

**Wallum Estate
Torakina Road, Brunswick Heads
Lot 13 DP 1251383**

Revised Wallum Froglet Management Plan

Client	: Clarence Property Pty Ltd
Prepared by	: Australian Wetlands Consulting Pty Ltd
Project #	: 1-211400
Date	: September 2022

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Torakina Road, Brunswick Heads Lot 13 DP 1251383

Revised Wallum Froglet Management Plan

Project control

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AWC's management system has been certified to ISO 9001

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1 Introduction and Background

1.1 Introduction

Australian Wetlands Consulting (AWC) has completed this *Revised Wallum Froglet Management Plan* (WFMP) to comply with consent conditions in the concept plan approval issued by the NSW Department of Planning and Infrastructure (DPI) (now Department of Planning, Industry & Environment; 'DPE') for a residential subdivision at Lot 13 DP 1251383 Torakina Road, Brunswick Heads (refer Section 1.3).

In 2013 AWC completed an assessment of acid frog habitat at the site. Byron Shire Council (BSC) gave in-principle support to the assessment and the proposed strategies for stormwater treatment and acid frog management at the site. As such this WFMP has been prepared to incorporate the revised treatment of the central drain and clarify matters regarding the integration of stormwater works and Wallum Froglet habitat. The *Water Cycle Management Stormwater Concept* (Fletcher & Pfaeffli, 2014) and the *Stormwater and Acid Frog Habitat Management Strategy* (AWC, 2014) developed by AWC were previously approved by DPI.

Concept Plan Approvals and Statement of Commitments relevant to this WFMP are detailed in Table 1.1.

Table 1.1 Concept Plan Approvals and Statement of Commitments

Reference	Requirement
Concept Approval	
B4	<i>The Stormwater Concept and associated Wallum Froglet compensatory habitat rehabilitation as described in the PPR is not approved. A revised Stormwater Concept for the project must be prepared by a suitably qualified person in consultation with council to achieve the following objectives:</i> <i>a) retention of the existing north-south drain alignment with a buffer of 20m either side of the channel such that the existing wallum froglet habitat in this area is conserved and enhanced. Minor infringements of up to 5m into the buffer area can occur provided they are offset on the other side of the channel. For example, a buffer may be 15m on one side of the channel provided this is offset by increasing the other side to 25m (i.e. a total width of 40m plus channel width);</i> <i>b) the buffer areas should not contain stormwater management facilities other than a stormwater treatment basin at the southern end of the channel, where required;</i> <i>c) no significant change to the flow regimes from the pre-development regime.</i>
B5	<i>The existing north-south drain alignment and buffer (as determined under modification B4 of this approval) is to become a public reserve.</i>
Statement of Commitments	

Reference	Requirement
S1	<i>Development to be generally in accordance with the concept application plans and the recommendations of the appendices of the Environmental Assessment and Preferred Project Report, including but not limited to:</i> <i>a) development footprint not extending outside the 2(a) Residential zone pursuant to Byron LEP 1988;</i> <i>b) the number of lots;</i> <i>c) the mixture of lot sizes;</i> <i>d) conservation of ecologically sensitive areas;</i> <i>e) location and dimensions of Park 1 and Park 2;</i> <i>f) retention of trees on public land including road reserves and drainage reserves;</i> <i>g) location of stormwater treatment and disposal areas; and</i> <i>h) extent of earthworks.</i>
B1	<i>The width of the road corridors will be minimised where roads traverse significant habitats and vegetation.</i>
B3	<i>An area of constructed Wallum Froglet habitat is proposed within reserves which will be dedicated to Council. Those areas will be incorporated into the Stormwater management plan and will result in the net gain of almost 3000m² of Wallum Froglet habitat. A Wallum Froglet Compensatory Management Plan will guide the construction and management of this habitat.</i>
B4	<i>A Wallum Froglet Compensatory Habitat Plan will be prepared to the satisfaction of the Office of Environment and Heritage prior to approval of the first stage construction certificate. The WFCHP is to be generally in accordance with information prepared by James Warren and Associates and submitted for approval prior to the release of the CC.</i>
SW4	<i>Prepare resident information package regarding prevailing soil conditions the most ecologically sustainable methods for gardening in these conditions and any other sensitivities of the local ecosystem, including information on local endangered species such as the Wallum Froglet.</i>
SW7	<i>In the event that excavations are required outside of the proposed development footprint or below 2.0m below surface level within the building envelope additional testing should be considered by the consent authority.</i>

Approvals were given for the first stage of development (Stage 1A) to commence which involved a 1.514ha (12 lot Subdivision). Stage 1A has been completed and this area does not form part of the subject site (Lot 13 DP1251383). This WFMP relates to the creation and retention of Wallum Froglet (WF) Habitat within Lot 13 only.

NOTES

1. This WFMP has been prepared in collaboration with the *Stormwater Management Plan* (Martens & Associates 2021) and the *Surface Water and Groundwater Management Plan* (AWC, 2021) to ensure consistency in approach and to achieve best outcomes.
2. AWC have prepared a *Revised Vegetation Management Plan* (VMP) for the site which designates actions within several Management Zones. Actions in the VMP are separate to those prescribed in this WFMP and are not referenced further. Conversely, none of the actions prescribed in this WFMP are referenced in the VMP.

1.2 Property Details

The subject site (Lot 13 DP1251383) is located immediately south of the township of Brunswick Heads and has an area of approximately 30.5 ha (refer Figure 1.1). Most of the site is dominated by low heath which is maintained by slashing. The site is bound by residential development to the north with areas of undisturbed forest to the west and south of the site. The eastern boundary of the site is bound by Simpsons Creek. The property is bisected north-south by a constructed drainage line ('the central drain') which feeds into Everitts Creek to the south which connects to Simpsons Creek in the east. A road reserve of 20 metres width occurs in the eastern portion of the site (refer Figure 1.1) and continues into adjacent land at Lot 4 DP576360.

Coastal Wetlands gazetted under State Environmental Planning Policy (Resilience and Hazards) 2021 occur in the east of the site flanking Simpsons Creek.

