runoff (2019) is a guideline supported by Melbourne Water that is used to estimate rainfall and runoff entering the catchment

ERR – Earth Resources Regulation. Victoria's regulator of exploration, mining, quarrying, petroleum, recreational prospecting and other earth resource activities.

HEC-RAS - Hydrologic Engineering Centre's River Analysis System is used to determine peak water levels within a waterway

IFD – Intensity Frequency Duration. Design rainfall estimate datasets available from the Bureau of Meteorology which specify the expected intensity of rainfall for specific durations of storms for a range of annual exceedance probability (AEP)

RORB – Run Off Routing on a Boroughs is a hydrologic software used to estimate flows

SWMP – Surface Water Management Plan

WPV - Work Plan Variation

1 INTRODUCTION

1.1 SITE CONTEXT

Hanson Construction Materials is preparing a Work Plan Variation to expand their quarrying operations towards the northern boundary of their sand quarry located at 870-910 Westernport Road in Yannathan (Figure 1-1). There is an existing drainage channel (identified by Melbourne Water as Creek 2412) within the location of the proposed expansion, as shown in blue in Figure 1-1. The expansion will require the realignment of the existing channel towards the northern boundary of the site as shown indicatively by the red line in Figure 1-1.

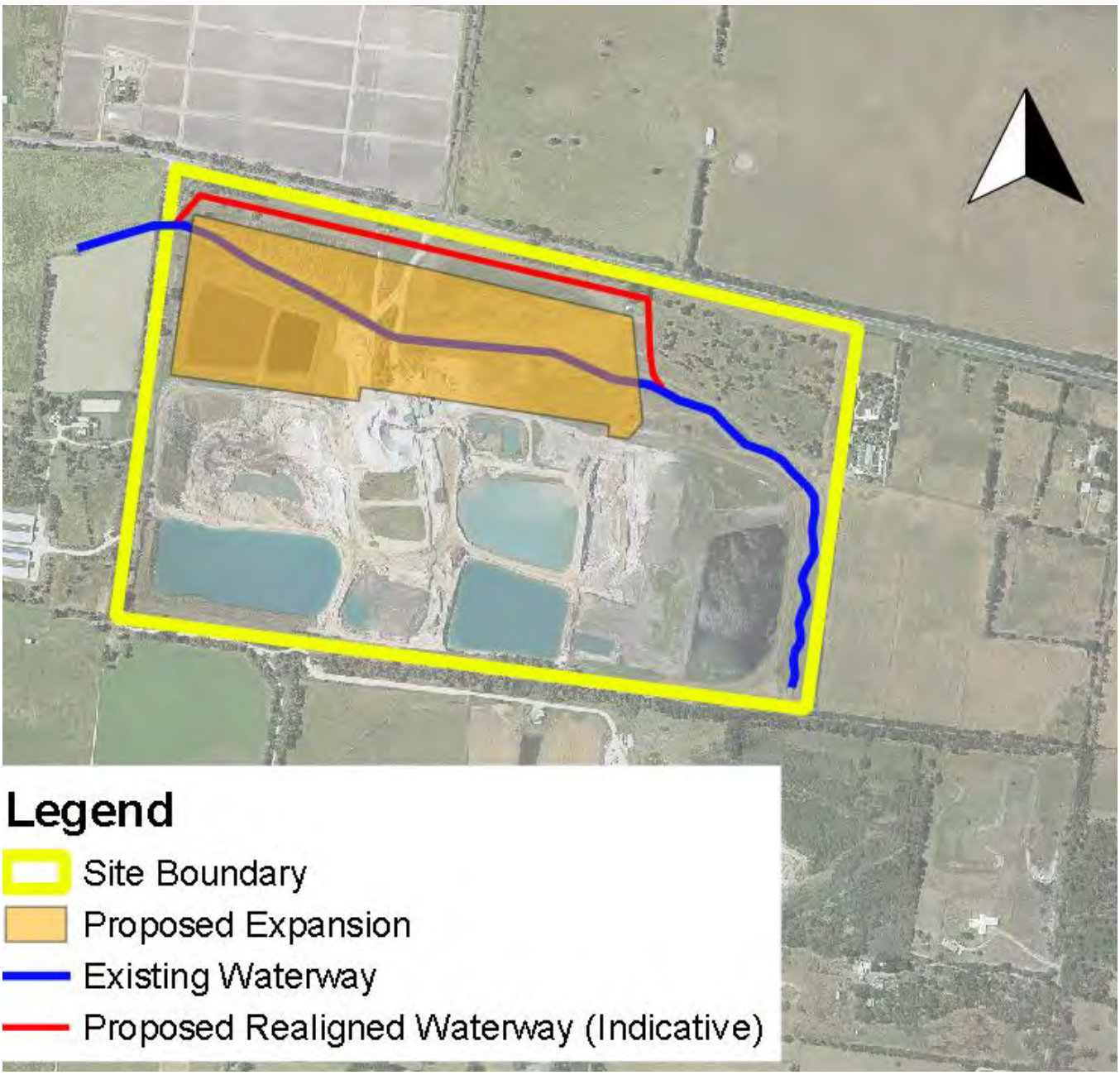


Figure 1-1: Proposed expansion and indicative realigned channel alignment

The existing drainage channel and waterway on the site have been modified from their pre-European settlement form. Approximately half of the length of channel through the site was realigned as a constructed waterway (compound form) with

pools, riffles and a low flow meandering channel in 2013. This realigned section of the waterway was designed and constructed based on the concept design undertaken by ATC Williams (Refer to **Appendix A** for report provided by Melbourne Water) with a detailed design completed by GHD.

The remaining section of channel through the site which is now proposed to be realigned is a reasonably straight rural drainage channel which was presumably constructed when the land was utilised for agricultural purposes prior to its use as a sand quarry. Given the flat nature of the area it is likely that prior to the construction of the drainage channels both on the site and in the surrounding area much of the land in this area would have been swampy/boggy for large parts of the year.

1.2 OBJECTIVES

Engeny Water Management (Engeny) has been engaged to undertake a Surface Water Management Plan (SWMP) of the site and associated upstream catchments to address the requirements of the Work Plan Variation (WPV).

The SWMP includes:

- Determination of the requirements of responsible authorities including Earth Resources Regulation (ERR) and Melbourne Water.
- Estimation of stormwater flows derived from catchments internal and external to the proposed expansion area.
- Design of a constructed waterway required to convey external catchment flows around the proposed expansion area. Engeny have been engaged to prepare conceptual and functional documentation to support the proposed design. The design will consider requirements during the operational and rehabilitated phases of the site.

This document will be updated as the design develops from a concept to detailed design. It is expected that Melbourne Water will be engaged at each stage to ensure that all requirements from Melbourne Water are addressed at each stage of the design.

1.3 SCOPE

The following tasks have been undertaken as part of the scope of works:

- One site meeting with Ricardo and Hanson.
- Hydrological modelling of the subject catchment area to estimate catchment flows entering the site.
- Hydraulic modelling to determine the required size of the proposed realigned waterway.
- Terrain modelling to determine the proposed extent of the proposed realigned waterway.
- Concept and functional design of the recommended drainage infrastructure as required by the responsible authorities.

1.4 APPROACH

The hydrological modelling has been undertaken using methods outlines in the Australian Rainfall and Runoff (ARR) 2019. All intensity-frequency duration (IFD) design rainfall intensities, temporal patterns and associated approaches to hydrological losses have been obtained from this publication.

Modelling has been undertaken using the following software programs:

Hydrological Modelling – RORB was developed by Monash University with support from Melbourne Water. It is a general runoff and streamflow routing program that is used to estimate design hydrographs and peak flows for a given catchment. These design flows are then used to develop the hydraulic model.

Hydraulic Modelling – HEC-RAS was developed by the US Army Corps of Engineers which is a 1d and 2d hydraulic software that is supported by Melbourne Water. HEC-RAS is used to perform one and two-dimensional hydraulic calculations to determine sizing and geometry for a given waterway. This will provide the minimum cross-sectional area required to convey the peak flow calculated in the hydrologic model.

Terrain Modelling – 12d Model is a terrain modelling and civil engineering software package that is used to determine the extent of the proposed waterway including its longitudinal grade and interface with the existing surface. 12d Model has been used to inform the extent of works shown on the concept design documentation.

1.5 STAGING OF WORKS

To extend the extraction area as shown in Figure 1-1, the proposed sequencing of works (from a stormwater perspective) is expected to be as follows:

1. Commence extraction of the area north of the existing waterway (no impact on the existing waterway).
2. Once extraction of the area north of the existing waterway is completed, backfill will be undertaken with a suitable material, preferably material sourced from the site, as required, to provide a corridor for the proposed realigned waterway. The specification of this backfill material will be developed by a suitably qualified geotechnical engineer and confirmed with Melbourne Water and provided during the functional design stage.
3. Existing waterway is to be realigned over the backfilled area. This waterway will be designed and constructed in accordance with the Melbourne Water Constructed Waterway Design Manual.
4. Commence extraction of the area south of the realigned waterway, including removal of the existing waterway.
5. Rehabilitation of the site to be undertaken once extraction completed. The rehabilitation of the site post extraction is proposed to involve filling some areas of the excavations which a suitable material and revegetating with native plants. Other areas of the site will be retained as open dams. The dams will be bunded off from the realigned waterway so that no flows from events up to and including the 1% AEP event can spill into the dams. Figure 1-2 shows the concept plan of the proposed site rehabilitation once the extraction has been completed.

At each stage of the works the quarrying pits will be protected from flooding in up to a 1% AEP event to prevent water from flowing into any of the pits.

Figure 1-2: Proposed rehabilitation plan (concept design for context)

2 SITE INSPECTION

2.1 OVERVIEW

Engeny has undertaken a site visit to the quarry site on 9 February 2021. The inspected channel has been split into three reaches (A, B and C) which is summarised as follows and as shown in Figure 2-1:

Reach A – Realigned section of the existing waterway as part of the most recent Work Plan Variation dated in October 2013.

Reach B – Existing waterway alignment that is to be realigned as part of the proposed variation of the current Work Plan (approx. 800 m in length).

Reach C – Existing waterway alignment that is to be retained (not modified) as part of the proposed variation of the current Work Plan.

The inspection involved undertaking measurements of the existing culverts and to obtain information regarding the conditions of the current. In addition, an understanding of the design constraints and requirements of the proposed diversion channel were developed.

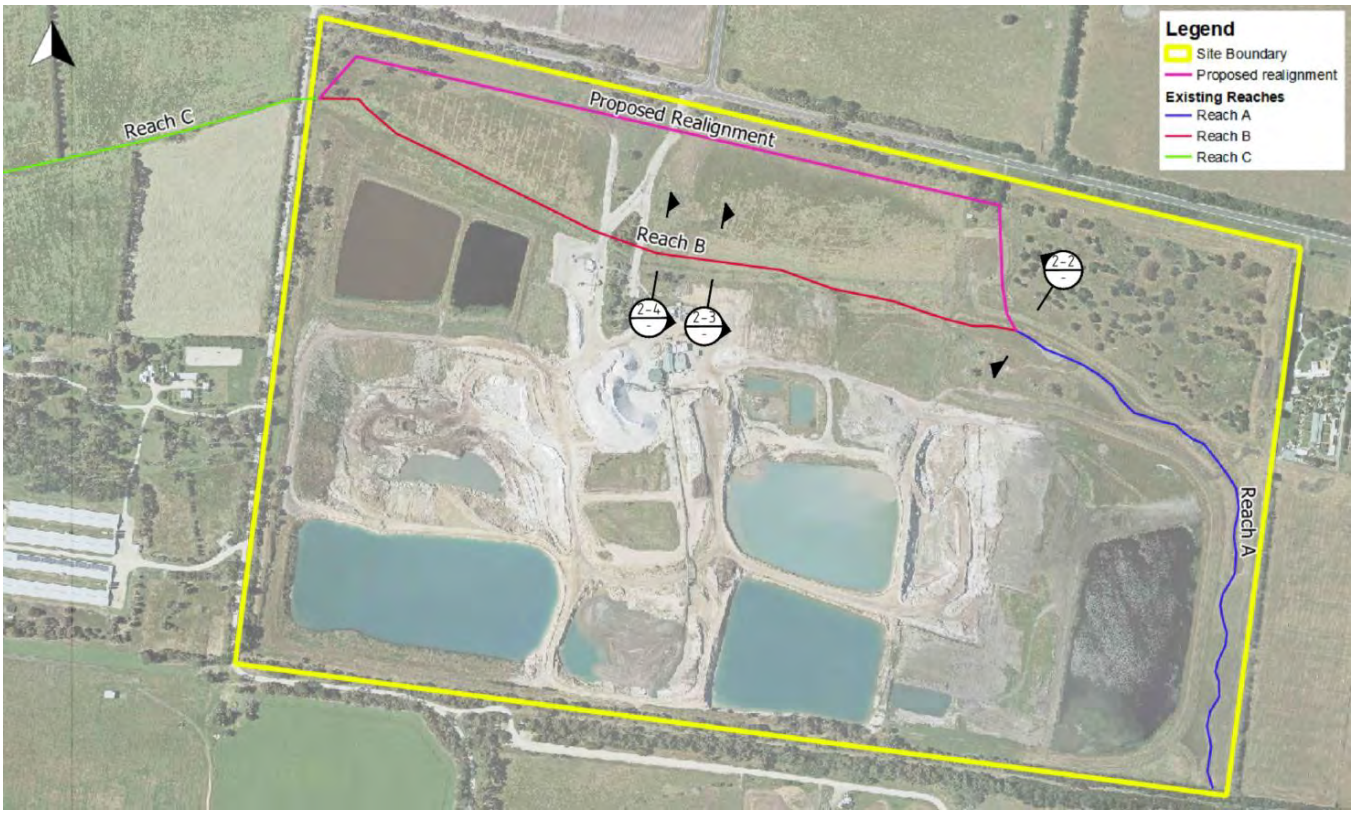


Figure 2-1: Site Waterway Reaches

2.2 SITE CHARACTERISTICS

2.2.1 Reach A

Reach A represents a previously re-aligned constructed waterway from the east of the quarry site flowing in the north-west direction towards Reach B. The waterway has low vegetation with some pasture grasses within some sections as shown in Figure 2-2. The surrounding broad floodplain consists mostly of a low-lying groundcover of pasture.

Figure 2-2: Constructed low flow channel (Reach A)

2.2.2 Reach B

Reach B features a shallow low–flow channel, in the order of 200 to 300 mm deep, and therefore water overtops to the surrounding floodplain once the low-flow channel depth is exceeded in a rainfall event. The floodplain surrounding the eastern section of this reach, is made of low-lying groundcover of pasture grasses consistent with findings along Reach A. The floodplain surrounding the western section of this reach is made up of dense groundcover consisting mostly of pasture grasses, with some dispersed trees on its floodplain further downstream towards the western boundary of the site.

The in-channel vegetation is thick, spreading across the channel at various sections (Figure 2-3). Some ponding was observed along this reach of the waterway (Figure 2-4). Isolated areas of localised ponding likely formed after a storm event were observed along the length of the reach east of the access road leading to the upstream end of Reach B.

Figure 2-3: Channel at Reach B flows on broad floodplain

Figure 2-4: Extended ponding upstream of Reach B

2.3 EXISTING CULVERT CROSSINGS

Due to the dense vegetation, Engeny was unable to observe the existing culverts at the two road crossings that cross Reach B. However, Hanson has advised Engeny that there are approximately six to eight 300 mm diameter circular pipes at each of the two access road crossings, therefore, the hydraulic modelling has assumed that there are six culverts under each of the two access roads to the site.

Additionally, Hanson have confirmed that the box culvert at Milners Road has dimensions of 1200 mm wide and 500 mm high. This culvert has also been included in the hydraulic model.

Refer to Figure 2-5 for existing culvert crossing locations.

Figure 2-5: Existing Culvert Crossing Locations

3 RESPONSIBLE AUTHORITY REQUIREMENTS

Earth Resources Regulation (ERR), Melbourne Water and Cardinia Shire Council are the responsible authorities to permit work within the site.

ERR and Cardinia Shire Council have not been contacted by Engeny and it is understood that Hanson will facilitate these communications.

Engeny have submitted a Pre-Development Advice application through Melbourne Water (MWA-1188291) dated 9 October 2020.

Melbourne Water has provided Engeny the advice to satisfy the proposed quarry extension. This email, dated 18 December 2020, is attached in **Appendix B**. A summary of the requirements and advice is shown on Table 3-1**.**

Table 3-1 Summary of Melbourne Water's requirements

Melbourne Water requirement	Action
Geotechnical / geomorphological report	Engeny has undertaken a geomorphological assessment of the site, which outlines the geomorphic values of the site, the feasibility of the proposed realignment and stream velocities and shear stresses. Refer to **Appendix C**
Channel capacity and freeboard	Details are provided in Section 6 of this report
Flora and Fauna Investigation (Biodiversity Assessment)	Refer to **Appendix D**
The location and species of vegetation affected by any proposed realignment at the project site as well as upstream and downstream of the project site	Refer to **Appendix D**
Sediment control elements	Sediment control elements such as silt traps can be recommended as part of the functional or detailed design documentation, however it will be ultimately up to the contractor or group undertaking the civil works to ensure that appropriate sediment control measures are implemented to protect the downstream water quality during construction and establishment of the realigned waterway.
Waterway corridor zones and/or design, including appropriate revegetation setbacks, revegetation treatment, exclusion zone and maintenance access on both sides of the waterway	Footprint of the realigned waterway is up to approximately 60 metres wide which include areas for revegetation. Maintenance access can be provided from the southern side of the waterway

4 HYDROLOGIC MODELLING

The stormwater management plan has assessed two scenarios for runoff to enter the site as summarised below:

1. Local Catchment (Scenario 1) – Based on the catchment delineation undertaken by Engeny and informed by LiDAR data
2. Little Lang Lang Catchment (Scenario 2) – Based on the ATC Williams modelling undertaken in 2011 to inform the previously realigned waterway (Reach A) and advice provided by Melbourne Water from a regional flood model of the Little Lang Lang River.

4.1 LOCAL CATCHMENT (SCENARIO 1)

4.1.1 Overview

Engeny developed a hydrological model using RORB software in accordance with Australian Rainfall and Runoff 2019 (ARR 2019) to generate inflows to the HEC-RAS hydraulic model for the 1 % AEP storm event from the local catchment.

Appendix E provides technical details relating to the development of the RORB hydrological model for this study.

4.1.2 Catchment delineation

Most of the site is low-lying with a gentle slope of approximately 2 % towards the existing waterway. The topography of the area lends to very shallow drainage depressions in most areas. Broad flat plains also characterise large parts of the contributing catchment while the site extremities extend into the surrounding bund adjacent to Westernport Road along the northern site boundary. The existing channel flows north-west around the boundary of the site, from the south-eastern site boundary to the north- western boundary.

As part of the hydrological model development, a catchment delineation has been undertaken for the site to determine the expected catchment area that would contribute flows to the site. Engeny has determined an upstream catchment area of approximately 2.7 km^2 would contribute flows to the site. Refer to Figure 4-1 for catchment area.

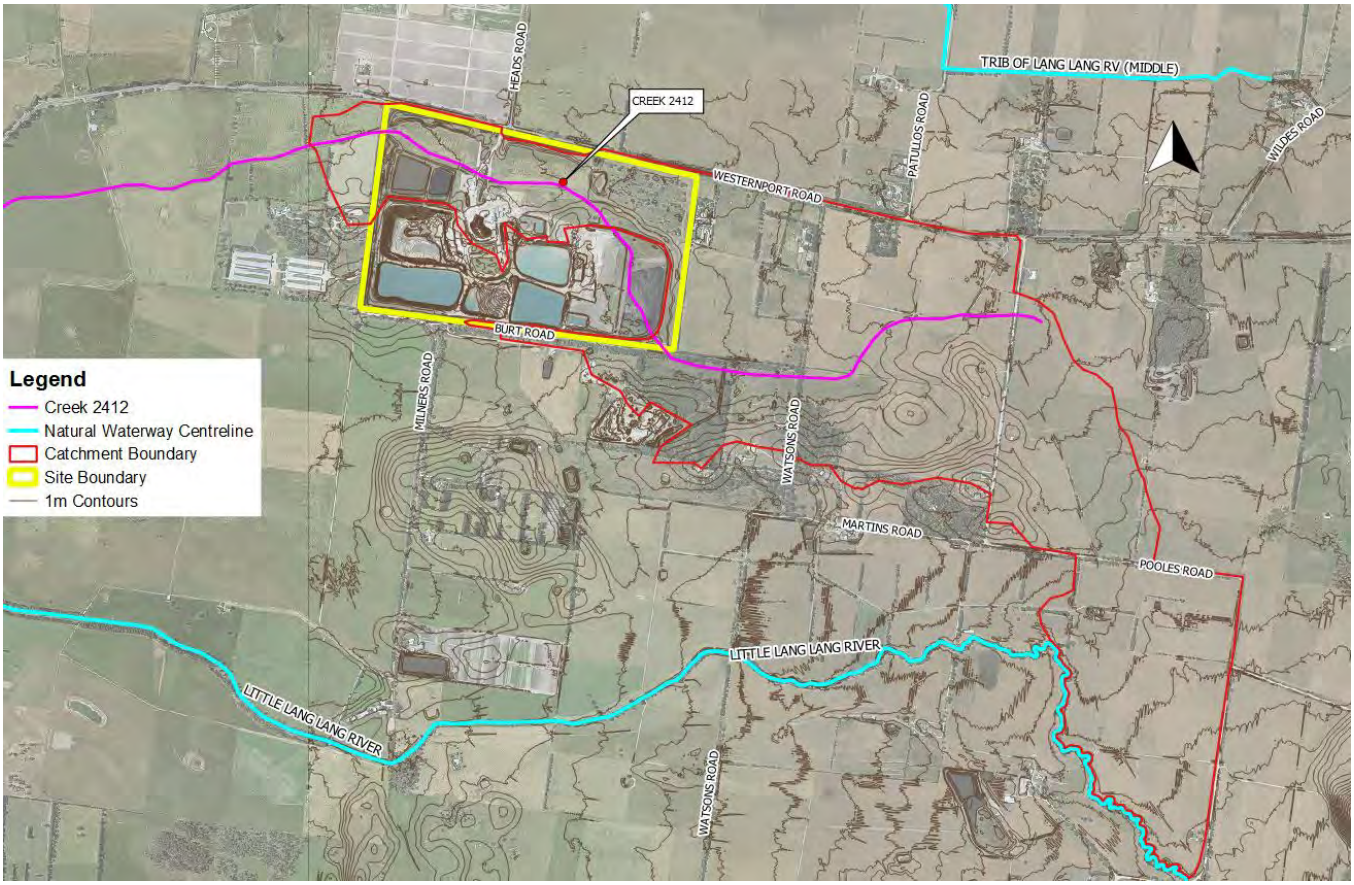


Figure 4-1: Local catchment contributing flows to the study area (delineated by Engeny)

The catchment and sub-catchments (subareas) were delineated considering the following information:

- The Digital Elevation Model (DEM) generated from the available LiDAR data and terrain contours created from the DEM.
- Land use identified in the Victorian Planning Scheme.
- Property boundaries.
- Aerial photography.

As shown in Figure 4-1, the local catchment extends up to the northern bank of the Little Lang Lang River in some locations. There is a high bank/bund at the top of the waterway channel and the land then fall gently north away from the river. This also facilitates breakout flow from Little Lang Lang River which is discussed further in Section 4.2.

Appendix Figure E-1 presents the RORB hydrological model catchment delineation by Engeny. The subareas were delineated taking into consideration of overland flow paths.

The local catchment identified by Melbourne Water is shown in Figure 4-2. Compared to the catchment delineation undertaken by Engeny for the local catchment which shows the upstream boundary to end at Pooles Road, the information provided by Melbourne Water shows the catchment boundary extend further east to the ridges south of Mount Lyall Road.

Figure 4-2 has been provided by Melbourne Water which shows the Little Lang Lang River, Creek 2412 and other watercourses (natural waterways that are above Melbourne Water's limit).

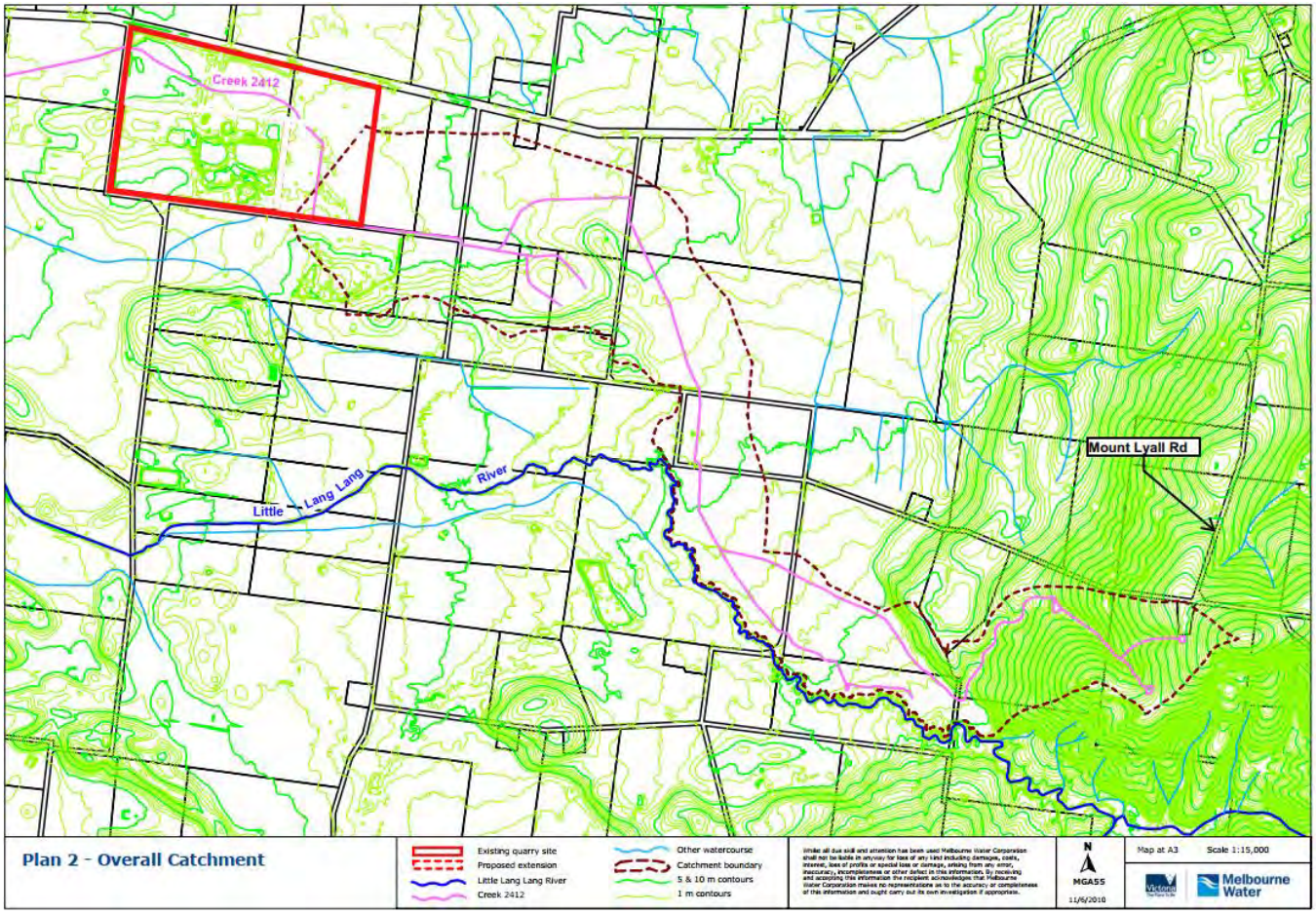


Figure 4-2: Larger catchment contributing flows to the study area from Little Lang Lang River (identified by Melbourne Water)

Catchment Delineation Comparison

As shown in Figure 4-3, Tributary A (nominally labelled for this study as a tributary of the Little Lang Lang River) flows into Little Lang Lang River and therefore was not considered to contribute to the local catchment flows of the site. Furthermore, analysis of the Pooles Road surface levels indicates embankments on the eastern side of Pooles Road, as shown on Figure 4-4. Therefore, flows flowing from the east towards Pooles Road are expected to be diverted along the eastern embankment and flow towards Haysoms Road without contributing to flows at the quarry site.

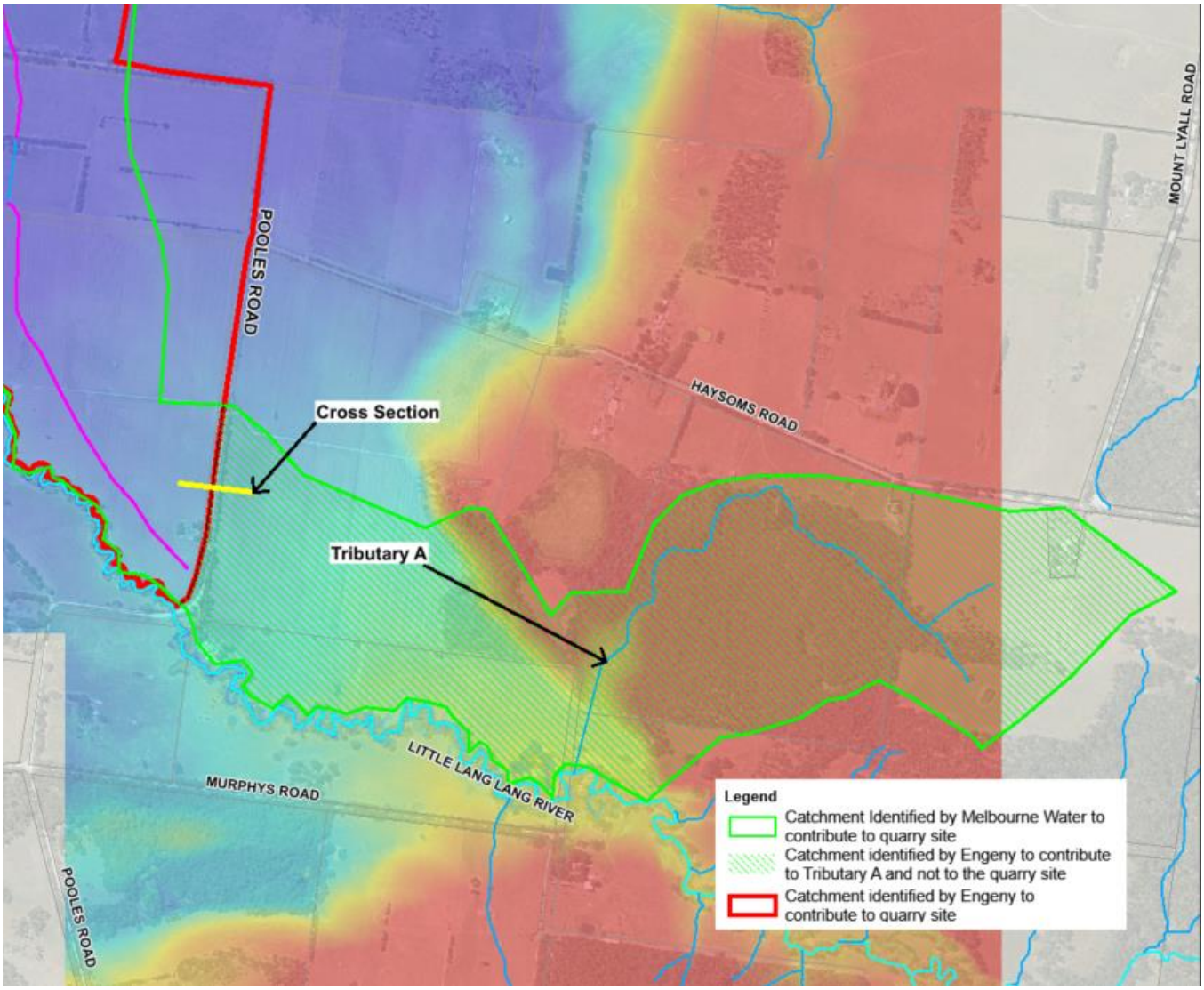


Figure 4-3: Digital Terrain Model east of Pooles Road

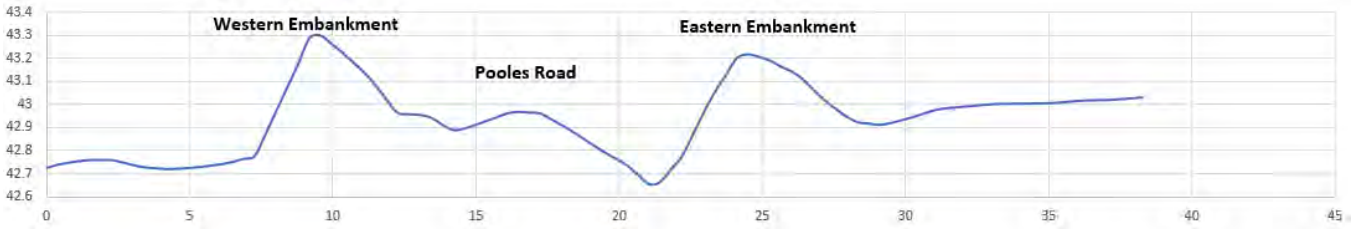


Figure 4-4: Pooles Road (location of eastern catchment boundary) cross-section

A site investigation was undertaken by Engeny on 24 March 2022 to validate whether surface water upstream of Pooles Road, to the east, would be directed towards the quarry site or diverted north along Pooles Road. The findings of the site investigation confirmed embankments on both the eastern and western side of Pooles Road, for the entire length of the road that direct flows towards a channel on the east side of Pooles Road at the intersection of Pooles Road and Haysoms Road as shown in Figure 4-5.

Figure 4-5: Channel along Pooles Road

This channel runs north, along the eastern side of Pooles Road and directs flow north, towards Westernport Road as shown in Figure 4-6.

Figure 4-6: Channel towards Westernport Road

A cattle crossing was found that crosses Pooles Road, south of Haysoms Road, however a diversion channel was observed at the upstream end of the crossing, that directs flow along the western embankment and towards Haysoms Road. Refer to for diversion channel location.

Figure 4-7: Cattle Crossing

4.1.3 Adopted Catchment

Engeny submitted the catchment delimitation shown in Figure 4-1 to Melbourne Water as part of the initial submission of this strategy. Melbourne Water has provided feedback that they require the catchment to be expanded to include the additional area shown in Figure 4-2 and Figure 4-3. While Engeny disagrees with Melbourne Water's assessment of the catchment boundary we have updated the RORB modelling to include this additional catchment area in accordance with what is required by Melbourne Water.

Figure 4-8 shows the adopted RORB model catchment layout including the additional catchment area to the east of Pooles Road.

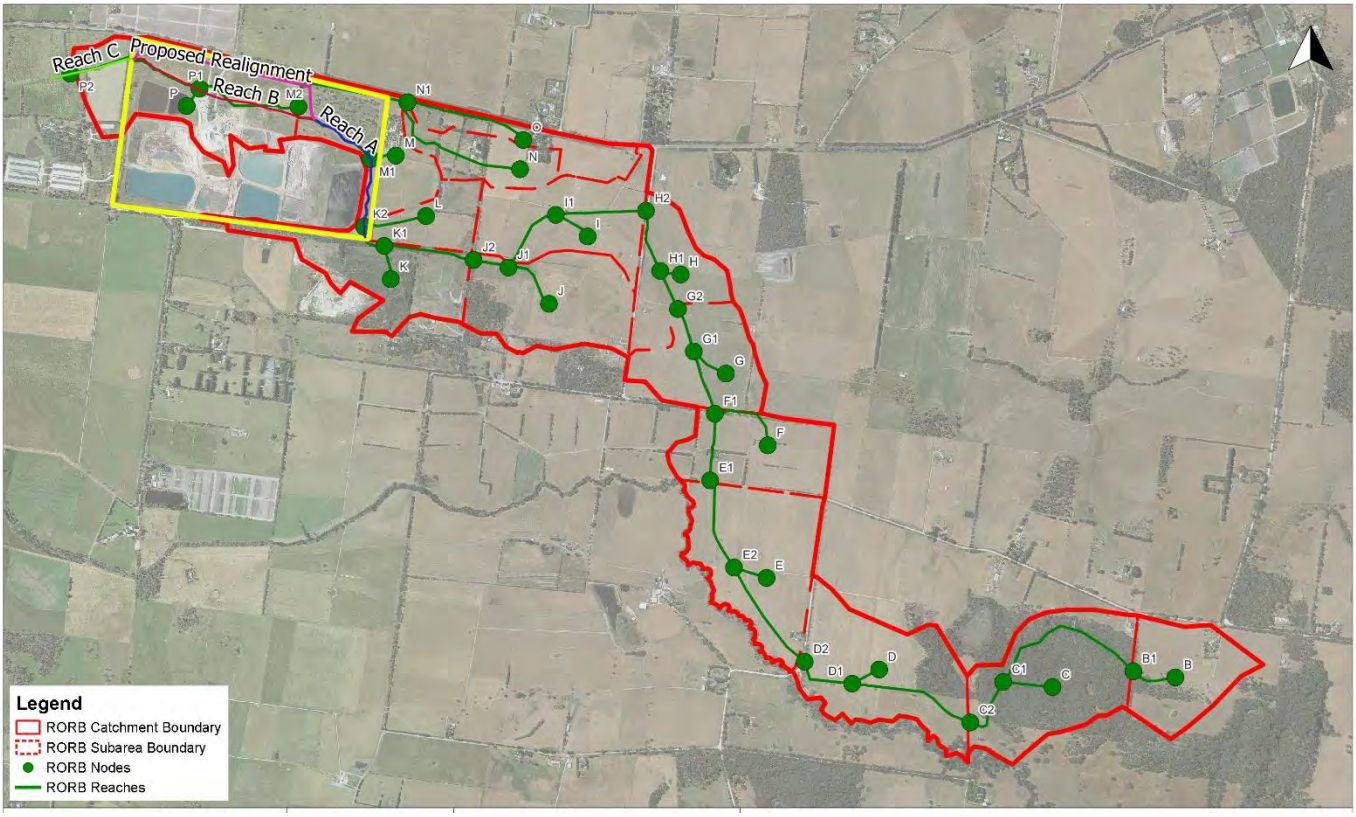


Figure 4-8: Adopted Yannathan RORB model layout

4.1.4 Fraction Impervious

The impervious fraction (FI) values were assigned at a parcel scale based on the recommended values for different planning zones and allotment size (Melbourne Water MUSIC Guidelines, 2018 and Melbourne Water Technical Specifications, September 2019). A visual assessment of these initial values was undertaken, and values were adjusted to better reflect the extent of current development and land use (defined by Modella 2018 DELWP aerial dataset) across the study area. Figure 4-9 displays the fraction impervious adopted across the study area.

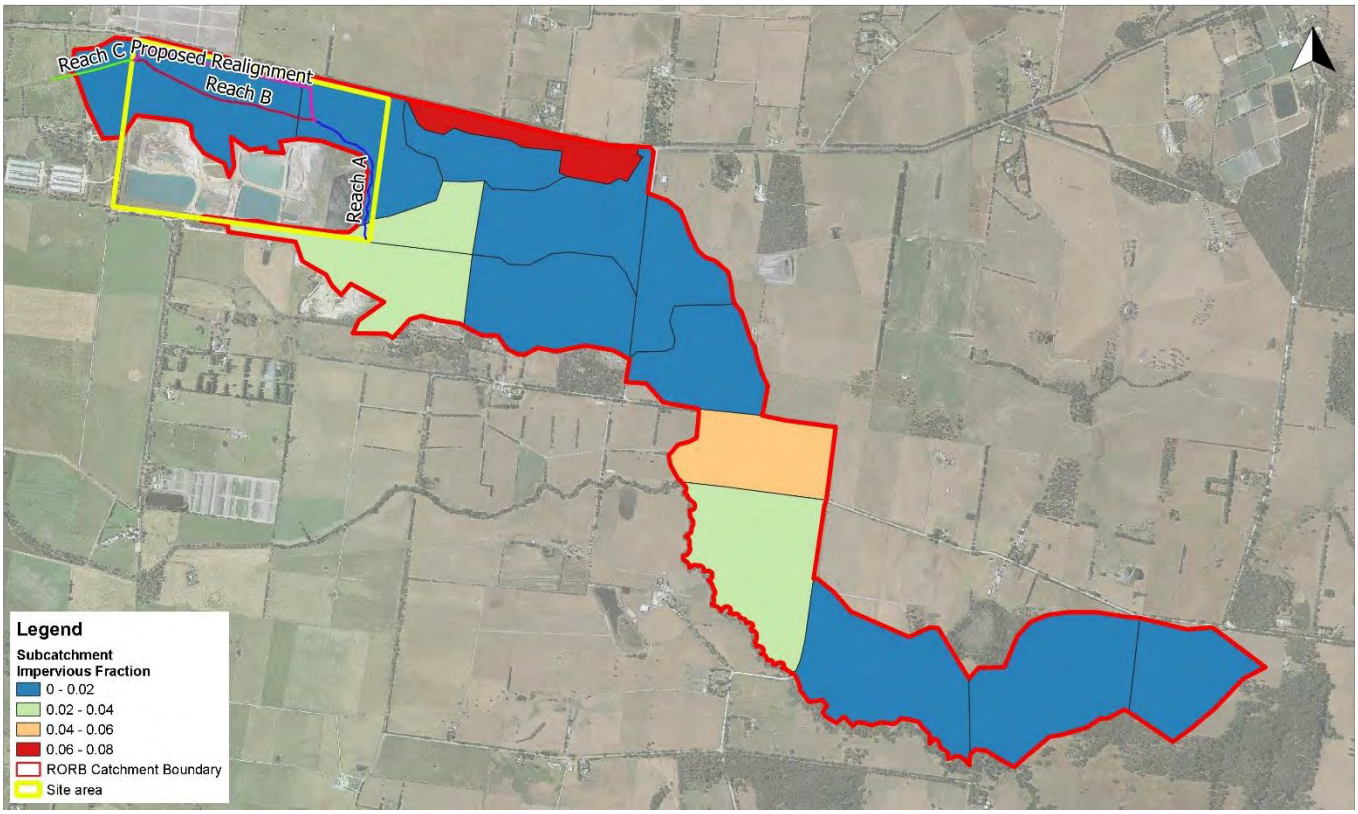


Figure 4-9: Yannathan RORB Fraction Impervious

4.1.5 Design Flows

A design flow of 10.6 m^3/s was obtained from the RORB modelling for the 1 % AEP (1 in 100 year ARI) design storm event and included in the hydraulic modelling.

4.2 LITTLE LANG LANG RIVER CATCHMENT

4.2.1 Overview

Further correspondence between Melbourne Water and Engeny on 5 August 2021 includes advice relating to the realigned waterway (Reach A) that was provided in 2011. Refer to **Appendix F** for email correspondence. In summary, previous correspondence provided in 2011 confirmed that Melbourne Water has previously undertaken modelling of the Little Lang Lang River. This modelling indicated that there was a breakout of flow from the main Little Lang Lang River channel to the north of approximately 64 m^3/s in a 1 % AEP event. Melbourne Water have then estimated that 27 m^3/s of that breakout flow *"would reach Pooles Rd south of Westernport Rd and continue westerly to the quarry site"*. This figure of 27 m^3/s is similar to the flow that was provided to ATC Williams, who completed the design of the already realigned section of waterway (Reach A).

As per Melbourne Water correspondence and the ATC Williams report, a flow of 27.8 m^3/s has been adopted in the HECRAS modelling. Figure 4-10 shows the flood modelling results provided by Melbourne Water for the 1 % AEP event.

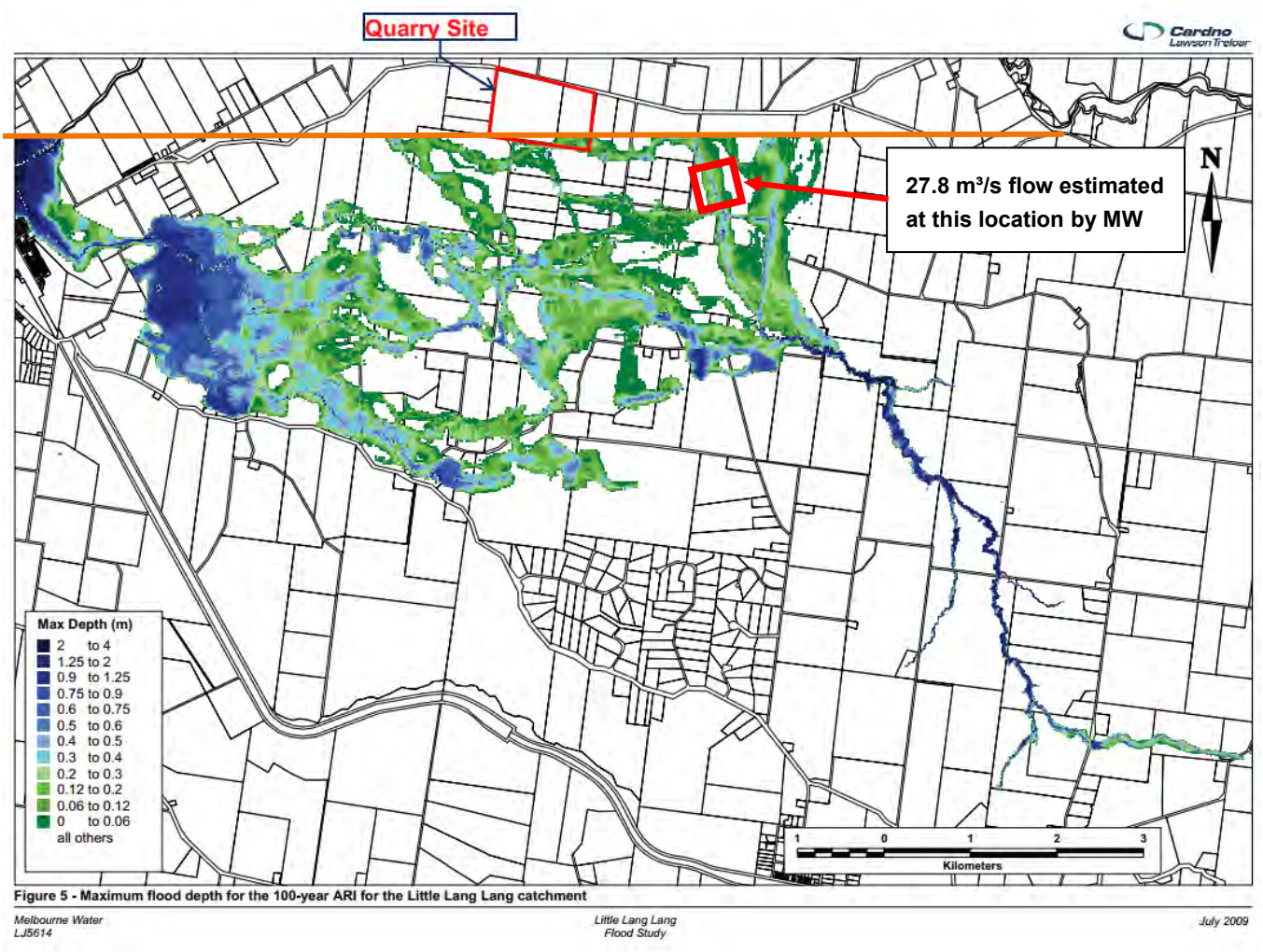


Figure 4-10: Little Lang Lang River 1 % AEP (100-year ARI) Flood Mapping

Engeny note that the flood modelling results are cut off in a horizontal line (marked by Engeny in orange on Figure 4-10). Engeny believes this may represents the boundary of the hydraulic model. This potential model boundary location is also very close to the entry to the quarry site. Results obtained from hydraulic models in close proximity to a boundary can be influenced by the presence of the boundary.