Actions in this Plan relate to undeveloped parts of the site in the east, the central drain and the west. A substantially vegetated part of the site occurs in the east flanking Simpsons Creek. No actions in this Plan are proposed within this land.

1.3 Proposed Development

The Proposal is for the subdivision of 15 Torakina Road, Brunswick Heads (Lot 13 in DP 1251383) in 3 stages comprising, 123 residential lots, three (3) medium density lots and four (4) public reserves together with associated public roads and infrastructure services (water, sewer, drainage and stormwater management works), bulk earthworks, tree removal and vegetation management works.

The development footprint occupies approximately 13.33 ha (43.7 %) of the site. Residual land outside of the development footprint (~17.2 ha) will be managed for biodiversity. Residual land in the west of the site, the central drain and west of the road reserve will be dedicated to Council once required works are completed. The portion of the site east of the road reserve flanking Simpsons Creek (10.24 ha) will also be dedicated to Council.

The proposed development is shown at Figure 1.2; subdivision design plans are provided in Appendix A.

The refined development footprint provides substantial gains with regard to protection and enhancement of Wallum Froglet habitat at the site including:

- A substantial increase in the retention of habitat within the central drain (Management Zone 3). In the revised concept the buffer width has increased to 50m+ and the total area of frog habitat in this portion of the site is now approximately three hectares.
- All habitat in the east and west will be dedicated to Council as a conservation reserve.

- There will be no dual use of drainage channels for stormwater conveyance and acid frog habitat; dual use drainage lines were a point of concern in the previous application and subsequently the stormwater, frog habitat and conveyance channels have been separated.

Figure 1.3 illustrates areas of Wallum Froglet habitat impacted and retained by the proposed subdivision, whereby:

- 1.3 ha of Wallum Froglet habitat will be lost
- 2.6 ha of Wallum Froglet habitat will be retained
- A further 1.9 ha of habitat will be created, achieving a net increase of approximately 0.6 ha.

1.4 Previous Studies

An Amended Ecological Assessment Report was prepared by James Warren and Associates (JWA, 2011) and accompanied the initial submission to DPI. In response to requests by DPI for revisions to the existing Acid Frog Management Strategy and Stormwater Management Plan, ecological, hydrological and groundwater assessments have been completed by AWC (2013) as well as a revised Stormwater Management Strategy (AWC 2016) in collaboration with CivilTech Consulting Engineers.

In early 2022 AWC prepared a BDAR for the project; several additional threatened fauna species were recorded including the Olongburra Frog (*Litoria olongburensis*). As noted in the BDAR, the Olongburra Frog was recorded in two locations (Feb 2022). In the west, a single individual was recorded calling every night within a small patch of PCT 1290 within historically disturbed regrowth wet heath. In the south-east corner of the site, a small area of PCT 1290 occurs within surrounding wet heath. Up to four frogs were recorded calling at this location on a number of occasions. Other wet vegetation at the site is not suitable for the species as it lacks the qualities of PCT 1290, ie. slightly deeper areas of ponded water with robust erect sedges (*Baloskion pallens*, *Schoneus brevifolius*). An area of high quality habitat suitable for the Olongburra Frog is known to occur south west of the site (Lot 14 DP 881230) adjacent to the Pacific Highway and this habitat is well connected to the site. It is suspected the species may utilise this habitat and disperse into surrounding areas of suitable habitat during inundation events.

The recent finding of the Olongburra Frog at the site has partially informed the revised layout (habitat in the west is now retained in-situ). While habitat is not impacted several habitat ponds have been designed with depths of up to 0.4 m to suit the species.

1.5 Species Profile

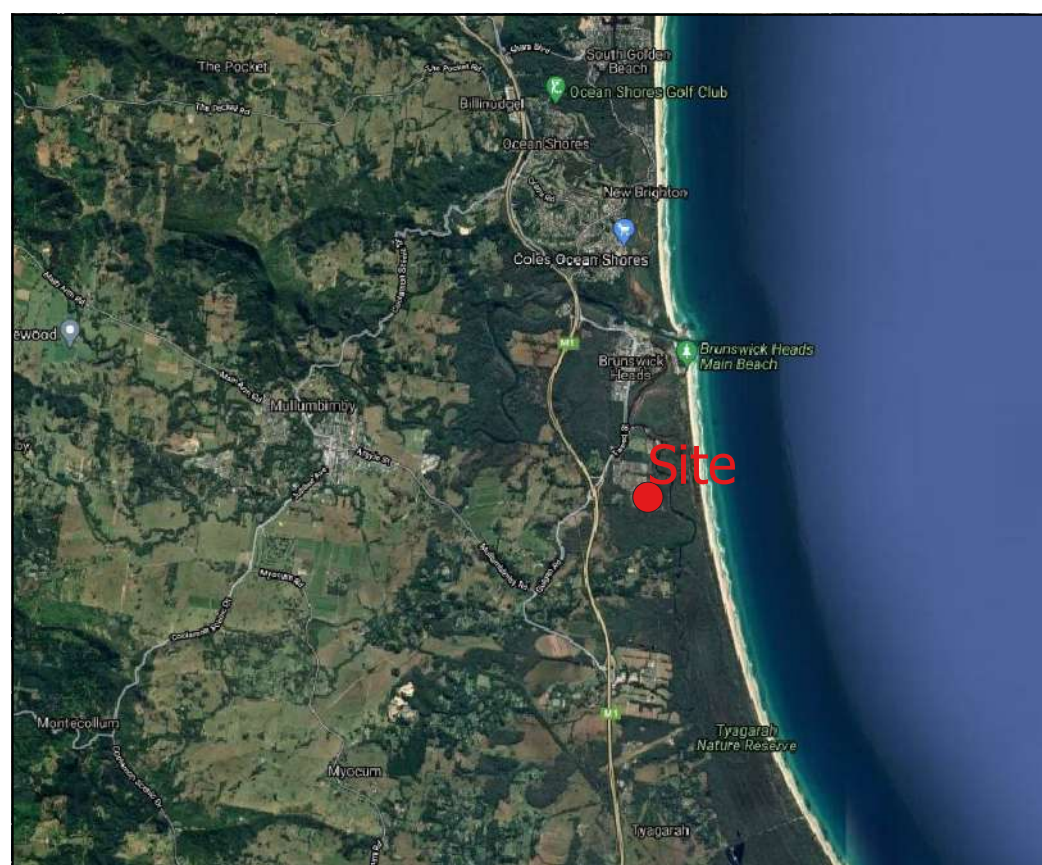
The Wallum Froglet (*Crinia tinnula*) is listed as Vulnerable under the *Biodiversity Conservation Act 2016* and typically occurs in sedgelands and wet heathlands, usually associated with acidic swamps on coastal sand plains. The species can also be found along drainage lines within other vegetation communities and disturbed areas, and occasionally in swamp sclerophyll forests. Acidic swamps and lakes in these areas provide essential breeding habitat for wallum-dependent frog species.

Wallum Froglets breed in swamps with permanent water as well as shallow ephemeral pools and drainage ditches. Breeding is thought to peak in the colder months but can occur throughout the year following rain. Eggs are deposited in nutrient poor water with a pH of <6 and tadpoles take 2-6 months to develop into frogs. Wallum Froglets shelter under leaf litter, vegetation, other debris or in burrows of other species. Shelter sites are wet or very damp and often located near the water's edge. Males may call throughout the year and at any time of day, peaking following rain.

1.6 Management Plan Objectives

The objectives of this plan are:

- To retain Wallum Froglet/Olongburra Frog habitat wherever possible within the three proposed management zones
- To enhance acid frog habitat within management zones by a variety of methods
- Provide suitable water quality and hydroperiod conditions for acid frogs.



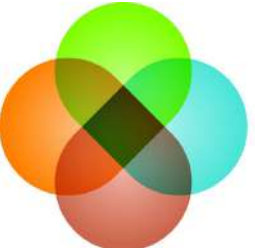


Figure:

File:

Source:

1.1 Subject Site

1-211400-BaysideBrunswick_ClarenceProperty

Aerial Image - Near Maps 2021



050100150200250 m

Legend

 Site Boundary

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A3 Scale 1:4000
Coordinate System: MGA 56 Projection: Transverse Mercator
Date: 17-8-21





LEGEND

- PROPERTY BOUNDARY
- EXISTING DRAIN
- RETAINED WF HABITAT
AREA = 2.6ha
- CREATED WF HABITAT AREA
AREA = 1.9ha
- REMOVED WF HABITAT
AREA = 1.3ha

TOTAL EXISTING WF HABITAT = 3.9ha
NET INCREASE IN HABITAT = 0.6ha



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CLIENT:



**CLARENCE
PROPERTY**

DRAWING: **FIGURE 1.3 - WALLUM
FROGLET HABITAT MAPPING**

PROJECT: **WALLUM ESTATE**

REV.	ISSUE / AMENDMENTS	DATE
A	FOR APPROVAL	21.09.22

ADDRESS:
**LOT 13 DP 1251383, TORAKINA DR
BRUNSWICK HEADS**

SCALE
0 50 100m

DESIGNED IC/SS
DRAWN SS
CHECKED DMc

CAD FILE No.
1-211400_WALLUM.DWG

DWG No.
1-211400_WALLUM_

REV. **A**

2 Habitat Assessment

2.1 Vegetation

Wallum Froglet (WF) habitat occurs at several locations at the site where wet heath and drainage areas in shallow swales are present. Typical vegetation in these areas includes: *Gahnia clarkei*, *Sporadanthus caudatus*, *Empodisma minus*, *Baloskion tetraphyllum subsp. meiotachyum*, *Gonocarpus micranthus subsp. ramosissima*, *Gleichenia dicarpa*, *Drosera spatulata*, *Xanthorrhoea fulva*, *Leptospermum liversidgei*, *Baumea rubiginosa*, *Schoenus brevifolius*, *Callistemon pachyphyllus*, *Villarsia exaltata*, *Boronia falcifolia*, *Goodenia paniculata*, *Xyris complanata* and *Haemodorum tenuifolium*. The topography of the site (shallow undulating swales from remnant back-barrier dunes) provides suitable areas for wet heath in slightly lower drainage areas where soils are peaty and acidic and where sedges are common (principally *Schoenus brevifolius*, *Empodisma minus* and *Baumea rubiginosa*).

A substantial portion of the property is maintained through slashing which degrades WF habitat. It is anticipated that any slashed areas located within proposed habitat zones will improve post development when the vegetation regenerates naturally.

The presence of sedges and the wetland species Erect Marsh Flower (*Liparophyllum exaltatum*) indicates water persists in some parts of the site for a reasonable time (the duration of inundation however has not been confirmed within this study). Slightly elevated 'ridge' communities do not provide Wallum Froglet habitat due to an inability to retain water, with soils in these areas generally being exposed sands with little organic matter and an absence of sedges and wet heath species.

Extensive areas of swamp sclerophyll forest dominated by Broad-leaved Paperbark (*Melaleuca quiquenervia*) in the east of the site are not considered to provide Wallum Froglet habitat based on a lack of any historic records (JWA, 2011), extensive tree cover and proximity to estuarine environments. As such, acid frog habitat is essentially restricted to heathland and fringing vegetation, such as open swamp sclerophyll forest in the south-west of the site where an extensive ground layer of sphagnum moss (*Sphagnum cristatum*) occurs in combination with a matrix of sedge land and wet heath (refer Plate 2.1). Two small areas of sedgeland within this community provide habitat for the Olongburra Frog.

The best quality Wallum Froglet habitat occurs in the south-east of the site, where a substantial area (~1 ha) of good quality habitat occurs within a shallow swale and where numerous records occur (refer Plate 2.2). Breeding habitat commonly occurs in ephemeral and intermittent shallow water found in informal vehicular accessways and wheel ruts (refer Plate 2.2).



Plate 2.1 Wallum Froglet habitat in the south-west of the site with fringing Melaleuca quinquenervia and regrowth Leptospermum juniperinum.