4.2.2 Design Flows

Engeny has modelled a design flow of 27.8 m^3/s, as part of the scenario 2 analysis to model flows from the Little Lang Lang River Catchment. This includes the reported flow of 27 m^3/s that continues west to the quarry site and 0.8 m^3/s from the runoff reporting from the previously diverted channel, upstream of the proposed works, as outlined on ATC Williams' Site Drainage Report.

5 HYDRAULIC MODELLING

5.1 MODELLING APPROACH

Engeny has used HEC-RAS for the hydraulic modelling of the following scenarios:

- Scenario 1A: flows from the local catchment only, for existing conditions
- Scenario 1B: flows from the local catchment only, for design conditions
- Scenario 2A: breakaway flows from Little Lang Lang River, for existing conditions
- Scenario 2B: breakaway flows form Little Lang Lang River, for design conditions

Existing Conditions – The current drainage arrangement on site including the realigned section of the existing waterway (Reach A).

Design Conditions – Realignment of the existing waterway around the proposed extension for quarry activities (Reach B).

The HECRAS model extents are from the south-east boundary of the quarry site at the upstream end to approximately 150 metres west of Milners road at the downstream end, past the north-west boundary of the quarry site (Figure 5-1). A summary of the parameters used for the existing conditions and design conditions modelling is shown on Table 5-1.

Figure 5-1: HECRAS Model Extents

Table 5-1: HEC-RAS Modelling Parameters

Modelling Parameter	Values	Basis
1 % AEP Design Flow (m^3/s) (Scenario 1)	10.6	Local catchment RORB model
1 % AEP Design Flow (m^3/s) (Scenario 2)	27.8	Provided by Melbourne Water and ATC Williams
Flow Regime	Mixed	
Upstream Boundary Condition	Normal Depth, slope = 0.0016	Measured using LiDAR data
Downstream Boundary Condition	Normal Depth, slope = 0.004587	Measured using LiDAR data
Manning's 'n' values – existing conditions model	0.08 (main channel)	E.g. Chow – site observations
	0.05 (left and right banks on quarry site)	E.g. Chow – site observations
	0.035 (left and right banks on downstream property)	E.g. Chow – site observations
Manning's 'n' values – design conditions model	0.08 (main channel for the cross-sections that are not going to be changed from existing conditions)	
	0.07 (main channel for the cross-sections of the design diversion)	Assumed that the proposed channel will ultimately contain similar vegetation to the existing channel
	0.05 (left and right banks on quarry site)	
	0.035 (left and right banks on downstream property)	
Existing Culverts	The culvert on Milners Road is a 500 mm deep by 1200 mm wide box culvert.	Advice from Hanson
	Existing culverts under each of the two quarry access roads were modelled as being six (6) 300 mm diameter culverts	Number of culverts is consistent with the advice provided by Hanson that there are six to eight 300 mm culverts under the site's access roads. Modelling six rather than 8 culverts will also provide a slightly higher and more conservative flood level.
Proposed Culverts	Five (5) 600 mm (wide) by 450 mm (high) box culverts at the access road to the site, with the top of deck levels modelled as the same existing surface levels on the access road with the assumption there will be no change	Proposed culverts were sized to achieve safe overtopping depths and velocities in the design flow from the local catchment runoff of 10.6 m^3/s. Box culvert sizes are also such that there is a minimum 500 mm of cover from the top of box culvert to the road deck levels
Left and right bank locations	River banks locations have been modelled at the top of the low-flow channel for both cross-sections that will be unchanged from existing conditions and cross-sections of the proposed design	

5.2 RESULTS

Appendix G and H shows the HEC-RAS long-section plots and cross-section plots of the existing and design conditions modelling. As outlined in Section 6, the proposed waterway in the section to be diverted has conveyance capacity for the scenario 2 design flow of 27.8 m^3/s and does not overtop the channel bund in this flood event. Freeboard that is achieved in the scenario 1 and 2 analysis is also outlined in Section 6.

5.2.1 Site access and safety

The proposed five (5) 600 mm (wide) by 450 mm (high) box culverts on the quarry site, underneath the existing access road exhibits an overtopping depth of 0.30 metres in scenario 1B. Based on the ARR 2019 guidelines for flood hazard assessment, as shown in Figure 5-2, a hazard rating of H1 is generally safe for people, vehicles and buildings. For scenario 1B, the overtopping velocity multiplied by the overtopping depth (V x D) is 0.25 m^2/s. This is within the H1 category and therefore meets Melbourne Water's Floodway Safety Criteria requirements.

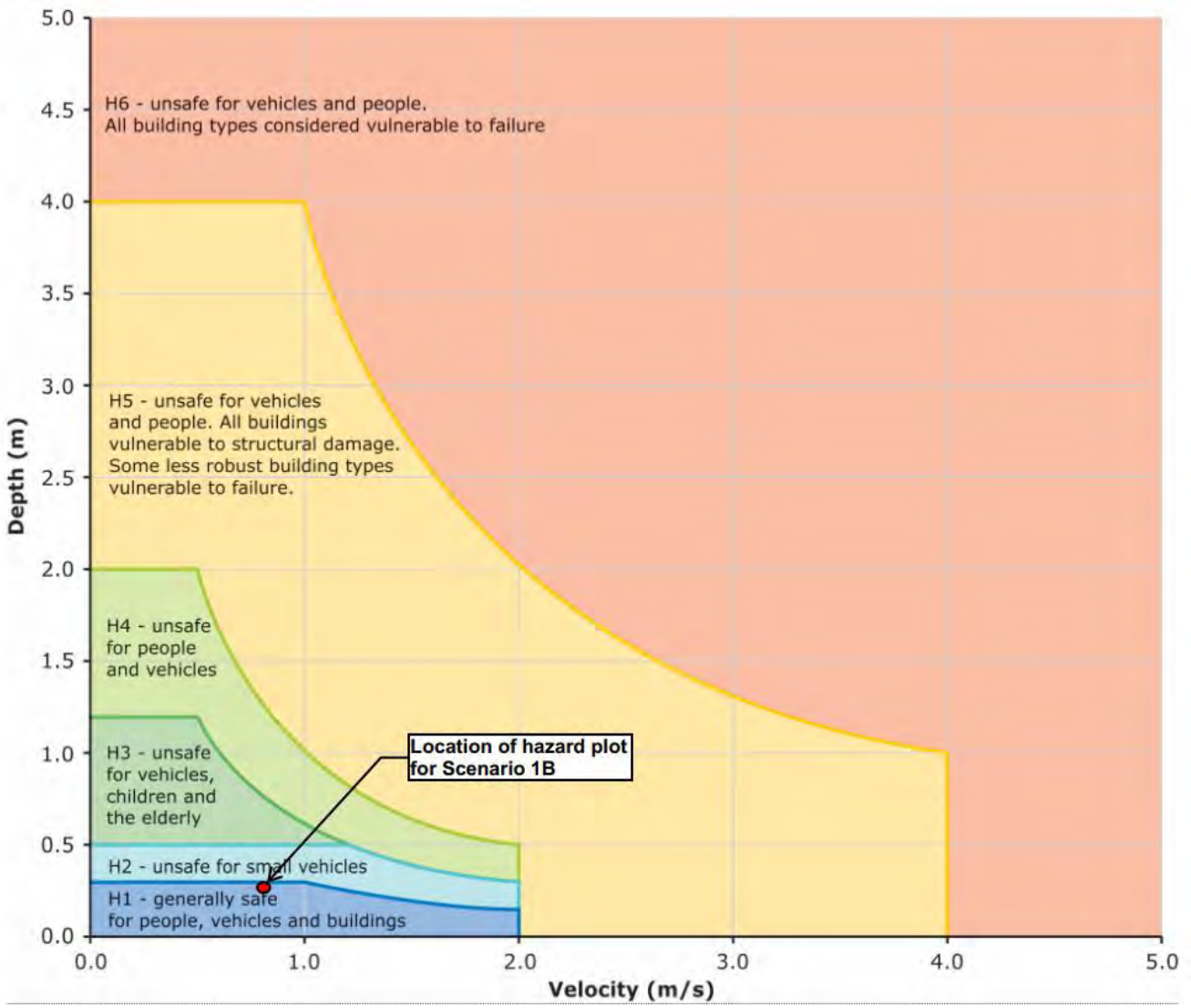


Figure 5-2: Flood Hazard Curve

In Scenario 2, existing conditions, based on the capacity of the culverts under the access road and the existing waterway capacity, the expected depth and velocity of overtopping are 0.88 m and 0.19 m/s respectively resulting in a hazard rating of H3 which is classified as unsafe for people and vehicles.

Under Scenario 2 design conditions, there is a more significant overtopping of the access road into the site compared to scenario 1. The expected depth and velocity of the overtopping are **0.65 m** and **1.28 m/s**, where the overtopping velocity multiplied by the overtopping depth (V x D) is 0.83 m^2/s. This corresponds to a hazard category of H4. This exceeds Melbourne Water's recommended safety criteria for overtopping. The value quoted for the peak hazard rating is at the peak of the flood event, so there would be a significant portion of the flood event where the access path would still meet Melbourne Water's safety criteria. There is also an alternative access route out of the site to the south onto Burt Road which could be used in the event of an emergency to evacuate the site. Safety considerations should also be made during the detailed design of the culvert crossing to

minimise the risk of vehicles being swept from the access road. More detailed hydraulic modelling of the Little Lang Lang River breakout flow would also allow for a more accurate assessment of that flow to be made. This modelling may determine a lower flow which would need to be conveyed through the site, reducing the depth and velocity of overtopping of the culverts. A flood emergency management plan could also be implemented for the site if required, pending the outcome of a more detailed investigation of Little Lang Lang River breakout flows.

5.2.2 Changes in flood levels on adjacent properties

Modelling for the local catchment flows (scenario 1) shows that the proposed design does not increase flood levels on the adjacent downstream property. Upstream of the proposed works, modelling shows that the proposed design causes a reduction in flooding of between **10 mm and 250 mm** for up to approximately 380 metres upstream of the start of the channel diversion.

Modelling for the Little Lang Lang River breakout flows (scenario 2) also shows the proposed design does not increase flood levels, upstream of the site. Downstream of the site, there is approximately 5 mm increase in the peak water level.

5.2.3 Velocity of flows

Melbourne Water have specified in their email dated 5 August 2021 (appendix F) that the flow velocity must not increase by more than 10 %. A comparison of velocities is provided in Table 5-2 below. The results within Table 5-2 include an analysis of velocities upstream and downstream of the proposed diversion waterway. It is shown that there are increases in velocity however they are generally relatively small and the maximum velocity in in the realigned channel is just over 1 m/s, which is quite manageable within the context of a constructed waterway. Figure 5-3 shows the locations of the river stations (chainages) for existing conditions (scenarios 1A and 2A) and Figure 5-4 shows the locations of the river stations (chainages) for design conditions (scenarios 1B and 2B). The locations of the cross sections to not match exactly as the cross sections need to be aligned perpendicular to the main direction of flow and a single set of cross sections could not achieve this for the existing and developed catchments.

Table 5-2: Velocity Comparison (Scenario 2 (Q=27.8 m^3/s) for Existing and Design Conditions)

Existing Conditions		Design Conditions	
River Station (Chainage) (m)	Velocity (m/s)	River Station (Chainage) (m)	Velocity (m/s)
1745.4	0.14	1745.25	0.17
1720.4	0.18	1720.24	0.2
1670.31	0.25	1670.16	0.28
1641.45	0.26	1641.3	0.3
1602.27	0.27	1602.12	0.31
1554.38	0.32	1554.23	0.34
1496.07	0.44	1495.92	0.5
1471.16	0.67	1471.01	0.53
1446.15	0.59	1446	0.64
1421.23	0.56	1421.07	0.53
1388.44	0.7	1388.28	0.72
1371.22	0.66	1371.07	0.68
1339.66	0.73	1339.51	0.77
1321.53	0.62	1321.38	0.63

Existing Conditions		Design Conditions	
River Station (Chainage) (m)	Velocity (m/s)	River Station (Chainage) (m)	Velocity (m/s)
1271.31	0.66	1271.16	0.64
1246.31	0.72	1246.16	0.64
1225.07	0.79	1224.92	0.64
1196.35	0.79	1196.2	0.6
1171.4	0.84	1171.25	0.62
1146.4	0.65	1146.24	0.53
1121.39	0.82	1121.24	0.61
1096.38	0.96	1096.23	0.38
1077.25	0.92	1068.41	0.56
1048.91	0.79	1025.86	0.53
1011.38	1.28	1000.86	0.51
969.6	0.74	973.94	0.49
943.61	0.53	958.8	0.48
918.28	0.28	943.44	0.47
892.83	0.19	928.31	0.46
824.15	0.15	914.02	0.45
797.35	0.14	900.88	0.44
772.15	0.12	875.88	0.43
746.78	0.11	850.88	0.41
721.42	0.1	825.88	0.4
698.89	0.09	801.41	0.39
673.79	0.09	775.93	0.38
648.69	0.1	750.88	0.37
622.99	0.2	725.88	0.36
605.96	0.13	700.88	0.35
591	0	675.88	0.34
571.82	0.62	650.88	0.33
559.43	2.54	624.96	0.32
546.81	0.64	603.92	0.31
543	0	590	0

Existing Conditions		Design Conditions	
River Station (Chainage) (m)	Velocity (m/s)	River Station (Chainage) (m)	Velocity (m/s)
531.99	0.8	585.84	0.91
522.06	0.46	574.97	0.95
499.53	0.42	549.97	0.91
473.2	0.43	524.97	0.91
447.18	0.39	499.97	0.91
421.71	0.38	474.97	0.92
396.79	0.36	449.97	0.93
370.99	0.31	424.97	0.92
345.1	0.3	399.97	0.93
318.5	0.28	374.97	0.95
291.91	0.29	347.99	0.96
264.67	0.35	324.97	0.98
214.45	0.41	299.97	1
178.92	1.67	279.97	1.04
166.16	0.31	251.44	0.98
165	0	224.99	1.14
140.12	0.5	178.92	1.89
109.4	0.42	166.16	0.42
86.03	0.36	165	0
61.86	0.42	140.12	0.71
38.03	0.42	109.4	0.51
11.59	0.5	86.03	0.41
		61.86	0.47
		38.03	0.46
		11.59	0.53
1745.4	0.14	1745.25	0.17
1720.4	0.18	1720.24	0.2
1670.31	0.25	1670.16	0.28

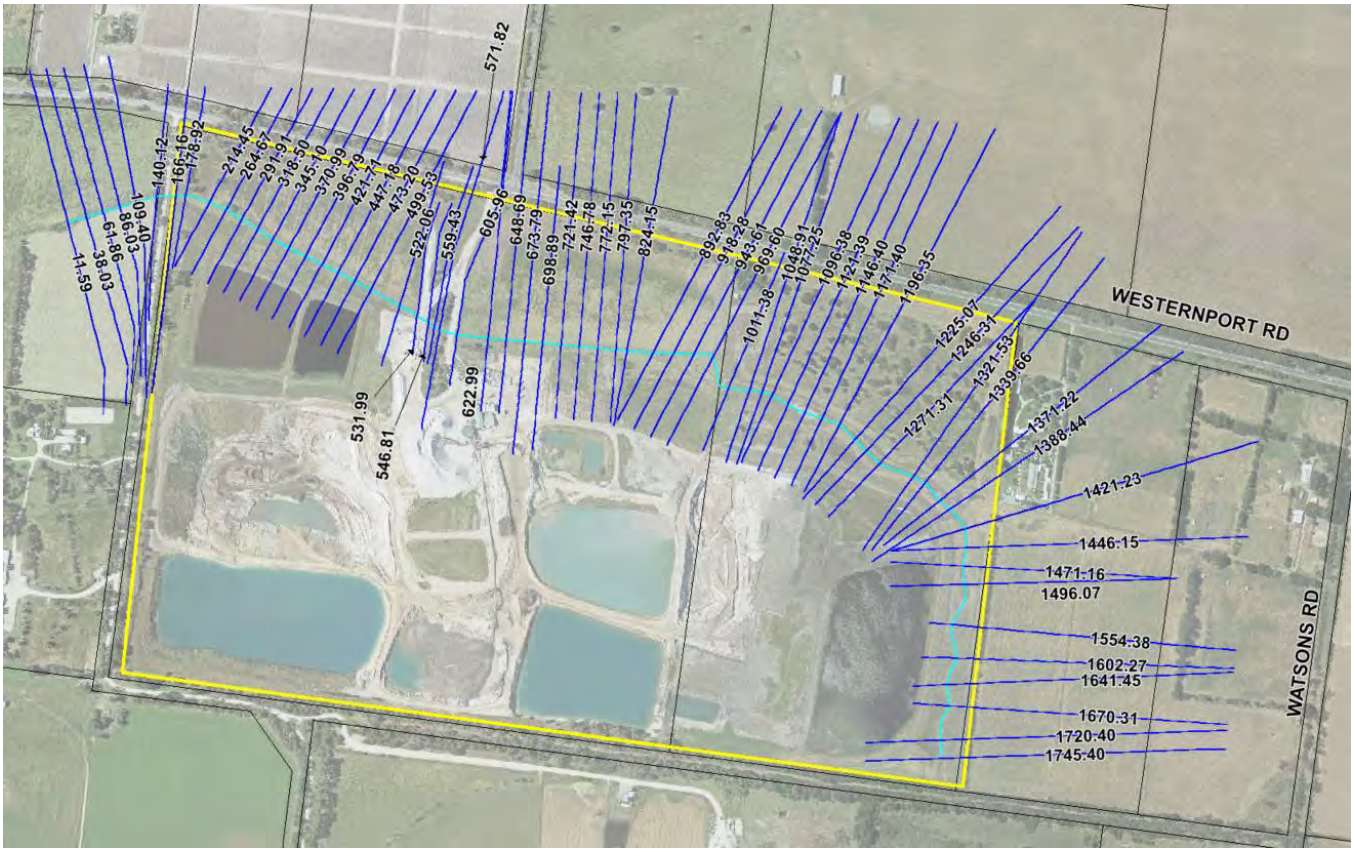


Figure 5-3: Existing Conditions River Stations (Chainages)

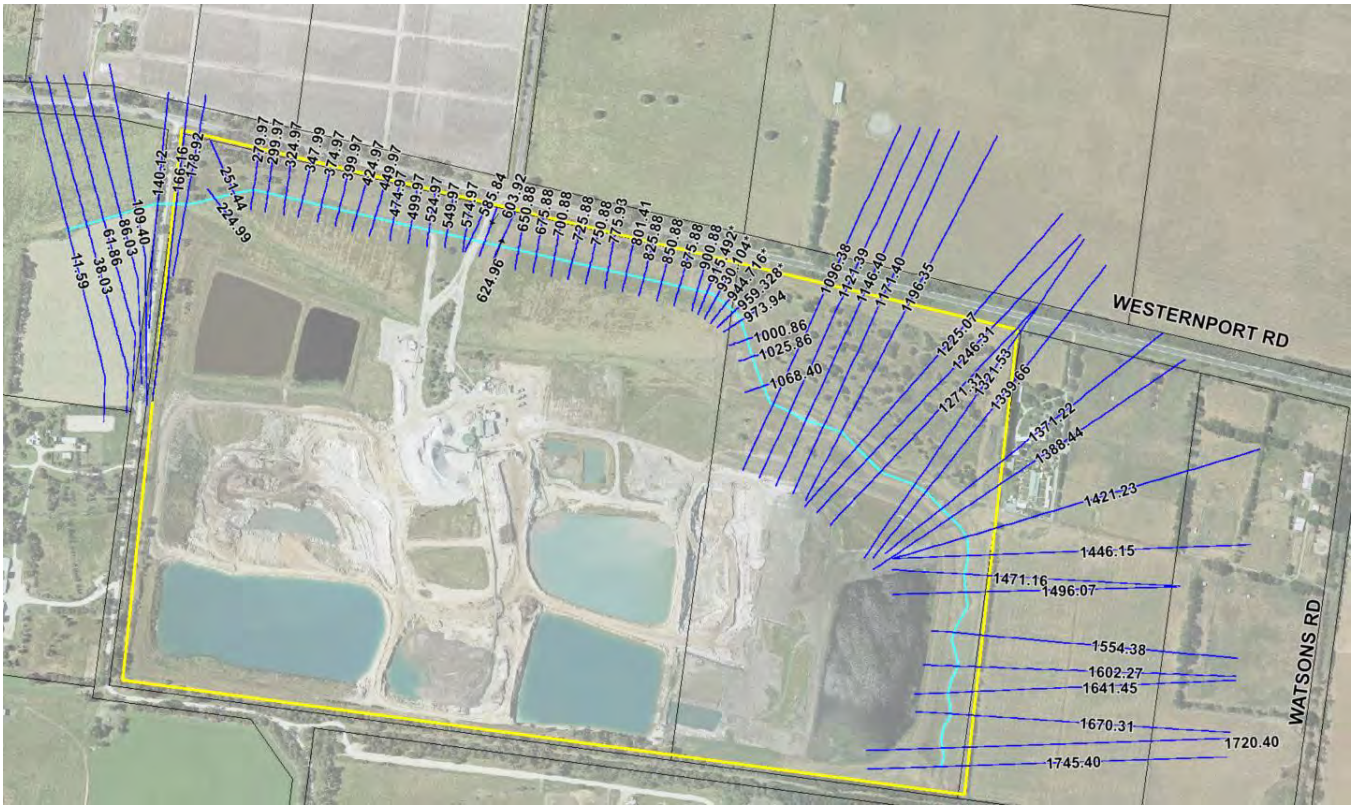


Figure 5-4: Design Conditions River Stations (Chainages)

5.2.4 Flood storage volume

Engeny has assessed the floodplain storage provide on the site under a range of conditions. The floodplain storage has been determined using the HECRAS model to create a water surface elevation digital elevation model (DEM) which has been exported to 12d. in 12d the water surface elevation DEM from each of the scenarios has been compared to the existing or design ground level DEM (as appropriate). This has enabled an estimate of the available floodplain storage on the site to be made.

When assessing the floodplain storage provided on the site, it was noted that the internal site access roads are acting as a levee and holding additional water back on the site. These access roads have not been engineered to act as a levee and so cannot be relied upon to hold back flood water on the site. The modelling also shows that in a 1% AEP event, with breakout flows from the Lang Lang River impacting the site that these roads would be inundated to a significant depth and that erosion of the road is a likely outcome. To provide a clearer estimate of pre developed conditions, a versions of the HECRAS model with the access roads removed has been run and the storage remaining on the site calculated for the purpose of comparing to the developed conditions modelling with the constructed waterway.

Table 5-3 shows an approximate comparison of the floodplain storage on the site based on the HEC-RAS modelling undertaken. As the results show the internal access road is responsible for creating approximately 35,000 m³ of floodplain storage on the site. As the road is not engineered to hold back flood water or to withstand significant overtopping, as would occur in a 1% AEP event with breakout flows form the Lang Lang River the volume of storage within the road has been calculated.

The table also shows that under developed conditions there is approximately 2,000m³ increase in floodplain storage compared to the existing conditions of the site without the storage behind the road considered. Given the total expected extent of a flood and available floodplain storage in a 1% AEP event this net loss of floodplain storage is not expected to significantly impact on flood levels. The HECRAS modelling also demonstrates that from a conveyance point of view there are minimal changes in flood levels as a result of the proposed works. The HECRAS model is also quite conservative as it assumes a steady state simulation with an effective inflow rate of 27.8 m³/s. The actual flood event would have a hydrograph which peaks at 27.8 m³/s (according to MW modelling) and would then recede, meaning not all of the floodplain area may be engaged.

Table 5-3: Floodplain storage comparison (scenario 2)

Scenario	Available floodplain storage (approx.)
Existing conditions including access road storage	127,000 m^3
Existing conditions with access road removed	90,000 m^3
Proposed developed conditions (includes raising the access road to 27.80 RL	92,000 m^3

6 CONCEPT DESIGN

To provide a larger area for the quarry operations, it is proposed for a portion of the existing waterway (Reach B) to be removed and a new realigned waterway to be constructed along the northern property boundary and adjacent to the existing bund. **Appendix I** presents the concept design of the proposed channel, showing the layout and typical profiles of the channel. The design basis for the realigned waterway is summarised as follows:

- 1 % AEP flow (27.8 m^3/s) conveyance capacity for the Scenario 2 flows.
- A cross section profile that is predominantly in cut but utilises the existing noise and dust control bund (northern bund) and a new bund (southern bund) for conveyance of flows.
- A longitudinal gradient 1 in 393.
- Alignment avoids existing vegetation that is along the east of the site.
- The offset from the northern property boundary to the southern end of the proposed channel works varies but is mostly within 80 metres from the northern boundary.
- Separate low-flow pilot channel to convey the 4 EY flows from the local catchment and the main channel to convey the 1 % AEP flows (Lang Lang River breakaway flows 27.8 m^3/s).
- 3 metre wide and 0.5 metres deep pilot channel with batters of 1 in 3.
- The high-flow portion of the channel has a total base width of 26 metres, therefore having 10 metre wide benches on either side of the channel.
- The low flow channel will have space to meander within the waterway corridor which will allow for the connection between the low flow channel and the floodplain to be maintained (within the corridor).
- A bund on the southern side of the channel is required as part of the high-flow channel, which functions to contain the 1 % AEP flows in the channel so 600 mm of freeboard is achieved from the 1 % AEP Top Water Level (TWL) to the top of the channel. The top of the bund will be 1.4 to 1.55 metres higher than the base of the high-flow channel and have 1 in 5 side batters.
- The proposed diversion channel will match into existing surface levels at the upstream and downstream ends and the existing culvert on Milners Road will be retained.
- The total channel width at the tie in location with the existing ground surface varies but is generally approximately 60 metres.

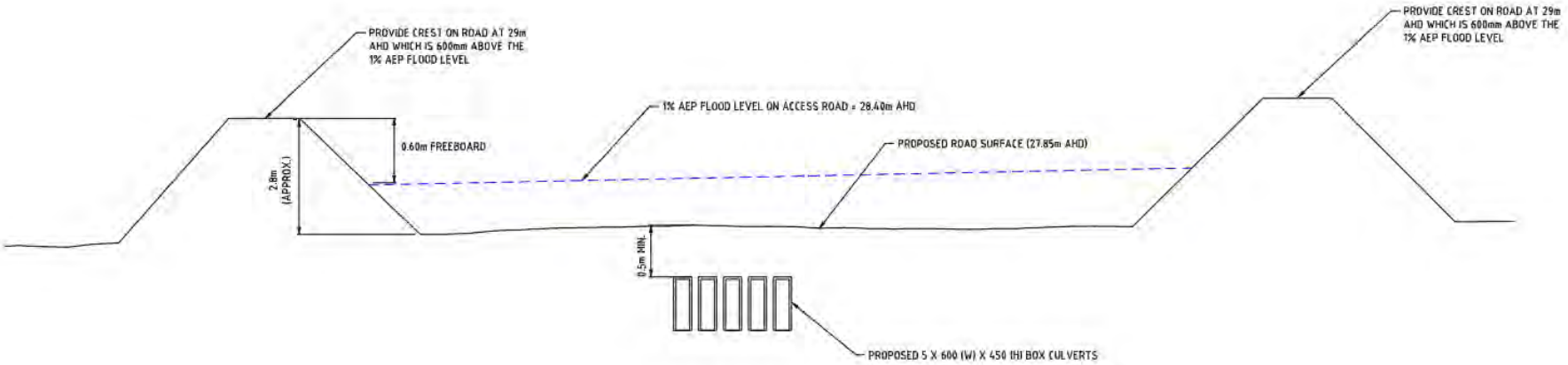
The functional design includes additional elements to facilitate surface water management in the future site. This includes:

- Five (5) 600 mm (wide) by 450 mm (high) box culverts at the access road to the site.
- Existing bund along the northern side of the channel to be extended closer to the access road to the site to prevent water from overtopping the channel.
- A raised road crossing at the access road to the site, above the proposed culverts as shown in Figure 6-1. A high point or apex in the access road one each side of the culvert crossing will be required to be 600 mm above the 1 % AEP top water level (from the Lang Lang catchment analysis, Scenario 2B) at the road which is 28.40 m AHD. Therefore, the high point or apex of the crossing is required to be no lower than 29 m AHD. This requires an approximate 2.8 m rise from the existing road level.

The detailed design will also include

- Fencing to prevent access of livestock into the waterway corridor
- Provision of a maintenance access path.

Figure 6-1: Road Crossing Typical Section



It is expected that groundwater monitoring will be required to ensure that the proposed engineered fill face of the quarry pit is not compromised by water leakage from the realigned waterway during rainfall events. A Ground Control Management Plan has been prepared for the site (CMW (2022). Proposed Quarry Expansion, Hanson Yannathan Sand Quarry, 870-910 Westernport Road, Yannathan, Ground Control Management Plan (GCMP). 1 September 2022). A "Fill Specification for Construction of Waterway Diversion" is provided as Appendix D of: CMW (2022) (Proposed Sand Quarry Expansion, Yannathan, Victoria, Geotechnical Assessment, 1 September 2022, Rev 2) which details the geotechnical engineering requirements of the backfill material to ensure that the diverted waterway is stable.

6.1 FREEBOARD

- In the Scenario 1B analysis, in which a flow of 10.6 m^3/s was modelled, a minimum freeboard of approximately 1 metre has been achieved to the top of the channel bund, within the section of channel that is proposed to be diverted.
- In the Scenario 2B analysis, in which a flow of 27.8 m^3/s was modelled, modelling shows that a minimum freeboard of 600 mm has been achieved for the section of channel that is proposed to be diverted.

7 GEOMORPHIC ASSESSMENT SUMMARY

In 2021 Engeny undertook a geomorphic assessment of the current and proposed waterway through the quarry site. A full copy of the report is contained within Appendix C. Figure 7-1 shows the waterway locations and the reach (segments) breakdowns which was used in the assessment.

Figure 7-1: Site Waterway Reaches

Table 7-1 provides the different geomorphic condition categories and explanation of each and Table 7-2 provides the different geomorphic condition assigned to the inspected reaches.

Table 7-1: Geomorphic condition categories

Geomorphic condition	Definition
Intact	Reach form in natural condition, presents all the typical features of the stream type, no evidence of erosion processes.
Good	Reach form in near natural condition, some limited impacts but most of the typical features of the stream type are retained.
Moderate	Reach form impacted by erosion or land use practices. Some features of the stream type may be retained but the majority of the features are highly modified.
Poor	Reach in a degraded condition due to extensive erosion or modified due to land use practices changing the form of the stream type.

Table 7-2: Geomorphic condition categorisation of inspected reaches

Reach	Condition	Justification
Reach A	Moderate	Reach has some bank instability, and limited habitat diversity. some lateral connectivity value. Reach form partly impacted by land use activities.
Reach B	Poor	Reach form impacted by land use activities, little to no geomorphic characteristics, limited instream habitat value, no erosion, limited riparian vegetation, some lateral connectivity value, dense homogenous vegetation, no marked erosion noted
Reach C	Poor	Little to no geomorphic characteristics, limited instream habitat value, no erosion.

Table 7-3 summarises the geomorphic value assigned to each inspected reach.

Table 7-3: Geomorphic value categorisation of inspected reaches.

Reach	Representativeness	Rarity	Diversity	Condition	Geomorphic Value
Reach A	Anthropogenic/Constructed channel	Common	Homogenous	Moderate	Low
Reach B	Anthropogenic/Constructed channel	Common	Homogenous	Poor	Low
Reach C	Anthropogenic/Constructed channel	Common	Homogenous	Poor	Low

Overall, the assessment shows that Reach A (the constructed waterway previously constructed by Hanson's) has the highest value of the three waterway reaches on the site. Reaches B and C have low geomorphic values and are basically farm drains. The proposal is to build a similar style of constructed waterway to what now exists in Reach A. On this basis it would be expected that the waterway diversion would improve the overall condition of reaches B and C of the waterway once the diversion construction is completed.

8 SUMMARY

The hydrologic and hydraulic modelling has assisted to inform the required sizing of the channel to be diverted along the northern boundary of the site. The following summarises key outcomes of the analysis:

- The channel section to be diverted is required to have a pilot channel of base width of 3 metres and a depth of 0.5 metres at 1 in 3 batters.
- The high – flow channel is required to have a base width of approximately 26 metres and have a minimum height of 0.8 metres.
- Within the design channel section that is to be diverted, a minimum freeboard of 600 mm is achieved from the 1 % AEP top water to the top of the channel in both the scenario 1B and 2B analysis, respectively for the local catchment 1 % AEP flow of 10.6 m^3/s and the 1 % AEP flow from Lang Lang River of 27.8 m^3/s.

9 QUALIFICATIONS

a) In preparing this document, including all relevant calculation and modelling, Engeny Water Management (Engeny) has exercised the degree of skill, care and diligence normally exercised by members of the engineering profession and has acted in accordance with accepted practices of engineering principles.

b) Engeny has used reasonable endeavours to inform itself of the parameters and requirements of the project and has taken reasonable steps to ensure that the works and document is as accurate and comprehensive as possible given the information upon which it has been based including information that may have been provided or obtained by any third party or external sources which has not been independently verified.

c) Engeny reserves the right to review and amend any aspect of the works performed including any opinions and recommendations from the works included or referred to in the works if:

   i) Additional sources of information not presently available (for whatever reason) are provided or become known to Engeny; or
   ii) Engeny considers it prudent to revise any aspect of the works in light of any information which becomes known to it after the date of submission.

d) Engeny does not give any warranty nor accept any liability in relation to the completeness or accuracy of the works, which may be inherently reliant upon the completeness and accuracy of the input data and the agreed scope of works. All limitations of liability shall apply for the benefit of the employees, agents and representatives of Engeny to the same extent that they apply for the benefit of Engeny.

e) This document is for the use of the party to whom it is addressed and for no other persons. No responsibility is accepted to any third party for the whole or part of the contents of this Report.

f) If any claim or demand is made by any person against Engeny on the basis of detriment sustained or alleged to have been sustained as a result of reliance upon the Report or information therein, Engeny will rely upon this provision as a defence to any such claim or demand.

g) This Report does not provide legal advice.

ENGENY
WATER MANAGEMENT

Appendix A:
ATC Williams Site Drainage Report

Appendix K

ATC Williams Site Drainage Report

Our Ref: 110441.01 - 001

4 October 2010

Hanson Construction Materials
Ground Floor
601 Doncaster Road
DONCASTER VIC 3108

ATTENTION: Peter Browne

Dear Sir,

YANNATHAN DIVERSION CHANNEL ANALYSIS AND DESIGN

1 INTRODUCTION

This Report presents the findings of a hydrological analysis undertaken by ATC Williams (ATCW) to simulate the routing of 1 in 100 year flood flows in a diversion channel. The diversion channel is to be constructed around the perimeter of the proposed Hanson Constructions Materials (Hanson) Yannathan aggregate quarry expansion.

The scope of the assessment is in accordance with our email proposal to Hanson dated 28 April 2010 as subsequently modified following discussions with Mark Warren, Floodplain Services, Waterways Group, Melbourne Water.

2 SITE DESCRIPTION

The Hanson Yannathan aggregate quarry is located on the southern side of Westernport Road in Yannathan, some 7 km east of Lang Lang. The area around the quarry is open farm land, which is low lying and virtually level with a slight fall to the east towards Western Port Bay. The quarry is located approximately mid way between the Lang Lang River (to the north) and the Little Lang Lang River (to the south). Drainage from the site is limited but the catchment area for storm events is relatively large. The area around the site is susceptible to minor flooding after periods of heavy rain, however it is understood that the flooding subsides within a few days.

The surface level of the paddock and site of the proposed quarry expansion is generally RL 28.5, but has a central swale with a level of approximately RL 28 m. The swale drains to the northeast where the surface level is RL 27.5.

A locality Plan is presented as **Figure 1**. The plan shows the existing quarry, the proposed expansion, local drainage channels and rivers and the catchment boundaries.

An existing conditions Site Plan is presented as **Figure 2**. This plan shows the surface levels and existing drainage channel in the swale.

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ATC Williams unites the companies of Australian Tailings Consultants and MPA Williams & Associates

3 PROJECT BACKGROUND

3.1 General

Hanson is looking to enlarge the Yannathan aggregate quarry by relocating the eastern pit boundary approximately 450 metres further east. As a result, an existing drainage channel, located within the expanded quarry, will require relocation along the south and eastern perimeter of the quarry expansion as shown in **Figure 3**.

The existing drainage channel comprises a small (approximately 1 m wide) shallow (approximately 0.5 m deep) 'U' shaped grass lined swale located within a topographical depression several hundred metres wide. Melbourne Water reports the topographical depression provides significant additional flow capacity for large flood flows reporting from the Little Lang Lang River catchment.

The proposed quarry expansion will cut off this topographical depression so the proposed diversion drain is required to provide a similar flow capacity.

3.2 Hydrological Requirements

Melbourne Water states that the replacement diversion channel is required to pass a 1-in-100 year flood flow of 27 cumecs reporting as overflow from the Little Lang Lang River as well as the upstream catchment to the diversion channel. Melbourne Water states that the Little Lang Lang River flood is the result of a time of concentration (T_c) rainfall event of 9 hours which corresponds to rainfall intensity of 10.2 mm/hr or 91.8mm in total (**Figure 3**).

Evaluation of the diversion channel upstream catchment area (**Figure 4**) was carried in accordance with the requirements of Australian Rainfall and Runoff Manual **[Ref 1]**. It was determined this catchment has a T_c of 69 minutes which corresponds to rainfall intensity of approximately 38 mm/hr or 43.5 mm (**Figure 3**). As this time of concentration was significantly less than the Little Lang Lang River catchment, a check will be required to ensure the channel will be able to convey the peak runoff flow originating from this rainfall event. It has been assumed that the shorter T_c rainfall will not result in overflows from the Little Lang Lang River catchment.

3.3 Diversion Channel Design

The diversion channel was designed to accommodate:

- A base flow of 27 cumecs (Little Lang Lang River overflow) plus the diversion channel catchment runoff for a rainfall event with a T_c = 9 hrs.
- The diversion channel catchment for a rainfall event with a T_c = 69 minutes.
- The very flat terrain with an overall elevation change of 2.5 metres from start of channel to the outlet (approximately 1200 metres).
- The channel is required to be stable against erosion under peak flow conditions.
- A maximum flood elevation of RL 29.0 metres at the existing buildings located adjacent to the Westernport Road northeast of the expanded pit. This is equivalent to a flood depth of 0.5 m to 1.0 m in the area of the proposed quarry expansion.

The overall riding design constraints are the flat slopes that need to be accommodated while not creating higher flood conditions at the Westernport Road buildings. These constraints meant that instead of using hydraulic efficient deep, moderately sloping channel, a shallow very gently sloping wide channel had to be utilised. Accordingly, a wide shallow trapezoid channel section has been used as the basis for the design.

The channel will comprise:

- a 20 metre wide base width,
- 3:1 (H:V) side slopes,
- channel slopes to accommodate the local topography while ensuring sufficient flow depth (minimum of 0.75 metres but varies with the natural surface level), and
- erosion protection with the use of well established grasses.

The perimeter bund to the quarry has been modelled with:-

- a 1 m crest width;
- a crest level of RL 29.0 m (This is the same level as the estimated flood depth in the vicinity of the Westernport Road buildings, refer to **Section 4** following);
- 2:1 (H:V) side slopes.

The minimum perimeter bund dimensions presented above maximize the quarry area but provide negligible freeboard to peak flood levels. A crest level of RL 29.5 to 30.0 m (+) will provide better flood protection to the quarry. A crest width of at least 3 m will permit plant to traffic the crest of the bund. However both of these changes will result in the perimeter bund encroaching further into the quarry reserves.

Consideration of the most appropriate crest width and level of the perimeter bund is beyond the scope of this report and is an issue best considered by Hanson along with the risk of flooding of the quarry and the cost of pumping water from the quarry against the quarry reserves sterilized.

The layout of the diversion channel with the minimum perimeter bund is presented on **Figure 5.**

The 20 m wide channel base with 3:1 (H:V) side slopes and the perimeter bund to the quarry requires a set back from the boundary that is greater than the nominal 20 m set back. The channel and perimeter bund encroaches on the original quarry boundary on the southern and part of the eastern sides as shown on **Figure 5.** To compensate for the loss of quarry reserves it is recommended that the boundary on the north east corner is moved toward the north east. The arrangement presented on **Figure 5** results in a potential net gain in quarry reserves.

Note that a sound bund located to the north of the northeast corner of the quarry extension has been rotated through 45 degrees and repositioned on **Figure 5**. The sound bund may need to be redesigned.

Figure 6 and 7 provides a long section and a typical cross-section, through the channel respectively.

4 HYDROLOGICAL ANALYSYS

4.1 Methodology

The hydrological analysis was performed using the computer program HydroCAD a hydrological routing package that incorporates both the rational methodology and the US Army Corp of Engineers TR-20 methodology. As recommended by the Australian Rainfall and Runoff manual **[Ref 1]**, the rational methodology was used.

The inputs to the program comprised.

- The base flow reporting from the Little Lang Lang River of 27 cumecs.
- Rainfall intensity for a Tc of 9 hours and a Tc of 69 minutes.

- The diversion channel subcatchment areas as outline in **Appendix A.**
- The diversion channel base slopes as determined by the existing ground elevation.
- Subcatchment time of concentrations and runoff coefficients as per the recommendations of the Australian Rainfall and Runoff Manual **[Ref 1]**.
- The rainfall distribution for the two design events as determined by recommendations and procedures outlined by the Australian Rainfall and Runoff Manual **[Ref 1]**.

4.2 Results of Analysis

The results of the two analyses are as follows,

- The runoff reporting from the diversion channel for the 9 hour storm event is only a minor component of the total flow being approximately 0.8 cumecs for a total flow in the channel of 27.8 cumecs.
- A peak flow depth of 0.91 metres is calculated for the diversion channel for the 9 hour event with the 27 cumecs overflow. This is estimated to result in a flood depth on the order of RL 29.0 metres in the vicinity of the Westernport Road buildings.
- A peak velocity of 1.26 m/s is estimated for the channel. This velocity is within the stable range for a well established grass channel liner.
- The Tc rainfall event for the diversion channel catchment generates a peak flow on the order of 1.2 cumecs.
- A peak flow depth of 0.14 metres is calculated for the diversion channel, therefore the entire runoff flow is contained within the channel with no overtopping.
- A peak flow velocity of 0.42 m/s was calculated which is well within accepted design specifications for a grass lined channel.