Plate 2.2 Good quality Wallum Froglet habitat in the south-east of the site



Plate 2.3 Central drain showing lack of macrophyte or sedge cover and steep partly eroded banks

As previously noted (and acknowledged by BSC in their letter of 10th February 2014), the central drain comprises poor quality habitat due to extensive disturbance, presumably from maintenance activities (refer Plate 2.3). The floor of the drain typically comprises bare sand with infrequent sedges/macrophyte cover (*Juncus planifolius*, *Philydrum lanuginosum*, *Utricularia gibba*). The drain floor sits relatively deep (up to 1.8m deep in places), with fringing regrowth vegetation on spoil banks comprising woody regrowth (Satinwood, Black She-oak, Banksia) and providing unsuitable habitat for Wallum Froglets. Coral Fern (*Gleichenia dicarpa*) is a common feature on sandy exposed banks.

2.2 Groundwater Considerations

Habitat creation requires groundwater expression over an adequate period to ensure that breeding conditions for Wallum Froglets occur (i.e., a minimum 30-100 days (refer Meyer *et al.* 2006)). Several groundwater level monitoring bores have been installed across the site. Two historic bores had data collected between 2012 and 2014-15 with a short block of data collected during 2020. Four newer bores were constructed in 2017 for the purpose of further understanding groundwater behaviour in the western section of the development site to inform the WFMP. Locations of the bores are shown at Figure 2.1.

To understand groundwater behaviour across the site groundwater level has been monitored using Odyssey and HOBO water level data loggers, with data points collected generally hourly. Groundwater level data has been calibrated to mAHD to aid in the assessment and design of constructed WSF ponds. A summary of the groundwater data is provided in Table 2.1 which includes water level percentile values and other relevant data.

Table 2.1 Summary statistics - groundwater levels

Groundwater level (mAHD) data summary						
Data	Historic		Current			
	3A	4A	1	2	3	4
Ground surface level (mAHD)	4.42	4.56	4.76	4.17	4.57	4.57
n (data points) #	18845	43050	14185	23707	27094	10070
n (days) ##	498	984	591	988	1129	420
min	2.76	2.88	3.63	3.61	3.21	3.37
max	3.82	4.04	4.79	4.48	4.08	4.50
95%ile	3.81	3.86	4.58	4.38	3.99	4.34
75%ile	3.61	3.81	4.38	4.27	3.89	4.15
50%ile (median)	3.28	3.65	4.24	4.13	3.73	3.94
25%ile	2.99	3.43	4.10	4.00	3.59	3.76
5%ile	2.78	3.14	3.73	3.74	3.42	3.38
Years data collected	2012-2014	2012-2015 2020	2017- 2019	2017- 2020	2017- 2021	2017- 2020
# = total data points after erroneous values 'cleaned' from data set						
## = total days calculated based on varying data point time step – not necessarily consecutive						

Previous investigations reveal two groundwater sources – a perched shallow aquifer underlain by partly indurated sands which occurs approximately 1-2m below ground level. A deeper groundwater layer is below the indurated sand layer. Bores were formed to different depths to capture the groundwater levels of the two aquifers at two sites (refer Bores 3A/B and 4A/B at Figure 2.1).

Percolation of rainfall through the upper layers of the soil profile results in acidification of the perched aquifer with a mean pH value range of 3.47-3.96 recorded. Bore monitoring indicates increased rainfall results in rapid elevation of groundwater level, while during lower rainfall periods the groundwater level is reduced.

Based on this information frog habitat design for breeding areas has shallow excavation at depths which ensure groundwater interception and allow for windows of groundwater expression to provide breeding habitat for Wallum Froglets. While rainfall varies annually, it is important to recognise that habitat areas do not require permanent water to perform adequately but provide 30-100 days of surface water ponding for breeding to occur. Guided by groundwater fluctuations over wet and dry periods, the design will ensure that a combination of groundwater and surface water will achieve hydrological requirements where habitat is created or embellished.

Breeding habitat areas (ponds) will be created as discussed further below and shown on the plans in Appendix B within extensive areas of created or retained habitat that include foraging habitat.

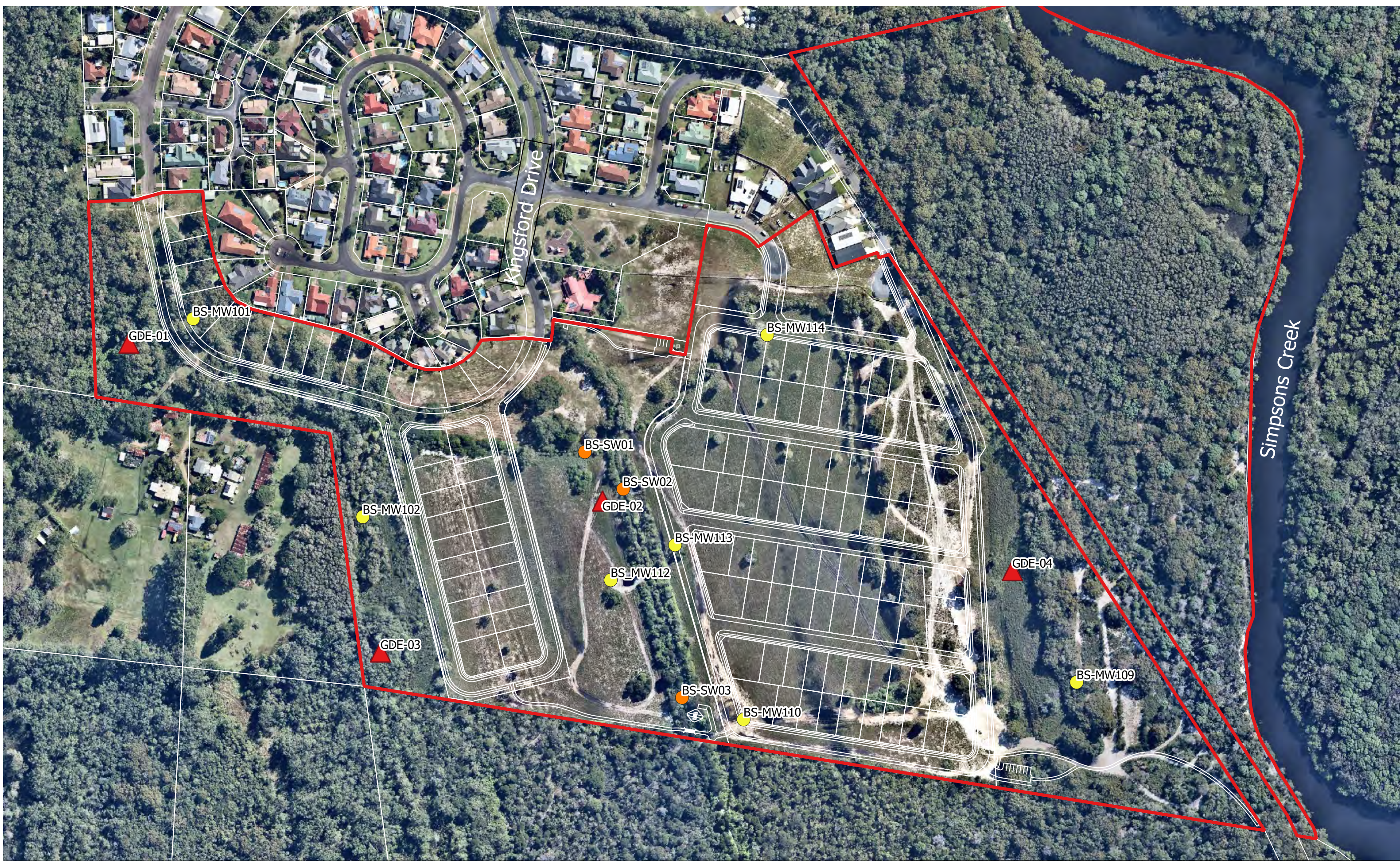




Figure:2-1 Location of groundwater monitoring bores

File:1-211400-BaysideBrunswick_ClarenceProperty

Source:Aerial Image - Near Maps 2021



050100150 m

Legend

- Surface water monitoring locations
- GDE Monitoring
- Groundwater monitoring bores
- Site

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A3 Scale 1:2500
Coordinate System: MGA 56 Projection: Transverse Mercator

3 Habitat Restoration

3.1 Habitat Loss and Retention

Development of the site as per the amended concept (refer Figure 1.2, Appendix A) will result in the loss of 1.2 ha of Wallum Froglet habitat within shallow swales in the slashed heathland community and the connecting eastern and western drains. The lost habitat areas, as mapped (JWA, 2014) are typically in isolated ribbons within existing swales and depressions which will be improved through consolidation of much larger areas of created and retained habitat incorporating foraging and breeding habitat features.

As shown at Figure 1.3, 2.6 ha of Wallum Froglet habitat will be retained, with a further 1.9 ha of habitat created/restored. Habitat to be retained comprises some good quality and some degraded habitat due to impacts including slashing and motorbikes. Degraded habitat will be restored and additional habitat areas will be created. Table 3.1 provides details of habitat impacts.

Table 3.1 Wallum Froglet habitat to be retained and created at the site

Wallum Froglet habitat portion	Area (ha)
Existing WF habitat	3.9 ha
Retained WF habitat	2.6 ha
Created/offset WF habitat	1.9 ha
Removed WF habitat	1.3 ha
Net habitat increase (created – removed)	0.6 ha

3.2 Habitat Creation and Improvement

The footprint of the proposed development has been carefully orientated to minimise impacts on the existing Wallum Froglet Habitat. The three largest areas mapped as WF habitat have largely been retained. Suitable areas adjacent to these habitats will be embellished to create further habitat and linkages to existing. It is important that overland water flow from the development into WF habitat is minimised. Stormwater runoff from perimeter roads will be directed into swales for treatment and detention and is contained for all rainfall events up to 15-minute 5yr ARI event.

Factors critical to the success of constructed Wallum Froglet habitat are:

- Proximity to known areas of habitat
- Appropriate excavation levels such that groundwater is intercepted and a 'window' for groundwater expression is created at depths corresponding to existing habitat areas
 - Maximum water depth of any breeding habitat areas should be no greater than 0.3 metres
- Delivery of water to ponds via groundwater to ensure a pH less than 5
- Translocation and/or provision with suitable vegetation

- Suitable measures to ensure AF habitat areas are not impacted by trampling or disturbance
- Groundwater dynamics in the post-development scenario are substantially maintained

All proposed breeding habitat areas are to be excavated as per the concept plans (AWC, 2021) and with reference to the construction notes above. Any excavated material must be placed at a minimum of 10m from known Wallum Froglet habitat and must not be placed into any habitat areas which are to be retained.

Following shaping and inspection/approval of the created habitat, 100mm of finely mulched organic matter should be evenly spread over the swale surface. Organic material should be sourced from the site where vegetation requires removal (e.g., woody regrowth along the central drain). Areas of created habitat will not be lined to ensure groundwater expression. Constructed habitat will be planted with appropriate native species to ensure greater than 80% vegetation cover (refer Appendix B).

A variety of sedges/wet heath species from tube stock will be planted around the perimeter of each restoration area, with species selection based on habitat at the site. Revegetation within the buffers to the central drain will use the species schedule at Appendix B.

3.3 Translocation of Material

Translocation of existing Wallum vegetation from within the development footprint is a method of habitat creation when proximity and availability of suitable material exists. Following preliminary preparation (as above) translocation of material to habitat areas may commence generally as follows:

- Translocation of suitable material from donor areas by using 'slabs' of sedges removed with a positrack and slab bucket or similar, is a proven methodology and may also be beneficial in translocating individuals directly into habitat areas
 - The project ecologist is to nominate the most suitable donor plots
- Removal of donor vegetation of a minimum depth of 300mm of organic matter is necessary to ensure that root systems and rhizomes are 'captured'
- Ideally donor material shall be removed and placed directly into receiving ponds, or temporarily placed on the site and watered daily until placed within habitat areas
 - A maximum of 3 days in-situ care is recommended to reduce stress to slabbed donor material
- Following placement within receiving habitat areas, these areas must be flooded, and this treatment repeated for a minimum of five consecutive days
 - Water used for flooding must be sourced from the central drain and treated (town) water must not be used
 - Following initial aftercare, habitat areas shall be watered once weekly for a minimum four (4) week period, with this increased to a six (6) week period if works occur during the summer months

4 Integration with Stormwater Management

4.1 Introduction

Stormwater controls proposed for the development include:

- Kerb and gutter
- Bioretention swale with underdrain
- Bioretention swale with no underdrain

Liaison with CivilTech Consulting Engineers has been completed as part of the preparation of this plan to ensure the proposed stormwater measures can be integrated with WF habitat creation and management. Stormwater treatments proposed in each of the retained/created WF habitat areas are discussed below. This Plan should be read in conjunction with the (revised) Stormwater Management Plan.