Details of each analysis are provided in **Appendix A.**

5 RECOMMENDATIONS AND ADDITIONAL COMMENTS

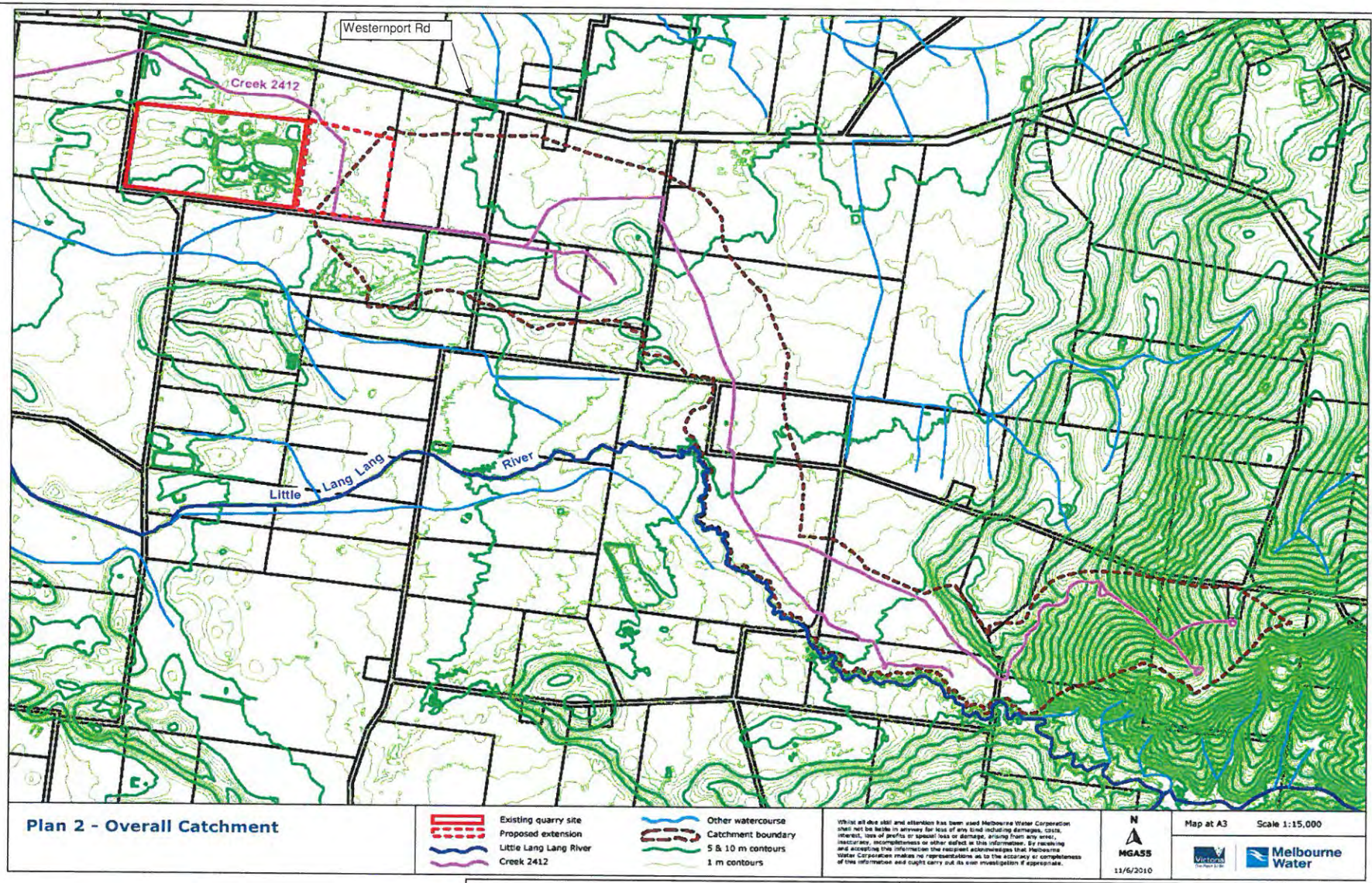
Based upon the hydrological analysis, the underflow diversion channel should comprise of a grass lined trapezoidal channel with a base width of 20 metres, 3H:1V side slopes and the profile and cross-section provided in **Figures 5 and 6.**

We trust the information contained within this report is sufficient for your current needs. If you need any further information or clarification regarding any of the information provided, please contact either Peter Reid or myself.

Yours Sincerely,

DAVID MACHIN
ATC Williams Pty Ltd

FIGURES



This plan is produced from information provided by Melbourne Water

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HANSON CONSTRUCTION MATERIALS

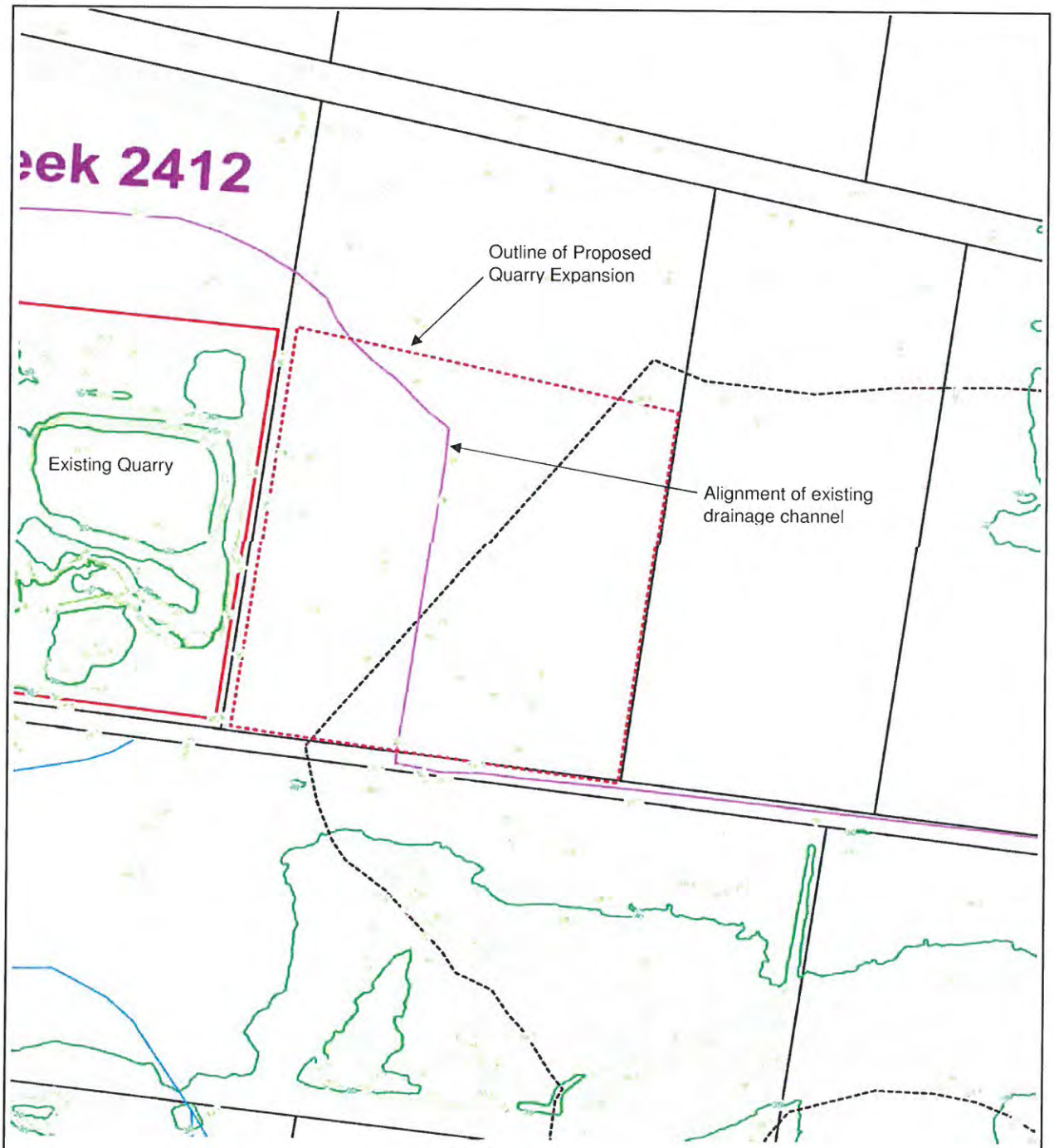
YANNATHAN AGGREGATE QUARRY

DIVERSION DRAIN

LOCALITY PLAN

Date:	8/09/2010	Job No:	110441.01	FIGURE 1

J:\Synergy\Projects\110\110441 Yannathan Diversion Drain (Hanson)\02 Design Yannathan Diversion Drain\Drawings and Figures\Figure 1 Locality Plan A3 Landscape



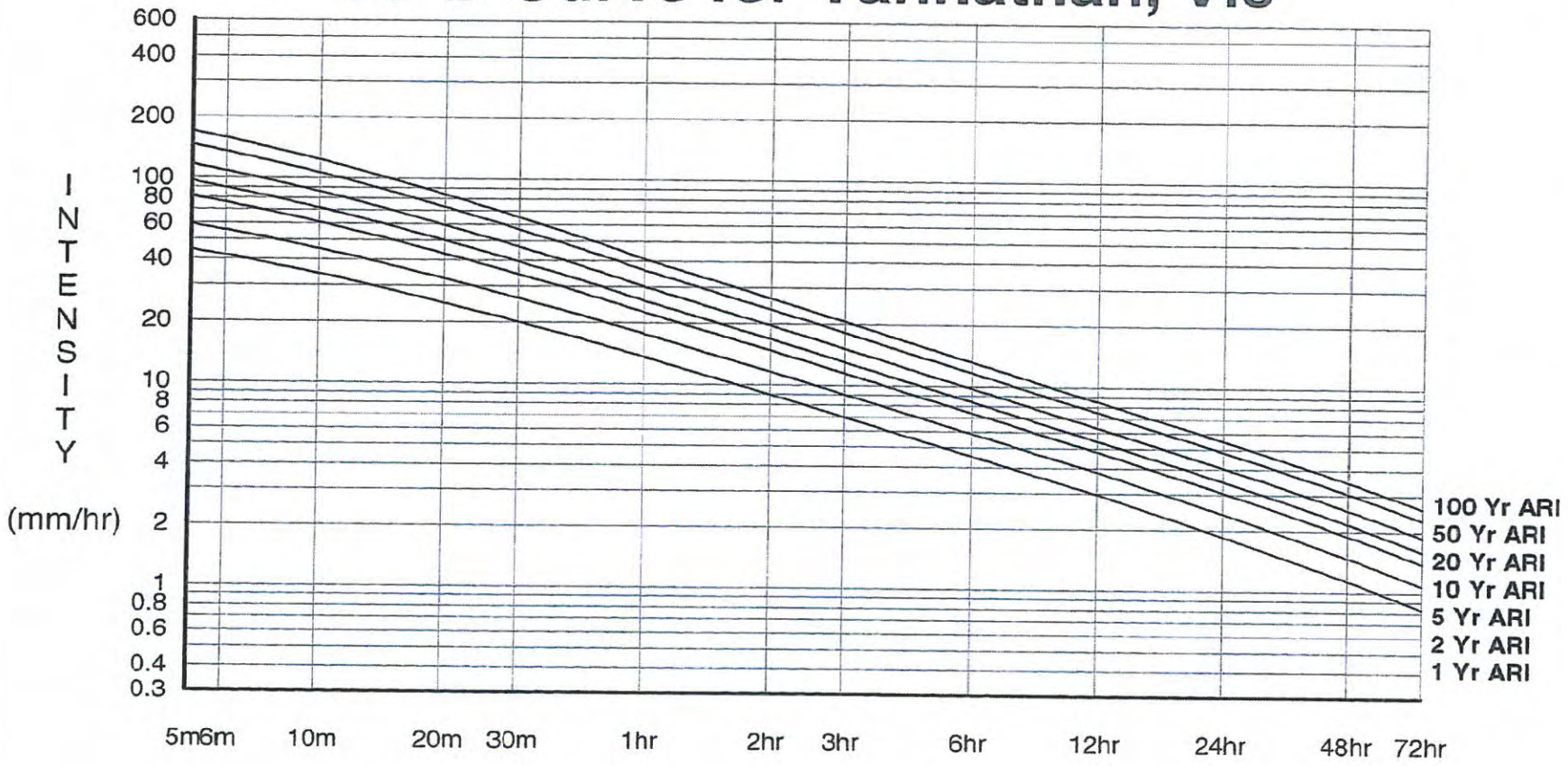
NOTE TO SCALE

This plan drawn from information supplied by Melbourne water

HANSON CONSTRUCTION MATERIALS **YANNATHAN AGGREGATE QUARRY** **DIVERSION DRAIN**	**SITE PLAN** **EXISTING CONDITIONS**
ATC Williams GROUNDED IN DESIGN ATC Williams Pty Ltd 222 Beach Road (P.O. Box 5286) Mordialloc Vic 3195 AUSTRALIA T ▫61 3 8587 0900 F ▫61 3 8587 0901 melb@atcwilliams.com.au www.atcwilliams.com.au	**Job No:** 110441.01 **Date:** 8/09/2010 **FIGURE 2**

J:\Synergy\Projects\110\110441 Yannathan Diversion Drain (Hanson)\02 Design Yannathan Diversion Drain\Drawings and Figures\Figure 2 Existing Conditions A4 Portrait

I F D Curve for Yannathan, Vic



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HANSON CONSTRUCTION MATERIALS

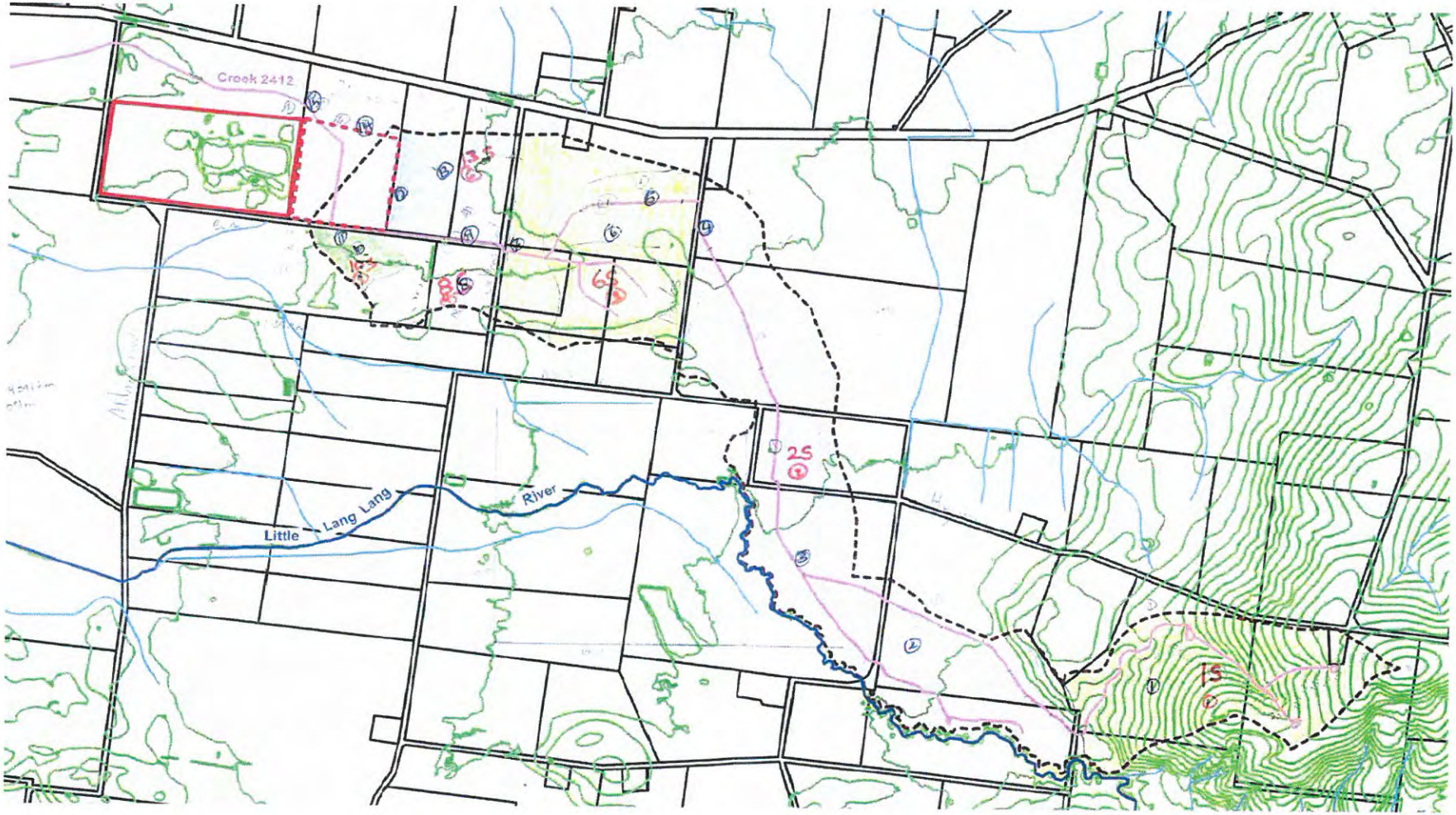
YANNATHAN AGGREGATE QUARRY

DIVERSION DRAIN

Intensity - Frequency - Duration Curve for Yannathan, Victoria

Date:	8/09/2010	Job No:	110441.01	FIGURE 3

J:\Synergy\Projects\110\110441 Yannathan Diversion Drain (Hanson)\02 Design Yannathan Diversion Drain\Drawings and Figures\Figure 3 IFD Curve.xls A3 Landscape



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HANSON CONSTRUCTION MATERIALS

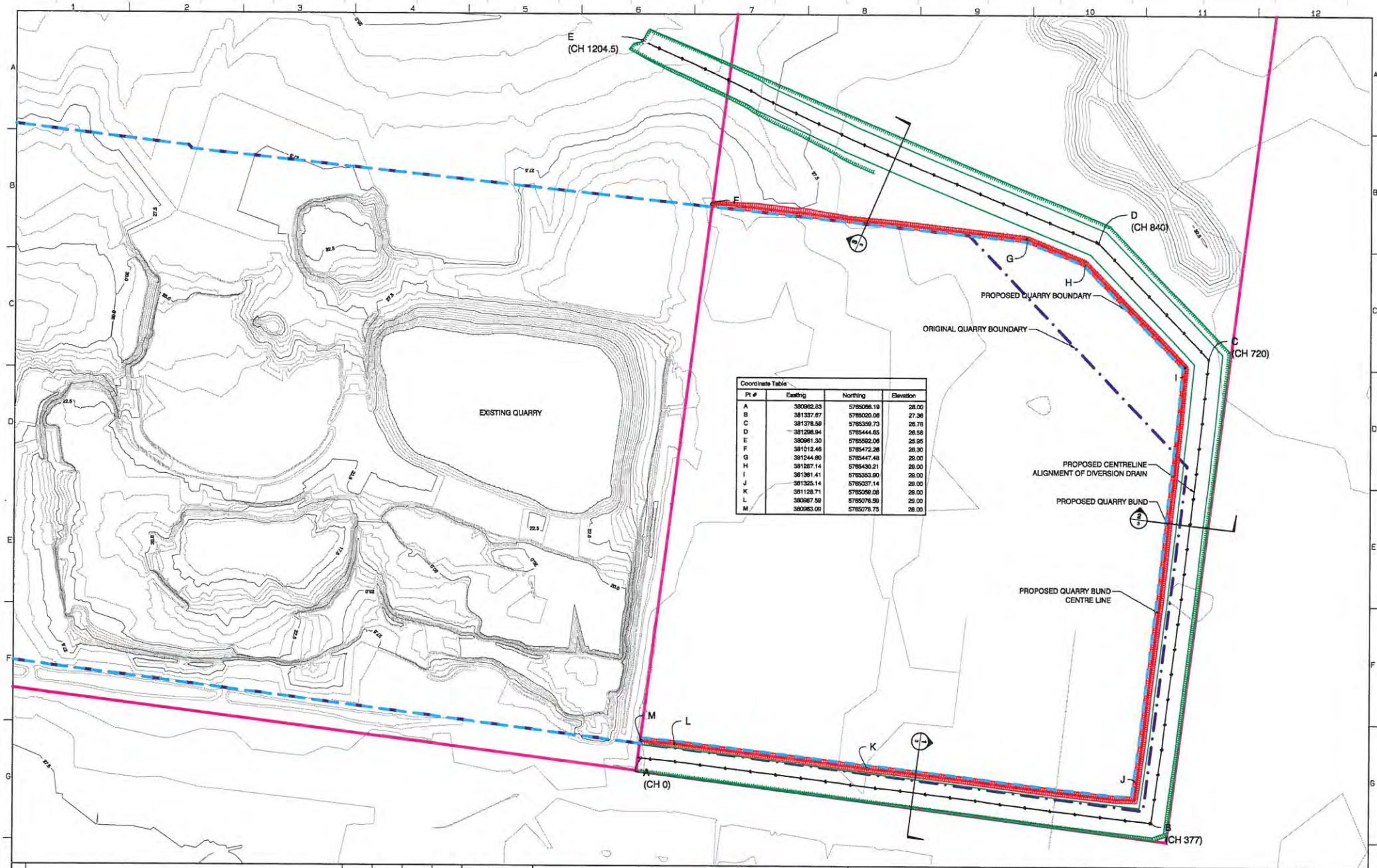
YANNATHAN AGGREGATE QUARRY

DIVERSION DRAIN

Yannathan Upstream Catchment Modelling Diagram

Date:	8/09/2010	Job No:	110441.01	FIGURE 4

J:\Synergy\Projects\110\110441 Yannathan Diversion Drain (Hanson)\02 Design Yannathan Diversion Drain\Drawings and Figures\Figure 4 Upstrean catchment modelling diagram.xls A3 Landscape



Coordinate Table

Pt #	Easting	Northing	Elevation
A	380982.83	5785086.19	28.00
B	381337.67	5785020.06	27.36
C	381378.59	5785359.73	26.78
D	381296.94	5785444.65	26.58
E	380961.30	5785592.06	25.95
F	381012.46	5785472.28	26.30
G	381244.80	5785447.48	29.00
H	381267.14	5785430.21	29.00
I	381361.41	5785353.90	29.00
J	381325.14	5785037.14	29.00
K	381128.71	5785056.06	29.00
L	380987.59	5785078.59	29.00
M	380983.09	5785078.75	28.00

No.	DESCRIPTION	DATE	DRAWN	CHECKD	APPRD

SCALE	1:2500
JOB No.	110441.02
DATE	30.09.10
DESIGN	PMR
DRAWN	GH
CHECKED	
APPROVED	

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HANSON CONSTRUCTION MATERIALS
YANNATHAN AGGREGATE QUARRY

DIVERSION DRAIN LAYOUT WITH SOUND BUNDS

FIGURE 5

CLIENT No.
CAD REF. 110441
REV. No. A | SHT SIZE A3
SHEET 1 OF 1

File J:\Synergy\Projects\IIO\IIO441 Yannathan Diversion Drain (Hanson)\02 Design Yannathan Diversion Drain\Terramodel\Yannathan Diversion Drain1.pro (Terramodel)
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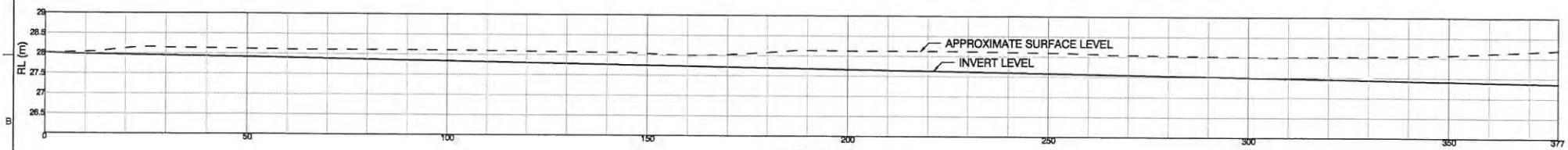
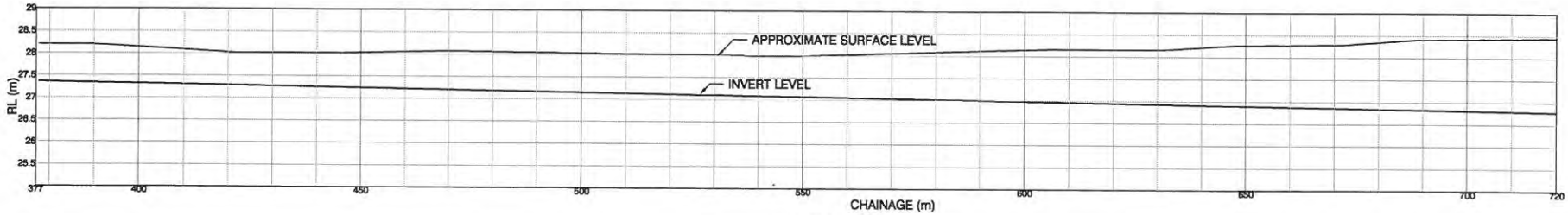


LONG SECTION (1/1)

SOUTHERN DRAIN AND BUND

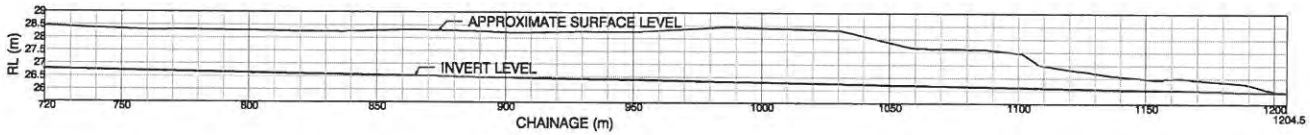
SCALE H 1:1000 V 1:100



LONG SECTION (2/1)

EASTERN WALL AND BUND

SCALE H 1:1000 V 1:100



LONG SECTION (3/1)

NORTHERN DRAIN AND BUND

SCALE H 1:2000 V 1:200

No.	DESCRIPTION	DATE	DRAWN	CHECK'D	APPR'D

SCALE AS SHOWN	
JOB No.	110441.02
DATE	01.10.10
DESIGN	PMR
DRAWN	GH
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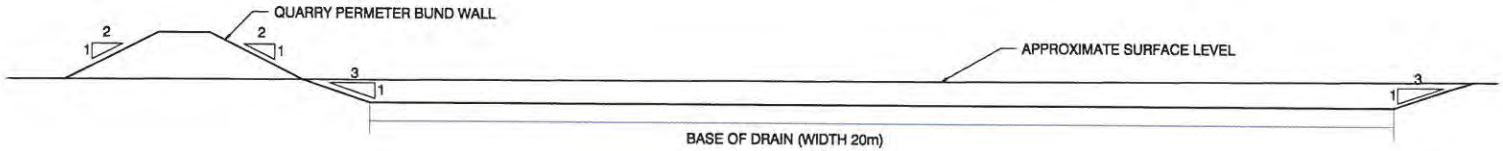
HANSON CONSTRUCTION MATERIALS
YANNATHAN AGGREGATE QUARRY

DIVERSION DRAIN - LONG SECTIONS

FIGURE 6

CLIENT No.
CAD REF. 110441
REV. No. A | SHT SIZE A3
SHEET 1 OF 1

File J:\Synergy\Projects\IC\110441 Yannathan Diversion Drain (Hanson)\02 Design Yannathan Diversion Drain\Terramodel\Yannathan Diversion Drain1.pro (Terramodel)
Mon 4 Oct 2010 15:31:13

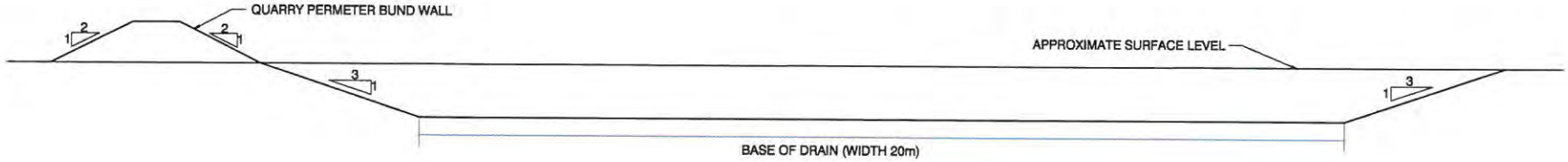


NOTE:
SOW AND MAINTAIN GRASS COVER WITHIN THE DRAIN AND ON THE BUND

SECTION 1/1

TYPICAL SECTION OF THE SOUTH DRAIN AND BUND

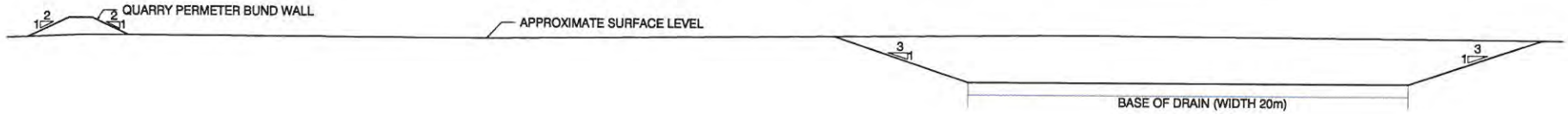
SCALE 1:100



SECTION 2/1

TYPICAL SECTION OF THE EAST DRAIN AND BUND

SCALE 1:100



SECTION 3/1

TYPICAL SECTION OF THE NORTH DRAIN AND BUND

SCALE 1:200

No.	DESCRIPTION	DATE	DRAWN	CHECKD	APPRD

SCALE AS SHOWN	
JOB No.	110441.02
DATE	01.10.10
DESIGN	PMR
DRAWN	GH
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HANSON CONSTRUCTION MATERIALS
YANNATHAN AGGREGATE QUARRY

DIVERSION DRAIN - TYPICAL CROSS SECTION

FIGURE 7

CLIENT No.
CAD REF. 110441
REV. No. A | SHT SIZE A3
SHEET 1 OF 1

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Mon 4 Oct 2010 15:31:46

Appendix B:
Melbourne Water Preliminary Advice Email (18th December 2020)

Milan Wickramarachchi

From: Melbourne Water <No_reply@melbournewater.com.au>
Sent: Friday, 18 December 2020 9:52 AM
To: Julian Giannetti
Subject: MWA-1188291 Re-alignment of waterway advice

Hi Julian,

Further to your email, please consider the following preliminary advice for Realignment of waterway/channel:

If waterway/s are proposed to be diverted within the quarry site these diversions must be included and outlined within the Work Authority and submitted to Melbourne Water for approval.

1. Any proposed realignment of the waterway must be submitted to Melbourne Water for approval at concept design, functional design and detailed design stages. Each submission must include the following information:

a. The proposed centreline and alignment of the realigned section;
b. A geotechnical/geomorphologic report by a suitably qualified professional identifying the geomorphic values of the existing waterway and providing assessment of the significance of those values within the local, regional and state context.
c. A geotechnical/geomorphologic report by a suitably qualified professional addressing the feasibility of any proposed realignment, with reference to soil types, topography and any future possible channel movement. Within the report, the proponent must demonstrate the hydraulic function including:

i. channel capacity; (normally required to contain 100 year ARI flow plus freeboard, freeboard amount to be determined by risk assessment of the consequences of flows exceeding the channel capacity);
ii. stream velocities;
iii. shear stresses and stream powers at different flow rates likely to be experienced by the realigned section (according to the flow regime and proposed channel geometry) in order to determine the likely impact on channel stability.

2. The report must demonstrate that the hydraulic function of the realigned section:

i. causes no significant change from base conditions (i.e. the current hydraulics of the existing channel), where the existing channel is in good geomorphic condition and not exhibiting unstable behaviour
ii. that channel stability and in channel vegetation is not negatively impacted by the hydraulics of the realigned section
iii. minimises the requirement for rock lining and scour protection
iv. potential consequence of lengthening channel in relation to sediment accumulation.
v. outlines the predicted rate of meander and impact on intended design and riparian reserve width;

d. Waterway corridor zones and/or design, including appropriate revegetation setbacks, revegetation treatment, exclusion zone and maintenance access on both sides of the waterway.

- The realigned waterway must be re-vegetated with an appropriate indigenous Ecological Vegetation Class. Vegetation must be established and provide stability for the realigned waterway prior to the waterway's flows being redirected into the final waterway re-alignment.

- An appropriate exclusion zone is required (e.g. minimum 100m from the waterway (top of bank)) to protect the waterway from any direct (e.g. quarrying) or indirect (e.g. water quality) impacts from extraction activities.
- Maintenance access (vehicle) must be designated on both sides of the waterway (and within the proponent's property title) to ensure that any future waterway rectification or maintenance works can be safely undertaken.

e. Detailed flora and fauna investigation of the affected areas will need to be undertaken by an appropriately qualified consultant on behalf of the proponent and submitted to Melbourne Water for approval. These investigations must take into account the proposed subject site as well as the upstream, downstream and adjacent areas that may be affected. Appropriate measures to mitigate any potential impacts must be identified. Note that Melbourne Water reserves the right to ask for surveys to be repeated or targeted where required.

f. The location and species of vegetation affected by any proposed realignment at the project site as well as upstream and downstream of the project site, and

g. Provide details of sediment control elements (e.g. silt traps) that will be incorporated during the construction and establishment of the new waterway alignment to protect downstream water quality.

3. Melbourne Water recommends rehabilitation of the riparian corridor include fencing and revegetation with trees, shrubs and groundcover species. It is recommended that the waterway frontage be fenced at the required setback distance prior to works commencing to minimise damage to the waterway. A rehabilitation plan is to be forwarded to Melbourne Water for approval. Revegetation is to be undertaken with indigenous plant species.

Please be advised in order to receive final formal approval from Melbourne Water regarding the proposed re-alignment, a works offer application must be submitted
via: https://apply.melbournewater.com.au/develop/online.html?ApplicationType=OOCW

The above information is only preliminary and is subject to change upon submission of further information and plans.

Please email us at DevConnect@melbournewater.com.au quoting MWA-1188291 in the subject line.

This email is sent from a notification-only email address that does not accept incoming email.

For general development enquiries contact our Customer Service Centre on 131 722.

Regards,

Segujja Kakembo | Planner , Development Planning Services | Melbourne Water
T: 131 722 | 990 La Trobe Street, Docklands, VIC 3008 | PO Box 4342 Melbourne VIC 3001
| melbournewater.com.au

ENGENY
WATER MANAGEMENT

Appendix C:
Geomorphological Assessment

ENGENY
WATER MANAGEMENT

Hanson Construction Materials

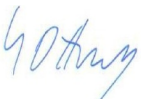
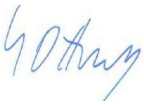
Yannathan Quarry

Geomorphic Assessment

April 2022

V1259_003_REP_001_3

Job no. and Project Name: V1259_003 – Yanathan Geomorph
Doc Path File: \\online.com\files\ManagementMelbourne\Projects\V1259 Hanson Construction Materials\V1259_003 Yannathan Geomorph\07 Deliv\2. Report\V1259_003_REP_001_3_Yannathan Geomorph Assesment.docx

Rev	Date	Description	Author	Reviewer	Project Mgr.	Approver
0	10/09/2021	For Issue	Desmond Anim	David Sexton	Julian Giannetti	Glenn Ottrey
1	30/09/2021	For Issue	Desmond Anim	David Sexton	Julian Giannetti	Glenn Ottrey
2	17/12/2021	For Issue	Desmond Anim	Glenn Ottrey	Julian Giannetti	Glenn Ottrey
3	12/04/2022	For Issue	Desmond Anim	Glenn Ottrey	Julian Giannetti	Glenn Ottrey
Signatures						

DISCLAIMER

This Report has been prepared on behalf of and for the exclusive use of Hanson Construction Materials and is subject to and issued in accordance with Hanson Construction Materials instruction to Engeny Water Management (Engeny). The content of this Report was based on previous information and studies supplied by Hanson Construction Materials.

Engeny accepts no liability or responsibility whatsoever for it in respect of any use of or reliance upon this Report by any third party. Copying this Report without the permission of Hanson Construction Materials or Engeny is not permitted.

Contents

Appendices

List of Tables

List of Figures

1 INTRODUCTION

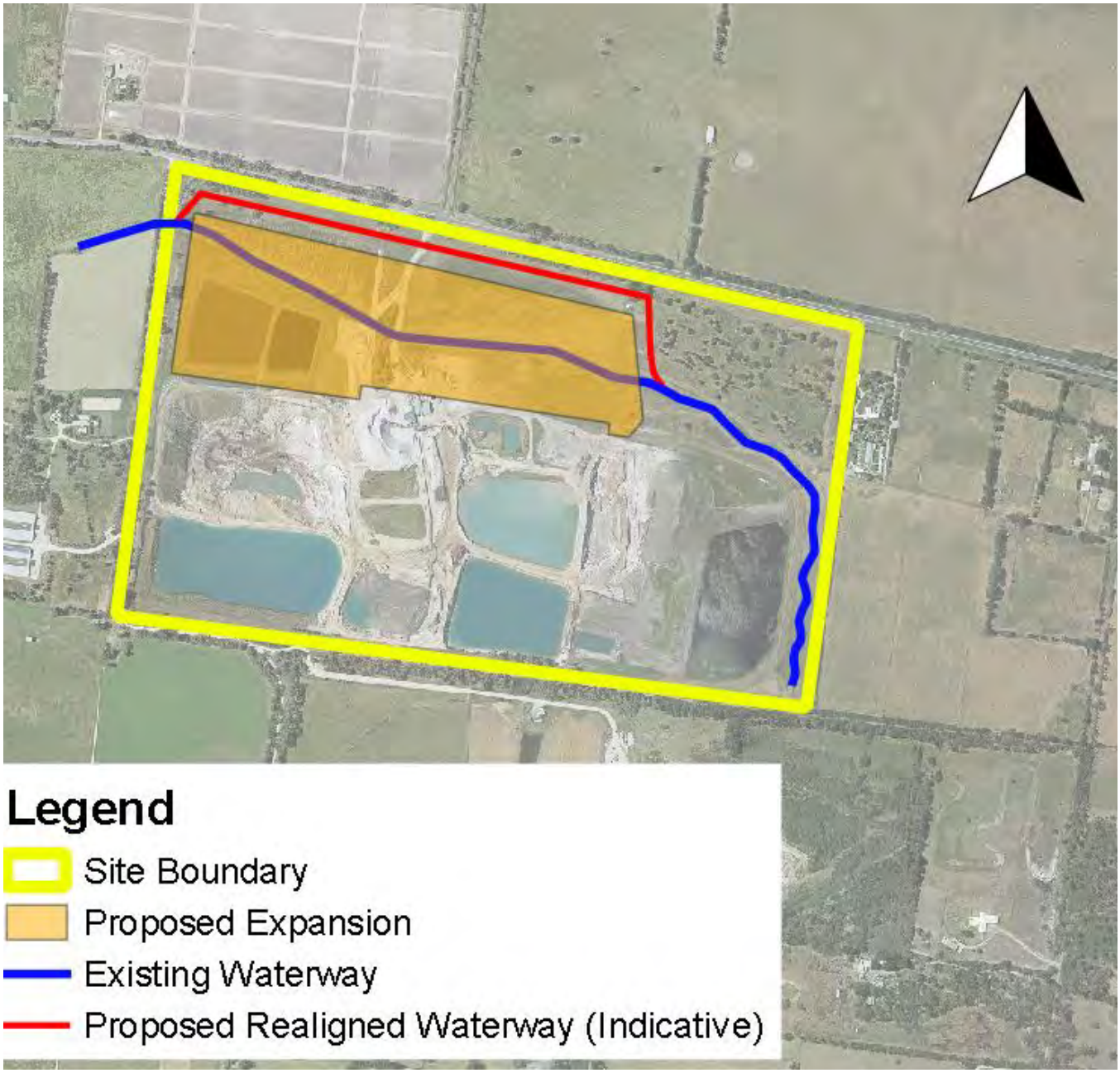
1.1 PROJECT BACKGROUND AND OBJECTIVES

Hanson Construction Materials is proposing to extend extraction activities at 870-910 Westernport Road in Yannathan to the north of the current extraction area within the existing Work Authority (Figure 1.1). There is an existing drainage channel within the location of the proposed expansion, as shown in blue in Figure 1.1. The expansion will require the realignment of the existing channel towards the northern boundary of the site.

A geomorphic assessment has been requested by Melbourne Water as a key part of the proposed channel realignment for the expansion of quarry activities. This geomorphic assessment:

- Examines the geomorphic condition and values and trajectory of the existing channel within the site.
- Identifies the hydraulic condition, including shear stresses and velocities at different flow rates that are likely to be experienced by the realigned channel (according to the flow regime and proposed channel geometry), to determine the likely impact on channel stability.
- Addresses the feasibility of any proposed realignment with reference to soil type, topography and defines the degree and type of management intervention needed (if any) to ensure the long terms stability of the channel and mitigate against any future possible channel movement.

Figure 1.1: Proposed expansion and approximate realigned channel alignment



1.2 APPROACH

Melbourne Water has provided a preferred methodology for the geomorphic assessment. Based on this information and Engeny Water Management's (Engeny's) experience in similar assessments, the following primary tasks have been undertaken:

- Information review and initial desktop assessment of site.
- Field inspection of the length of the existing channel within the site.
- Geomorphic condition and value assessment of the existing channel.
- Hydraulic assessment of proposed channel realignment and potential upstream and downstream impacts.
- Identification of management consideration and recommendations.

2 SITE DESCRIPTION AND DESKTOP ASSESSMENT

2.1 INFORMATION REVIEW

Pertinent background information of the project area was reviewed including:

- Port Philip and Westernport Geological/Geomorphological landform mapping and explanatory notes (Agriculture Victoria 2018 a).
- Aerial photography (historical and current) accessed via Nearmap viewer to identify natural and anthropogenic changes of the channel.
- Topographical mapping (Digital Elevation Model).

2.2 STUDY AREA AND SITE CHARACTERISTICS

The study area is located at 870-910 Westernport Road in Yannathan about 76 km south-east of central Melbourne. It is on the southern edge of the Koo Wee Rup Swamp and south of the Lang Lang River which discharges to Western Port Bay. The majority of the study area is bounded by farmlands (grazing modified pastures land) and the quarry activities (Figure 2.1). Westernport Road forms the Northern portion of the site boundary. The site falls in the Bunyip basin within the Port Phillip and Westernport region. Most waterways within the basin are rated to have a poor stream condition based on the 2010 Index of Stream Condition (The Third Benchmark of Victoria River Condition (ISC3) report).

The drainage channel traverses the site from the eastern boundary towards the northern edge of the existing quarry operations and exits at the western boundary. The upstream section of the waterway has been previously re-aligned in 2011 as shown in Figure 2.1 to allow for quarry works expansion towards the eastern boundary at that point in time.

Figure 2.1: Site overview

2.2.1 Geology and Soils

Engeny has reviewed the geology of the site based on information provided in Victorian Resources Online for Port Phillip and Westernport (Agriculture Victoria 2018 b). This information shows that areas around the site is underlain by Neogene sediments (aeolian and riverine). The site falls within a region with a Tier 1, 2 and 3 geomorphologies of Eastern Plains (EP), Low relief Southern Uplands and Prior Stream Plains (Agnes, Yarram, Yinnar, Tinamba, Clydebank) respectively (Agriculture Victoria 2020).

Generally, most of the flat country east of Kooweerup and near the Lang Lang River where the study area is located, comprises of soils on alluvium, derived from the Cretaceous uplands and to a lesser extent, from the older basalt cappings near Warragul (Sargeant, 1975). The Australian Soil Classification (Agriculture Victoria 2018 c) also identifies the soil in this region as Humose, Humic/Sesquic, Semiaquic PODOSOL which is strongly acidic, low salinity and non-sodic.

2.2.2 Site topography and drainage

Figure 2.2 shows the topography across the study area using 2 m contour lines. The majority of the site is low-lying with a gentle slope of approximately 2 % towards the existing waterway. The topography of the area lends to very shallow drainage depressions in most areas. Broad flat plains also characterise large parts of the contributing catchment while the site extremities extend into the surrounding bund adjacent to Westernport Road along the northern site boundary. The existing channel flows north-west around the boundary of the site, from the south-eastern site boundary to the north- western boundary. A local external drainage catchment of approximately 2.7 km^2 contributes flows to the study area, the larger coming from the south-east as shown in Figure 2.3. Areas of natural local ponding occur throughout the waterway.