4.2 Stormwater management

Infiltration of surface water into the soil and recharge of the perched groundwater reserves is a key aim of the stormwater strategy with the intent of retaining groundwater hydrology behaviour and WF habitat preservation. Swales are designed to limit the amount of surface water that enters the created Wallum Frog Habitats. A summary of the stormwater works in relation to WF habitat in each of the proposed management zones (refer Figure 1.2) is provided below. No stormwater works are planned with relation to WF habitat in Management Zone 1.

4.2.1 Management Zone 2

The perimeter road (Road 2 East) has a one-way crossfall with the downslope side falling directly to the bioretention swale (with no underdrain). This will maximise the infiltration of surface flow to the soil and the groundwater reserves up to the Q5 stormflow. Once the Q5 is exceeded, the bioretention swale will overtop with flow spread evenly over the surface into the swale planting buffer strip, and beyond to the retained WF habitat. The catchment for this swale is relatively small at 14,650m².

Refer Sheets 1133-DA6 & 7 in Appendix A (CivilTech, 2021) and Sheets 04 and 07 in Appendix B (AWC, 2021).

4.2.2 Management Zone 3

Two swales will be constructed. The first is to the west of Road 2 (west). The bioretention swale (with underdrain) will be constructed immediately downslope of the road. The bioretention swale underdrain outlets are spaced evenly along the swale and discharging to the constructed realigned north south drain that conveys flow to the central south of the site and into the existing north south drain. The eastern side of the western residential portion of the development discharges to the bioretention swale (with underdrain). An existing open drain conveys the discharge from the bioretention swale to the primary north south drain.

Refer Sheets 1133-DA6 & 7 in Appendix A (CivilTech, 2021) and Sheets 02, 04 and 06 in Appendix

B (AWC, 2021).

4.2.3 Management Zone 4

The western and northwestern side of the western residential portion of the development discharges to the bioretention swale (with underdrain). The swale underdrain outlets discharge at the north into portions of the retained and created/offset WF habitat in the P3 zone.

4.3 Access and Contamination Mitigation

In areas of proposed clearing of WF habitat pre-clearing surveys will be undertaken; if WF are detected they will be captured and relocated to suitable habitat in proximity. During the construction phase and continuing into the establishment phases sediment and erosion control is a priority. A sediment and erosion control plan (S&ECP) for the project has been prepared by Civiltech (2017). The following general recommendations are made:

- Staff on the site should be provided with an understanding of environmental management and incident reporting
- Timing of works should coincide with dry weather as far as practical. Winter months are generally the driest however weather forecasts should be monitored and works programmed accordingly (i.e. postponed if intense rainfall and/or storms are imminent)
- Stage the works to minimise the area of proposed transportable sediment and any stage
- Provide cover (vegetation, mulch or jute mat etc.) to areas of soil disturbance as soon as possible
- Restrict machinery access to site to nominated access points
- Use sediment and erosion control measures as detailed in the S&ECP
- Clearly delineate areas of retained WF habitat to be undisturbed, to ensure encroachment is prevented.

5 Habitat Management

5.1 Introduction

Retained and embellished acid frog habitat requires active management to ensure Wallum Froglet populations are sustained. Threats to WF habitat from development of the site may occur during both the construction and occupation stages of the development.

Potential impacts from construction include:

- Introduction of weed species by machinery
- Erosion and sedimentation
- Stormwater in flow
- Accidental filling of habitat areas
- Accidental removal/disturbance of habitat
- Dust creation
- Chemical/fuel spills
- Mortality from vehicle movements.

Potential impacts from occupation include:

- Mortality from vehicle movements
- Reduced water quality within retained and compensatory habitats
- Habitat disturbance
- Introduction of aquatic pest/weed species
- Rubbish dumping
- Hydrological changes to both ground and surface waters.

Management actions to address these impacts are further discussed in the following sections.

5.2 Wallum Froglet Habitat Creation

Areas of WF habitat creation/offset will include the construction of WF breeding ponds. Pond base levels will be designed to replicate a hydroperiod suitable for WF through groundwater expression. Each pond will have batters surrounding each constructed pond and have a grade of 1:3-1:6. WF breeding ponds and batters will be planted with species representative of WF habitat (refer Appendix B). Planting and vegetation management should not occur within constructed WF habitat zones until ground works have taken place and ponds have been established.

WF habitat creation follows four general stages:

1. Construction mark-out
2. Topsoil stripping and bulk earth works
3. Topsoil spreading
4. Pond and batter planting.

Further management actions include:

- Define the perimeter of all WF habitat areas
- Exotic species control
- Monitor and maintain vegetation
- Management of Chytrid Fungus via adoption of suitable hygiene measures.

These actions will be addressed via the CEMP.

5.3 Management Zones

Of the four management zones (refer Figure 1.2) on the site, WF management will be undertaken in three. Management for WF in each zone is summarised in the sections below. Note: there are no works for WF habitat proposed in Management Zone 1.

5.3.1 Management Zone 2 - Actions

Existing/retained and created/offset WH habitat is proposed in this zone (Refer Sheet 07 in Appendix A). Several (6) constructed WF breeding ponds have been proposed though this will be confirmed during detailed design phase.

This area is generally in poor condition with many informal tracks exposing areas of compacted sand. Much of this area has been previously cleared with regrowth occurring patchily throughout. Restoration of WF habitat is to be undertaken in this zone.

5.3.2 Management Zone 3 - Actions

This zone includes the retention of the primary and lateral drainage line and associated WF habitat. Two large areas of existing WH habitat are retained with the remaining land to be created/offset WF habitat. Several (18) constructed WF breeding ponds have been proposed though this will be confirmed during detailed design phase.