Figure 2.2: Site Topography (2 m contours)

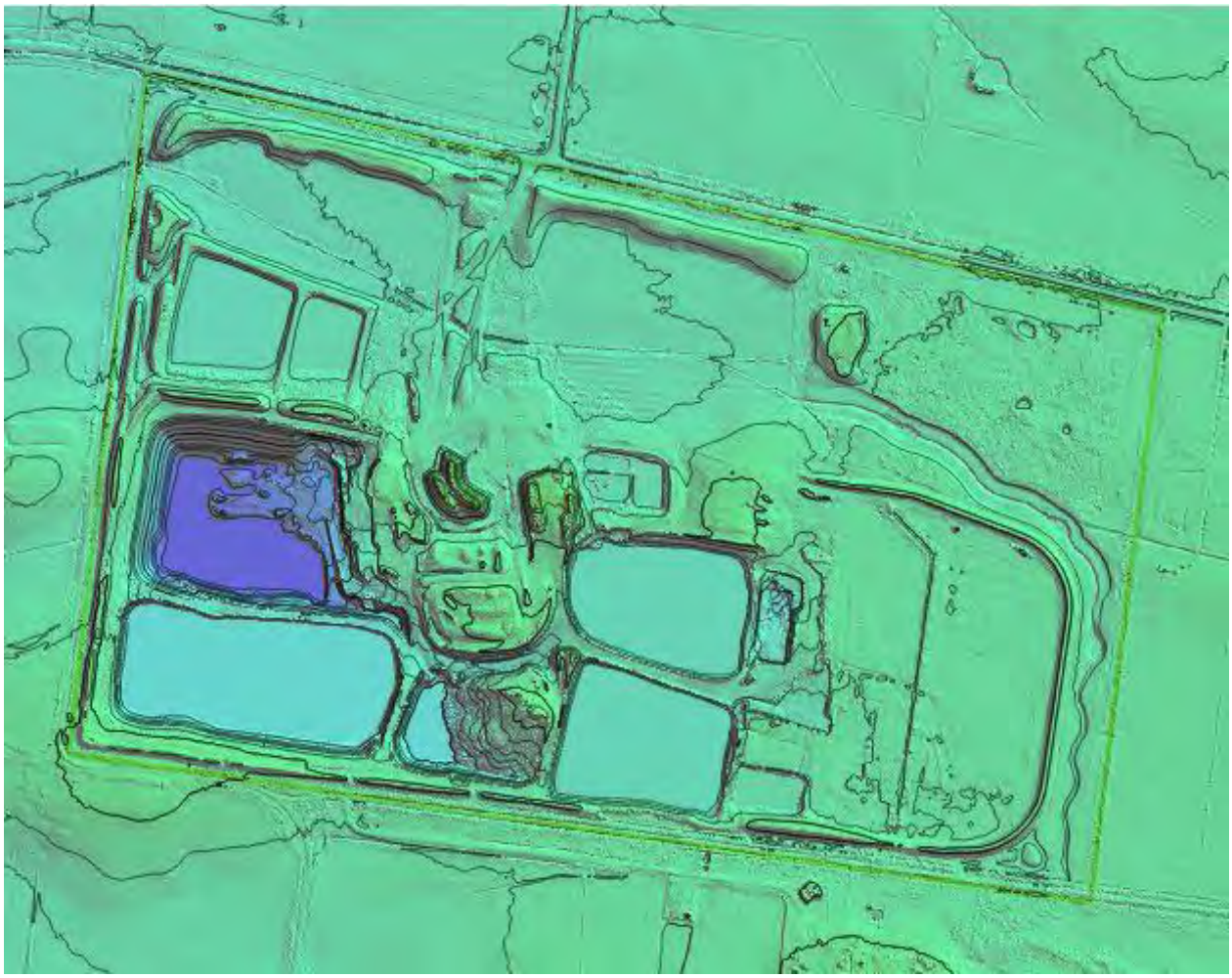
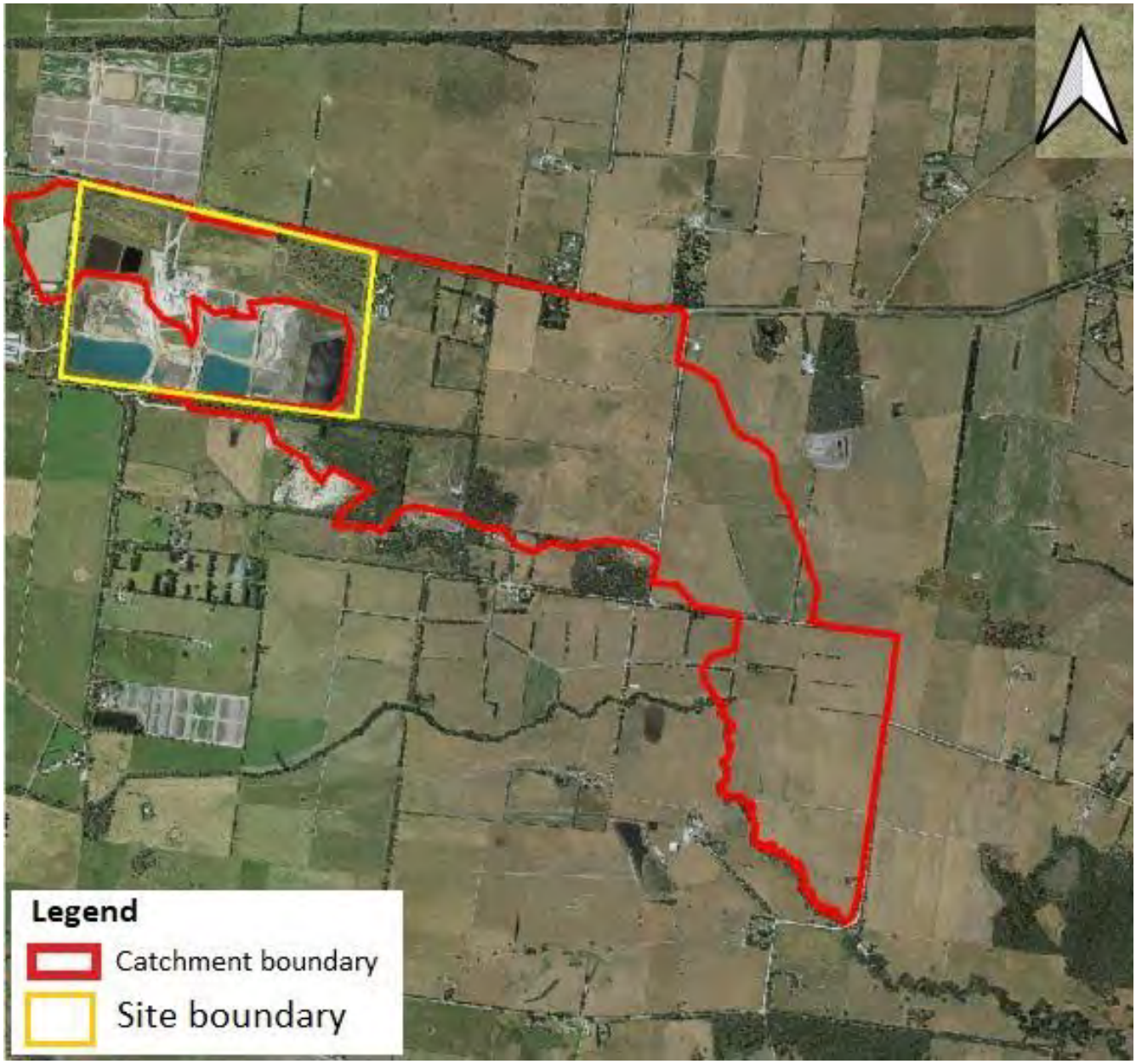


Figure 2.3: Catchment area contributing flows to the study area



2.3 CULTURAL HERITAGE ASSESSMENT

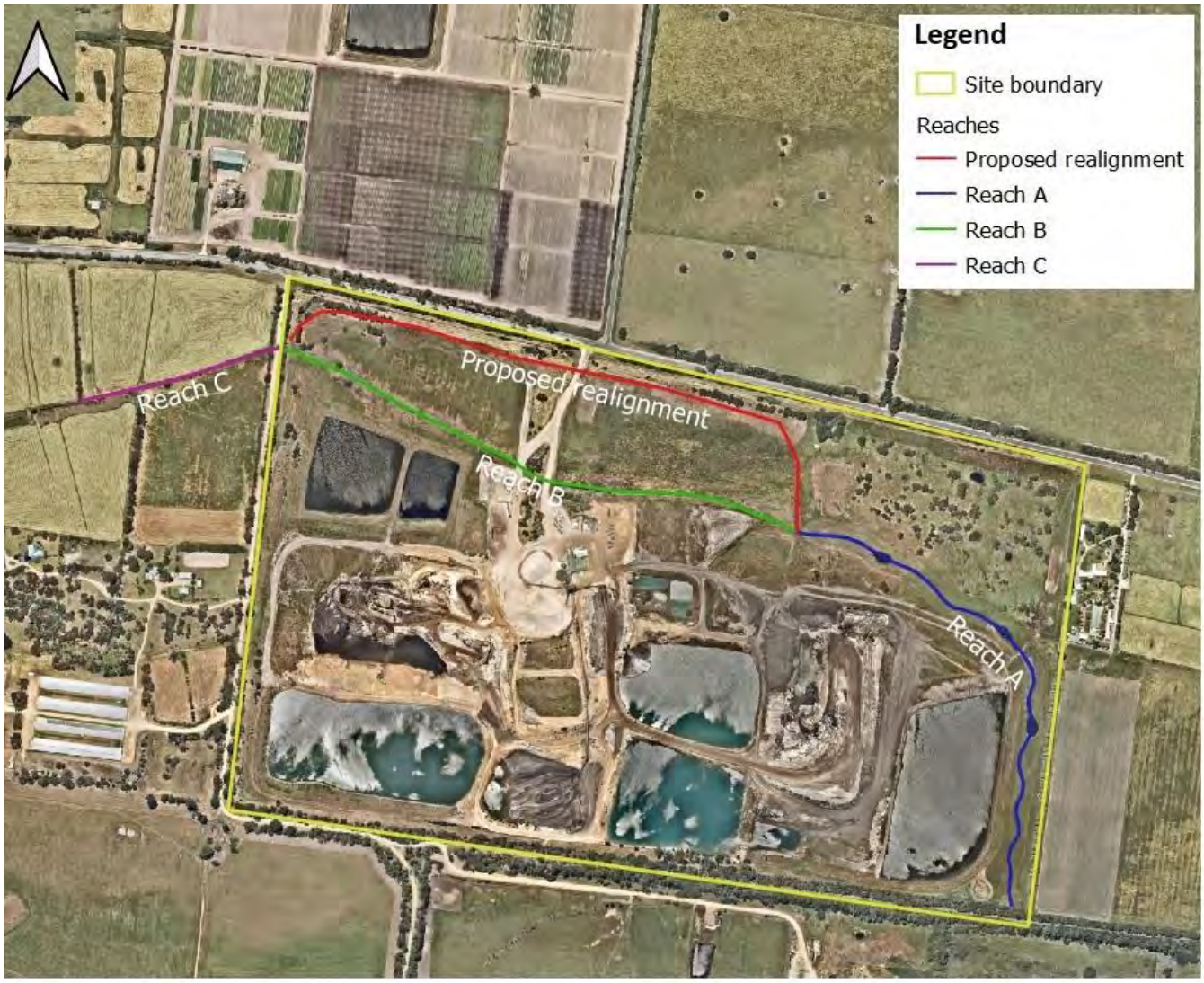
Heritage Insight have been involved throughout the geomorphic assessment and have provided insights to address the potential of soil/sand within the current landscape within the study area that may contain deposits of culturally sensitive Aboriginal material. Refer to Appendix B for advice from Heritage Insight.

3 GEOMORPHIC ASSESSMENT

3.1 SITE INSPECTION

A site inspection was undertaken by Engeny on 30th July 2021. The inspected channel has been split into three reaches (A, B and C) which includes the section of the channel (Reach B) to be affected by the proposed expansion (~ 800 m), as well as upstream (Reach A) and downstream (Reach C) segments comprising of approximately 1.2 km of the total channel length (Figure 3.1). The inspection involved a rapid geomorphic assessment of the reaches and corridor to define geomorphic processes, waterway features, geomorphologic risks and inform the proposed realignment works.

Figure 3.1: Site Waterway Reaches



Key findings from the site assessment are summarised below in Table 3.1 with photos of typical features included in Figures 3.2 to 3.16.

Table 3.1: Summary of field observations for each inspected reach

Channel segment	Key Observations
A	This reach represents a previously re-aligned constructed channel from the east of the quarry site flowing in the north-west direction to the current proposed segment to be re-aligned. Reach A primarily consists of a defined shallow low flow meandering channel and localised chain-of-ponds. The channel is lightly vegetated with some pasture grasses within some sections (Refer to figures below of photos that were taken on site. Figure 3.2, Figure 3.3). The surrounding broad floodplain consists mostly of low-lying groundcover made up of a mixture of weed, turf/pasture grasses (Figure 3.7). Most sections of this reach have no defined channel banks (Figure 3.3). The banks of the localised pools have been stabilised by rock work in some locations (Figure 3.6). Some isolated bank areas show signs of instability (Figure 3.4, Figure 3.5). These isolated bank areas have lost vegetation with exposed clayey-silt soil-based banks. This reach is generally considered stable with no incision.
B	Reach B is the proposed section to be re-aligned. The reach has no well-defined channel, and the waterway flows through the broad floodplain (Figure 3.8, Figure 3.9). The surrounding floodplain of this reach, upstream of the access road crossing is made of low-lying groundcover of pasture grasses consistent with Reach A (Figure 3.11). The floodplain downstream of the road crossing is made up of dense groundcover consisting mostly of a mixture of weeds and some pasture grasses, with some dispersed trees on its floodplain further downstream towards the western boundary of the site (Figure 3.12). The in-channel vegetation (mostly pasture grasses) is very thick, filling / choking the channel at various sections (Figure 3.9, Figure 3.10, Figure 3.16). Midway through the reach, the channel is impacted by backwater from the access road crossing (Figure 3.14) which causes extended ponding up to about 20 m from the low-flow channel (Figure 3.15). Isolated areas of localised ponding likely formed after storm event were observed along the length of the reach after the access road leading up to the downstream section of the reach. No evidence of incision, bank erosion or instream works was noted.
C	The proposed realignment of reach B will connect to the upstream section of this reach. Access to visually assess this reach was not possible, hence the assessment was undertaken using aerial imagery. The reach consists of a straight shallow channel (Figure 3.18, Figure 3.19). The channel is lightly vegetated and the floodplain on both sides of the channel is covered by predominately moderately dense low-lying pasture grasses. The channel seems relatively stable under existing land use. No evidence of instream works was identified.

3.2 CONDITION ASSESMENT

A condition assessment was undertaken for the inspected reaches based on the findings from the field assessment considering the channel form, channel stability (bank and bed), in-channel habitat and riparian vegetation. Table 3.2 provides the different geomorphic condition categories and explanation of each.

Table 3.3 provides the different geomorphic condition assigned to the inspected reaches.

Table 3.2: Geomorphic condition categories

Geomorphic condition	Definition
Intact	Reach form in natural condition, presents all the typical features of the stream type, no evidence of erosion processes.
Good	Reach form in near natural condition, some limited impacts but most of the typical features of the stream type are retained.
Moderate	Reach form impacted by erosion or land use practices. Some features of the stream type may be retained but the majority of the features are highly modified.
Poor	Reach in a degraded condition due to extensive erosion or modified due to land use practices changing the form of the stream type.

Table 3.3: Geomorphic condition categorization of inspected reaches

Reach	Condition	Justification
Reach A	Moderate	Reach has some bank instability, and limited habitat diversity. some lateral connectivity value. Reach form partly impacted by land use activities.
Reach B	Poor	Reach form impacted by land use activities, little to no geomorphic characteristics, limited instream habitat value, no erosion, limited riparian vegetation, some lateral connectivity value, dense homogenous vegetation, no marked erosion noted
Reach C	Poor	Little to no geomorphic characteristics, limited instream habitat value, no erosion.

3.3 GEOMORPHIC VALUE ASSESMENT

Table 3.4 summarises the geomorphic value assigned to each inspected reach.

Table 3.4: Geomorphic value categorization of inspected reaches.

Reach	Representativeness	Rarity	Diversity	Condition	Geomorphic Value
Reach A	Anthropogenic/Constructed channel	Common	Homogenous	Moderate	Low
Reach B	Anthropogenic/Constructed channel	Common	Homogenous	Poor	Low
Reach C	Anthropogenic/Constructed channel	Common	Homogenous	Poor	Low

Refer to figures below of photos that were taken on site.

Figure 3.2: Constructed low flow channel (Reach A)

Figure 3.3: Section of channel (Reach A)

Figure 3.4: Typical chain of ponds at Reach A showing signs of bank instability

Figure 3.5: Localised areas of bank instability at Reach B

Figure 3.6: Pools sections at Reach A with rockwork

Figure 3.7: Floodplain reach A

Figure 3.8: Reach B with no clearly defined channel

Figure 3.9: Channel at Reach B flows on broad floodplain (no defined channel)

Figure 3.10: Channel at Reach B with excessive pasture grass growth filling the channel

Figure 3.11: Floodplain Reach B (upstream of access road crossing)

Figure 3.12: Floodplain Reach B (downstream of access road crossing)

Figure 3.13: Areas of chain of ponds created in channel separated by dense vegetation (Reach B)

Figure 3.14: Extended ponding upstream of Reach B

Figure 3.15: Access Road crossing at Reach B

Figure 3.16: In-channel (highly dense) vegetation covers channel depth

Figure 3.17: Access Road crossing channel upstream at Reach B

Figure 3.18: Aerial image showing Reach C in the west of study area boundary

Figure 3.19: Channel in Reach C and associate floodplain

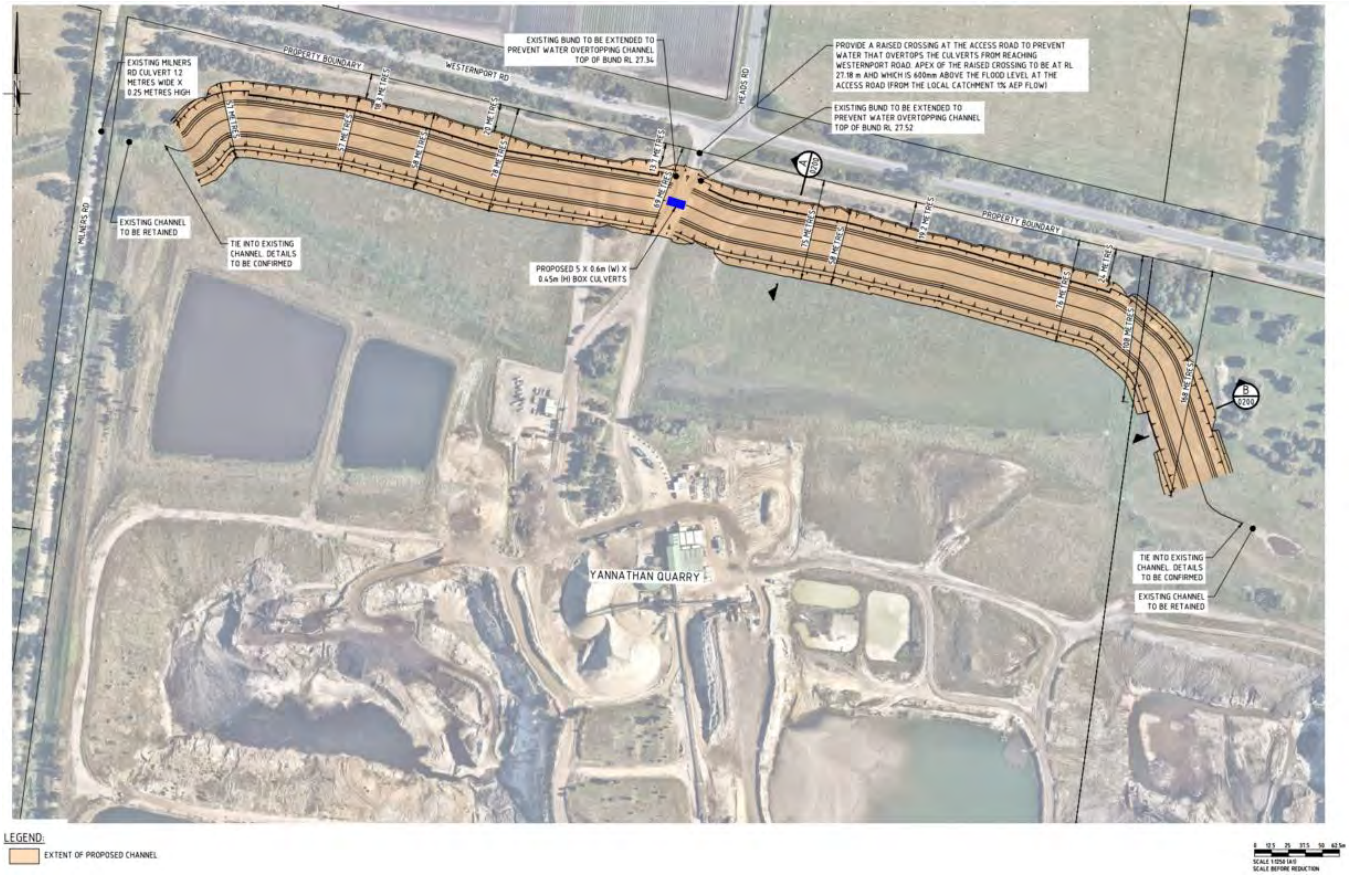
4 HYDRAULIC OUTPUT ASSESMENT

4.1 PROPOSED CHANNEL

As part of the proposed expansion of the existing quarry site, the existing drainage channel will need to be realigned to divert flows through the site. The re-aligned channel will tie into the existing topography in regards to the levels of the existing channel upstream and downstream. Refer to Figure 4.1 for conceptual layout of the proposed channel.

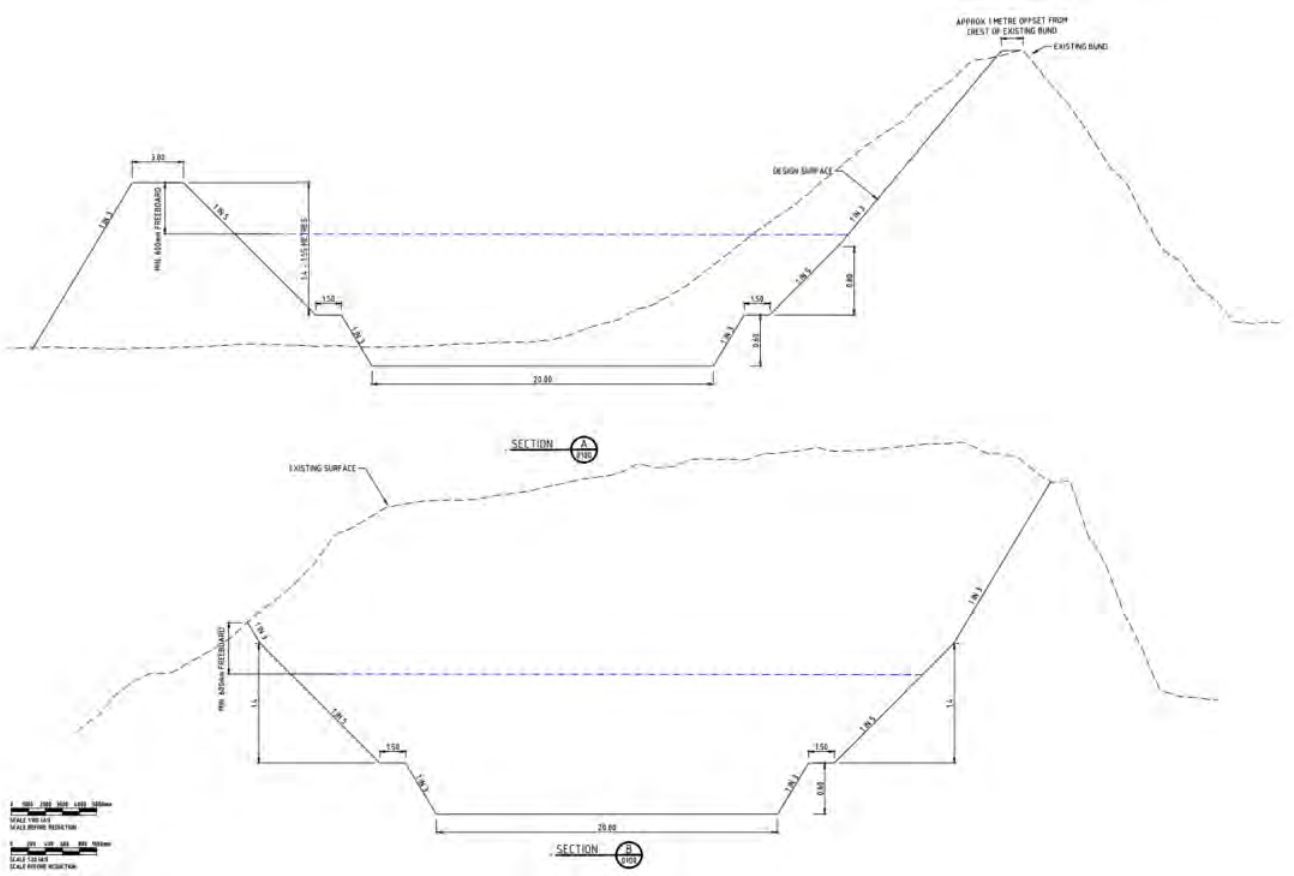
The re-aligned channel has a longitudinal grade of approximately 1 in 400 to ensure that it can tie into the existing channel at the downstream end.

Figure 4.1: Realigned Channel – Concept Layout



A typical cross section profile has been provided in Figure 4.2 which shows that the channel is in cut and utilises the existing visual screening bund (northern bund) and proposes a new bund to the south of the realigned channel to contain the 1 % AEP peak flow.

Figure 4.2: Re-aligned Channel – Typical Cross Section



Refer to **Appendix A** for concept design, noting that this concept design is subject to change based on outcomes of this geomorphic assessment and discussions with Melbourne Water and Hanson.

4.2 WATERWAY STABILITY

Engeny completed a HEC-RAS hydraulic model for both the existing and proposed re-alignment channel configuration to:

- Identify whether the proposed realignment result significant change in Shear Stress and Velocity when compared to base/existing conditions.
- Ensure downstream in-channel features (e.g., channel geometry, vegetation) not negatively impacted by the hydraulics of the realigned section.

For the geomorphologic assessment, shear stresses and velocity values for different design events were extracted from the hydraulic model and used as a guide to identify the likely impact on channel stability. The assessment considered the results for the 1 % (1 in 100 ARI) AEP event using the existing and proposed channel topography. The hydraulic values (shear stress, and velocity) results are based on the 1 % AEP flow of 27.8 m³/s, which is the estimated flow rate (provided by Melbourne Water and is discussed in the Yannathan SWMP) for local catchment flows, inclusive of break out flows from the Little Lang Lang River during the 1 % AEP design storm event.

The results from the model have been compared with the 2019 Melbourne Water Constructed Waterways Design (MWCWD) Manual guidelines for acceptable values of shear stresses and velocity. This was conducted to determine how the modelled values compare with acceptable limits to maintain good channel condition.

The existing channel condition was used as a ‘natural’ analogue for comparison with the development scenario (post-development) for each of the reaches above. However, it is acknowledged that the existing channel is in poor condition and does not provide a ‘natural’ analogue for a channel performing well. Thus, the comparison generally provides an understanding of

how the proposed re-alignment compares with existing conditions. In addition, the comparison of modelled hydraulic values with published acceptable values helps to provide guidance for detailed design as well as guide the extent of the re-aligned channel that may require different levels of treatments (e.g., vegetation, rock lining) for scour/erosion protection.

The modelled hydraulic output provides depth-averaged shear stress at different cross-sections for the banks and main channel. Following the 2019 MWCWD guidelines, the depth-averaged shear stresses calculated by HEC-RAS were factored up to estimate the maximum shear stresses occurring on the bed and sides of the cross section. A scale-factor was adopted based on the relationship of the base width (low flow or high flow channel) divided by the depth of the 1 % AEP flow and the side slope. A scale factor of 1.5 and 1.7 was used for the channel bed and sides respectively by adopting a conservative approach that selects the highest scale factor and applying to the entire channel as recommended by MWCWD guidelines.

The shear stress values provided by the HEC-RAS model will generally be compared against Table 4.1 and Table 4.2. In general, a threshold velocity of 1.5 m/s is often referred to by Melbourne Water as a limiting velocity before scour may potentially occur or for above which channel stabilisation measured may be required.

Table 4.1: Shear stress and velocity erosion threshold for different waterway boundary materials (2019 Melbourne Water Constructed Waterways Design Manual, Fischenich 2001)

Boundary Category	Boundary Type	Shear stress (N/m^2)	Velocity (m/s)
Soils	Fine colloidal sand	1.5	0.5
	Alluvial silt and silty loam (non-colloidal)	3	0.5 – 0.7
	Firm loam and fine gravels	4	0.8
	Stiff clay and alluvial silts (colloidal)	12	1 – 1.5
Gravel/Cobble	25 mm, 51 mm, 152 mm and 305 mm	16, 32, 96 and 192 respectively	0.8 - 1.5, 0.9 - 1.8, 1.2 - 2.3, and 1.7 - 3.7 respectively
Vegetation	Turf	45 to 177	1 – 2.5
	Long native grasses	80	1.2 – 1.8
	Short native and bunch grass	45	0.9 – 1.2

Table 4.2: Shear stress thresholds for different parts of the channel materials (2019 Melbourne Water Constructed Waterways Design Manual)

Design event (AEP)	Low Flow Channel	High Flow Channel
5 %	Thresholds exceeded by no more than 10 %	Below threshold for boundary material
2 %	Thresholds exceeded by no more than 10 %	Below threshold for boundary material
1 %	Thresholds exceeded by no more than 10 %	Below threshold for boundary material

Engeny have assessed the existing and proposed channel conditions hydraulic outputs for the 1 % AEP peak flow and compared to the MWCWD tolerable limits, focusing on the distribution frequency. Table 4.3 shows the frequency distribution of hydraulic conditions (shear stresses and velocities) for both the existing and proposed realigned channels.

The hydraulic conditions (shear stresses and velocities) within the existing and proposed channels are generally within MWCWD guidelines acceptable ranges. Shear stress and velocities are generally below the acceptable thresholds, primarily around 15 - 60 N/m^2 and 0.5 -1.0 m/s respectively. The proposed channel has generally increased the shear stresses occurring within the ranges 30-60 N/m^2 for the channel bed and 15-45 N/m^2 for the channel sides. Similarly, there is slight increases in velocities mostly occurring in the range of 0.5 -1.0 m/s. These predicted increases in shear stresses and velocities in the proposed channel

are below the MWCWD thresholds and are within acceptable ranges for a vegetated channel. This minimises the requirement for rock lining and scour protection. This will also help maintain sediment transport reducing the likelihood of excess sediment accumulation or deposition. These modelled shear stress and velocity ranges in the proposed channel are also indicative that the downstream channel hydraulics and channel vegetation will not have a significant impact.

Table 4.3: Distribution of hydraulic parameters across modelled reach for the existing and proposed channel.

Range Distribution	1 in 100 Year (Channel bed) (frequency of occurrence)		1 in 100 Year (channel sides) (frequency of occurrence)	
	Existing	Proposed	Existing	Proposed
Shear Stress(N/m^2)				
0-15	30	9	39	20
15-30	13	9	18	40
30-45	10	39	5	13
45-60	7	15	1	2
60-80	1	4	0	2
80-100	1	1	0	0
100-120	0	0	0	0
120-200	1	0	2	0
>200	3	1	1	1
Velocity (m/s)				
< 0.2	13	2	12	3
0.2-0.5	15	6	19	8
0.5-1.0	31	67	29	64
1.0-1.5	1	0	2	0
1.5-2.0	3	1	1	1
> 2.0	0	0	0	0

5 CONCLUSIONS, CONSIDERATIONS AND RECOMMENDATION

The geomorphic assessment has assisted in informing the geomorphic condition of the existing channel and to evaluate the viability and implications of the proposed realignment of section of the channel to the northern site boundary. The following summarises the findings and considerations:

- It is noted that the proposed realigned channel does not cause significant deviations in hydraulic conditions from the existing state, and where any deviations do occur, they can primarily be addressed using vegetation.
- The modelling showed only a slight increase in shear stress in the proposed channel, but this is below the MWCWD thresholds and the acceptable ranges for a vegetated channel. This will help maintain sediment transport reducing the likelihood of excess deposition as seen in the existing channel.
- Velocities and shear stresses for the 1 % AEP scenario are generally within the acceptable thresholds, primarily around 0.5-1.0 m/s and 15-60 N/m^2 respectively. This indicates that variety of vegetation such as native grass, shrubs, and trees are deemed appropriate surface treatments to provide means of long-term stability and reduce the risk of erosion and channel movement in the proposed channel reach. This minimises the requirement for rock lining and scour protection.
- The hydraulic condition of the proposed re-aligned channel suggests that the re-alignment will not have a significant impact on the downstream reach.
- It is recommended to introduce a suitable range of vegetation in the channel design. Riparian buffer and fencing should be considered in the design to exclude livestock and impact from grazing activities as well as providing buffer against erosion. Vegetation is to be selected to ensure that it can withstand the seasonal variation in rainfall and water levels throughout the year to improve survivability and establishment.
- The proposed channel is to be designed to provide a smooth transition into existing downstream reach.

6 QUALIFICATIONS

a) In preparing this document, including all relevant calculation and modelling, Engeny Water Management (Engeny) has exercised the degree of skill, care and diligence normally exercised by members of the engineering profession and has acted in accordance with accepted practices of engineering principles.

b) Engeny has used reasonable endeavours to inform itself of the parameters and requirements of the project and has taken reasonable steps to ensure that the works and document is as accurate and comprehensive as possible given the information upon which it has been based including information that may have been provided or obtained by any third party or external sources which has not been independently verified.

c) Engeny reserves the right to review and amend any aspect of the works performed including any opinions and recommendations from the works included or referred to in the works if:

   i) Additional sources of information not presently available (for whatever reason) are provided or become known to Engeny; or
   ii) Engeny considers it prudent to revise any aspect of the works in light of any information which becomes known to it after the date of submission.

d) Engeny does not give any warranty nor accept any liability in relation to the completeness or accuracy of the works, which may be inherently reliant upon the completeness and accuracy of the input data and the agreed scope of works. All limitations of liability shall apply for the benefit of the employees, agents and representatives of Engeny to the same extent that they apply for the benefit of Engeny.

e) This document is for the use of the party to whom it is addressed and for no other persons. No responsibility is accepted to any third party for the whole or part of the contents of this Report.

f) If any claim or demand is made by any person against Engeny on the basis of detriment sustained or alleged to have been sustained as a result of reliance upon the Report or information therein, Engeny will rely upon this provision as a defence to any such claim or demand.

g) This Report does not provide legal advice.

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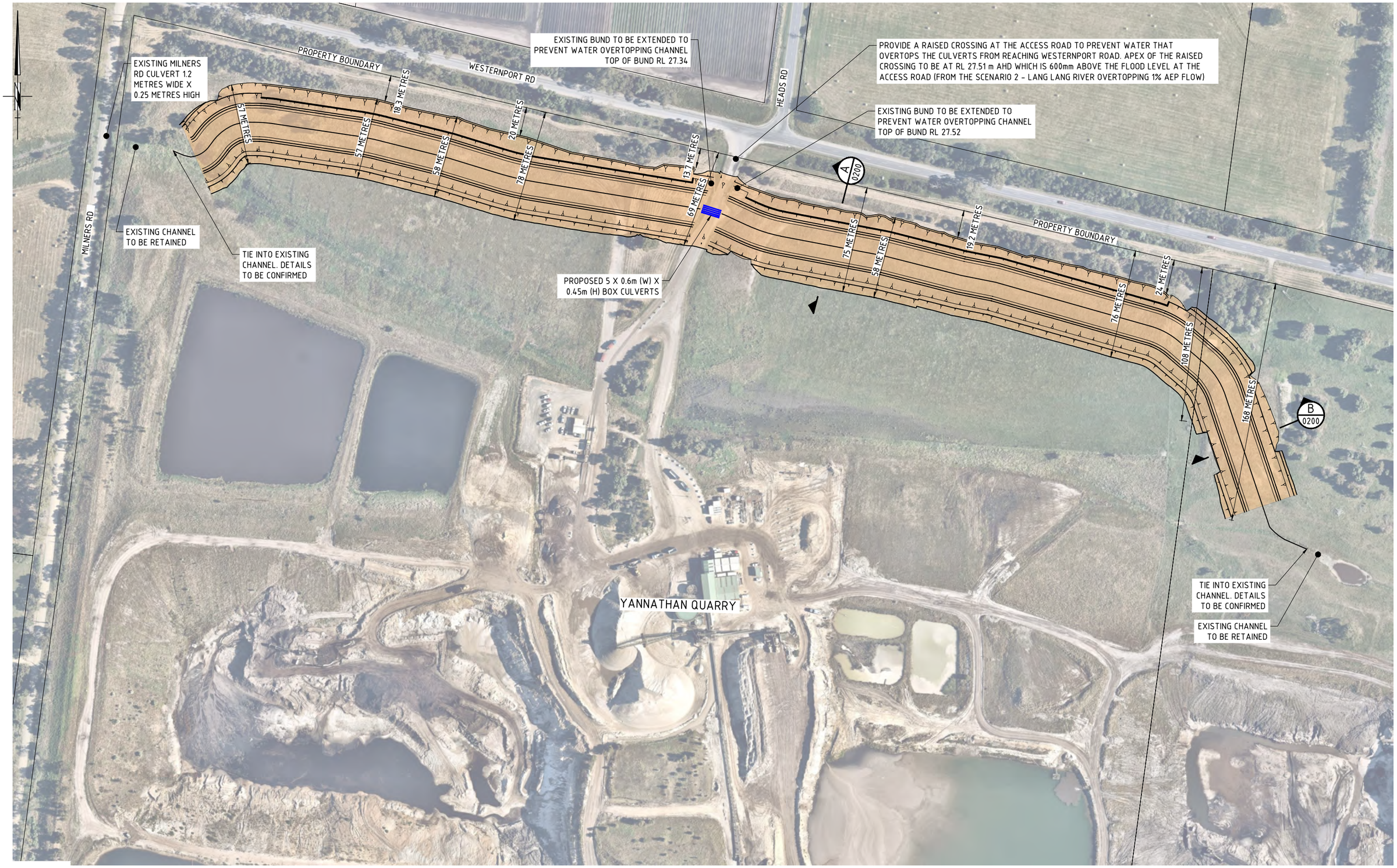
Appendix A:
Concept Design of Proposed Channel



LEGEND:

EXTENT OF PROPOSED CHANNEL

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SCALE BEFORE REDUCTION

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REV	BY	DATE	REVISION DESCRIPTION	PM APPD.
A				

DOC. NUMBER	DOCUMENT TITLE
REFERENCE DOCUMENTS	

Hanson

ENGENY WATER MANAGEMENT
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STATUS: NOT FOR CONSTRUCTION - FOR REVIEW

DESIGNED		CHECKED	
DRAWN		CHECKED	
PM APPD.		PD APPD.	
CPENG		CPENG No.	

HANSON CONSTRUCTION MATERIALS

YANNATHAN SURFACE WATER ASSESSMENT CONCEPT LAYOUT PLAN

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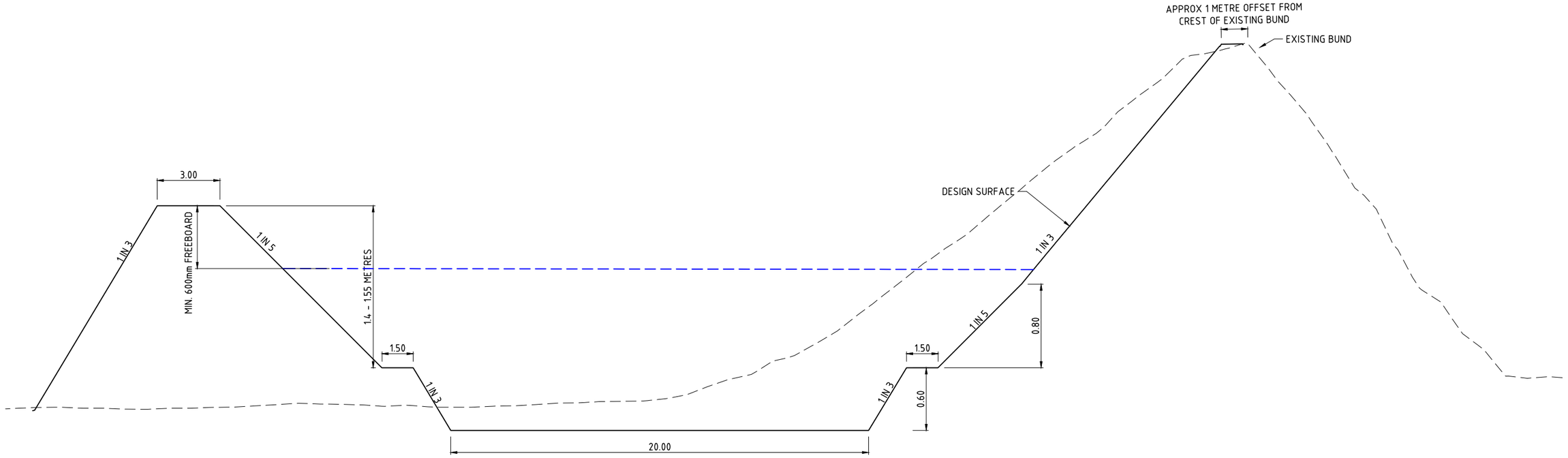
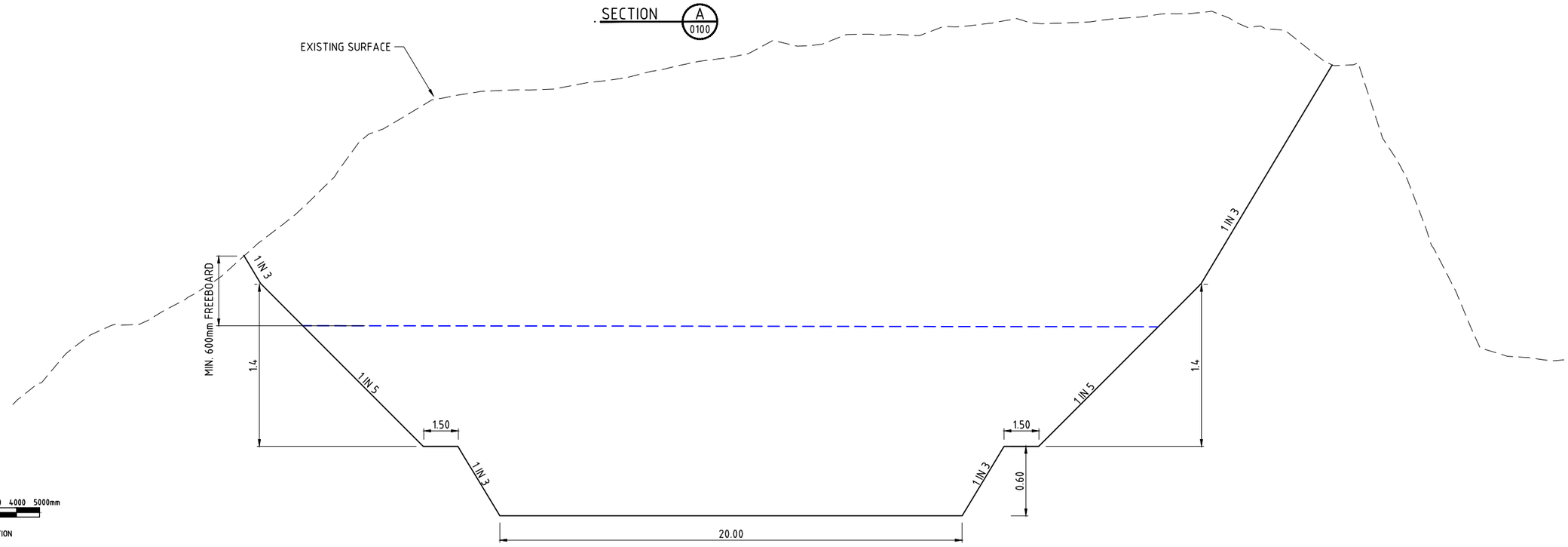
DWG NO.: V1259-002-DWG-0100
REV.: A



SECTION A 0100



SECTION B 0100

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SCALE BEFORE REDUCTION

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SCALE BEFORE REDUCTION

SECTION A 0100

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LAST MODIFIED:15/12/2021 11:31 AM

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DRAWN		CHECKED		
PM APPD.		PD APPD.		
CPENG		CPENG No.		

HANSON CONSTRUCTION MATERIALS

YANNATHAN SURFACE WATER ASSESSMENT
CONCEPT TYPICAL SECTION

ORIGINAL SIZE	DWG NO.	REV.
A1	V1259-002-DWG-0200	A

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Appendix B:
Cultural Heritage Advice

40,000 years of Aboriginal Occupation within the Westernport Region

The current landscape is the product of environmental changes that have occurred before and within the last 10,000 years. Human occupation within the region may potentially be considerably older by a magnitude of 30,000 years or more, during which environmental conditions would have been significantly different and therefore highly consequential for Aboriginal occupation and movement within the region. Aboriginal people moving throughout what is now the Port Phillip region during the Pleistocene period they would have encountered a very different landscape from today, most notably the Bassian land bridge which existed from c.40,000–36,000 BP until c.14,000 BP (although tenuous land bridges may have existed prior to this ~76, 000, 68,000 to 62,000 and 46,000 BP), joining Tasmania with mainland Australia (Lambeck and Chappell, 2001, pp. 684–5).

During the last glacial maximum (LGM) c. 20–25,000 BP, glacial conditions seen elsewhere in the world (e.g., New Zealand and Chile) translated into extreme arid conditions throughout Australia (Bowler *et al.*, 1976; Bowler, 2009), with a concomitant expansion of dune fields (de Deckker, 2001). It is therefore likely that the sand plains and dunes of the region were reworked during this dry period; throughout Australia there is also little evidence for swamp or bog communities during the height of the glacial period. However, geomorphological evidence from archaeological excavations conducted at Bend Road (Dandenong South) indicates that wetland areas did exist in parts of Victoria during the Pleistocene (Kershaw, 1995, p. 664; Joyce *et al.*, 2003, p. 556; Hewitt and De Lange, 2007, p. 124). However, there would probably have been periods of stability when wetter and less windy conditions permitted vegetation to colonise the dunes, thus affording Aboriginal peoples opportunities to exploit otherwise impermissive settings (Ellender, Luebbers and Bowler, 2009, p. 101). The earliest occupation at Bend Road is dated to 30–35,000 BP, although it has been argued that this date range is unexceptional (Hewitt and Allen, 2010, p. 13) given the presence of Pleistocene dated sites elsewhere in the Victoria (Ossa, Marshall and Webb, 1995; Bird, Frankel and van Waarden, 1998; Cupper, White and L. Neilson, 2003; Rhodes, 2004; Richards *et al.*, 2007). This is suggestive of human occupation prior to the period of maximum aridity c. 25–20,000 BP. It is therefore feasible that given the assumed but comparable age of the sand sheet observed at Westernport Road that there exists the potential for evidence of very old human occupation at the site.

By the Late Pleistocene and Early Holocene, the environment had become less arid and more conducive to human occupation. The late glacial and Pleistocene-Holocene boundary was however a period of rapid environmental transformation with several climatic reversals (such as the younger Dryas c.11,000–10,000 BP) and changes in vegetation cover, with 12,000–9,000 BP witnessing the greatest change in pollen assemblages (Kershaw 1995). It can be said with confidence that by the time of the mid-Holocene Aboriginal occupation within the region was firmly established, as indicated by the prevalence of the Australian Small Tool Tradition (small stone artefacts utilised in the manufacture of multi-component tools, such as spears) on many intensively occupied sites within the region which are chronologically aligned with mid-Holocene deposits.

A review of Aboriginal Places located within the broader geographic region shows that stone artefact scatters are commonly associated with high points within the landscape, although they are not solely limited to sandy rises. It can be concluded that sandy rises and high points would have

been utilised as lookouts, camp sites and routes through the landscape when traversing from north to south along the coast of Western Port Bay and the margins of Koo Wee Rup Swamp to the north and east

Therefore, it is probable that any Aboriginal occupation present at Westernport Road relates to a similar pattern of mid-Holocene occupation which focused on wetland margins and sandy ridgelines seen elsewhere in the region. However, the possibility of older phases of Aboriginal occupation at Westernport Road is also feasible.

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Appendix D:
Biodiversity Assessment

Final Report

Biodiversity Assessment for proposed expansion to the Yannathan Sand Quarry: 870 and 910 Western Port Road, Yannathan, Victoria

Prepared for

Ricardo Energy Environment and Planning

September 2022

Ecology and Heritage Partners Pty Ltd

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DOCUMENT CONTROL

Assessment type	Biodiversity Assessment for proposed expansion to the Yannathan Sand Quarry
Address	870 and 910 Western Port Road, Yannathan, Victoria
Project number	14023
Project manager	Claire Ranyard (Senior Botanist)
Report reviewer	Shannon LeBel (Geelong Resource Manager / Associate Ecologist)
Other EHP staff	Nerissa Crabbe (Botanist); Anneke Martin (Consultant Botanist)
Mapping	Dr Monique Elsley (GIS Coordinator)
File name	14023_EHP_BA_YannathanQuarryExpansion_Final_16092022
Client	Ricardo Energy Environment and Planning
Bioregion	Gippsland Plain
Catchment Management Authority	Port Phillip and Westernport
Council	Cardinia Shire Council

VERSION CONTROL

Report versions	Comments	Comments made by:	Date submitted
Draft	Report sent to client for review	-	23/02/2021
Preliminary Final	Updated impact footprint, reassessment of significant flora and fauna under updated FFG Act, updated Avoid and Minimise statement, updated offset register search statement, and reference updates.	SLB/AM	06/09/2022
Final	Minor grammatical updates. Amended watercourse realignment shown.	SLB	16/09/2022

SUMMARY

Introduction

Ecology and Heritage Partners Pty Ltd was commissioned by Ricardo Energy Environment and Planning to conduct an Ecological Assessment of the proposed extension to the Yannathan Sand Quarry.

This assessment was undertaken to identify and characterise the vegetation on-site, determine the presence (or likelihood thereof) of any significant flora and fauna species and/or ecological communities, and address any implications under Commonwealth and State environmental legislation.

Methods

A field assessment was undertaken on 17 December 2020 to obtain information on terrestrial flora and fauna values within the study area. Vegetation within the study area was assessed according to the habitat hectare methodology, which is described in the Vegetation Quality Assessment Manual.

Results

Flora

Thirty flora species (13 native and 17 non-native) were recorded within the study area during the field assessment. Two flora species listed as protected under the *Flora and Fauna Guarantee Act 1988* were present within the study area. No additional significant flora species were recorded in the study area. Based on the highly modified nature of the study area, historical and ongoing land-uses, landscape context and the proximity of previous records, significant flora species are considered unlikely to occur within the study area due to the absence of suitable habitat and high levels of disturbance.

Fauna

No significant fauna species are considered likely to occur within the study area, due to the lack of suitable habitat features (e.g. wetlands, structurally diverse vegetation, hollow bearing trees), and modified state of the study area through previous removal of vegetation for agricultural use and construction of two large water retention basins.

Communities

Vegetation within the study area did not meet the condition thresholds that define any significant ecological communities.

Removal of native vegetation (the Guidelines)

The naturally established patches of Swampy Riparian Woodland shown on Figure 2 are not included in the impact assessment, due to being classified as 'regrowth' which has naturally established on the land within the last ten years.

The vegetation proposed to be removed is within Location 2, with one Large scattered tree (with an extent of 0.0703 hectares) proposed to be removed. As such, the permit application falls under the Intermediate Assessment pathway.

The offset requirement for native vegetation removal is 0.015 General Habitat Units (HUs) and one Large Tree.

Legislative and Policy Implications

Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act - Federal)

No nationally significant values were recorded within the study area or are considered likely to occur, and the proposed action is unlikely to have a significant impact on any matter of NES. As such, a referral to the Commonwealth Environment Minister is not required regarding matters listed under the EPBC Act.

Flora and Fauna Guarantee Act 1988 (FFG Act - Victoria)

Two species listed as protected under the FFG Act were recorded within the study area, Prickly Moses *Acacia verticillata* and Shiny Cassinia *Cassinia longifolia*. A total of two Prickly Moses and approximately 15 Shiny Cassinia are proposed to be removed. The study area occurs within private property, therefore a permit under the FFG Act will not be required for the removal of these species.

Mineral Resources (Sustainable Development) Act 1990 (MRSD Act)

A work plan variation will need to be prepared as the proposed development does not meet any of the exemptions listed under the Act. In order for a Work Plan to be approved, the relevant State Government departments must be satisfied of "all necessary planning consents and approvals" including where Victoria's native vegetation policy requires action has been addressed.

Planning and Environment Act 1987

The clearing of native vegetation for extractive industries is exempt from the requirement for a planning permit subject to an assessment as part of the work plan approval process.

Other Legislation and Policy

Implications relating to other local and State policy (*Wildlife Act 1975*, *Catchment and Land Protection Act 1994*, local government authorities) as well as additional studies or reporting that may be required (Conservation Management Plan, Weed Management Plan, Construction Environment Managements Plan) are provided in Section 4.

CONTENTS

1 INTRODUCTION

1.1 Background

Ecology and Heritage Partners Pty Ltd was commissioned by Ricardo Energy Environment and Planning on behalf of Hanson Construction Materials Pty Ltd (Hanson)to undertake a Biodiversity Assessment for proposed expansion to the Yannathan Sand Quarry at 870 and 910 Western Port Road, Yannathan, Victoria.

We understand that Hanson plan to extend the sand quarry extraction area boundary beyond the current Work Plan and realign the existing watercourse. As such, the Work Plan Variation requires an updated ecological assessment corresponding to the proposed extraction areas and watercourse.

The purpose of the assessment was to identify the extent and type of native vegetation present within the study area and to determine the presence of significant flora and fauna species and/or ecological communities. This report presents the results of the assessment and discusses the potential ecological and legislative implications associated with the proposed action. The report also provides recommendations to address or reduce impacts and, where necessary, highlights components that require further investigation.

1.2 Study Area

The study area is located in the north western section of 870 and 910 Western Port Road, Yannathan and is approximately 80 kilometres south-east of Melbourne's CBD (Figure 1). The study area covers approximately 23 hectares and is bound by the existing quarry along the southern boundary, Milners Road to the west, Western Port Road to the north, and agricultural land to the east. Past land use within the study area has historically been used for grazing activities and predominantly cleared of native vegetation (Plate 1).

In addition to grazing land, the study area supports four water retention basins, existing buildings, laydown areas, the main access road into the quarry and grazing land (Plate 2). It is generally flat, with no ridges, crests within or immediately adjacent to the site. A minor drainage line is present within the study area, running east to west through the middle of the site, which is proposed to be realigned.

For the purposes of this assessment, the proposed 'extension area' and 'realigned watercourse' areas (as shown in Figure 2) were subject to the on-ground assessment.

According to the Department of Environment, Land, Water and Planning (DELWP) NatureKit Map (DELWP 2022a), the study area is located within the Gippsland Plain bioregion, Port Phillip and Westernport Catchment Management Authority (CMA) and Cardinia Shire Council.

2 METHODS

2.1 Desktop Assessment

Relevant literature, online-resources and databases were reviewed to provide an assessment of flora and fauna values associated with the study area. The following information sources were reviewed:

- The DELWP NatureKit Map (DELWP 2022a) and Native Vegetation Information Management (NVIM) Tool (DELWP 2022b) for:
    - Modelled data for location risk, native vegetation patches, scattered trees and habitat for rare or threatened species; and,
    - The extent of historic and current Ecological Vegetation Classes (EVCs).
- EVC benchmarks (DELWP 2022c) for descriptions of EVCs within the relevant bioregion;
- The Victorian Biodiversity Atlas (VBA) for previously documented flora and fauna records within the project locality (DELWP 2022d);
- The Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) Protected Matters Search Tool (PMST) for matters of National Environmental Significance (NES) protected under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (DCCEEW 2022);
- Relevant listings under the Victorian *Flora and Fauna Guarantee Act 1988* (FFG Act), including the latest Threatened (DELWP 2022e) and Protected (DELWP 2019) Lists;
- The online VicPlan Map (DELWP 2022f) to ascertain current zoning and environmental overlays in the study area;
- Aerial photography of the study area; and
- Previous ecological assessments relevant to the study area; including;
    - Flora and Fauna Assessment and Net Gain Analysis of the Proposed Expansion of the Hanson Yannathan San Extraction Quarry, Victoria. Ecology and Heritage Partners 2013.

2.2 Field Assessment

A field assessment was undertaken on 17 December 2020 to obtain information on flora and fauna values within the study area. The study area was walked, with all commonly observed vascular flora and fauna species recorded, significant records mapped and the overall condition of vegetation and habitats noted. Ecological Vegetation Classes (EVCs) were determined with reference to DELWP pre-1750 and extant EVC mapping (DELWP 2022a) and their published descriptions (DELWP 2022c).

Plate 1. Previously disturbed agricultural land within the study area.

Plate 2. Water retention dams within the study area.

2.3 Removal, Destruction or Lopping of Native Vegetation (the Guidelines)

The clearing of native vegetation for mining and extractive industries is exempt from the requirement for a planning permit under the *Planning and Environment Act 1987* subject to an assessment as part of the work plan approval process required under the *Mineral Resources (Sustainable Development) Act 1990* (MRSD Act). The removal of native vegetation for the Earth Resources Industry (ERI) is regulated through the Mining and Extractive Industry Work Approvals Process. A Memorandum of Understanding (MoU) between the former DSE and DPI recognises that native vegetation should be offset in accordance with the relevant legislation.

Further information regarding the legislative requirements are provided in Section 4.

2.3.1 Assessment Pathway

The Guidelines manage the impacts on biodiversity from native vegetation removal using an assessment-based approach. Two factors – extent risk and location category – are used to determine the assessment pathway. The location category (1, 2 or 3) has been determined for all areas in Victoria and is available on DELWP's NVIM Tool (DELWP 2022b). Determination of assessment pathway is summarised in Table 1.

Table 1. Assessment pathways for applications to remove, destroy or lop native vegetation (DELWP 2017).

Extent		Location		
		1	2	3
Native Vegetation	Less than 0.5 hectares and not including any large trees	Basic	Intermediate	Detailed
	Less than 0.5 hectares and including one or more large trees	Intermediate	Intermediate	Detailed
	0.5 hectares or more	Detailed	Detailed	Detailed

Notes: For the purpose of determining the assessment pathway of an application to remove native vegetation the extent includes any other native vegetation that was permitted to be removed on the same contiguous parcel of land with the same ownership as the native vegetation to be removed, where the removal occurred in the five year period before an application to remove native vegetation is lodged.

2.3.2 *Vegetation Assessment*

Native vegetation (as defined in Table 2) is assessed using two key parameters: extent (in hectares) and condition. For the purposes of this assessment, both condition and extent were determined as part of the habitat hectare assessment.

Table 2. Determination of a patch of native vegetation (DELWP 2017).

Category	Definition	Extent	Condition
Patch of native vegetation	An area of vegetation where at least 25 per cent of the total perennial understorey plant cover is native; OR An area with three or more native canopy trees where the drip line of each tree touches the drip line of at least one other tree, forming a continuous canopy; OR any mapped wetland included in the *Current Wetlands map*, available in DELWP systems and tools.	Measured in hectares. Based on hectare area of the native patch.	Vegetation Quality Assessment Manual (DSE 2004). Modelled condition for *Current Wetlands*.
Scattered tree	A native canopy tree that does not form part of a native patch.	Measured in hectares. Each Large scattered tree is assigned an extent of 0.071 hectares (30m diameter). Each Small scattered tree is assigned a default extent of 0.31 hectares (10 metre diameter)	Scattered trees are assigned a default condition score of 0.2 (outside a patch).

Notes: Native vegetation is defined in the Victoria Planning Provisions as 'plants that are indigenous to Victoria, including trees, shrubs, herbs and grasses'.

2.3.3 *Impact Avoidance and Minimisation*

All applications to remove native vegetation must demonstrate the three-step approach of avoid, minimise and offset. This is a precautionary approach that aims to ensure that the removal of native vegetation is restricted to what is reasonably necessary, and that biodiversity is appropriately compensated for any native vegetation removal that is approved.

2.3.4 *Offsets*

Biodiversity offsets are required to compensate for the permitted removal of native vegetation. Offset obligations and offset site criteria are determined in accordance with the Guidelines (DELWP 2017) and are divided into two categories, being General Habitat Units and Species Habitat Units.

The offset requirements for native vegetation removal are calculated by DELWP and presented in a Native Vegetation Removal (NVR) Report, which are based on the vegetation condition scores determined during the biodiversity assessment.

2.4 Assessment Qualifications and Limitations

This report has been written based on the quality and extent of the ecological values and habitat considered to be present or absent at the time of the desktop and/or field assessments being undertaken.

The 'snapshot' nature of a standard biodiversity assessment meant that migratory, transitory or uncommon fauna species may have been absent from typically occupied habitats at the time of the field assessment. In addition, annual or cryptic flora species such as those that persist via underground tubers may also be absent.

A comprehensive list of all terrestrial flora and fauna present within the study area was not undertaken as this was not the objective of the assessment. Rather a list of commonly observed species was recorded to assist in determining the broader biodiversity values present within the study area.

Ecological values identified within the study area were recorded using a hand-held GPS or tablet with an accuracy of +/-3 metres. This level of accuracy is considered to provide an accurate assessment of the ecological values present within the study area; however, this data should not be used for detailed surveying purposes.

Targeted flora or fauna surveys were not undertaken, as this was beyond the preliminary scope of the project. Nevertheless, the terrestrial flora and fauna data collected during the field assessment and information obtained from relevant desktop sources is considered to adequately inform an accurate assessment of the ecological values present within the study area.

3 RESULTS

3.1 Vegetation Condition

Several patches of native vegetation, regrowth and one scattered native tree were recorded within the study area. The remainder of the study area comprised introduced and planted vegetation, present as pasture grass and screen plantings around buildings and along the property boundary.

A list of all flora species recorded during the field assessment are provided in Appendix 1.1.

3.1.1 Patches of Native Vegetation

Native vegetation in the study area is representative of one EVC: Swampy Riparian Woodland (EVC 83). The presence of this EVC is generally consistent with the modelled pre-1750s native vegetation mapping (DELWP 2022a), however the vegetation comprised within the patches has naturally regrown since the previous assessment undertaken in 2013 (Ecology and Heritage Partners 2013). Specific details relating to the observed EVC is provided below.

The results of the habitat hectare assessment are provided in Appendix 1.2.

Swampy Riparian Woodland

Swampy Riparian Woodland (SRW) was recorded within and directly adjacent to the study area, present in varying conditions. A linear strip of SRW was recorded adjacent to the western boundary of the study area, containing several large trees and an understory dominated by Swamp Paperbark *Melaleuca ericifolia* (SRW1, Figure 2). This patch is considered to be remnant

Within the study area, SRW occurred as naturally established (regrowth) vegetation. Previous vegetation mapping of the study area did not record any patches of SRW within the current study area (Ecology and Heritage Partners 2013), which is consistent with the historical imagery for the study area. The patches of SRW mapped in the recent assessment primarily comprised of scattered understory species, such as Shiny Cassinia *Cassinia longifolia*, Prickly Moses *Acacia verticillata,* Prickly Tea-tree *Leptospermum continentale* and Blackwood *Acacia melanoxylon* (SRW2, SRW3, SRW4, SRW5, SRW6, SRW 9, SRW10, SRW11, SRW12, SRW13, Figure 2*),* or patches of Common *Reed Phragmites australis,* Pale Rush *Juncus pallidus* and Tall Spike-rush *Eleocharis sphacelata* (SRW7 [Plate 3]; SRW8 [Plate 4], Figure 2). No patches contained large trees, supporting the conclusion that they have naturally established since the previous assessment was undertaken.

3.1.2 Large Trees in Patches

Five Large Trees, comprising four Swamp Gums *Eucalyptus ovata* and one stag, were recorded in the Swampy Riparian Woodland patch located along the western boundary of the study area (Plate 5; Figure 2).

3.1.3 Scattered Trees

One scattered tree, a large Swamp Gum, was recorded within the study area (Plate 6; Figure 2).

Plate 3. Patch of Rush establishment along the modified drainage line within the study area.

Plate 4. Patch of Tall Spike-rush establishment along the modified drainage line within the study area.

Plate 5. Large tree in a Swampy Riparian Woodland patch along the western boundary of the study area.

Plate 6. A large scattered Swamp Gum present in the north western corner of the study area.

3.1.4 Introduced and Planted Vegetation

Areas not supporting native vegetation had a high cover (>95%) of exotic grass species, dominated by environmental weeds such as Rye-grass *Lolium* spp., Sweet Vernal-grass *Anthoxanthum odoratum*, Yorkshire Fog *Holcus lanatus*, Brown-top Bent *Agrostis capillaris* and Prairie Grass *Bromus catharticus*.

Planted species occurred throughout the study area, with a selection of mixed native shrub species planted around the site office, containing Black Sheoak *Allocasuarina littoralis*, Prickly Tea-tree, Swamp Paperbark *Melaleuca ericifolia* and Blackwood. The location of planted vegetation is shown on Figure 2, which is mainly located on bund walls surrounding the outer edge of the western and northern side of the current study area (Plate 7).

Noxious weeds were present within the study area, with Blackberry *Rubus fruticosus* spp. agg. mainly located along the dam fringes and Spear Thistle *Cirsium vulgare* present in limited numbers within the study area's southern half (Plate 8; Figure 2). Blackberry is also a Weed of National Significance (WoNS).

Plate 7. A row of planted trees along the study area's western boundary.

Plate 8. A noxious weed, Spear Thistle, present along the dam edge within the study area.

3.2 Fauna Habitat

Most of the study area consisted of paddocks and existing dams, which contained improved exotic pastures, likely to be used as a foraging resource by common generalist bird species that are tolerant of modified open areas. Fauna observed using this habitat included; Pacific Black Duck *Anas superciliosa*, Australian Magpie *Cracticus tibicen*, Common Blackbird *Turdus merula*, Welcome Swallow *Hirundo neoxenica* and Eastern Banjo Frog *Limnodynastes dumerilii.*

It should be noted that since the assessment was undertaken, the two dams present within the proposed extension area have been removed as per a directive from Earth Resources Regulations (ERR), and aquatic habitat is no longer present.

3.3 Removal, Destruction or Lopping of Native Vegetation (the Guidelines)

The below clearing scenario is based on the removal of native vegetation present within the current study area, as provided by Ricardo Energy Environment and Planning on 25 August 2022 (Figure 2). The naturally established patches of Swampy Riparian Woodland shown on Figure 2 are not included in the below assessment due to being classified as regrowth which has naturally established on the land within the last ten years (See Section 4.3.2 for further details). This includes 0.73 hectares of naturally established Swampy Riparian Woodland within the proposed extension area.

3.3.1 Vegetation proposed to be removed

The study area is within Location 2, with 0.0703 hectares of native vegetation proposed to be removed (Figure 2). As such, the permit application falls under the Intermediate assessment pathway (Table 3).

Table 3. Removal of Native Vegetation (the Guidelines) (DELWP 2017).

Assessment pathway	Intermediate
Location Category	2
Total Extent (past and proposed) (ha)	0.0703
Extent of past removal (ha)	0.00
Extent of proposed removal (ha)	0.0703
Large Trees (scattered and in patches) to be removed (no.)	1
EVC Conservation Status of vegetation to be removed	Endangered (Swampy Riparian Woodland)

3.3.2 Offset Targets

The offset requirement for native vegetation removal is 0.015 General Habitat Units and 1 Large Tree.

A summary of proposed vegetation losses and associated offset requirements is presented in Table 4 and the Native Vegetation Removal (NVR) report is presented in Appendix 3.

Table 4. Offset Targets.

General Offsets Required	0.015 General Habitat Units
Large Trees	1
Vicinity (catchment/council)	Port Phillip and Westernport CMA / Cardinia Shire Council
Minimum Strategic Biodiversity Value*	0.352

*The minimum Strategic Biodiversity Value is 80% of the weighted average score across habitat zones where a General offset is required.

3.4 Significance Assessment

3.4.1 Flora

The VBA contains records of one nationally significant and nine State significant flora species previously recorded within 10 kilometres of the study area (DELWP 2022d) (Figure 3). The PMST nominated 12 additional nationally significant species which have not been previously recorded but have the potential to occur in the locality (DCCEEW 2022) (Appendix 1.4).

No national or State significant flora were recorded during the site assessment, and based on the highly modified and disturbed condition of the study area, landscape context and the proximity of previous records, significant flora species are considered unlikely to occur within the study area due to the and high levels of disturbance through past agricultural activities (e.g. pasture paddocks), construction of two large water retention dams and absence of suitable habitat.

3.4.2 Fauna

The VBA contains records of 11 nationally significant and 12 State significant fauna species previously recorded within 10 kilometres of the study area (DELWP 2022d) (Figure 4). The PMST nominated an additional 19 nationally significant species which have not been previously recorded but have the potential to occur in the locality (DCCEEW 2022) (Appendix 2.1).

There are 155 previous records of Southern Brown Bandicoot *Isoodon obesulus* within 10 kilometres of the study area (Figure 4; Appendix 2.1). The habitat preferences of Southern Brown Bandicoot are relatively broad, with the species known to occur in a variety of habitats, including seemingly disturbed areas dominated by exotic species (e.g. Blackberry *Rubus* spp.) (Maclagan *et al.* 2018).

However, the vegetation within the proposed extraction extension footprint did not contain any of the preferred habitat characteristics of Southern Brown Bandicoot, with a lack of structural vegetation (e.g. shrubs or large tussocks). Further, the study area is relatively isolated from nearby habitat corridors. As a result, Southern Brown Bandicoot are considered unlikely to occur within the expansion footprint or use the vegetation within the extraction footprint as a habitat corridor to traverse between other habitats. Linear corridors of vegetation are present surrounding the study area within the road reserves of Milners Road and Burt Road, however no impacts are proposed to these areas.

The nearby past Southern Brown Bandicoot records are largely confined to Adams Creek Nature Conservation Reserve, which is a large bushland reserve located approximately six kilometres south of the study area (Figure 4).

Based on the modified nature of the study area, the removal of the dams (as per an ERR directive), landscape context and the proximity of previous records, additional significant fauna species are considered unlikely to rely on habitat within the study area for foraging or breeding purposes due to the lack of suitable and/or important habitat features (e.g. large, hollow bearing trees).

3.4.3 Ecological Communities

No national or State-significant communities are present within the study area.

4 LEGISLATIVE AND POLICY IMPLICATIONS

4.1 *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) establishes a Commonwealth process for the assessment of proposed actions likely to have a significant impact on any matters of National Environment Significance (NES), described in Table 5.

Table 5. Potential impacts to matters of National Environmental Significance (NES)

Matter of NES	Potential Impacts
World Heritage properties	The proposed action will not impact any properties listed for World Heritage.
National heritage places	The proposed action will not impact any places listed for national heritage.
Ramsar wetlands of international significance	The study area occurs upstream of one Ramsar wetland (DCCEEW 2022): Westernport Ramsar site (10 – 15 kms) Provided management practices and construction techniques are consistent with Construction Techniques for Sediment Pollution Control (EPA 1991) and Environmental Guidelines for Major Construction Sites (EPA 1996), the proposed action is highly unlikely to impact the ecological character of any Ramsar wetland.
Threatened species and ecological communities	No nationally significant flora species were recorded within the study area.
Migratory and marine species	There is no marine habitat within the study area. Further, the study area would not be classed as an 'important habitat' as defined under the EPBC Act Policy Statement 1.1 Principal Significant Impact Guidelines (DoE 2013), in that it does not contain: • Habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species; • Habitat utilised by a migratory species which is at the limit of the species range; or, • Habitat within an area where the species is declining.
Commonwealth marine area	The proposed action will not impact any Commonwealth marine areas.
Nuclear actions (including uranium mining)	The proposed action is not a nuclear action.
Great Barrier Reef Marine Park	The proposed action will not impact the Great Barrier Reef Marine Park.
Water resources impacted by coal seam gas or mining development	The proposed action is not a coal seam gas or mining development.

4.1.1 *Implications*

No nationally significant values were recorded within the study area or are considered likely to occur, and the proposed action is highly unlikely to have a significant impact on any matter of NES. As such, a referral to the Commonwealth Environment Minister is not required regarding matters listed under the EPBC Act.

4.2 *Flora and Fauna Guarantee Act 1988* (Victoria)

The FFG Act is the primary legislation dealing with biodiversity conservation and sustainable use of native flora and fauna in Victoria. Proponents are required to apply for an FFG Act Permit to 'take' listed and/or protected flora species, listed vegetation communities and listed fish species in areas of public land (i.e. within road reserves, drainage lines and public reserves). An FFG Act permit is generally not required for removal of species or communities on private land, or for the removal of habitat for a listed terrestrial fauna species.

No species listed under the FFG Act were recorded within the study area during the field assessment. The following threatening processes listed under the FFG Act should be considered in relation to the proposed development:

- Invasion of native vegetation by 'environmental weeds'.
- Alteration to the natural flow regimes of rivers and streams.

4.2.1 Implications

Two species listed as protected under the FFG Act were recorded within the study area, Prickly Moses and Shiny Cassinia. A total of two Prickly Moses and approximately 15 Shiny Cassinia are proposed to be removed. The study area occurs within private property, therefore a permit under the FFG Act will not be required for the removal of these species.

4.3 *Planning and Environment Act 1987* (Victoria)

The *Planning and Environment Act 1987* outlines the legislative framework for planning in Victoria and for the development and administration of planning schemes. All planning schemes contain native vegetation provisions at Clause 52.17 which require a planning permit from the relevant local Council to remove, destroy or lop native vegetation on a site of more than 0.4 ha, unless an exemption under Clause 52.17-7 of the Victorian Planning Schemes applies.

Importantly, under the exemptions outlined in Clause 52.17-7 of the Cardinia Shire Planning Scheme, a permit is not required where native vegetation that is to be removed, destroyed or lopped to the minimum extent necessary to enable the carrying out of extractive industry in accordance with a work plan approved under the *Mineral Resources (Sustainable Development) Act 1990* and authorised by a work authority under that Act.

4.3.1 Local Planning Scheme

The study area is located within the Cardinia Shire Council. The study area is zoned Green Wedge Zone 1 (GWZ 1) and is covered by a Significant Landscape Overlay – Schedule 3 (SLO3) (DELWP 2022f).

4.3.2 Implications

Extractive Industry

The clearing of native vegetation for mining and extractive industries is exempt from the requirement for a planning permit subject under the 'Stone Extraction' exemption detailed in Clause 52.17-7 of the Cardinia Shire Planning Scheme subject to an assessment as part of the work plan approval process (MRSD Act).

Regrowth

No permit is required to remove, destroy or lop native vegetation that has naturally established or regenerated on land lawfully cleared of naturally established native vegetation, and is less than 10 years old.

The native vegetation within the current proposed extraction footprint was previously assessed in 2013, which did not record any patches of Swampy Riparian Woodland at the time. The initial vegetation clearing of the property occurred prior to 1995 (when Hanson purchased the land), with the previous land use as agriculture, and the vegetation with the study area maintained as cleared land through regular slashing (pers. comm. Yannathan Quarry Manager).

Based upon the vegetation mapping completed in 2013 (Ecology and Heritage Partners 2013), historical land use of the study area and a review of the aerial imagery, it is considered that the SRW patches within the 'extension area' have naturally regenerated on land lawfully cleared of naturally established native vegetation, and is less than 10 years old, and therefore meets the definition of 'regrowth' as per Clause 52.17-7 of the Cardinia Shire planning scheme. As such, these areas have been excluded from the native vegetation impact assessment detailed in Section 3.3.

Significant Landscape Overlay – Schedule 3

No permit under the SLO is required for vegetation that is to be removed, destroyed or lopped to the minimum extent necessary to enable the carrying out of extractive industry in accordance with a work plan approved under the *Mineral Resources (Sustainable Development) Act 1990* and authorised by a work authority granted under that Act.

4.4 *Mineral Resources (Sustainable Development) Act 1990* (Victoria)

Mineral exploration and mining in Victoria are regulated under the *Mineral Resources (Sustainable Development) Act 1990* (MRSD Act). The purpose of this Act is to encourage an economically viable mining industry that operates in a way that is compatible with the environmental, social and economic objectives of the State.

One of the key objectives of this legislation is to establish a legal framework to ensure that mineral resources are developed in ways that minimise the impacts on the environment. The Act requires that a licensee proposing to work under a mining licence submit a Work Plan.

Section 79 of the Act requires that the Work Plan includes a 'Rehabilitation Plan' for the progressive rehabilitation of land disturbed by the project.

The 'Mineral Resources (Sustainable Development) (Mineral Industries) Regulations 2019' require that, as of 1 July 2020, the Rehabilitation Plan component of the draft mining Work Plan must include the proposed land uses after rehabilitation, which must consider the community views expressed during consultation.

The Regulations also require that the draft mining Work Plan must include an identification and assessment of the risks that may require monitoring, maintenance, treatment or other ongoing land management activities after rehabilitation is complete, in relation to the environment, any member of the public, or land, property or infrastructure in the vicinity of the rehabilitated land.

4.4.1 *Implications*

In order for a Work Plan to be approved, DELWP and the Department of Jobs, Precincts and Regions (DJPR) must be satisfied of "all necessary planning consents and approvals" including where Victoria's native vegetation policy requires action, has been addressed (DPI 2009).

4.4.2 *The Guidelines*

The State Planning Policy Framework and the decision guidelines at Clause 12.01 Biodiversity and Clause 52.17 Native Vegetation require Planning and Responsible Authorities to have regard for the Guidelines (DELWP 2017).

The vegetation proposed to be removed is within Location 2, with one Large scattered tree (with an extent of 0.0703 hectares) proposed to be removed. As such, the permit application falls under the Intermediate Assessment pathway.

The offset requirement for native vegetation removal is 0.015 General Habitat Units (HUs) and one Large Tree.

4.5 *Catchment and Land Protection Act 1994* (Victoria)

Two weeds listed as noxious under the *Catchment and Land Protection Act 1994* was recorded during the assessment, Blackberry and Spear Thistle (Figure 2). Similarly, there is evidence that the study area is currently occupied by several pest fauna species listed under the CaLP Act, European Rabbit *Oryctolagus cuniculus*, Red Fox *Vulpes vulpes*. Listed noxious weeds/pests should be appropriately controlled throughout the study area.

4.6 *Wildlife Act 1975* and Wildlife Regulations 2013 (Victoria)

The *Wildlife Act 1975* (and associated Wildlife Regulations 2013) is the primary legislation in Victoria providing for protection and management of wildlife. Authorisation for habitat removal may be obtained under the *Wildlife Act 1975* through a licence granted under the *Forests Act 1958*, or under any other Act such as the *Planning and Environment Act 1987*. Any persons engaged to remove, salvage, hold or relocate native fauna during construction must hold a current Management Authorisation under the *Wildlife Act 1975*, issued by DELWP.

5 MITIGATION MEASURES

5.1 Avoid and Minimise Statement

The study area has not been subject to a strategic level planning process for the purposes of detailing native vegetation removal. However, the study area is within covered by the Cardinia Western Port green Wedge Management Plan (Cardinia Shire Council 2017).

It is not possible to avoid impacts to native vegetation without undermining the requirements of the project. Due to the nature of the proposed development (extractive industry) and the location of the resource in the ground, the extraction footprint is proposed to extend north from the existing extraction pit.

The extent of native vegetation within the study area is minimal, and predominately comprises of low quality vegetation which has re-established over the past ten years. One large native scattered tree is located in the north western corner. When identified during the site assessment, the tree was observed partially lying down, likely to have fallen during strong winds over the previous years, although still appeared to be surviving (Section 3.1.3, Plate 5).

In the context of the development, the modified condition of ecological values proposed to be impacted, and the extent of native vegetation proposed to be retained and enhanced within the study area, it is considered that the minimisation measures implemented are appropriate in this instance.

No feasible opportunities exist to further avoid or minimise impacts on native vegetation without undermining the key objectives of the proposal

5.2 Best Practice Mitigation Measures

Recommended measures to mitigate impacts upon terrestrial and aquatic values present within the study area may include:

- Ensuring any proposed works remain within the intended extraction (and greater development) footprint, i.e. not disturbing or removing areas of native vegetation outside the proposed works area. This also applies to machinery storage, materials stockpiles, personnel rest areas and access roads;
- Minimise impacts to native vegetation and habitats through construction and micro-siting techniques, including fencing retained areas of native vegetation. If indeed necessary, trees should be lopped or trimmed rather than removed. Similarly, soil disturbance and sedimentation within wetlands should be avoided or kept to a minimum, to avoid, or minimise impacts to fauna habitats;
- All contractors should be aware of ecologically sensitive areas to minimise the likelihood of inadvertent disturbance to areas marked for retention. Native vegetation (areas of sensitivity) should be included as a mapping overlay on any construction plans;
- Where possible, construction stockpiles, machinery, roads, and other infrastructure should be placed away from areas supporting native vegetation and wetlands;
- Ensure that best practice sedimentation and pollution control measures are undertaken at all times, in accordance with Environment Protection Authority guidelines (EPA 1991; EPA 1996; Victorian Stormwater Committee 1999) to prevent offsite impacts to waterways and wetlands; and,

- As indigenous flora provides valuable habitat for indigenous fauna, it is recommended that any landscape plantings that are undertaken as part of the proposed works are conducted using indigenous species sourced from a local provenance, rather than exotic deciduous trees and shrubs.

5.3 Offset Impacts and Strategy

According to DELWPs Native Vegetation Offset Register (DELWP 2022g), there are 23 offset sites within the Port Phillip and Westernport CMA and/or Cardinia Shire Council region that can be used to satisfy the General Habitat Unit and Large tree offset requirements.

An offset register search statement identifying the relevant offsite sites is provided in Appendix 4.

6 FURTHER REQUIREMENTS

Further requirements associated with development of the study area, as well as additional studies or reporting that may be required, are provided in Table 6.

Table 6. Further requirements associated with development of the study area.

Relevant Legislation	Implications	Further Action
Environment Protection and Biodiversity Conservation Act 1999	No nationally significant values were recorded within the study area or are considered likely to occur, and the proposed action is unlikely to have a significant impact on any matter of NES. As such, a referral to the Commonwealth Environment Minister is not required regarding matters listed under the EPBC Act.	No further action required.
Flora and Fauna Guarantee Act 1988	Two species listed as protected under the FFG Act were recorded within the study area, Prickly Moses and Shiny Cassinia. A total of two Prickly Moses and approximately 15 Shiny Cassinia are proposed to be removed. The study area occurs within private property, therefore a permit under the FFG Act will not be required for the removal of these species.	No further action required.
Mining Resources (Sustainable Development) Act 1990	A Work Plan variation will need to be updated in order to comply with the requirements of the MRSD Act. The offset requirement for native vegetation removal is 0.015 General Habitat Units and 1 Large Tree.	Prepare and submit a variation to the Work Plan.
Planning and Environment Act 1987	The clearing of native vegetation for mining and extractive industries is exempt from the requirement for a planning permit subject under the 'Stone Extraction' exemption detailed in Clause 52.17-7, and Clause 42.03 (SLO) of the Cardinia Shire Council planning scheme subject to an assessment as part of the work plan approval process (MRSD Act).	No further action required (for native vegetation removal).
Catchment and Land Protection Act 1994	Two weed species listed under the CaLP Act were recorded within the study area (Blackberry and Spear Thistle). To meet requirements under the CaLP Act, listed noxious weeds should be appropriately controlled throughout the study area.	Listed noxious weeds and pests should be appropriately controlled throughout the study area
Wildlife Act 1975	Any persons engaged to conduct salvage and translocation or general handling of terrestrial fauna species must hold a current Management Authorisation.	Ensure wildlife specialists hold a current Management Authorisation.

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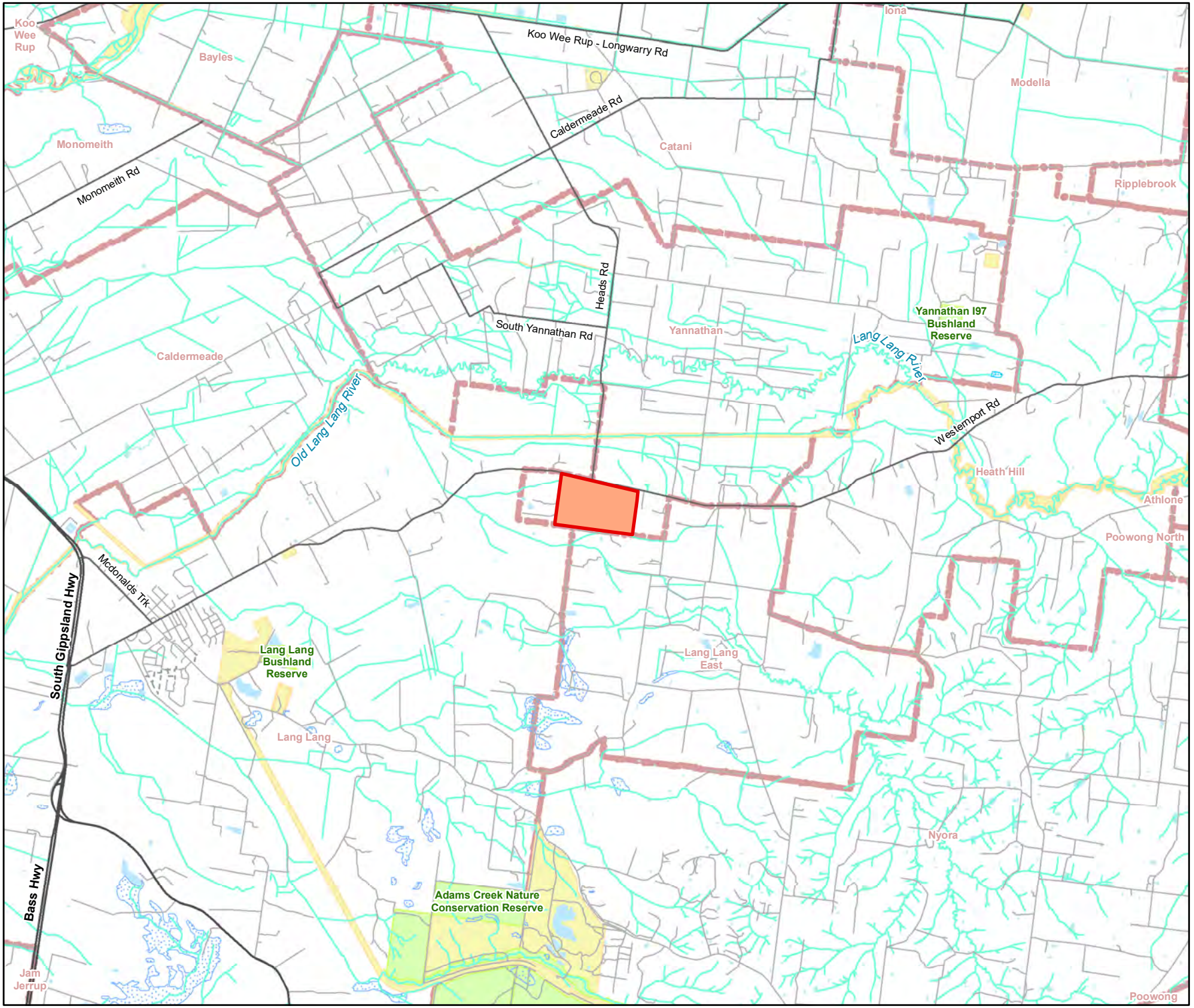


Legend

- Study Area
- Major Road
- Collector Road
- Minor Road
- Proposed Road
- Minor Watercourse
- Permanent Waterbody
- Land Subject to Inundation
- Wetland/Swamp
- Parks and Reserves
- Crown Land
- Localities

Figure 1

Location of the study area

Biodiversity Assessment at Yannathan Quarry

N

0 1 2

Kilometres

Map Scale: 1:75,000 @ A4
Coordinate System: GDA2020 MGA Zone 55

ecology & heritage partners

Legend

- Extension area
- Total disturbed area
- Property boundary
- Realigned watercourse (indicative)
- Scattered Large Tree
- Large Tree in a patch
- Impacted tree

Noxious weed

- Blackberry
- Spear Thistle

Vegetation

- Swampy Riparian Woodland (EVC 83)
- Planted vegetation
- Naturally established regrowth
- Impacted vegetation

Figure 2

Ecological features

Biodiversity Assessment at Yannathan Quarry

0 75 150

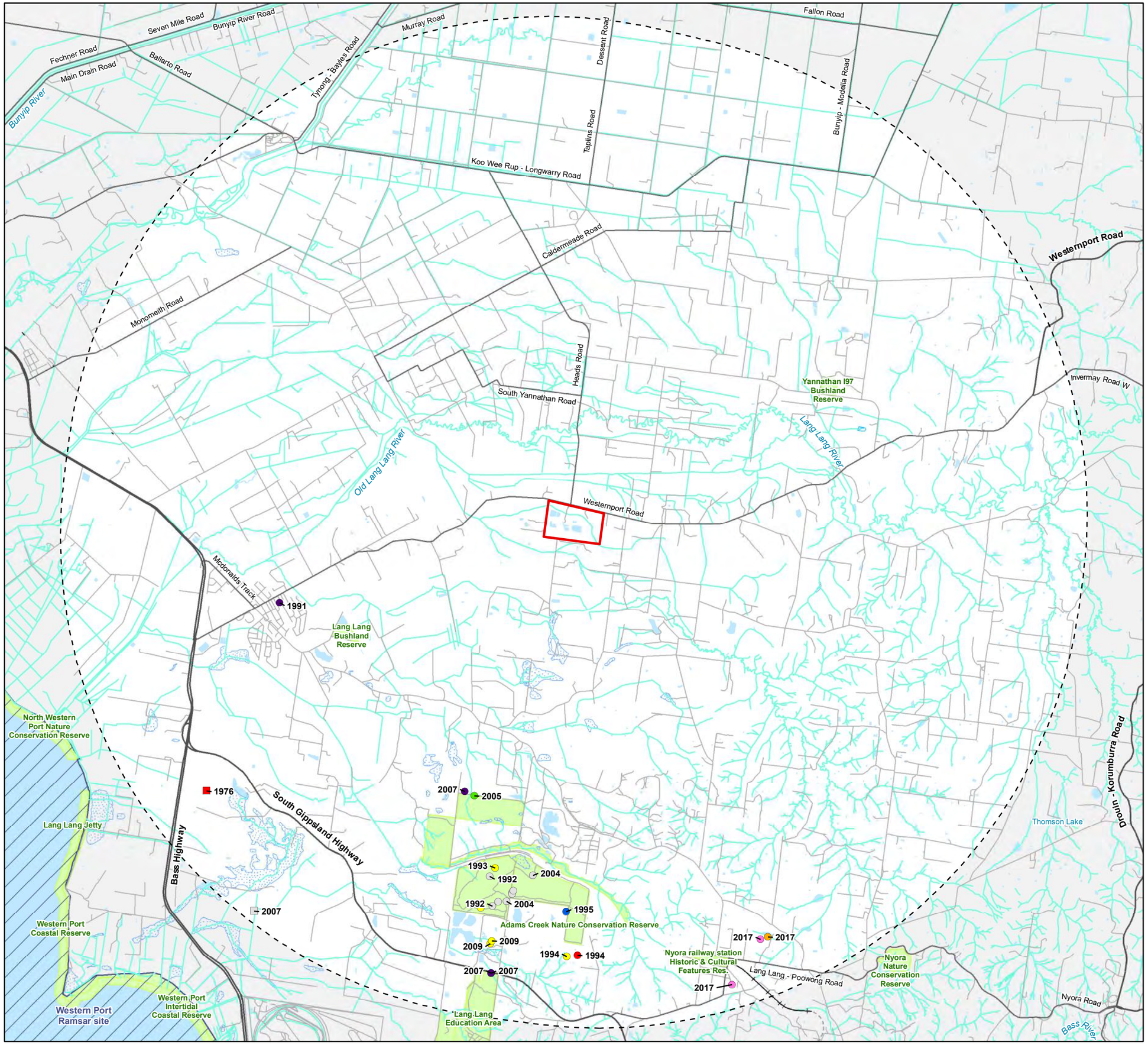
Metres

Map Scale: 1:5,700 @ A4
Coordinate System: GDA2020 MGA Zone 55

ecology & heritage partners

14023_Fig02_EcoFeat_G20 14/09/2022 dvaladares

Aerial source: Nearmap 2020



Legend

- Study Area

Significant flora

- Clasping Hypocreopsis
- Cobra Greenhood
- Giant Honey-myrtle
- Green-striped Greenhood
- Large-leaf Cinnamon-wattle
- Mauve-tuft Sun-orchid
- Spotted Gum
- Spurred Helmet-orchid
- Veined Spear-grass
- Velvet Apple-berry

Figure 3

Previously documented significant flora within 10km of the study area

Biodiversity Assessment at Yannathan Quarry

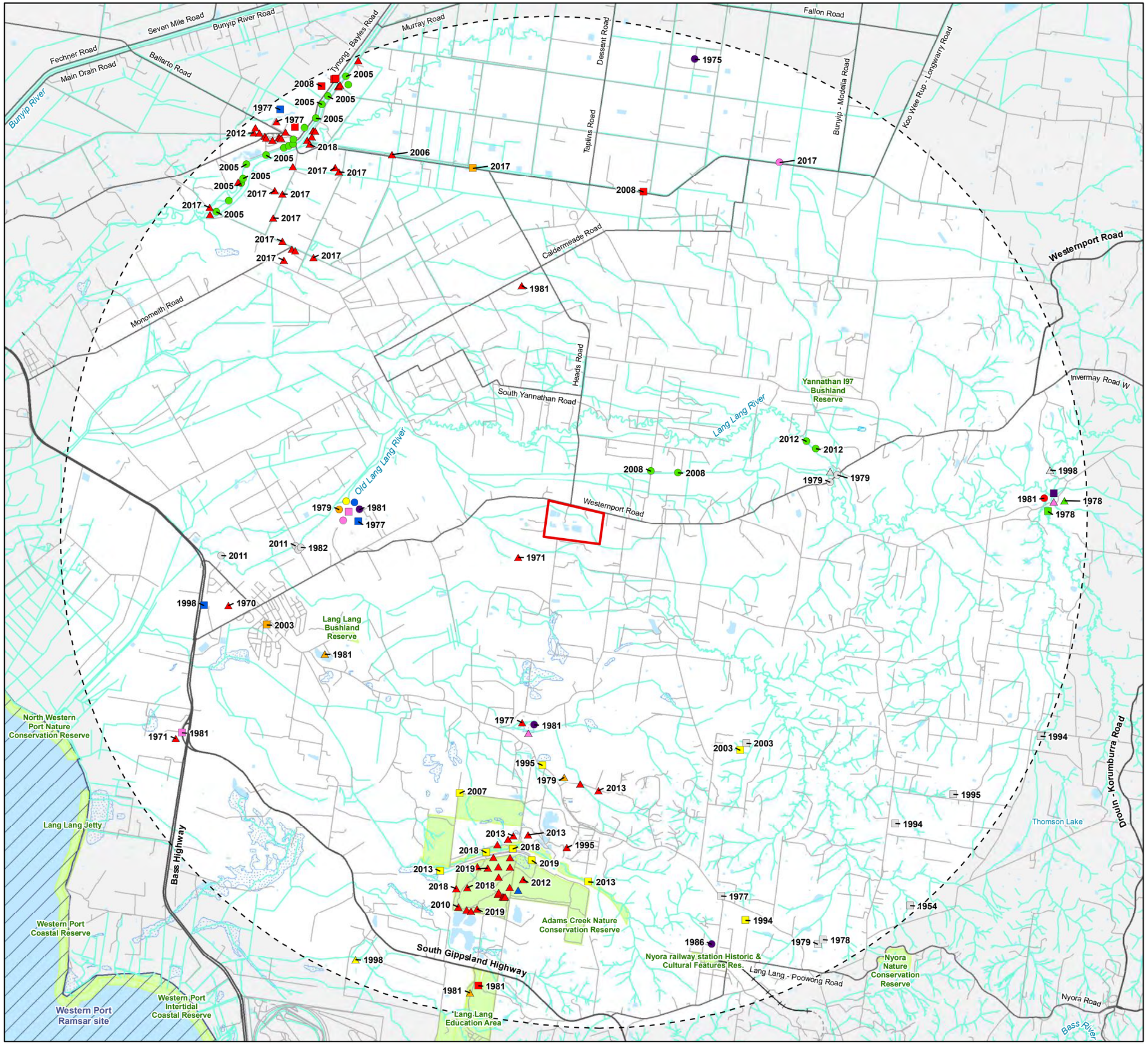
N

0 2 4

Kilometres

Map Scale: 1:75,000 @ A3
Coordinate System: GDA2020 MGA Zone 55

ecology & heritage partners



Legend

- Study Area

Significant fauna

- Australian Grayling
- Blue-billed Duck
- Caspian Tern
- Curlew Sandpiper
- Dwarf Galaxias
- Eastern Curlew
- Eastern Great Egret
- Gang-gang Cockatoo
- Giant Gippsland Earthworm
- Growling Grass Frog
- Hardhead
- Lace Monitor
- Little Eagle
- Little Egret
- Musk Duck
- Pilotbird
- Platypus
- Southern Brown Bandicoot
- Southern Toadlet
- Swamp Antechinus
- White-bellied Sea-Eagle
- White-footed Dunnart
- White-throated Needletail

Figure 4

Previously documented significant fauna within 10km of the study area

Biodiversity Assessment at Yannathan Quarry

N

0 2 4

Kilometres

Map Scale: 1:75,000 @ A3
Coordinate System: GDA2020 MGA Zone 55

ecology & heritage partners

APPENDIX 1 FLORA

Appendix 1.1 Flora Results

Legend:

I Protected under the FFG Act (DELWP 2019);
***** Listed as a noxious weed under the CaLP Act;
+ Planted indigenous species that also occur in native vegetation in the study area;
****** Planted indigenous species in the study area;
w Weed of National Significance.