5.3.3 Management Zone 4 - Actions

There is a relatively small area of created/offset WH habitat proposed in this Management Zone including one created WF breeding pond. A large area of existing retained WF habitat proposed; this is high quality habitat with many depressions and suitable species present.

5.4 General Construction Stage - Management Actions

The following management actions apply to general aspects applying to the construction/establishment of the site. Specific management actions relating to the works associated with VMZ 2 and 3 are discussed in Section 4 of this report.

5.4.1 Staging

The construction staging plan for the development is shown at Appendix A. Staging and timing matters associated with the development relevant to acid frog habitat protection and creation are summarised at Table 5.1. A summary of all management actions for the construction period is shown in Table 5.2.

Table 5.1 Staging and timing sequence

Stage No.	Works required (WF Mgt)	Wallum Froglet mitigation actions
1	Management Zone 2 & (part) 3 North South (N/S) Drain works	a) Preparation and approval of CEMP incorporating strategies and recommendations in this Plan b) Fencing of all protected WF habitat in Management Zones 2 and 3 c) Erosion and sediment controls installed along N/S drain d) Project ecologist to nominate translocation slabs from areas of removed/existing WF habitat e) Installation of WF breeding ponds f) Monitoring of created habitat areas for WF presence, vegetation establishment, water quality (etc.)
2	none	
3	Management Zone 3 (west of N/S drain) and Management Zone 4	a) Installation of required erosion and sediment controls b) Fencing of all protected WF habitat in Management Zone 3 and Management Zone 4 c) Installation of WF breeding ponds d) Project ecologist to nominate translocation slabs from areas of removed/existing WF habitat e) Installation of translocated material to WF habitat f) Monitoring of created habitat areas for Wallum Froglet presence, vegetation establishment, water quality (etc.)
	General construction works (earthworks, services etc.)	a) Maintenance of exclusion fencing and signage (as installed previously) during construction until permanent fencing and signage is installed around habitat areas b) Installation and maintenance of erosion and sediment controls c) Wallum Froglet habitat monitoring (retained and created habitat)
Post Construction phase		
	Stage releases and occupation	a) Monitoring and maintenance of all WF habitat in Management Zones 2, 3 and 4 prior to handover to Council
	Ongoing occupation	a) Hand-over of Wallum Froglet habitat in Management Zones 2 & 3 to Council b) Ongoing monitoring and maintenance by Council to ensure wallum habitats are maintained

Table 5.2 Summary of mitigation strategies for potential impacts on acid frog habitats during the construction phase

Matter	Objective	Mitigation	Responsibility
Environmental induction	All personnel are clearly aware of environmental matters relating to the site with specific information on acid frog habitats.	- Ecologist to provide input to induction material - Copies of relevant maps provided	Site foreman/principal contractor/ Ecologist
'No go' zones are clearly marked and maintained	Acid frog habitats are protected from disturbance by plant, machinery and vehicles.	- 'No go' zones are clearly marked and checked on a regular basis - Updates to all personnel are provided where any changes to 'No go' zones occur	Site foreman/principal contractor/ Ecologist
Appropriate signage is in place	Acid frog habitats are protected from disturbance by plant, machinery, vehicles and construction activities.	- Appropriate signage is in place to demarcate 'No go' zones, refueling points, erosion and sediment protection zones (etc.) and is maintained and/or amended during the life of the project	Site foreman/principal contractor/ Ecologist
CEMP is aligned with recommendations in this Plan	The CEMP is consistent with the WFMP recommendations and practice to reduce potential for ambiguity/confusion regarding works in or near acid frog habitat.	- Liaison between project ecologists and consultant preparing the CEMP	Ecologist/ principal contractor
Sediment and erosion controls	Acid frog habitats are appropriately protected from activities likely to result in sediment/erosion.	- Preparation of Sediment and Erosion Control Plan (SECP) in consultation with this Plan and/or project ecologists - SECP not to be implemented until approved by relevant authorities - Implementation and maintenance of all sediment and erosion control as per the approved plan for the life of the project	Principal contractor
Habitat translocation	Removal of suitable acid frog vegetation, and potentially translocate individuals, for use in compensatory habitat areas.	- Translocation measures defined within VMP - Identification of suitable donor material where acid frog habitat will be removed - Establishment of on-site nursery if required - Translocation process supervised by project ecologist or other appropriately qualified personnel in liaison with site foreman	Ecologist/consultant

5.4.2 Contractor Actions

For the construction phase of the project, several amelioration measures should be enforced/maintained throughout the construction period by appointed contractors. These include:

- Appropriate induction of all construction personnel
- Fencing of all 'no go' areas prior to construction commencing and maintenance throughout the construction period and installation of appropriate signage (refer Section 4)
- A Construction Environmental Management Plan (CEMP) is prepared which incorporates the recommendations within this plan for implementation with the Subdivision Works Certificate

- Installation and maintenance of sediment and erosion controls throughout the construction period guided by an approved Sediment and Erosion Control Plan
- Use of sterile grasses (e.g., sorghum, millet) for erosion control and stockpile stabilisation if required
- Translocation of vegetation (sedges/reeds) out of habitat areas to be removed either directly into compensatory habitat areas or established nursery areas on-site until receiving compensatory environments are established
- NPWS Frog Hygiene Protocol to be followed when working within WF habitat and handling WF to ensure no risk of Chytrid Fungus to the population.

It should be noted that it is the responsibility of the lead contractor to provide a CEMP for the site to address mitigation measures concerning the above-mentioned activities.

5.4.3 Habitat Protection

All Wallum Froglet habitat to be retained on-site must be clearly fenced and signposted to exclude machinery and personnel. This must be completed prior to any works being initiated at the site. Exclusion fencing and signage must remain in place until construction works are complete. Similarly, exclusion fencing must be installed and maintained to protect all habitat within the eastern portion of the site zoned for environmental protection.