Table A1.1. Flora within the study area.

Scientific Name	Common Name	Notes
INDIGENOUS SPECIES		
Acacia melanoxylon	Blackwood	-
Acacia spp.	Wattle	-
Acacia verticillata	Prickly Moses	I
Allocasuarina littoralis	Black Sheoak	**
Cassinia longifolia	Shiny Cassinia	I
Eleocharis sphacelata	Tall Spike-sedge	-
Eucalyptus ovata	Swamp Gum	+
Eucalyptus radiata s.l.	Narrow-leaf Peppermint	**
Juncus pallidus	Pale Rush	-
Juncus spp.	Rush	-
Leptospermum continentale	Prickly Tea-tree	**
Melaleuca ericifolia	Swamp Paperbark	**
Phragmites australis	Common Reed	-
NON-INDIGENOUS OR INTRODUCED SPECIES		
Agrostis capillaris	Brown-top Bent	-
Anthoxanthum odoratum	Sweet Vernal-grass	-
Brassica spp.	Turnip	-
Bromus catharticus	Prairie Grass	-
Cirsium vulgare	Spear Thistle	*
Daucus carota	Carrot	-
Holcus lanatus	Yorkshire Fog	-
Hypochaeris radicata	Flatweed	-
Lolium perenne	Perennial Rye-grass	-

Scientific Name	Common Name	Notes
Lotus angustissimus	Slender Bird's-foot Trefoil	-
Malva parviflora	Small-flower Mallow	-
Paspalum dilatatum	Paspalum	-
Plantago lanceolata	Ribwort	-
Romulea rosea	Onion Grass	-
Rubus fruticosus spp. agg.	Blackberry	***w**
Sonchus asper s.l.	Rough Sow-thistle	-
Trifolium spp.	Clover	-

Appendix 1.2 Habitat Hectare Assessment

Table A1.2. Habitat Hectare Assessment Table.

Vegetation Zone		SRF1	SRW7-SRF8 (regrowth)	SRF2-6; SRW9-13 (regrowth)
Bioregion		Gippsland Plain	Gippsland Plain	Gippsland Plain
EVC / Tree		Swampy Riparian Woodland	Swampy Riparian Woodland	Swampy Riparian Woodland
EVC Number		83	83	83
EVC Conservation Status		Endangered	Endangered	Endangered
Patch Condition	Large Old Trees /10	9	0	0
	Canopy Cover /5	4	0	0
	Under storey /25	10	5	5
	Lack of Weeds /15	2	2	2
	Recruitment /10	3	0	3
	Organic Matter /5	3	3	4
	Logs /5	2	0	0
	Treeless EVC Multiplier	1.00	1.00	1.00
	Subtotal =	33.00	10.00	14.00
Landscape Value /25		3	3	3
Habitat Points /100		36	13	17
Habitat Score		**0.36**	**0.13**	**0.17**

Appendix 1.3 Scattered Trees and Large Trees in Patches

Table A1.3. Scattered Trees and Large Trees in Patches.

Tree # (Figure 2)	Species Name	Common Name	DBH (cm)	Size Class	Scattered / Patch	Habitat features	Status
1	Swamp Gum	*Eucalyptus ovata*	96	Large	Scattered	-	Removed (direct impact)
27	stag	-	77	Large	Patch	Hollow	Retained
28	Swamp Gum	*Eucalyptus ovata*	74	Large	Patch	-	Retained
29	Swamp Gum	*Eucalyptus ovata*	72	Large	Patch	-	Retained
30	Swamp Gum	*Eucalyptus ovata*	70	Large	Patch	-	Retained
31	Swamp Gum	*Eucalyptus ovata*	72	Large	Patch	-	Retained

Appendix 1.4 Significant Flora Species

Significant flora within 10 kilometres of the study area is provided in the Table A1.4.3 at the end of this section, with Tables A1.4.1 and A1.4.2 below providing the background context for the values in Table 1.4.3.

Table A1.4.1 Conservation status of each species for each Act. The values in this table correspond to Columns 5 and 6 in Table A1.4.3.

EPBC (*Environment Protection and Biodiversity Conservation Act 1999*):		FFG (*Flora and Fauna Guarantee Act 1988*):	
EX	Extinct	ex	Extinct
CR	Critically endangered	cr	Critically endangered
EN	Endangered	en	Endangered
VU	Vulnerable	vu	Vulnerable
#	Listed on the Protected Matters Search Tool		

Table A1.4.2 Likelihood of occurrence rankings: Habitat characteristics assessment of significant flora species previously recorded within 10 kilometres of the study area, or that may potentially occur within the study area to determine their likelihood of occurrence. The values in this table correspond to Column 7 in Table A1.4.3.

1	Known Occurrence	• Recorded within the study area recently (i.e. within ten years).
2	High Likelihood	• Previous records of the species in the local vicinity; and/or, • The study area contains areas of high-quality habitat.
3	Moderate Likelihood	• Limited previous records of the species in the local vicinity; and/or • The study area contains poor or limited habitat.
4	Low Likelihood	• Poor or limited habitat for the species, however other evidence (such as lack of records or environmental factors) indicates there is a very low likelihood of presence.
5	Unlikely	• No suitable habitat and/or outside the species range.

Table A1.4.3 Significant flora recorded within 10 kilometres of the study area.

Scientific name	Common name	Total # of documented records	Last documented record	EPBC	FFG	Likely occurrence in study area
NATIONAL SIGNIFICANCE						
Amphibromus fluitans #	River Swamp Wallaby-grass	-	-	VU	-	4
Caladenia orientalis #	Eastern Spider Orchid	-	-	EN	en	5
Caladenia tessellata #	Thick-lipped Spider-orchid	-	-	VU	-	4
Dianella amoena #	Matted Flax-lily	-	-	EN	cr	4
Eucalyptus strzeleckii #	Strzelecki Gum	-	-	VU	cr	4
Glycine latrobeana #	Clover Glycine	-	-	VU	vu	4
Lepidium aschersonii #	Spiny Pepper-cress	-	-	VU	en	4
Prasophyllum spicatum #	Dense Leek-orchid	-	-	VU	cr	4
Pterostylis chlorogramma #	Green-striped Greenhood	5	2009	VU	en	4
Pterostylis cucullata #	Leafy Greenhood	-	-	VU	en	4
Senecio psilocarpus #	Swamp Fireweed	-	-	VU	-	4
Thelymitra epipactoides #	Metallic Sun-orchid	-	-	EN	en	4
Xerochrysum palustre #	Swamp Everlasting	-	-	VU	cr	4
STATE SIGNIFICANCE						
Acacia leprosa var. *uninervia*	Large-leaf Cinnamon-wattle	1	2005	-	en	4
Austrostipa rudis subsp. *australis*	Veined Spear-grass	1	2007	-	en	4
Billardiera scandens s.s.	Velvet Apple-berry	1	1976	-	en	4
Corybas aconitiflorus	Spurred Helmet-orchid	4	2007	-	en	4
Corymbia maculata	Spotted Gum	2	2017	-	vu	4

Scientific name	Common name	Total # of documented records	Last documented record	EPBC	FFG	Likely occurrence in study area
Hypocreopsis amplectens	Clasping Hypocreopsis	9	2004	-	cr	4
Melaleuca armillaris subsp. *armillaris*	Giant Honey-myrtle	1	2017	-	en	4
Pterostylis grandiflora	Cobra Greenhood	1	1994	-	en	4
Thelymitra malvina	Mauve-tuft Sun-orchid	1	1995	-	en	4

Data source: Victorian Biodiversity Atlas (DELWP 2022d); Protected Matters Search Tool (DCCEEW 2022).

APPENDIX 2 FAUNA

Appendix 2.1 Significant Fauna Species

Significant fauna within 10 kilometres of the study area is provided in the Table A2.1.3 at the end of this section, with Tables A2.1.1 and A2.1.2 below providing the background context for the values in Table 2.1.3.

Table A2.1.1 Conservation status of each species for each Act/Plan. The values in this table correspond to Columns 5 to 7 in Table A2.1.3.

EPBC (*Environment Protection and Biodiversity Conservation Act 1999*):		FFG (*Flora and Fauna Guarantee Act 1988*):	
EX	Extinct	EX	Extinct
CR	Critically endangered	CR	Critically endangered
EN	Endangered	EN	Endangered
VU	Vulnerable	VU	Vulnerable
CD	Conservation dependent	CD	Conservation dependent
#	Listed on the Protected Matters Search Tool		

Table A2.1.2 Likelihood of occurrence rankings: Habitat characteristics assessment of significant fauna species previously recorded within 10 kilometres of the study area, or that may potentially occur within the study area to determine their likelihood of occurrence. The values in this table correspond to Column 7 in Table A2.1.3.

1	High Likelihood	• Known resident in the study area based on site observations, database records, or expert advice; and/or, • Recent records (i.e. within five years) of the species in the local area (DELWP 2018); and/or, • The study area contains the species' preferred habitat.
2	Moderate Likelihood	• The species is likely to visit the study area regularly (i.e. at least seasonally); and/or, • Previous records of the species in the local area (DELWP 2021); and/or, • The study area contains some characteristics of the species' preferred habitat.
3	Low Likelihood	• The species is likely to visit the study area occasionally or opportunistically whilst en route to more suitable sites; and/or, • There are only limited or historical records of the species in the local area (i.e. more than 20 years old); and/or, • The study area contains few or no characteristics of the species' preferred habitat.

4	Unlikely	• No previous records of the species in the local area; and/or, • The species may fly over the study area when moving between areas of more suitable habitat; and/or, • Out of the species' range; and/or, • No suitable habitat present.

Table A2.1.3 Significant fauna recorded within 10 kilometres of the study area.

Common name	Scientific name	Total # of Records (VBA)	Last Documented Record (VBA)	EPBC	FFG	Likely occurrence in study area
NATIONAL SIGNIFICANCE						
Australasian Bittern #	*Botaurus poiciloptilus*	-	-	EN	cr	4
Australian Fairy Tern #	*Sternula nereis nereis*	-	-	VU	-	4
Australian Grayling	*Prototroctes maraena*	7	2011	VU	en	4
Australian Painted Snipe #	*Rostratula australis*	-	-	EN	cr	4
Broad-toothed Rat #	*Mastacomys fuscus mordicus*	-	-	VU	vu	4
Curlew Sandpiper	*Calidris ferruginea*	1	1979	CR	cr	4
Dwarf Galaxias	*Galaxiella pusilla*	25	2012	VU	en	4
Eastern Curlew	*Numenius madagascariensis*	2	1979	CR	cr	4
Gang-gang Cockatoo	*Callocephalon fimbriatum*	8	1986	EN	-	3
Giant Gippsland Earthworm	*Megascolides australis*	9	2003	VU	en	3
Golden Sun Moth #	*Synemon plana*	-	-	VU	vu	4
Greater Glider #	*Petauroides volans*	-	-	EN	vu	4
Greater Sand Plover #	*Charadrius leschenaultii*	-	-	VU	vu	4
Grey Falcon #	*Falco hypoleucos*	-	-	VU	vu	4

Common name	Scientific name	Total # of Records (VBA)	Last Documented Record (VBA)	EPBC	FFG	Likely occurrence in study area
Grey-headed Flying-fox #	*Pteropus poliocephalus*	-	-	VU	vu	4
Growling Grass Frog	*Litoria raniformis*	9	2008	VU	vu	4
Long-nosed Potoroo #	*Potorous tridactylus trisulcatus*	-	-	VU	vu	4
Nunivak Bar-tailed Godwit #	*Limosa lapponica baueri*	-	-	VU	-	4
Orange-bellied Parrot #	*Neophema chrysogaster*	-	-	CR	vu	4
Painted Honeyeater #	*Grantiella picta*	-	-	VU	vu	4
Pilotbird	*Pycnoptilus floccosus*	2	1977	VU	en	4
Red Knot #	*Calidris canutus*	-	-	EN	en	4
Regent Honeyeater #	*Anthochaera phrygia*	-	-	CR	en	4
Smoky Mouse #	*Pseudomys fumeus*	-	-	EN	en	4
Southern Brown Bandicoot	*Isoodon obesulus obesulus*	155	2019	EN	vu	3
Spot-tailed Quoll #	*Dasyurus maculatus maculatus*	-	-	EN	vu	4
Swamp Antechinus	*Antechinus minimus maritimus*	1	1998	VU	vu	4
White-throated Needletail	*Hirundapus caudacutus*	3	1981	VU	vu	4
Yarra Pygmy Perch #	*Nannoperca obscura*	-	-	VU	vu	4
Yellow-bellied Glider #	*Petaurus australis australis*	-	-	VU	-	4
STATE SIGNIFICANCE						
Blue-billed Duck	*Oxyura australis*	1	1981	-	vu	4
Caspian Tern	*Hydroprogne caspia*	1	1979	-	vu	4
Eastern Great Egret	*Ardea alba modesta*	2	2018	-	vu	4
Hardhead	*Aythya australis*	2	2017	-	vu	3

Common name	Scientific name	Total # of Records (VBA)	Last Documented Record (VBA)	EPBC	FFG	Likely occurrence in study area
Lace Monitor	*Varanus varius*	10	2019	-	en	3
Little Eagle	*Hieraaetus morphnoides*	3	1978	-	vu	3
Little Egret	*Egretta garzetta*	3	1998	-	en	4
Musk Duck	*Biziura lobata*	2	1981	-	vu	3
Platypus	*Ornithorhynchus anatinus*	4	1998	-	vu	4
Southern Toadlet	*Pseudophryne semimarmorata*	3	1981	-	en	3
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	1	1978	-	en	4
White-footed Dunnart	*Sminthopsis leucopus*	1	2012	-	vu	3

Data source: Victorian Biodiversity Atlas (DELWP 2022d); Protected Matters Search Tool (DCCEEW 2022).

APPENDIX 3 NATIVE VEGETATION REMOVAL (NVR) REPORT

Native vegetation removal report

A report to support an application to remove, destroy or lop native vegetation in the **Intermediate** Assessment Pathway using the modelled condition score

This report provides information to support an application to remove native vegetation in accordance with the *Guidelines for the removal, destruction or lopping of native vegetation*. The report is not an assessment by DELWP or local council of the proposed native vegetation removal. Biodiversity information and offset requirements have been calculated using modelled condition scores contained in the *Native vegetation condition map*.

Date and time: **13 January 2021 13:10 PM**

Lat./Long.: -38.247882976963,145.632626126845

Native vegetation report ID: 311-20210113-012

Address: 870 WESTERNPORT ROAD YANNATHAN 3981

Assessment pathway

The assessment pathway and reason for the assessment pathway

Assessment pathway	**Intermediate Assessment Pathway**
Extent of past plus proposed native vegetation removal	0.070 hectares
No. large trees	1 large tree(s)
Location category	Location 2 The native vegetation is in an area mapped as an Endangered Ecological Vegetation Class. Removal of less than 0.5 hectares of native vegetation will not have a significant impact on any habitat for a rare or threatened species.

Offset requirement

The offset requirement that will apply if the native vegetation is approved to be removed

Offset type	General offset
Offset amount	0.015 general habitat units
Offset attributes	
Vicinity	Port Phillip And Westernport Catchment Management Authority (CMA) or Cardinia Shire Council
Minimum strategic biodiversity value score	0.352
Large trees	1 large tree(s)

Biodiversity information about the native vegetation

Description of any past native vegetation removal

Any native vegetation that was approved to be removed, or was removed without the required approvals, on the same property or on contiguous land in the same ownership, in the five year period before the application to remove native vegetation is lodged is detailed below.

Permit/PIN number	Extent of native vegetation (hectares)
None entered	0 hectares

Description of the native vegetation proposed to be removed

Extent of all mapped native vegetation	0.070 hectares
Condition score of all mapped native vegetation	0.200
Strategic biodiversity value score of all mapped native vegetation	0.440
Extent of patches native vegetation	0.000 hectares
Extent of scattered trees	0.070 hectares
No. large trees within patches	0 large tree(s)
No. large scattered trees	1 large tree(s)
No. small scattered trees	0 small tree(s)

Additional information about trees to be removed, shown in Figure 1

Tree ID	Tree circumference (cm)	Benchmark circumference (cm)	Scattered / Patch	Tree size
A	301.6	220	Scattered	Large

Other information

Applications to remove, destroy or lop native vegetation must include all the below information. If an appropriate response has not been provided the application is not complete.

Photographs of the native vegetation to be removed

Recent, dated photographs of the native vegetation to be removed must be provided with the application. All photographs must be clear, show whether the vegetation is a patch of native vegetation or scattered trees, and identify any large trees. If the area of native vegetation to be removed is large, provide photos that are indicative of the native vegetation.

Ensure photographs are attached to the application. If appropriate photographs have not been provided the application is not complete.

Topographical and land information

Description of the topographic and land information relating to the native vegetation to be removed, including any ridges, crests and hilltops, wetlands and waterways, slopes of more than 20 percent, drainage lines, low lying areas, saline discharge areas, and areas of existing erosion, as appropriate. This may be represented in a map or plan. **This is an application requirement and your application will be incomplete without it.**

The study area is generally flat, with no ridges, crests within or immediately adjacent to the site. A minor drainage line is present within the study area, running east to west through the middle of the site.

Avoid and minimise statement

This statement describes what has been done to avoid the removal of, and minimise impacts on the biodiversity and other values of native vegetation. **This is an application requirement and your application will be incomplete without it.**

See Section 5 of the Biodiversity report

Defendable space statement

Where the removal of native vegetation is to create defendable space, a written statement explaining why the removal of native vegetation is necessary. This statement must have regard to other available bushfire risk mitigation measures. This statement is not required if your application also includes an application under the Bushfire Management Overlay.

Not applicable

Offset statement

An offset statement that demonstrates that an offset is available and describes how the required offset will be secured. **This is an application requirement and your application will be incomplete without it.**

Offsets will be sourced through the Native Vegetation Credit Register, with excess of 10 sites available (Appendix 4 of the Biodiversity Report).

Next steps

Applications to remove, destroy or lop native vegetation must address all the application requirements specified in *Guidelines for the removal, destruction or lopping of native vegetation.*If you wish to remove the mapped native vegetation you are required to apply for a permit from your local council. This *Native vegetation removal report*must be submitted with your application and meets most of the application requirements. The following needs to be added as applicable.

Property Vegetation Plan

Landowners can manage native vegetation on their property in the longer term by developing a Property Vegetation Plan (PVP) and entering in to an agreement with DELWP.

If an approved PVP applies to the land, ensure the PVP is attached to the application.

Applications under Clause 52.16

An application to remove, destroy or lop native vegetation is under Clause 52.16 if a Native Vegetation Precinct Plan (NVPP) applies to the land, and the proposed native vegetation removal is not in accordance with the relevant NVPP. If this is the case, a statement that explains how the proposal responds to the NVPP considerations must be provided.

If the application is under Clause 52.16, ensure a statement that explains how the proposal responds to the NVPP considerations is attached to the application.

Authorised by the Victorian Government, 8 Nicholson Street, East Melbourne.

For more information contact the DELWP Customer Service Centre 136 186

www.delwp.vic.gov.au

Figure 1 – Map of native vegetation to be removed, destroyed or lopped

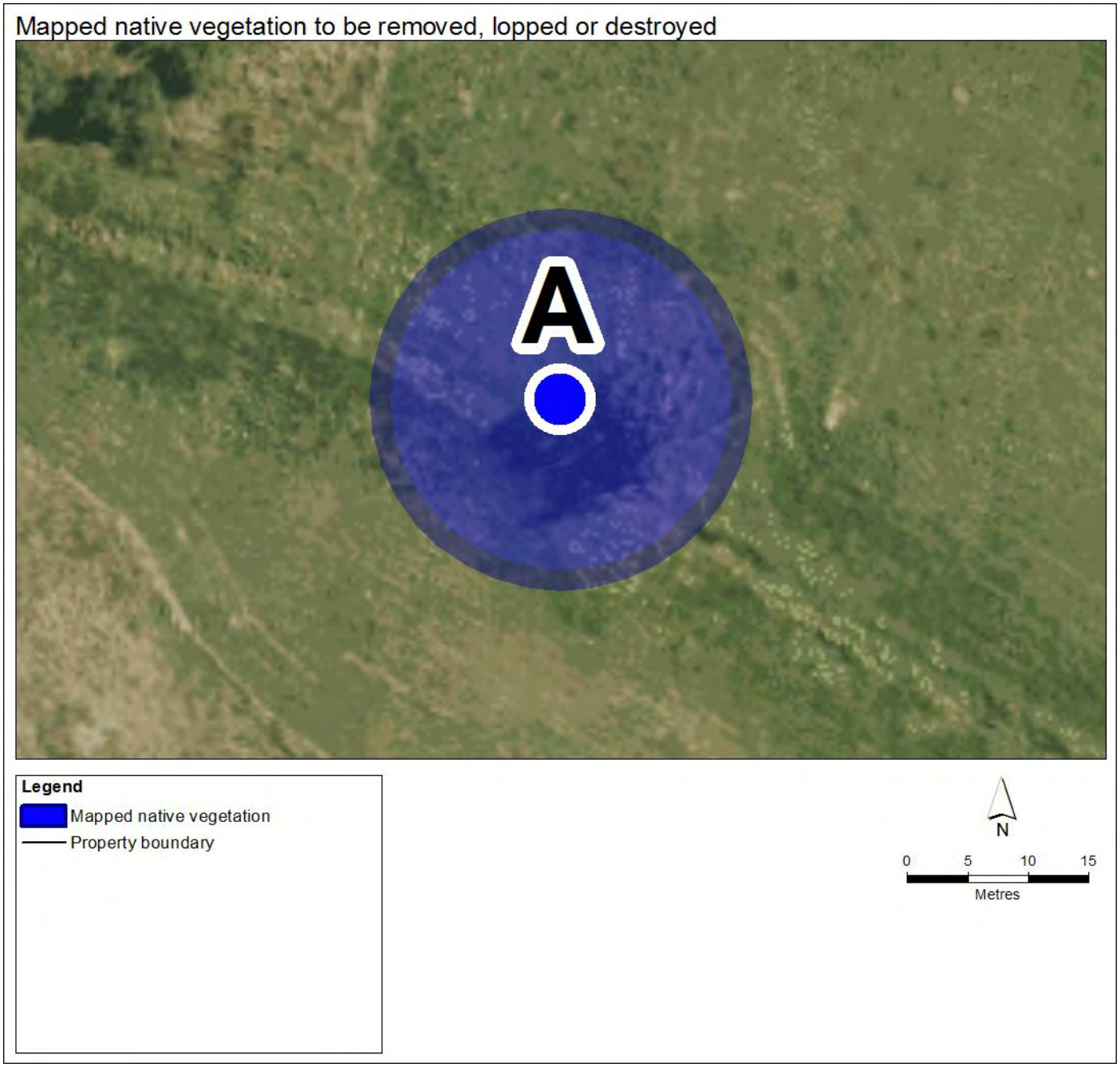


Figure 2 – Map of property in context

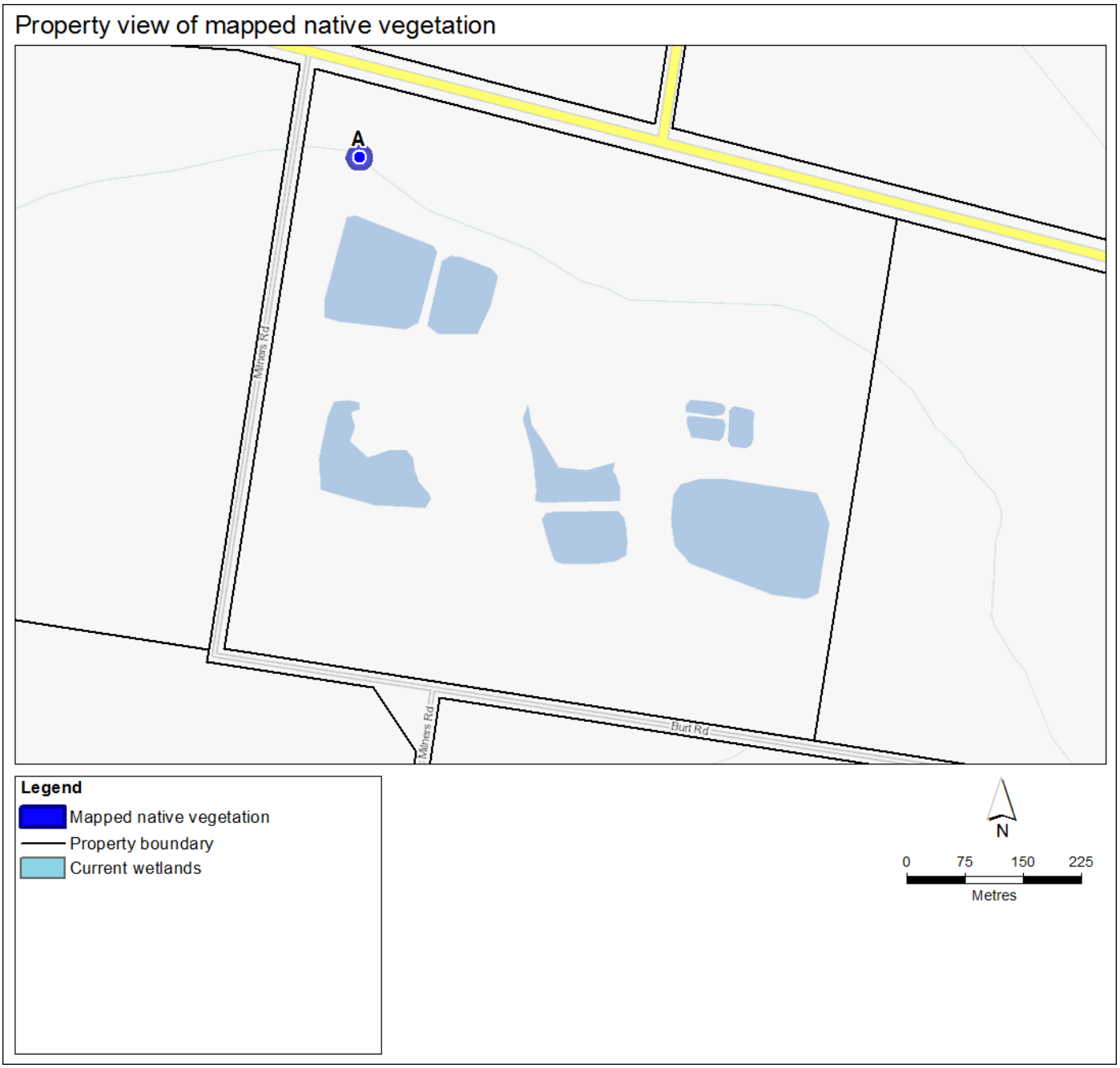
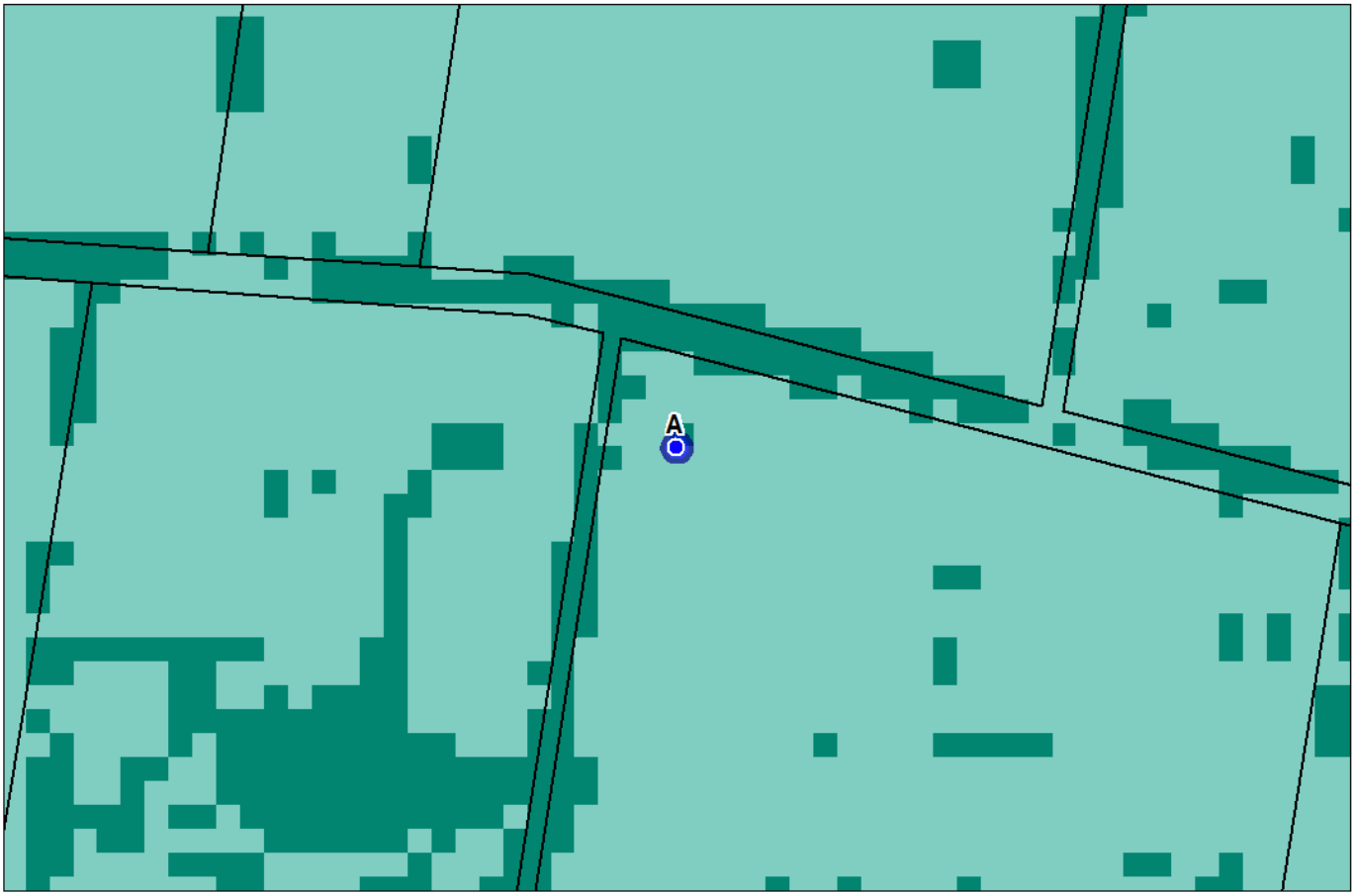
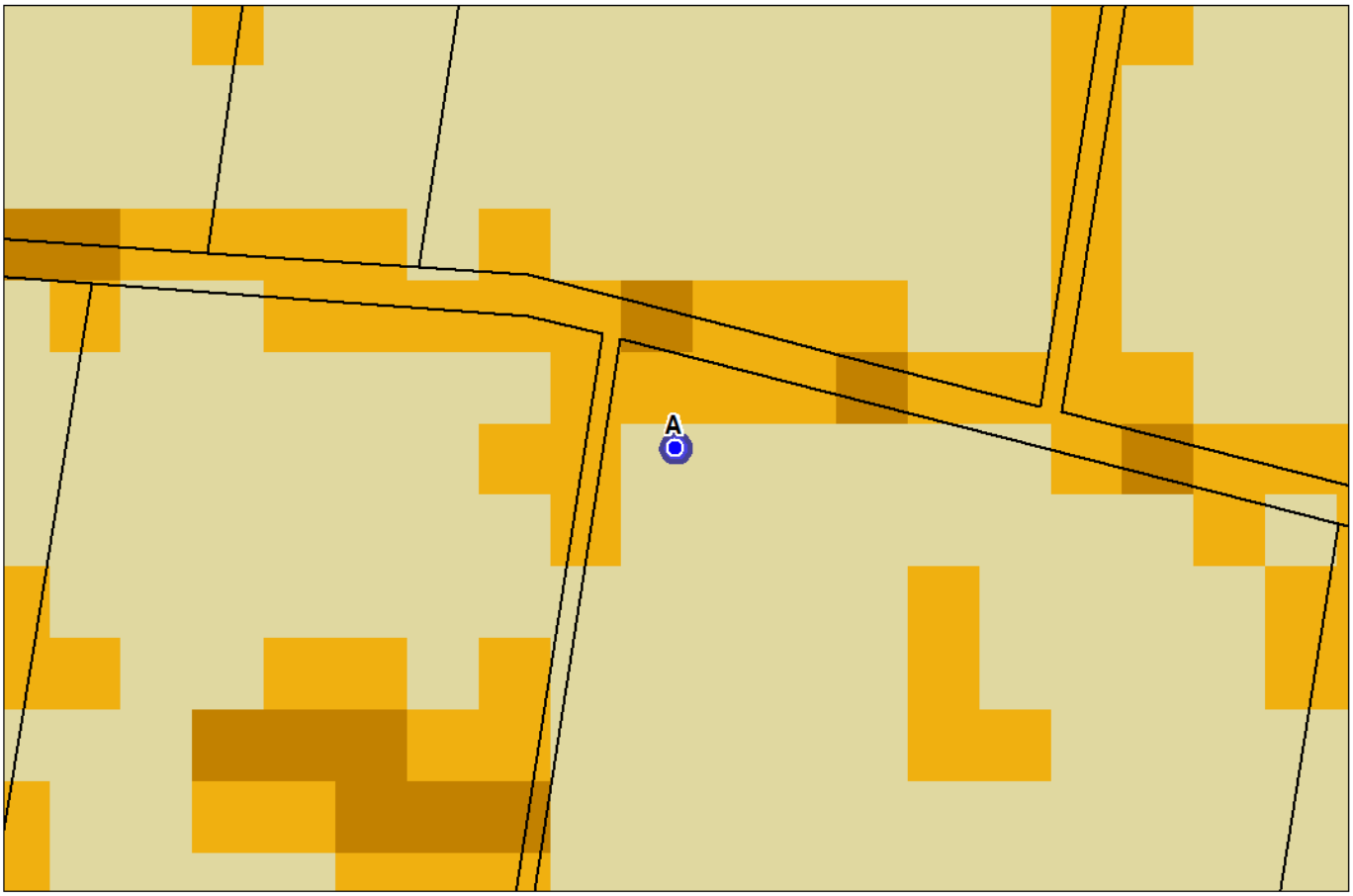


Figure 3 – Biodiversity information maps

Mapped native vegetation and the *Native vegetation location map*



Mapped native vegetation and the *Native vegetation condition map*



Mapped native vegetation and the *Strategic biodiversity value map*

Appendix 1 - Details of offset requirements

Native vegetation to be removed

Extent of all mapped native vegetation (for calculating habitat hectares)	0.070	The area of land covered by a patch of native vegetation and/or a scattered tree, measured in hectares. Where the mapped native vegetation includes scattered trees, each tree is assigned a standard extent and converted to hectares. A small scattered tree is assigned a standard extent defined by a circle with a 10 metre radius and a large scattered tree a circle with a 15 metre radius. The extent of all mapped native vegetation is an input to calculating the habitat hectares.
Condition score*	0.200	The condition score of native vegetation is a site-based measure that describes how close native vegetation is to its mature natural state. The condition score is the weighted average condition score of the mapped native vegetation calculated using the *Native vegetation condition map.*
Habitat hectares	0.014	Habitat hectares is a site-based measure that combines extent and condition of native vegetation. It is calculated by multiplying the extent of native vegetation by the condition score: ***Habitat hectares = extent x condition score***
Strategic biodiversity value score	0.440	The strategic biodiversity value score represents the complementary contribution to Victoria's biodiversity of a location, relative to other locations across the state. This score is the weighted average strategic biodiversity value score of the mapped native vegetation calculated using the *Strategic biodiversity value map*.
General landscape factor	0.720	The general landscape factor is an adjusted strategic biodiversity value score. It has been adjusted to reduce the influence of landscape scale information on the general habitat score.
General habitat score	0.010	The general habitat score combines site-based and landscape scale information to obtain an overall measure of the biodiversity value of the native vegetation. The general habitat score is calculated as follows: ***General habitat score = habitat hectares x general landscape factor***

* **Offset requirements for partial removal:** If your proposal is to remove parts of the native vegetation in a patch (for example only understorey plants) the condition score must be adjusted. This will require manual editing of the condition score and an update to the calculations that the native vegetation removal tool has provided: habitat hectares, general habitat score and offset amount.

Offset requirements

Offset type	General offset	A general offset is required when the removal of native vegetation does not have a significant impact on any habitat for rare or threatened species. All proposals in the Basic and Intermediate assessment pathways will only require a general offset.
Offset multiplier	1.5	This multiplier is used to address the risk that the predicted outcomes for gain will not be achieved, and therefore will not adequately compensate the biodiversity loss from the removal of native vegetation.
Offset amount (general habitat units)	0.015	The general habitat units are the amount of offset that must be secured if the application is approved. This offset requirement will be a condition to any permit or approval for the removal of native vegetation. ***General habitat units required = general habitat score x 1.5***
Minimum strategic biodiversity value score	0.352	The offset site must have a strategic biodiversity value score of at least 80 per cent of the strategic biodiversity value score of the native vegetation to be removed. This is to ensure offsets are located in areas with a strategic biodiversity value that is comparable to the native vegetation to be removed.
Vicinity	Port Phillip And Westernport CMA or Cardinia Shire Council	The offset site must be located within the same Catchment Management Authority boundary or municipal district as the native vegetation to be removed.
Large trees	1 large tree (s)	The offset site must protect at least one large tree for every large tree removed. A large tree is a native canopy tree with a Diameter at Breast Height greater than or equal to the large tree benchmark for the local Ecological Vegetation Class. A large tree can be either a large scattered tree or a large patch tree.

APPENDIX 4 AVAILABLE NATIVE VEGETATION CREDITS

Report of available native vegetation credits

This report lists native vegetation credits available to purchase through the Native Vegetation Credit Register.

This report is **not evidence** that an offset has been secured. An offset is only secured when the units have been purchased and allocated to a permit or other approval and an allocated credit extract is provided by the Native Vegetation Credit Register.

Date and time: 06/09/2022 03:15 **Report ID: 15759**

What was searched for?

General offset

General habitat units	Strategic biodiversity value	Large trees	Vicinity (Catchment Management Authority or Municipal district)	
0.015	0.352	1	CMA	Port Phillip and Westernport
			or LGA	Cardinia Shire

Details of available native vegetation credits on 06 September 2022 03:15

These sites meet your requirements for general offsets.

Credit Site ID	GHU	LT	CMA	LGA	Land owner	Trader	Fixed price	Broker(s)
BBA-0670	17.745	147	Port Phillip and Westernport	Cardinia Shire	No	Yes	No	Abezco, VegLink
BBA-0677	16.525	1492	Port Phillip and Westernport	Whittlesea City	No	Yes	No	Abezco, VegLink
BBA-0678	46.362	2627	Port Phillip and Westernport	Nillumbik Shire	No	Yes	No	VegLink
BBA-0678_2	0.388	59	Port Phillip and Westernport	Nillumbik Shire	No	Yes	No	VegLink
BBA-2774	0.020	9	Port Phillip and Westernport	Greater Geelong City	Yes	Yes	No	VegLink
BBA-2789	1.317	14	Port Phillip and Westernport	Baw Baw Shire	Yes	Yes	No	Contact NVOR
BBA-2790	2.911	116	Port Phillip and Westernport	Baw Baw Shire	Yes	Yes	No	Contact NVOR
BBA-2870	2.544	431	Port Phillip and Westernport	Yarra Ranges Shire	Yes	Yes	No	VegLink
BBA-2871	16.335	1668	Port Phillip and Westernport	Yarra Ranges Shire	Yes	Yes	No	VegLink
TFN-C1650	0.098	20	Port Phillip and Westernport	Yarra Ranges Shire	Yes	Yes	Yes	Yarra Ranges SC
TFN-C1663	0.109	27	Port Phillip and Westernport	Yarra Ranges Shire	Yes	Yes	Yes	Yarra Ranges SC
TFN-C1664	2.570	65	Port Phillip and Westernport	Yarra Ranges Shire	Yes	Yes	No	Yarra Ranges SC
TFN-C1962	0.098	9	Goulburn Broken, Port Phillip and Westernport	Macedon Ranges Shire	No	Yes	No	Contact NVOR

VC_CFL-0838_01	0.209	697	Port Phillip And Westernport	Yarra Ranges Shire	Yes	Yes	No	VegLink
VC_CFL-3084_01	0.498	386	Port Phillip And Westernport	Cardinia Shire	Yes	Yes	No	VegLink
VC_CFL-3084_02	0.613	56	Port Phillip And Westernport	Cardinia Shire	Yes	Yes	No	VegLink
VC_CFL-3687_01	0.728	78	Port Phillip And Westernport	Baw Baw Shire	Yes	Yes	No	Baw Baw SC
VC_CFL-3708_01	0.199	511	Port Phillip And Westernport	Yarra Ranges Shire	Yes	Yes	No	VegLink
VC_CFL-3709_01	0.139	395	Port Phillip And Westernport	Yarra Ranges Shire	Yes	Yes	No	VegLink
VC_CFL-3729_01	0.016	6	Port Phillip And Westernport	Melton City	Yes	Yes	No	VegLink
VC_CFL-3740_01	1.756	96	Port Phillip And Westernport	Cardinia Shire, Yarra Ranges Shire	Yes	Yes	No	Bio Offsets
VC_CFL-3740_01	0.365	22	Port Phillip And Westernport	Yarra Ranges Shire	Yes	Yes	No	Bio Offsets
VC_CFL-3762_01	0.549	125	Port Phillip And Westernport	Moorabool Shire	Yes	Yes	No	VegLink

These sites meet your requirements using alternative arrangements for general offsets.

Credit Site ID	GHU	LT	CMA	LGA	Land owner	Trader	Fixed price	Broker(s)

There are no sites listed in the Native Vegetation Credit Register that meet your offset requirements when applying the alternative arrangements as listed in section 11.2 of the Guidelines for the removal, destruction or lopping of native vegetation.

These potential sites are not yet available, land owners may finalise them once a buyer is confirmed.

Credit Site ID	GHU	LT	CMA	LGA	Land owner	Trader	Fixed price	Broker(s)
VC_CFL-3710_01	7.606	322	Port Phillip And Westernport	Yarra Ranges Shire	Yes	Yes	No	VegLink
VC_CFL-3744_01	3.717	384	Port Phillip And Westernport	Macedon Ranges Shire	Yes	Yes	No	VegLink
VC_CFL-3746_01	4.962	563	Port Phillip And Westernport	Macedon Ranges Shire	Yes	Yes	No	VegLink
VC_CFL-3764_01	12.037	55	Port Phillip And Westernport	Yarra Ranges Shire	Yes	Yes	No	VegLink
VC_CFL-3769_01	2.617	77	Port Phillip And Westernport	Nillumbik Shire	Yes	Yes	No	VegLink

LT - Large Trees *CMA - Catchment Management Authority* *LGA - Municipal District or Local Government Authority*

Next steps

If applying for approval to remove native vegetation
Attach this report to an application to remove native vegetation as evidence that your offset requirement is currently available.

If you have approval to remove native vegetation
Below are the contact details for all brokers. Contact the broker(s) listed for the credit site(s) that meet your offset requirements. These are shown in the above tables. If more than one broker or site is listed, you should get more than one quote before deciding which offset to secure.

Broker contact details

Broker Abbreviation	Broker Name	Phone	Email	Website
Abezco	Abzeco Pty. Ltd.	(03) 9431 5444	offsets@abzeco.com.au	www.abzeco.com.au
Baw Baw SC	Baw Baw Shire Council	(03) 5624 2411	bawbaw@bawbawshire.vic.gov.au	www.bawbawshire.vic.gov.au
Bio Offsets	Biodiversity Offsets Victoria	0452 161 013	info@offsetsvictoria.com.au	www.offsetsvictoria.com.au
Contact NVOR	Native Vegetation Offset Register	136 186	nativevegetation.offsetregister@delwp.vic.gov.au	www.environment.vic.gov.au/native-vegetation
Ecocentric	Ecocentric Environmental Consulting	0410 564 139	ecocentric@me.com	Not avaliable
Ethos	Ethos NRM Pty Ltd	(03) 5153 0037	offsets@ethosnrm.com.au	www.ethosnrm.com.au
Nillumbik SC	Nillumbik Shire Council	(03) 9433 3316	offsets@nillumbik.vic.gov.au	www.nillumbik.vic.gov.au
TFN	Trust for Nature	8631 5888	offsets@tfn.org.au	www.trustfornature.org.au
VegLink	Vegetation Link Pty Ltd	(03) 8578 4250 or 1300 834 546	offsets@vegetationlink.com.au	www.vegetationlink.com.au
Yarra Ranges SC	Yarra Ranges Shire Council	1300 368 333	biodiversityoffsets@yarraranges.vic.gov.au	www.yarraranges.vic.gov.au

For more information contact the DELWP Customer Service Centre 136 186 or the Native Vegetation Credit Register at nativevegetation.offsetregister@delwp.vic.gov.au

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Appendix E:
RORB Hydrological Model Development

E.1 INTENSITY-FREQUENCY-DURATION (IFD) DATA

Intensity-Frequency-Duration IFD information was sourced from the Bureau of Meteorology (BoM) using the online ARR IFD request tool. The coordinates used for the tool were based on the geographic centroid of the catchment being modelled. The resultant IFD's for the catchment are shown in Appendix E Table 1.

Appendix E Table 1: Yannathan Design Rainfall Depths in millimetres (38.2625 °S, 144.6625°E)

Duration	1 %
10 min	21.2
15 min	26.1
30 min	35.1
1 hour	44.7
2 hours	55.3
3 hours	62.5
6 hours	77.8
12 hours	98.8

E.2 LOSSES

The RORB model utilises an initial loss (IL) /continuing loss (CL) model approach, in accordance with the recommendations of ARR 2019. Losses in RORB were assigned based on three surface types:

Effective Impervious Area (EIA) – comprising areas which are effectively impervious and connected to the drainage system. As the Yannathan catchment area does not contain any areas directly to a drainage system, these losses have not been applied.

Indirectly Connected Area (ICA) – comprising impervious areas which are not directed to the drainage system (e.g. a paved patio or footpath) and pervious areas that interact with impervious areas which are not directly connected (e.g. nature strips and garden areas)

Pervious Area (Rural) – comprising of pervious areas such as parkland and bushland that do not interact with impervious areas or provide flow to piped or lined drainage systems

Appendix E Table 2 provides a summary of the loss parameters used in the RORB model.

Appendix E Table 2: Hydrological Losses

Surface Type	Initial Loss	Continuing Loss
ICA	14.7 mm (70 % of Rural IL sourced from ARR Data Hub – ARR 2019 recommends 60-80 % of Rural IL)	2.5 mm/hr (ARR 2019 recommends a CL of 2.5 mm/h for South-East Australia, range 1-3 mm/h)
Rural	21 mm (sourced from ARR Data Hub)	4.6 mm/hr (sourced from ARR Data Hub)

E.3 AREAL REDUCTION FACTORS

The IFD data provided by the BoM is applicable for rainfall in small catchments. As catchment size increases the chance of that average intensity of rainfall occurring over the entire catchment decreases. To address this issue an Areal Reduction Factor (ARF) is applied to the IFD data to account for the larger catchment area, this is applicable for areas greater than 1 km².

The total study catchment is approximately 3.6 km². The upstream catchment area from the site is approximately 2.8 km^2, therefore an ARF of 2.8 km^2 has been applied to the RORB model.

E.4 RAINFALL SPATIAL PATTERNS

As the catchment area does not exceed 20 km², a uniform spatial rainfall pattern has been used in accordance with ARR 2019 and Melbourne Water's Flood Mapping Projects Guidelines and Technical Specifications.

E.5 PRE-BURST RAINFALLS

The rural initial losses obtained from the ARR Data Hub correspond to complete storms (abbreviated as IL_s), however the IFD data provided by the Bureau of Meteorology is associated to rainfall bursts only. To account for this difference, ARR 2019 recommends reducing the rural initial loss (storm) to represent the initial burst loss (IL_b).

$$IL_{Burst} = IL_{STORM} - Preburst\ rainfall\ depth\ (mm)$$

Initial burst losses were applied in RORB as duration factors, which were calculated as ratios between a burst initial loss (IL_B) for each duration and AEP and storm initial loss (IL_S). For example, the duration factor for the 1 % AEP storm of 60 minutes duration was determined as follows:

$$Duration\ factor\ (1\%\ AEP, 60\ min) = \frac{ILs - Preburst\ rainfall\ depth}{ILs}$$

$$Duration\ factor\ (1\%\ AEP, 60\ min) = \frac{21\ mm - 1.1\ mm}{21\ mm} = 0.95$$

As pre-burst depths are not provided for storm durations of less than 60 minutes, the pre-burst rainfall is assumed to be the same for durations of 60 minutes and less in accordance with Melbourne Waters Flood Mapping Guidelines and Technical Specifications (Melbourne Water, 2019). Appendix E Table 3 summarises the pre-burst duration factors used.

Appendix E Table 3: Pre-burst Duration Factors

Duration	1 %
10 min	0.95
15 min	0.95
30 min	0.95
1 hour	0.95
2 hours	0.99
3 hours	0.77
6 hours	0.72
12 hours	0.64

E.6 KC (ROUTING PARAMETER)

There are no gauging stations against which the flow levels determined by the model can be compared to, against measured data. Therefore, a range of K_c values were trialled to determine the peak flow values calculated. A Kc value based on the DVA equations was adopted based on the region receiving approximately 800 mm/yr of rainfall. The following formula was adopted:

$$Kc = 1.53A^{0.55}$$

With a total catchment area of 3.62 km^2, the K_c value adopted

Appendix F:
Melbourne Water Lang Lang Catchment Flows Email (5th August 2021)

Milan Wickramarachchi

From: Melbourne Water <No_reply@melbournewater.com.au>
Sent: Thursday, 5 August 2021 10:40 AM
To: Julian Giannetti
Subject: Response to your application for Pre-development advice - MWA-1188291 - 870 Westernport Road Yannathan
Attachments: MWA1188291 Plans.zip

Dear Julian Giannetti,

Further to your email of 11 June 2021, the following advice is provided:

- Melbourne Water may be willing to consider a channel capacity less than the 1% AEP but it will need to be justified as to why the 1% AEP capacity can't be managed, what the risk assessment shows and how the flows up to the 1% AEP will be managed.
- Please see attached zip files and plans.

Additionally, our hydraulic engineer has provided further advice on the previous re-allignment of this waterway- Back in 2011, the requirements for the waterway realignment from the drainage and flooding perspective were:

- The watercourse passing along the northern edge of the existing quarry operations (we refer to it as Creek 2412 since it doesn't have a regular name) and continues upstream through the middle of the proposed quarry extension and on up the catchment which I highlighted on the Topo Plan as well as showing it on the attached "Plan2 - Overall Catchment". Plan 2 also includes the contours we have that makes identifying the catchment boundary a lot easier. The catchment as outlined on the plan totals 285 hectares.
- Modelling that has previously been undertaken for the Little Lang Lang River indicates that for the 100 Year ARI event, around 64 cumecs breaks away to the north into the Creek 2412 catchment. Some of this flow also breaks away into the adjoining catchment and continues to the north and across Westernport Rd. Although the modelling did not fully extend along the catchment of Creek 2412, I have been able to estimate that around 27 cumecs would reach Pooles Rd south of Westernport Rd and continue westerly to the quarry site.
- There must be no detrimental increase in the 100 Year ARI flood levels for the flow of 27 cumecs. We normally allow an increase of no more than 0.05m (50mm) as being tolerable however this will be dependent upon the floor levels of any buildings effected by the increased flood levels. If there is any building floor level that ends up being less than 300mm above the flood level, then the increase is not allowed.
- Some channelling of the flows is permitted however we do not want the flow velocity to increase any more than 10%. This together with the flat gradients along the waterway will not provide much opportunity of speeding up the flow through a significantly narrower constructed channel.

Plans included in the previous advice have also been attached;

- Plan 1 - Marked up Topo.pdf
- Plan 2 - Overall Catchment.pdf
- L&T Mapping.pdf

To respond to us regarding this application, please use **DevConnect@melbournewater.com.au** quoting MWA-1188291 in the subject line.

This email is sent from a notification-only email address that does not accept incoming email.

For general development enquiries contact our Customer Service Centre on 131 722.

Regards,

Segujja Kakembo | Planner , Development Planning Services | Melbourne Water
T: 131 722 | 990 La Trobe Street, Docklands, VIC 3008 | PO Box 4342 Melbourne VIC 3001
| melbournewater.com.au

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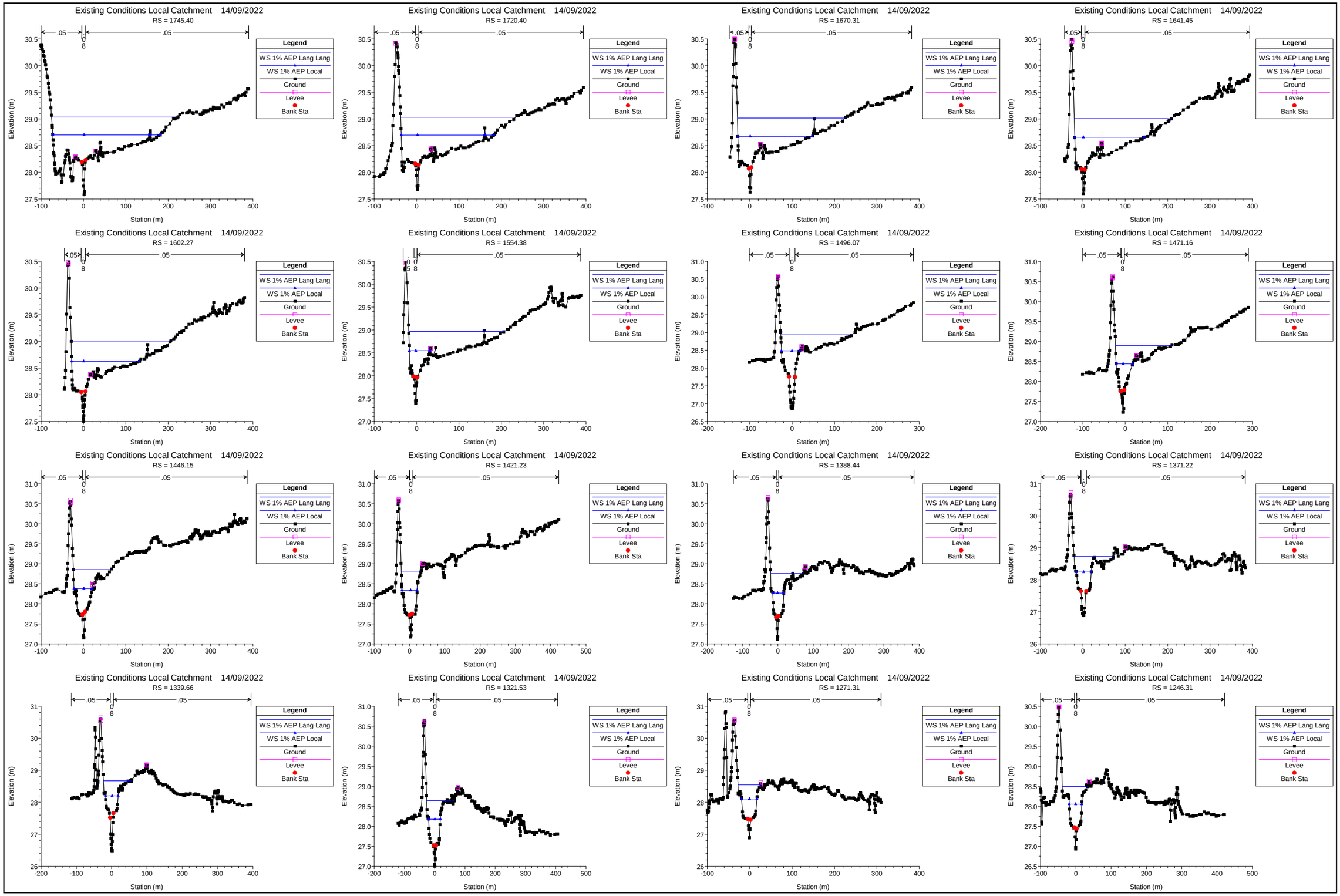
Appendix G:

Existing Conditions HEC-RAS Longitudinal Section and Cross Sections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Legend
WS 1% AEP Lang Lang
WS 1% AEP Local
Ground
Levee
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Elevation (m)
Station (m)

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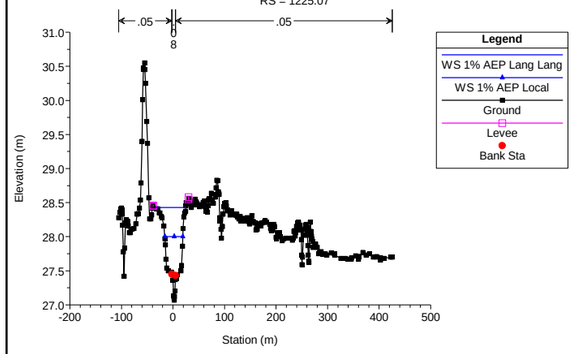

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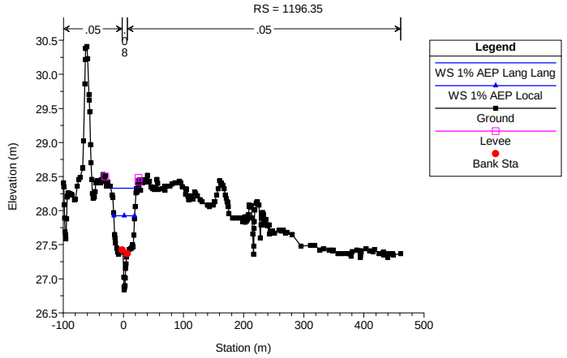

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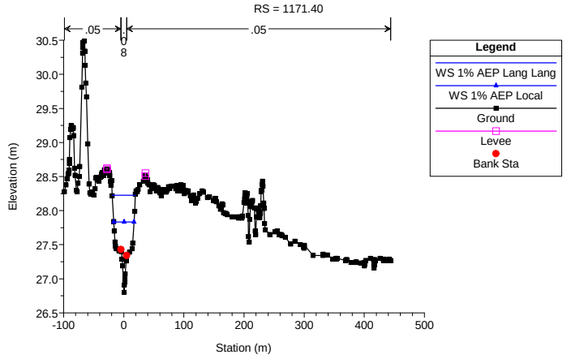

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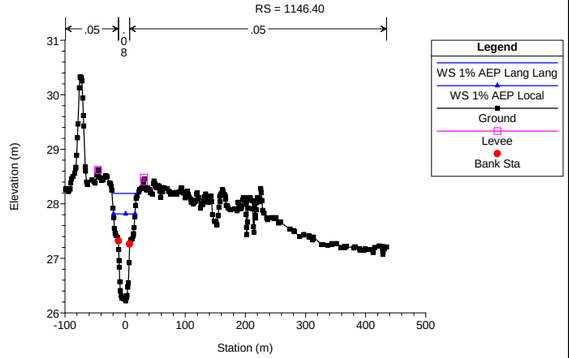

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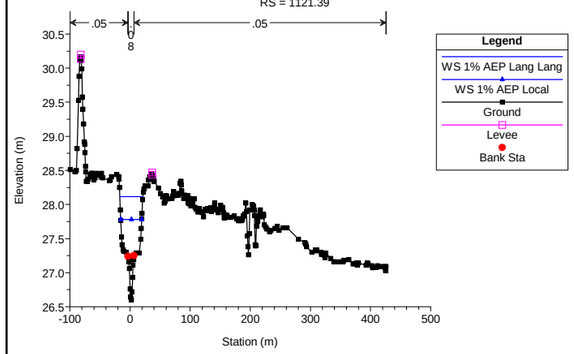

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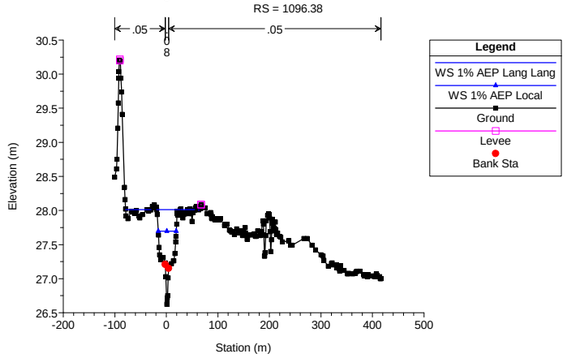

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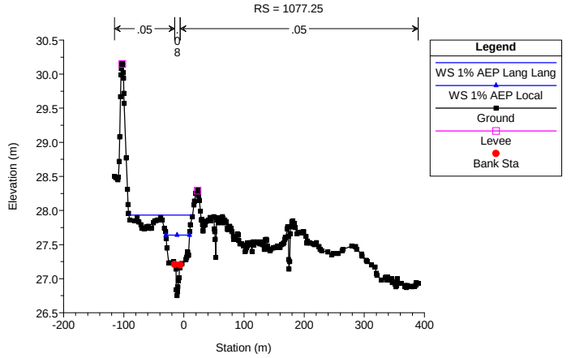

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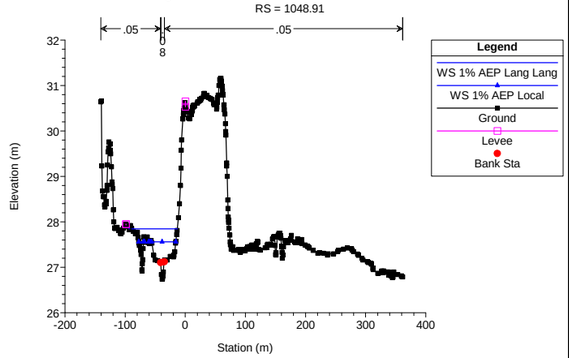

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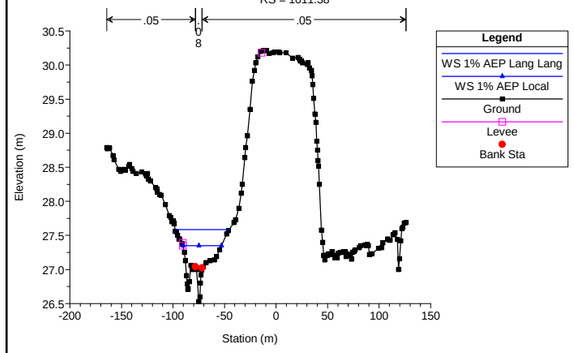

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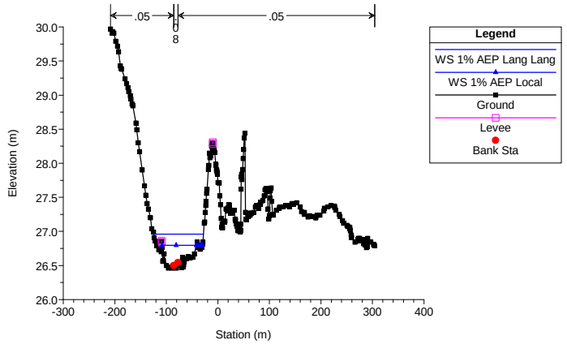
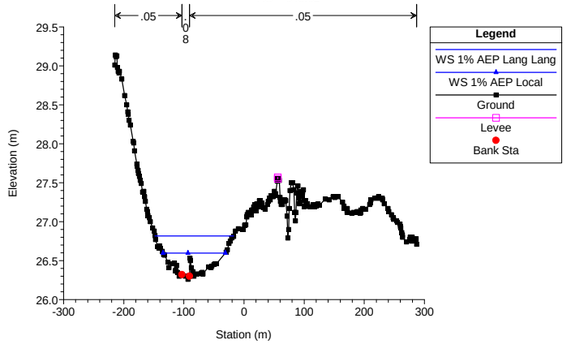


Existing Conditions Local Catchment 14/09/2022
RS = 943.61


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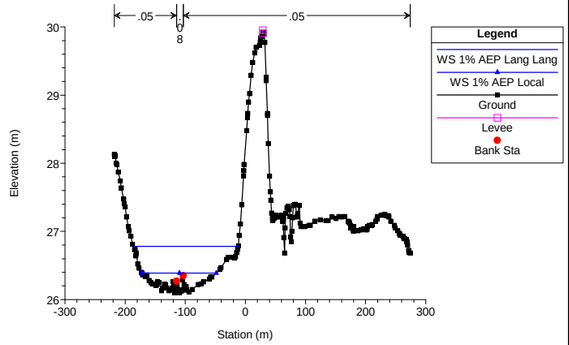
RS = 918.28


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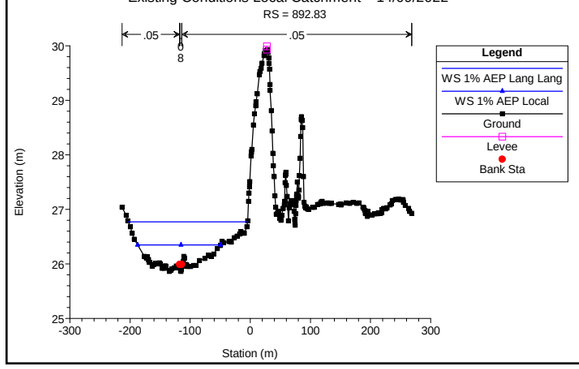
RS = 892.83


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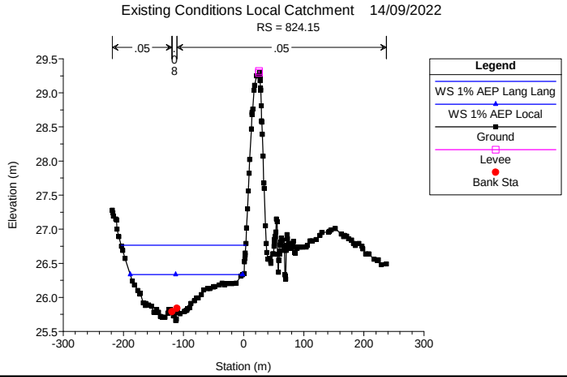
RS = 824.15


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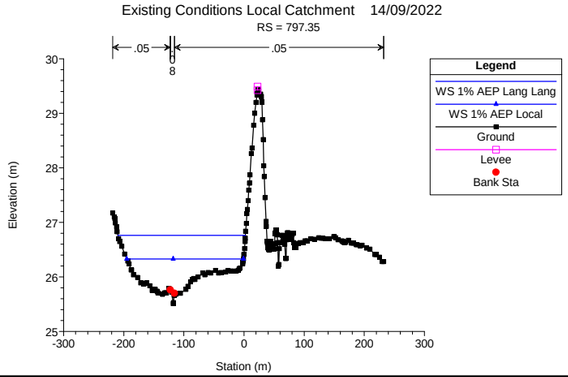
RS = 797.35


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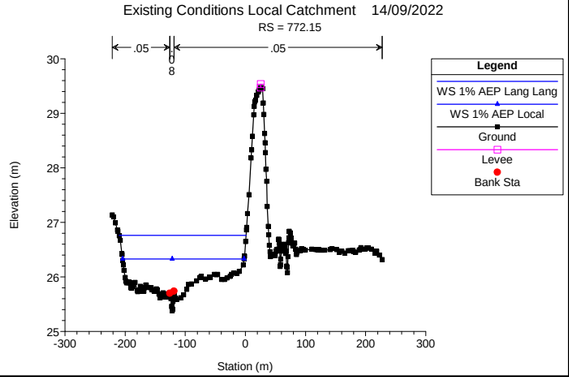

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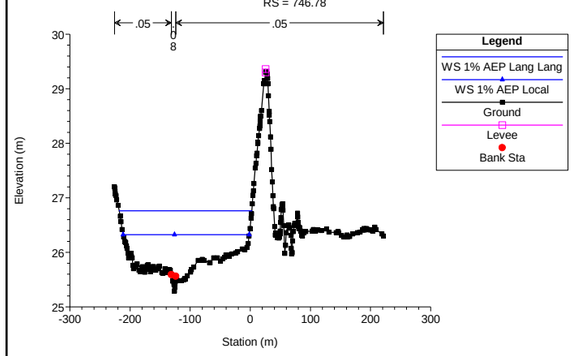

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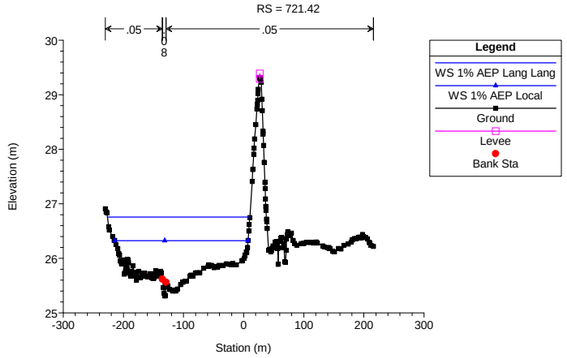
RS = 721.42


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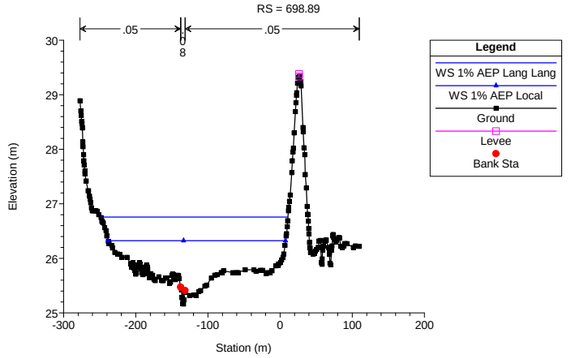

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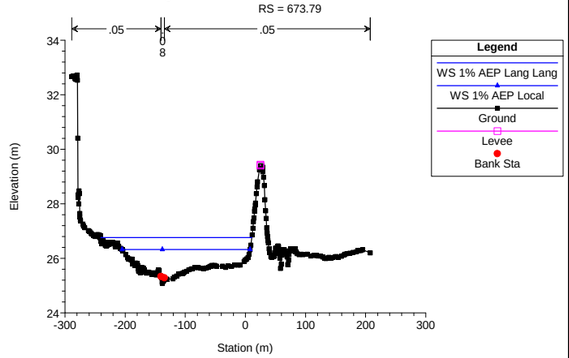
RS = 673.79


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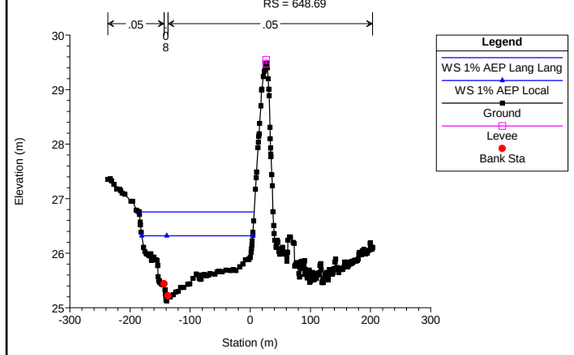

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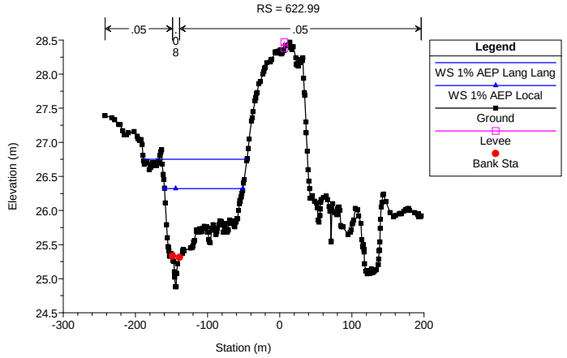

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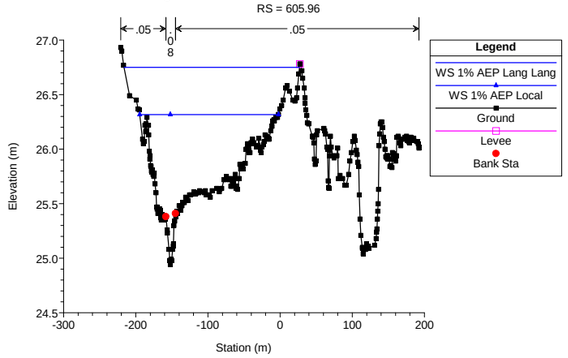
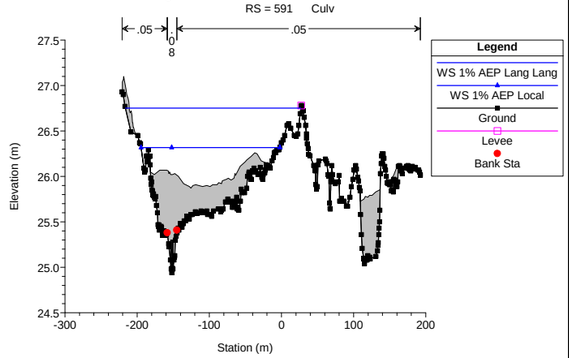
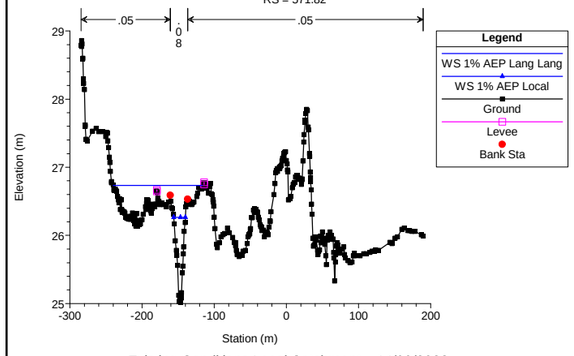


Existing Conditions Local Catchment 14/09/2022
RS = 591 Culv


Existing Conditions Local Catchment 14/09/2022
RS = 571.82


Existing Conditions Local Catchment 14/09/2022
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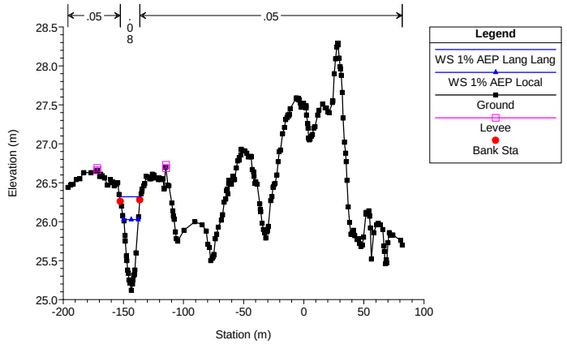

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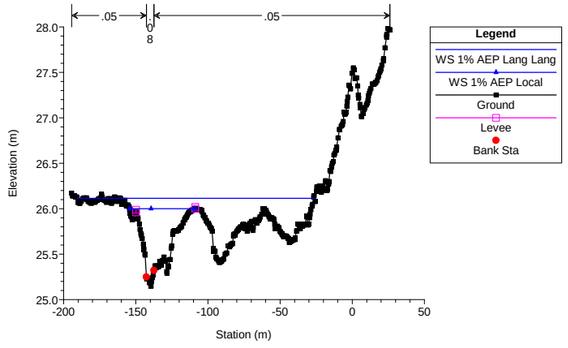
RS = 546.81


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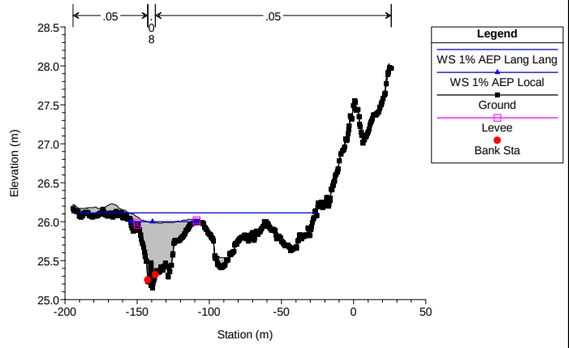

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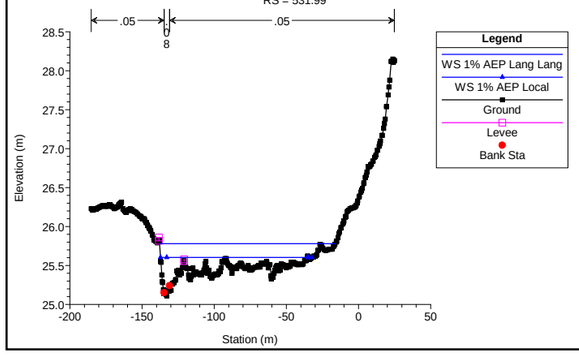

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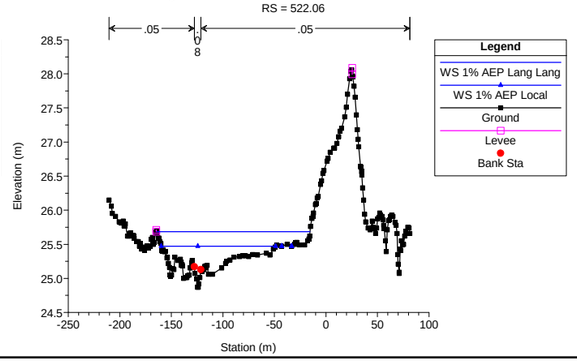
RS = 522.06


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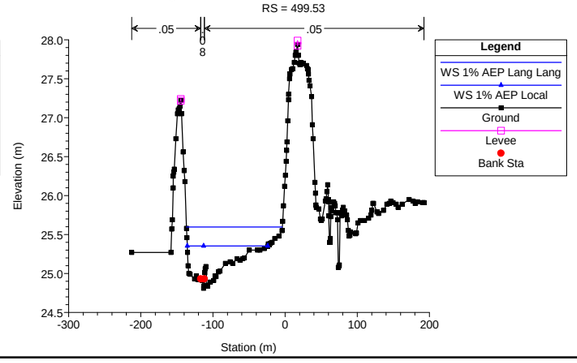

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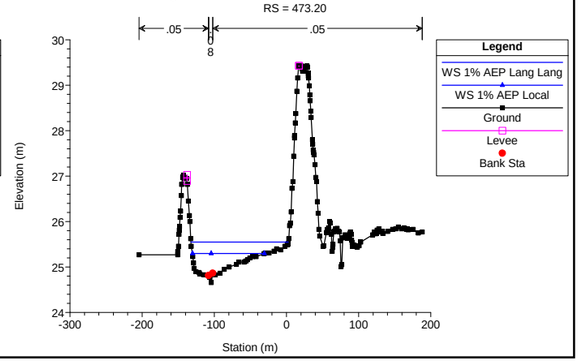

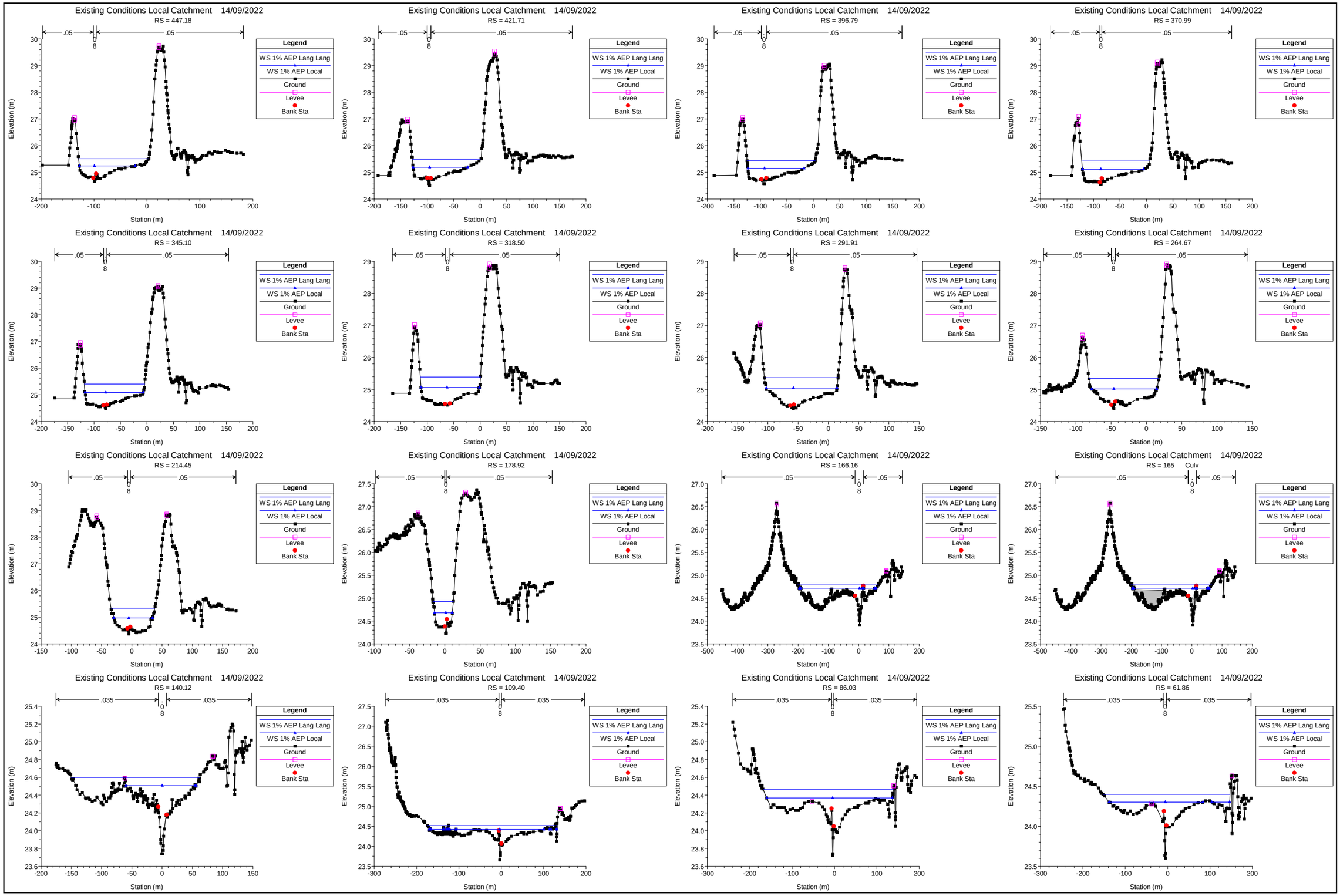
Existing Conditions Local Catchment 14/09/2022
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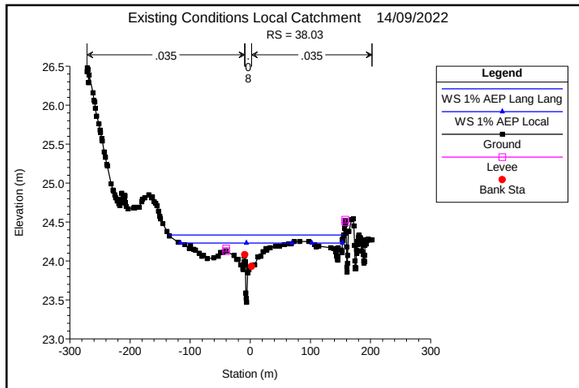
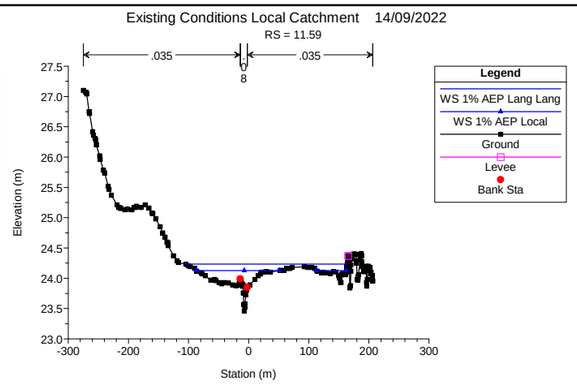
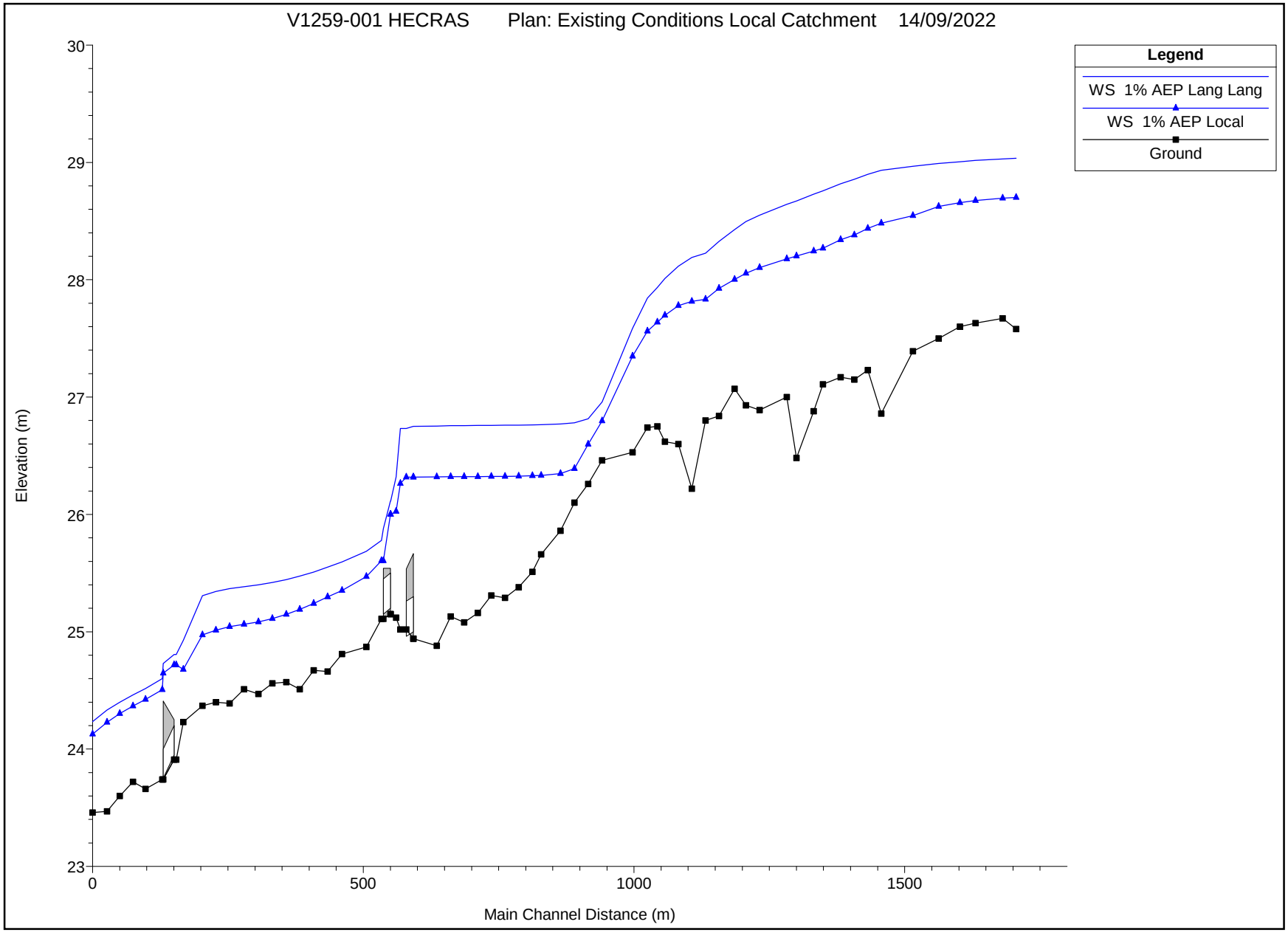
Existing Conditions Local Catchment 14/09/2022
RS = 421.71
Existing Conditions Local Catchment 14/09/2022
RS = 396.79
Existing Conditions Local Catchment 14/09/2022
RS = 370.99
Existing Conditions Local Catchment 14/09/2022
RS = 345.10
Existing Conditions Local Catchment 14/09/2022
RS = 318.50
Existing Conditions Local Catchment 14/09/2022
RS = 291.91
Existing Conditions Local Catchment 14/09/2022
RS = 264.67
Existing Conditions Local Catchment 14/09/2022
RS = 214.45
Existing Conditions Local Catchment 14/09/2022
RS = 178.92
Existing Conditions Local Catchment 14/09/2022
RS = 166.16
Existing Conditions Local Catchment 14/09/2022
RS = 165 Culv
Existing Conditions Local Catchment 14/09/2022
RS = 140.12
Existing Conditions Local Catchment 14/09/2022
RS = 109.40
Existing Conditions Local Catchment 14/09/2022
RS = 86.03
Existing Conditions Local Catchment 14/09/2022
RS = 61.86
Legend
WS 1% AEP Lang Lang
WS 1% AEP Local
Ground
Levee
Bank Sta
Elevation (m)
Station (m)
.05
.035
0
8

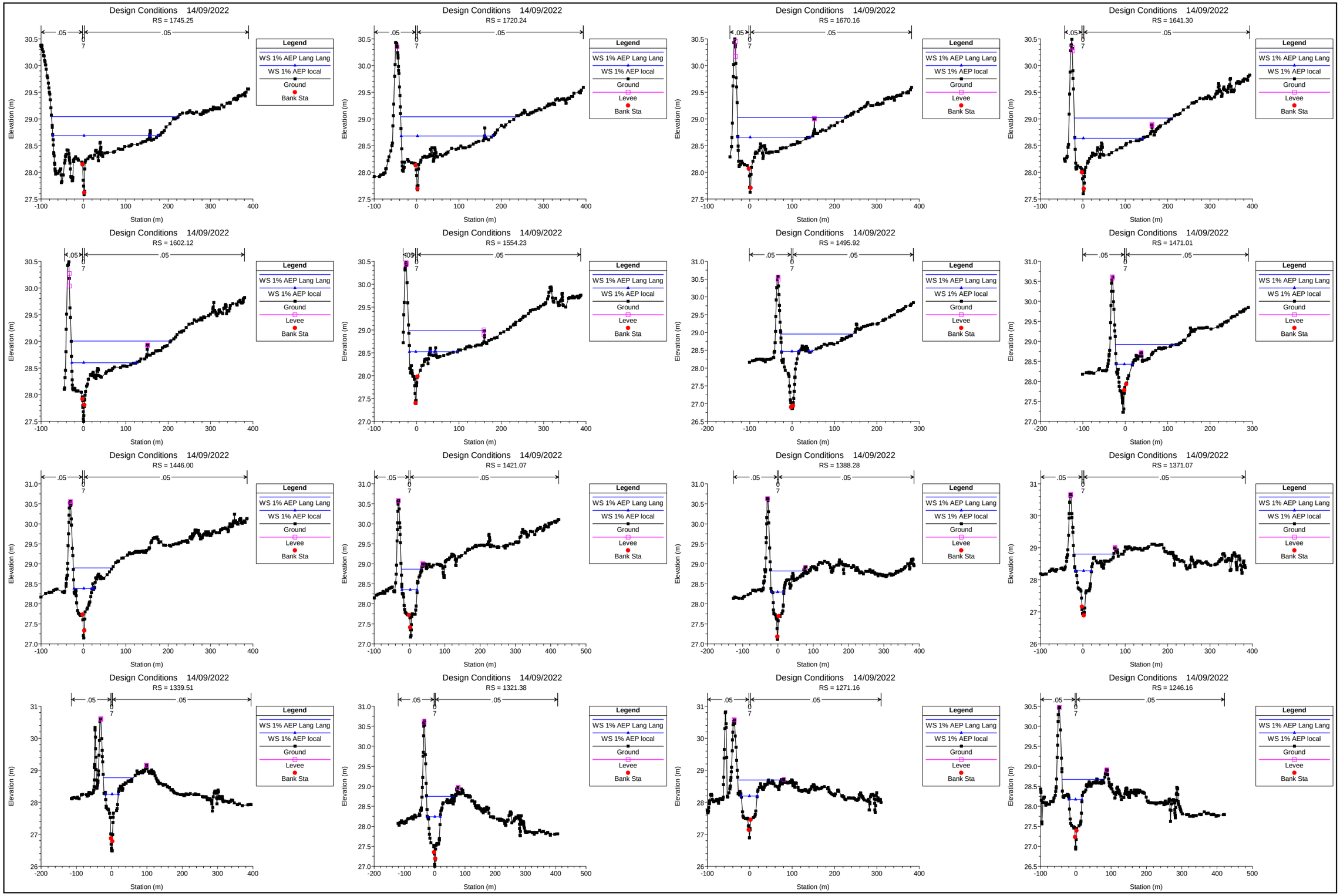

Existing Conditions Local Catchment 14/09/2022
RS = 38.03
.035
.035
8
Legend
WS 1% AEP Lang Lang
WS 1% AEP Local
Ground
Levee
Bank Sta
Elevation (m)
Station (m)

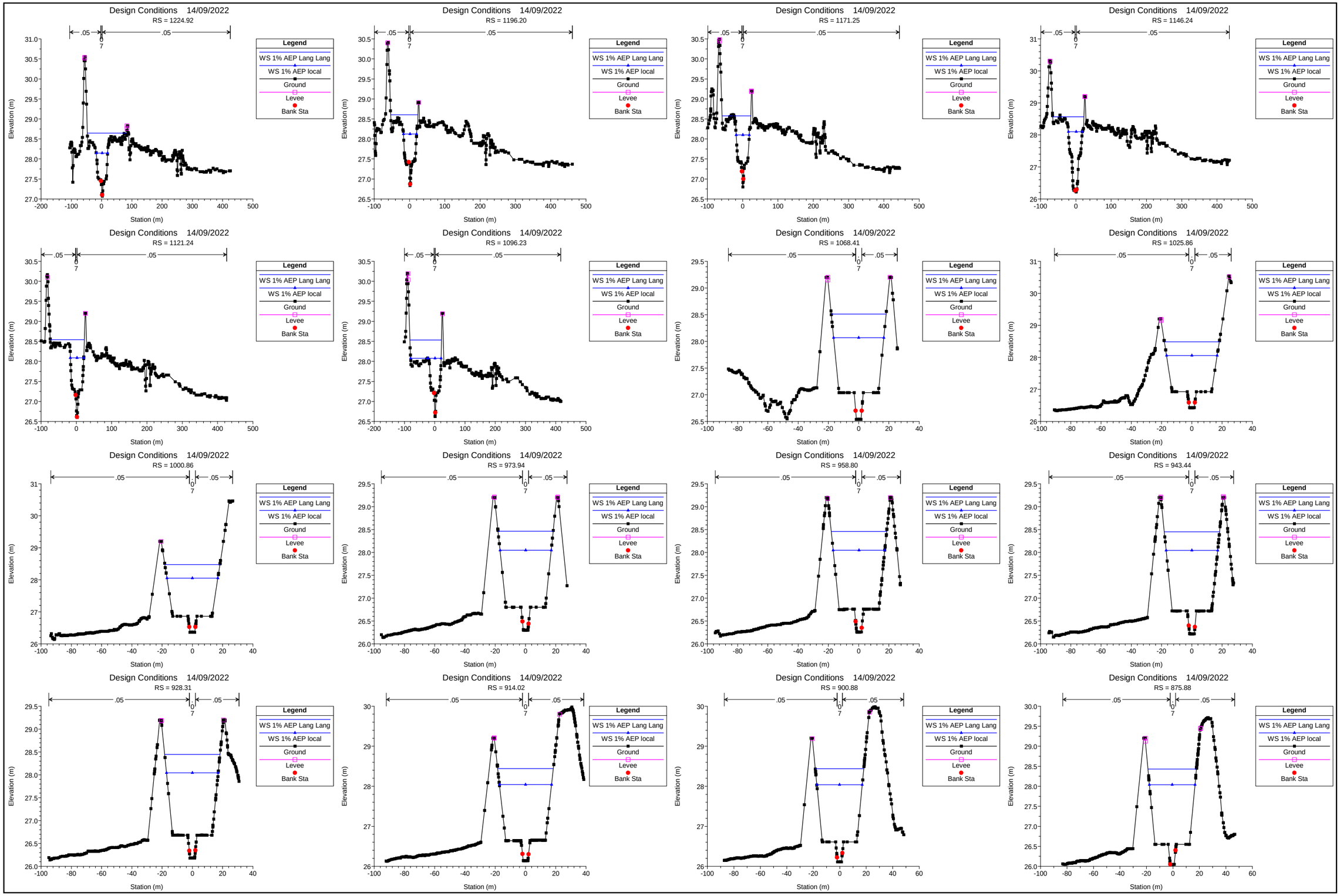

Existing Conditions Local Catchment 14/09/2022
RS = 11.59
.035
.035
8
Legend
WS 1% AEP Lang Lang
WS 1% AEP Local
Ground
Levee
Bank Sta
Elevation (m)
Station (m)

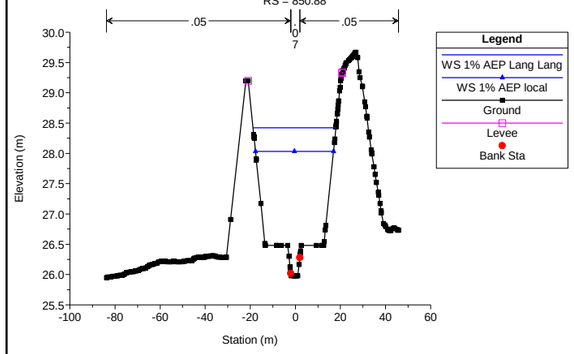

V1259-001 HECRAS Plan: Existing Conditions Local Catchment 14/09/2022
Legend
WS 1% AEP Lang Lang
WS 1% AEP Local
Ground
Elevation (m)
30
29
28
27
26
25
24
23
0
500
1000
1500
Main Channel Distance (m)

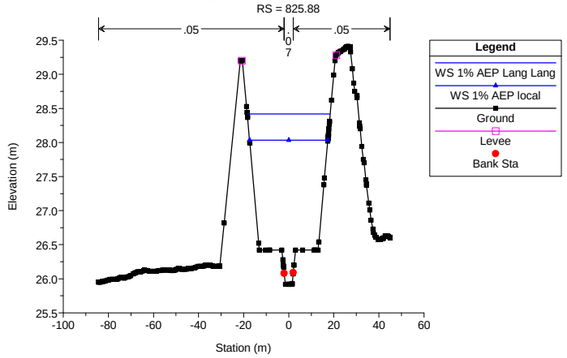
ENGENY
WATER MANAGEMENT

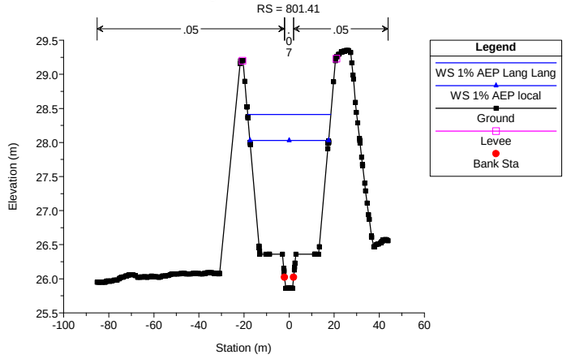
Appendix H:
Design Conditions HEC-RAS Longitudinal Section and Cross Sections


Design Conditions 14/09/2022
RS = 1745.25
Design Conditions 14/09/2022
RS = 1720.24
Design Conditions 14/09/2022
RS = 1670.16
Design Conditions 14/09/2022
RS = 1641.30
Design Conditions 14/09/2022
RS = 1602.12
Design Conditions 14/09/2022
RS = 1554.23
Design Conditions 14/09/2022
RS = 1495.92
Design Conditions 14/09/2022
RS = 1471.01
Design Conditions 14/09/2022
RS = 1446.00
Design Conditions 14/09/2022
RS = 1421.07
Design Conditions 14/09/2022
RS = 1388.28
Design Conditions 14/09/2022
RS = 1371.07
Design Conditions 14/09/2022
RS = 1339.51
Design Conditions 14/09/2022
RS = 1321.38
Design Conditions 14/09/2022
RS = 1271.16
Design Conditions 14/09/2022
RS = 1246.16
.05
0
7
Legend
WS 1% AEP Lang Lang
WS 1% AEP local
Ground
Levee
Bank Sta
Elevation (m)
Station (m)


Design Conditions 14/09/2022
RS = 1224.92
RS = 1196.20
RS = 1171.25
RS = 1146.24
RS = 1121.24
RS = 1096.23
RS = 1068.41
RS = 1025.86
RS = 1000.86
RS = 973.94
RS = 958.80
RS = 943.44
RS = 928.31
RS = 914.02
RS = 900.88
RS = 875.88
.05
.05
0
7
Legend
WS 1% AEP Lang Lang
WS 1% AEP local
Ground
Levee
Bank Sta
Elevation (m)
Station (m)

Design Conditions 14/09/2022
RS = 850.88


Design Conditions 14/09/2022
RS = 825.88


Design Conditions 14/09/2022
RS = 801.41


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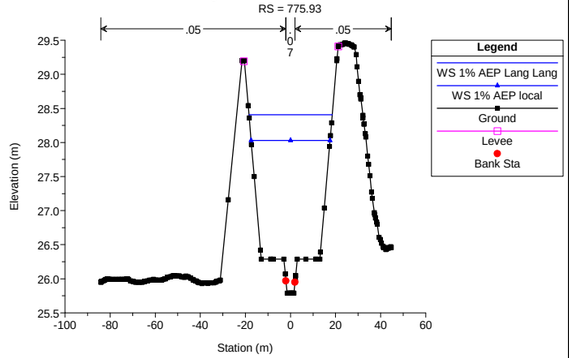

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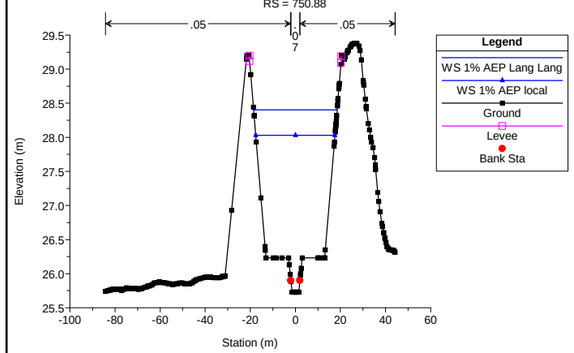
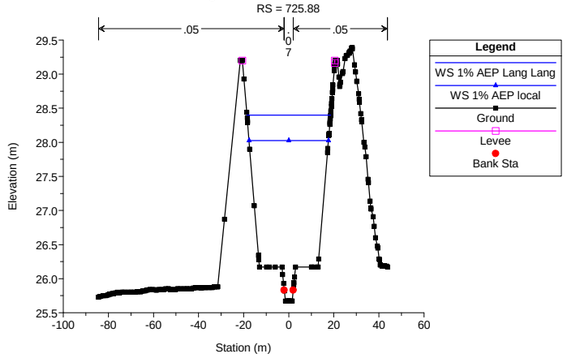
RS = 750.88


Design Conditions 14/09/2022
RS = 725.88


Design Conditions 14/09/2022
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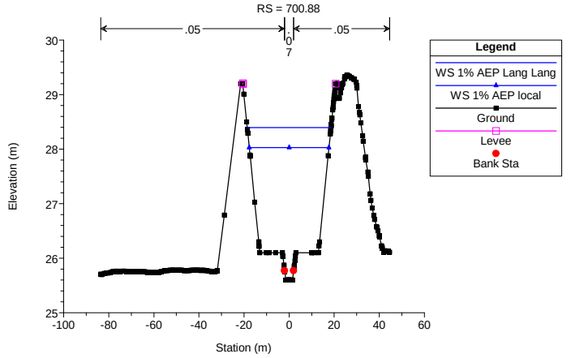

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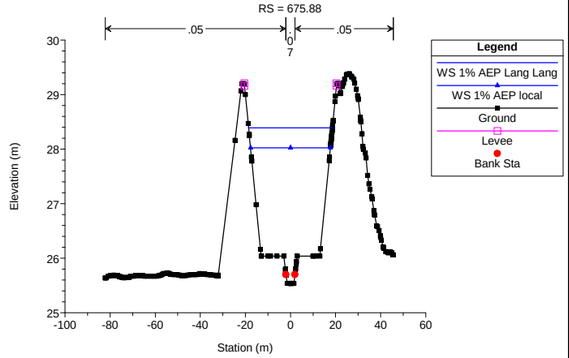

Design Conditions 14/09/2022
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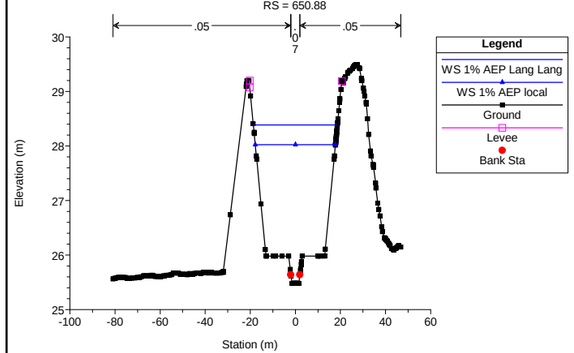
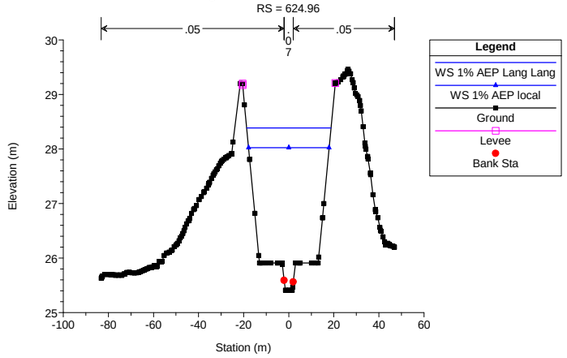


Design Conditions 14/09/2022
RS = 624.96


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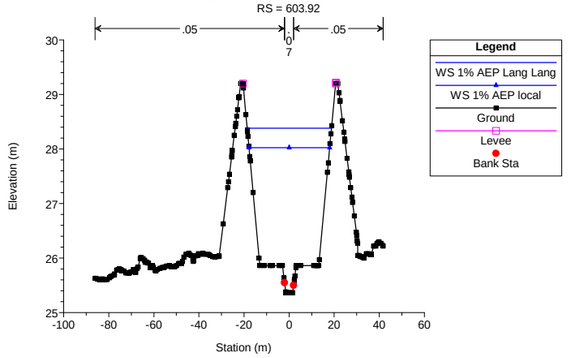
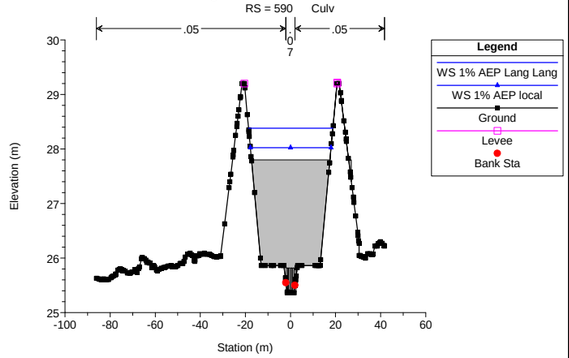
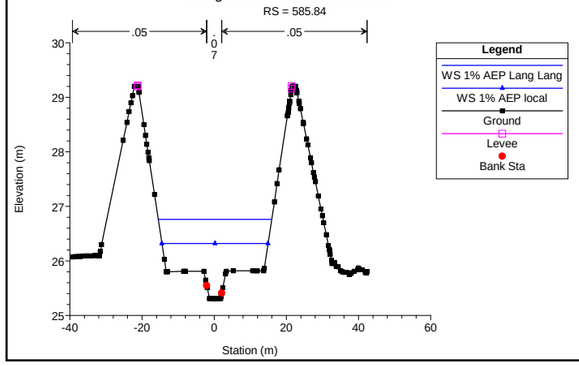


Design Conditions 14/09/2022
RS = 590 Culv


Design Conditions 14/09/2022
RS = 585.84


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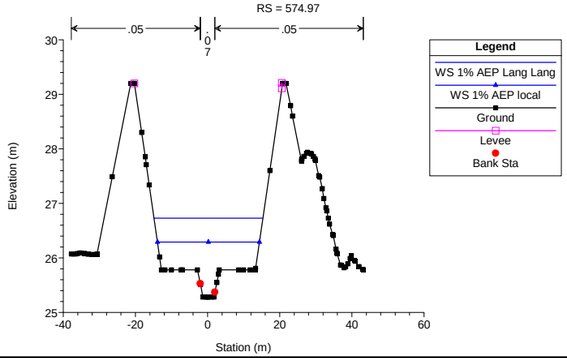

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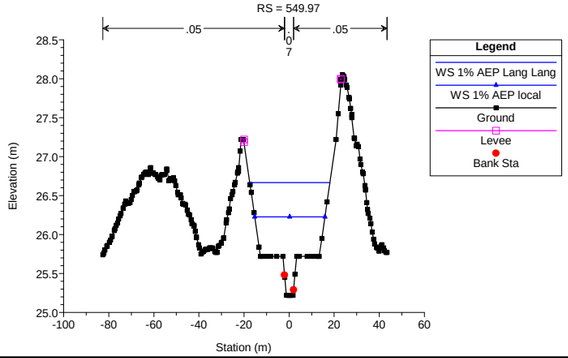

Design Conditions 14/09/2022
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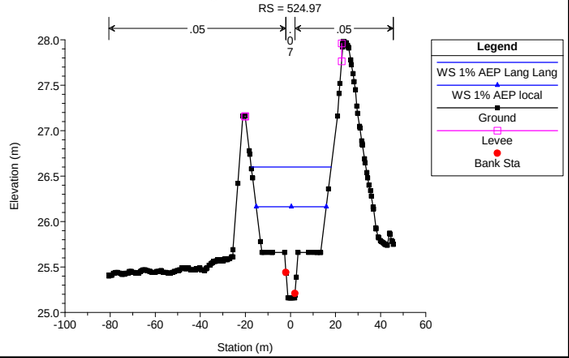

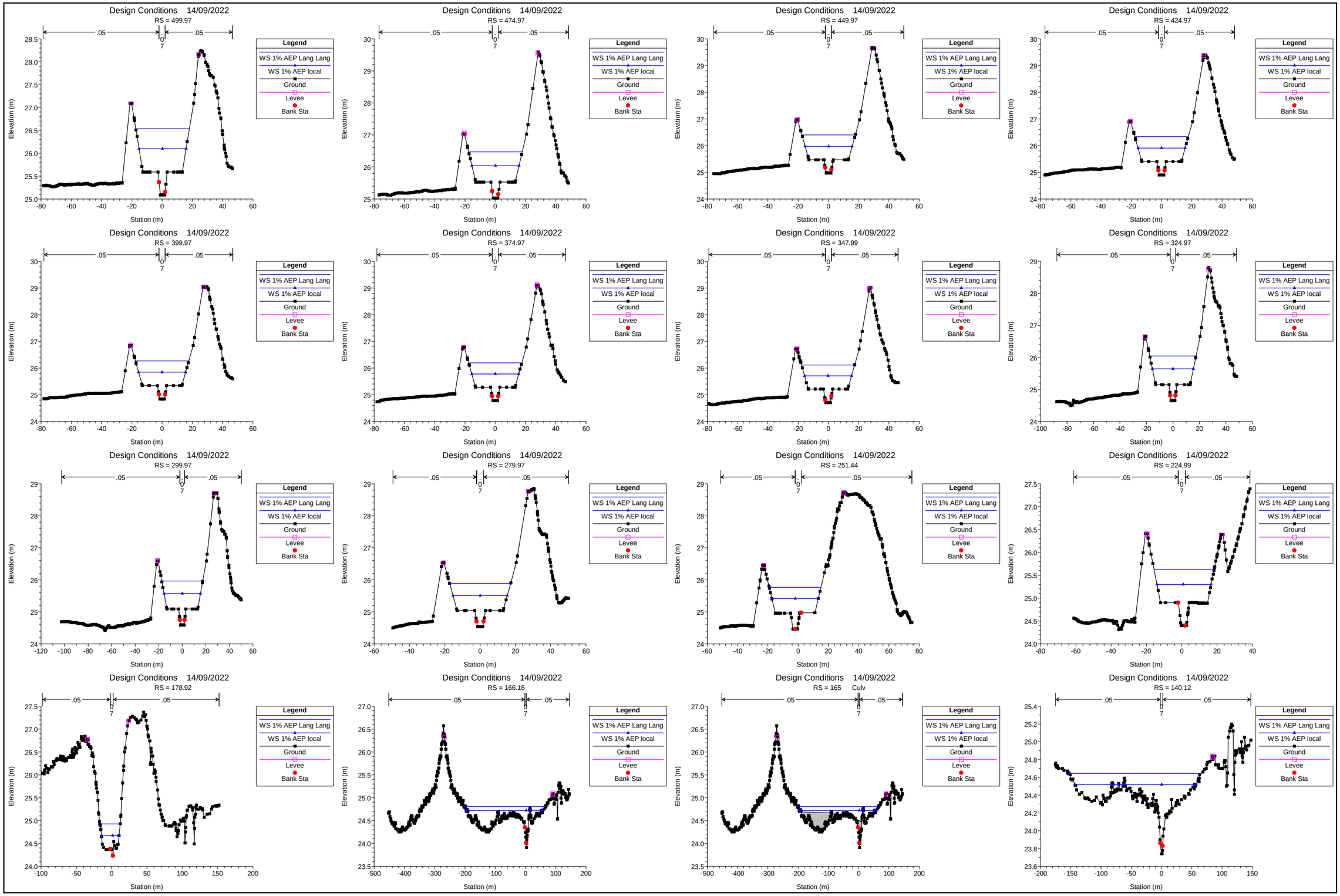
Design Conditions 14/09/2022
RS = 499.97
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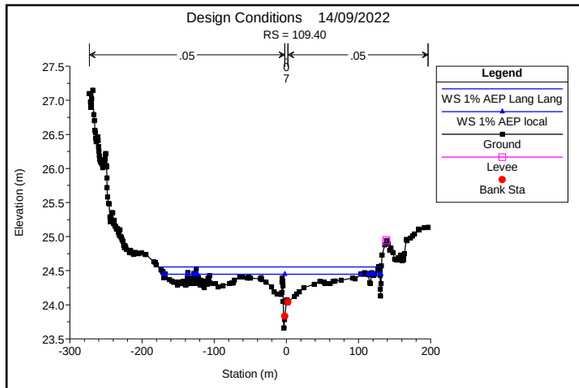
RS = 449.97
RS = 424.97
RS = 399.97
RS = 374.97
RS = 347.99
RS = 324.97
RS = 299.97
RS = 279.97
RS = 251.44
RS = 224.99
RS = 178.92
RS = 166.16
RS = 165 Culv
RS = 140.12
.05
0
7
Legend
WS 1% AEP Lang Lang
WS 1% AEP local
Ground
Levee
Bank Sta
Elevation (m)
Station (m)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.05
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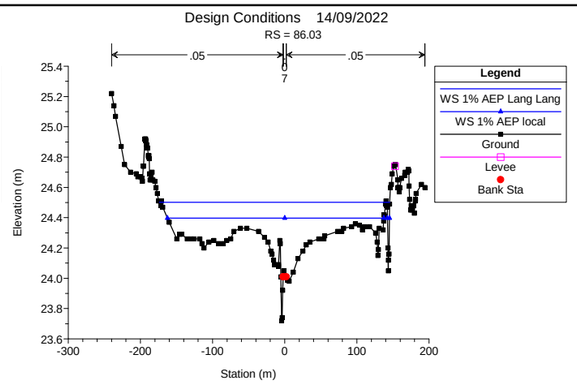
7
Legend
WS 1% AEP Lang Lang
WS 1% AEP local
Ground
Levee
Bank Sta
Elevation (m)
Station (m)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Legend
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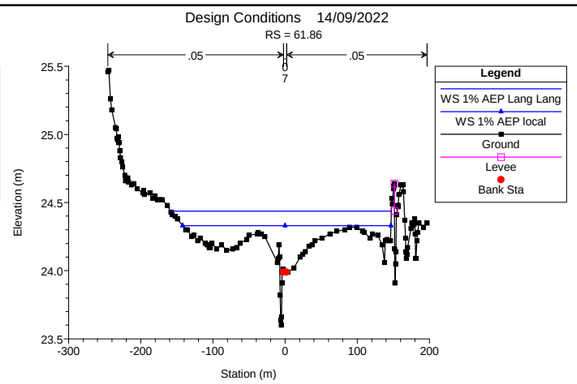
Ground
Levee
Bank Sta
Elevation (m)
Station (m)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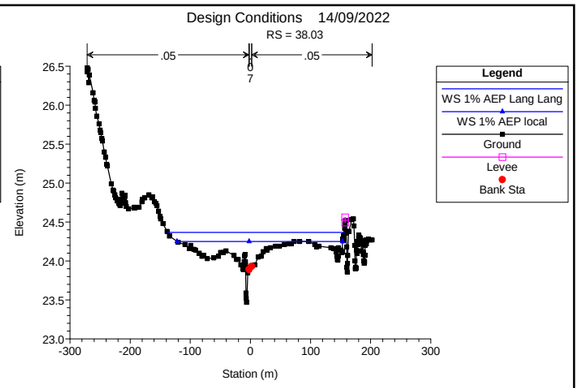
Ground
Levee
Bank Sta
Elevation (m)
Station (m)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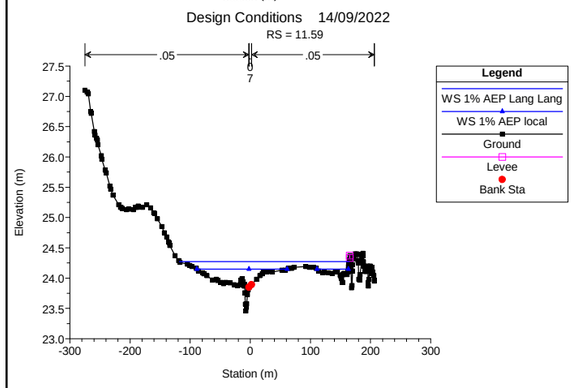
WS 1% AEP local
Ground
Levee
Bank Sta
Elevation (m)
Station (m)


Design Conditions 14/09/2022
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7
Legend
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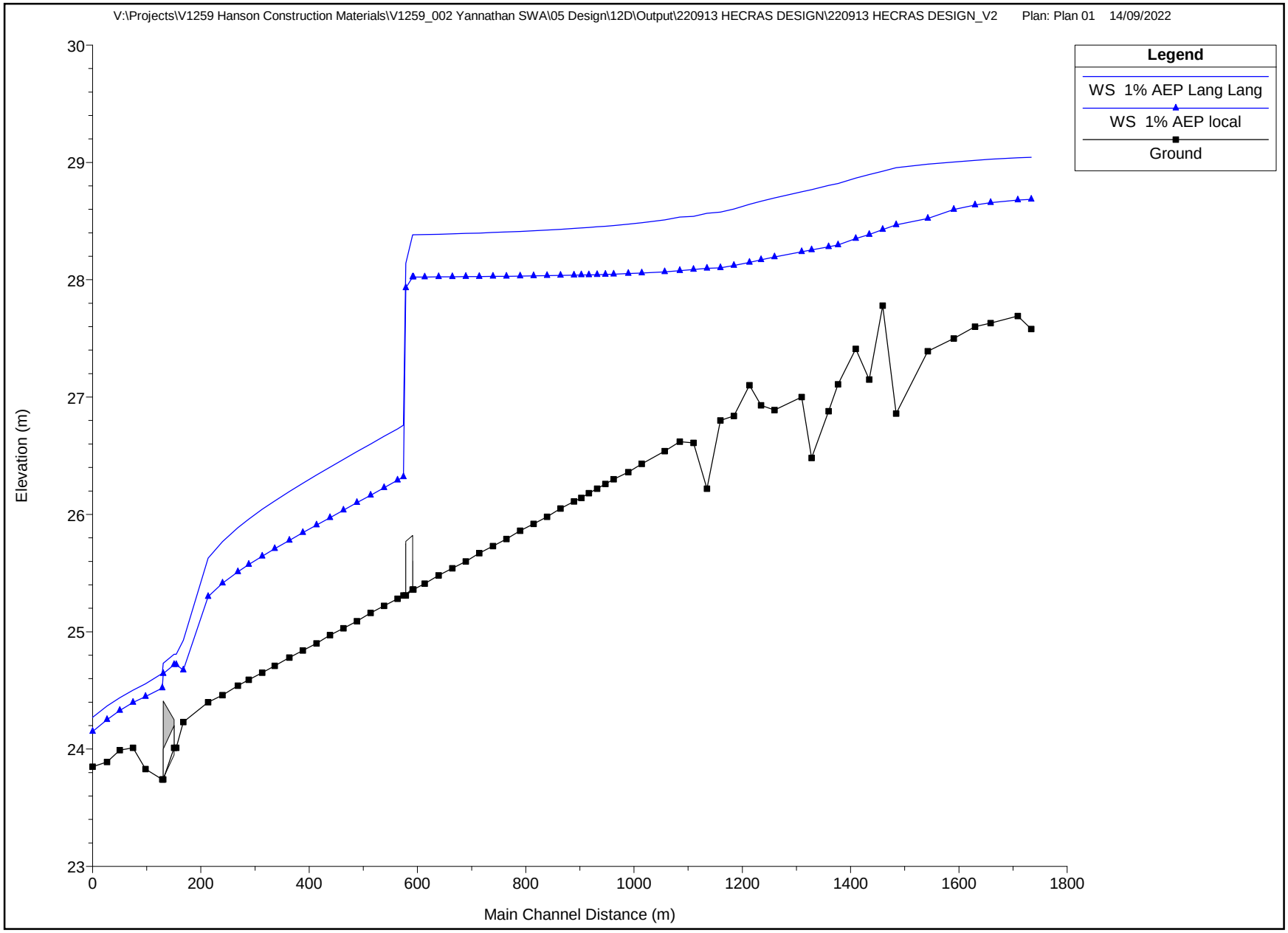
Ground
Levee
Bank Sta
Elevation (m)
Station (m)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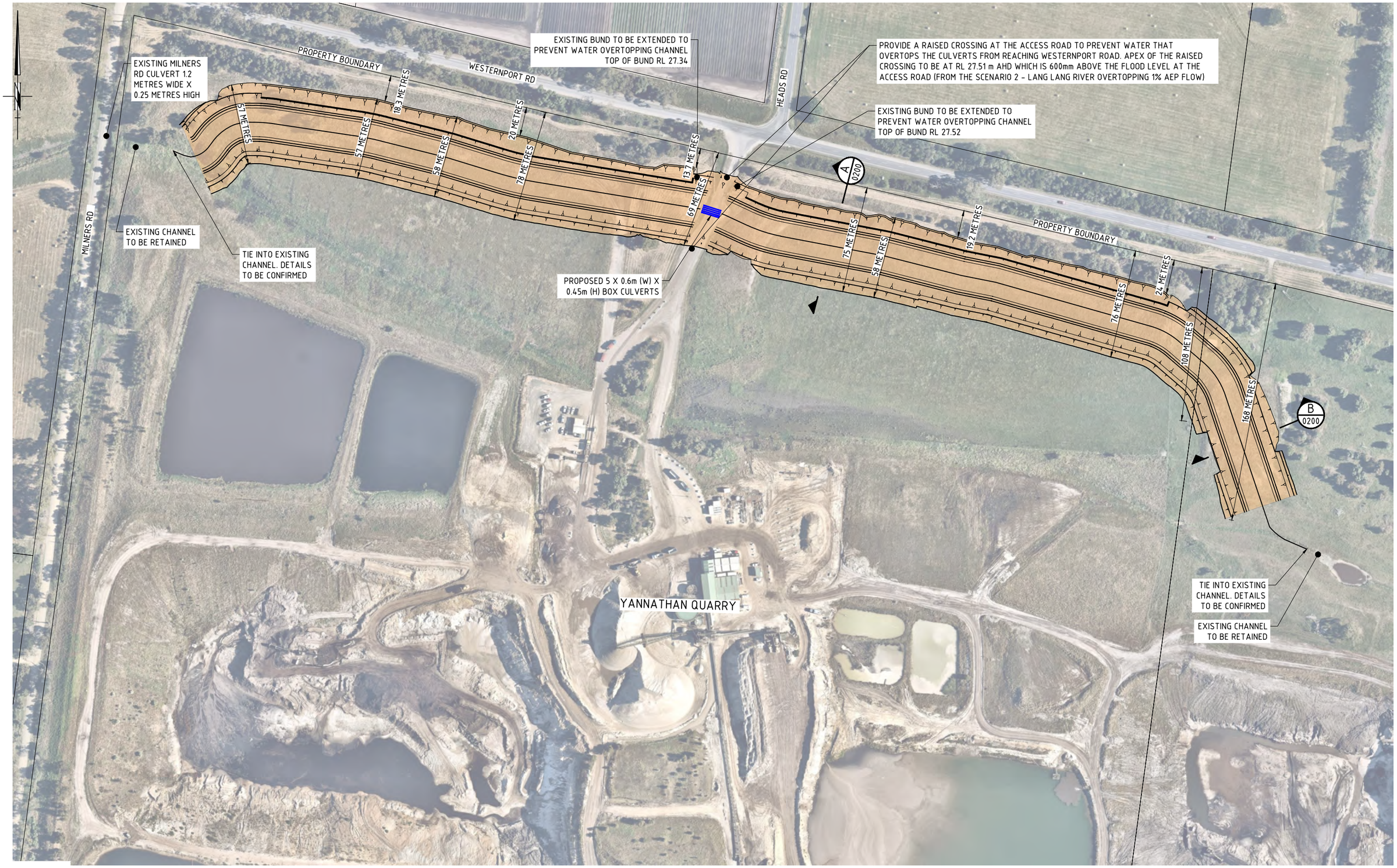
Legend
WS 1% AEP Lang Lang
WS 1% AEP local
Ground
Elevation (m)
Main Channel Distance (m)
30
29
28
27
26
25
24
23
0
200
400
600
800
1000
1200
1400
1600
1800

ENGENY
WATER MANAGEMENT

Appendix I:
Concept Design



LEGEND:

EXTENT OF PROPOSED CHANNEL

0 12.5 25 37.5 50 62.5m

SCALE 1:1250 (A1)
SCALE BEFORE REDUCTION

LAST MODIFIED:17/12/2021 12:33 PM
CAD REF:V:\PROJECTS\V1259 HANSON CONSTRUCTION MATERIALS\V1259_002 YANNATHAN SWA\05 DESIGN\AUTOCAD\DRAWINGS\CONCEPT DESIGN\V1259-002-DWG-0100.DWG

REV	BY	DATE	REVISION DESCRIPTION	PM APPD.
A				

DOC. NUMBER	DOCUMENT TITLE
REFERENCE DOCUMENTS	

Hanson

ENGENY WATER MANAGEMENT
Ph. 03 9888 6978
Level 34
360 Elizabeth St
Melbourne VIC
www.engeny.com.au

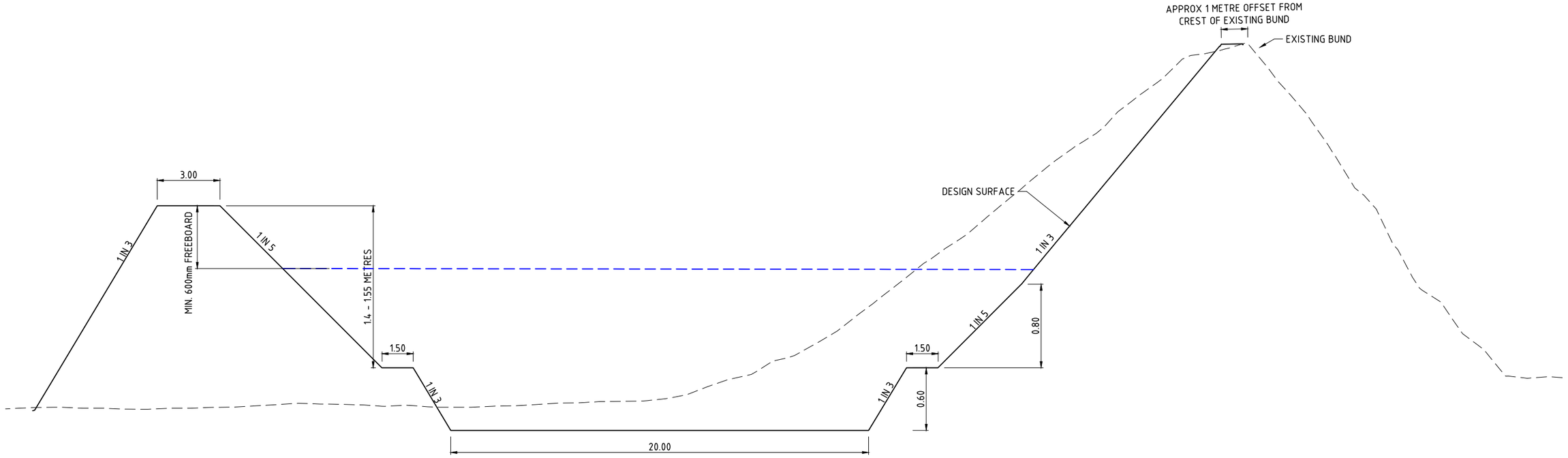
STATUS: NOT FOR CONSTRUCTION - FOR REVIEW

DESIGNED		CHECKED	
DRAWN		CHECKED	
PM APPD.		PD APPD.	
CPENG		CPENG No.	

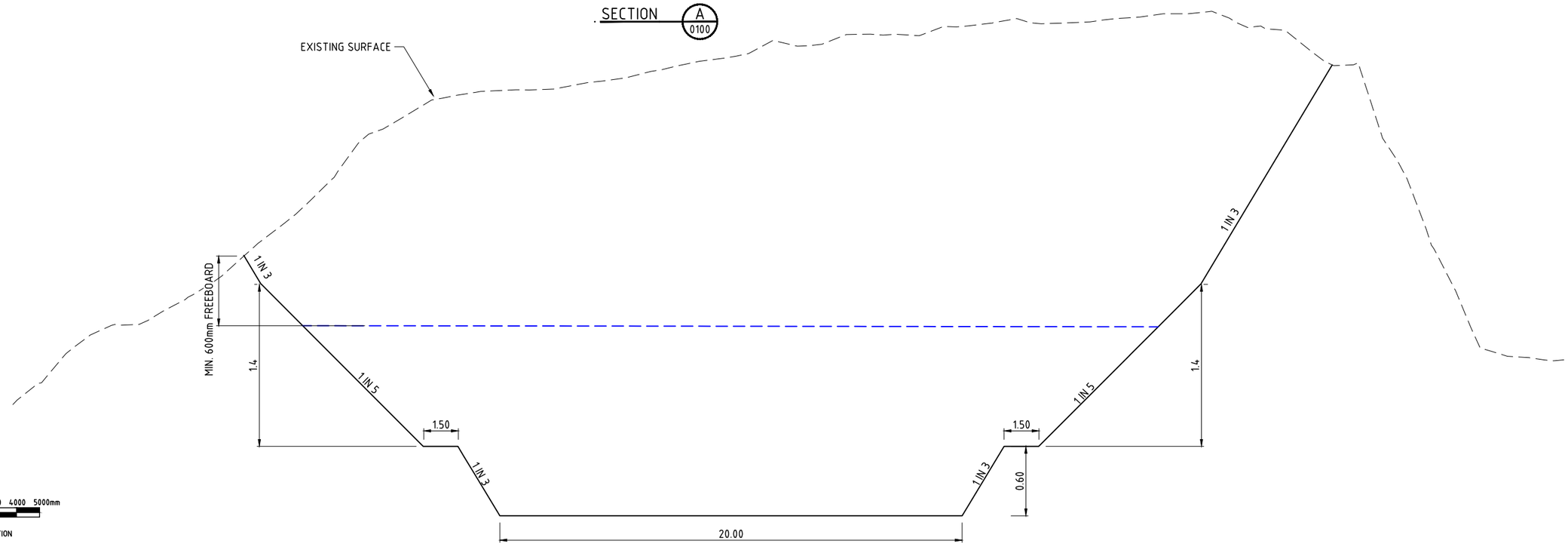
HANSON CONSTRUCTION MATERIALS

YANNATHAN SURFACE WATER ASSESSMENT CONCEPT LAYOUT PLAN

ORIGINAL SIZE: A1
DWG NO.: V1259-002-DWG-0100
REV.: A



SECTION A 0100



SECTION B 0100

0 1000 2000 3000 4000 5000mm
SCALE 1:100 (A1)
SCALE BEFORE REDUCTION

0 200 400 600 800 1000mm
SCALE 1:20 (A1)
SCALE BEFORE REDUCTION

SECTION A 0100

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LAST MODIFIED:15/12/2021 11:31 AM

REV	BY	DATE	REVISION DESCRIPTION	PM APPD.
A				

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REFERENCE DOCUMENTS	

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DESIGNED		CHECKED		
DRAWN		CHECKED		
PM APPD.		PD APPD.		
CPENG		CPENG No.		

HANSON CONSTRUCTION MATERIALS

YANNATHAN SURFACE WATER ASSESSMENT
CONCEPT TYPICAL SECTION

ORIGINAL SIZE	DWG NO.	REV.
A1	V1259-002-DWG-0200	A

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