5.4.4 Filling

As the site requires low volumes of fill for flood-proofing, it is essential that fill is sourced locally and certified as free from contaminants, weed propagules etc. If fill is stockpiled on site, stockpiling protocols stated in the CEMP must be complied with. Filling must not occur in any areas of Wallum Froglet habitat within the development footprint until suitable donor material is translocated into areas of created habitat. An approved filling plan must be provided in the CEMP.

5.4.5 Compensatory Habitat

Compensatory habitat adjacent to the central drain and in the south-east of the site must be established in accordance with approved plans and signed off by the site supervisor and project ecologist.

5.5 Occupation stage - Management Actions

5.5.1 Habitat Protection

To provide information to residents, signage will be installed at strategic locations to provide information about the Wallum Froglet and the need to retain the integrity of habitat areas.

5.5.2 Water Quality

As acid frogs breed in oligotrophic waters, increased nutrients from urban run-off may adversely affect habitat by reduction of water quality and the creation of conditions conducive to weed establishment. Toxicants such as oils and surfactants may also negatively affect wetland areas in which acid frogs occur where they accumulate following urban runoff.

Changes in hydrology may occur through changes in water quality (i.e., water chemistry), water drainage and hydroperiod (water persistence). Changes in water chemistry make conditions unsuitable for acid frog species (e.g., from elevated pH levels), while diversion of drainage lines or alteration to groundwater ecology may have significant effects on the suitability of habitat

areas in the long term.

Groundwater considerations are particularly important regarding compensatory wetland ponds, where the intent is to excavate 'windows' into the groundwater layer whereby groundwater expression provides an appropriate water source rather than surface water flows. Impacts to water quality will be minimised through sediment and erosion control, stormwater management and monitoring during the construction and occupation establishment phases of the development.

5.5.3 Cane Toads

Cane Toads occur at the site and may respond well to further development due to increased lighting, open spaces and scavenging opportunities. While Wallum Froglet habitat areas will be ephemeral and are unlikely to contain standing water for any extended period, Cane Toads may occupy and shelter within these areas. Dense fringing plantings of saw-sedge (*Gahnia clarkei*) around all areas of created habitat shall be installed to limit access to Cane Toads and hence reduce breeding opportunities.

5.5.4 Mosquito Fish

The Mosquito Fish (*Gambusia holbrooki*) is an introduced species common within NSW waterways which occurs within the central drain on the site. Mosquito Fish are known to predate on the eggs and tadpoles of young froglets and compete for habitat and food sources. This raises concern about the potential impacts that this species may have on the Wallum Froglet population. Seasonal drying within constructed drains and WF breeding ponds will control Mosquito Fish.

5.5.5 Weed Control

Although the site occurs on low-nutrient sands, increased nutrients and earthworks/disturbance may enhance conditions for the establishment of weed species within acid frog habitat areas (e.g., *Setaria*, Vasey Grass). Where invasive weed species are recorded, appropriate control methods will be implemented as required.

5.5.6 Monitoring

A monitoring program is required to ensure project objectives are met, (i.e., that retained habitat areas continue to support Wallum Froglets and that created habitat areas recruit Wallum Froglets and maintain suitable habitat values - vegetation, water quality, hydroperiod etc). Monitoring is further discussed in Section 6.

5.5.7 Long-term Management

As Council will ultimately be responsible for the management of Wallum Froglet habitat areas there is a need to develop Key Performance Indicators (KPI) prior to the handover of habitat areas. These are prescribed in Section 6.3. A key requirement is to ensure appropriate vegetation is maintained such that frog habitat is not lost via regeneration of incompatible species.

6 Monitoring and Reporting

6.1 Introduction

To determine the success of habitat compensation measures and the persistence of Wallum Froglets at the site, monitoring will need to be undertaken. The purpose of monitoring is to:

- Document the persistence of Wallum Froglets within retained areas of known habitat
- Determine whether areas of regenerated Wallum Froglet habitat are being utilised by the species
- Determine whether Wallum Froglets are utilising areas of created compensatory habitat
- Determine the presence/influence of Cane Toads
- Determine that suitable pH, temperature dissolved oxygen, turbidity, salinity (conductivity) and nutrients occur within all areas of Wallum Froglet habitat
- Record fluctuations in water depth and quality of groundwater in addition to surface water to assess potential impacts of urban development on the local hydrological regime
- Document persistence of habitat present within compensatory habitat areas, including the presence of any weed species
- Document the persistence of Mosquito Fish and the impact they are having on the Wallum Froglet population and habitat.

Monitoring results will inform adaptive management practices including weed control, habitat enhancement and pest control.

6.2 Monitoring Requirements

For monitoring to be successful, the various phases of development must be defined and the roles and responsibilities for each phase clearly identified. Monitoring requirements for the phases of development (Pre-Construction, Construction, Occupation), are outlined in Table 6.1. Monitoring post construction should continue for five years.

Monitoring should be completed as follows:

- Baseline monitoring recorded at retained Wallum Froglet habitat areas – vegetation assessment and water quality sampling (temperature, pH, conductivity, turbidity, tannin) prior to any works commencing at the site.
- Monitoring of retained Wallum Froglet habitat areas three times annually (i.e., every four months) – nocturnal survey and counting of Wallum Froglets within the two retained habitat areas; call playback used to elicit response; water quality sampled if standing water present; records of incidental species records at the site to be included; basic weather conditions recorded (temperature, relative humidity, rainfall)
 - Brief summary to be completed, with annual report provided to Council/DPIE
- Frog surveys should be conducted during periods of peak breeding activity and only during suitable weather conditions (they are inundated with water, nighttime air temperatures exceed 15°C, and wind strength is low and humidity levels are high)
- Surface and groundwater depth should be routinely recorded during each population

monitoring event using permanent ground and surface water depth markers, which should be installed at several representative sites throughout the range of retained, rehabilitated and created Wallum Froglet habitats

- Monitoring of created habitat areas in lateral benches as soon as vegetation translocation is completed
- Install some (6) water level loggers in constructed WF breeding ponds, and existing depressions in retained WF habitat, spread generally spatially evenly over the development site
- Monitoring as for retained habitat areas
- For monitoring during maintenance periods refer to Table 6.2 .

Table 6.1 Monitoring requirements for development phases

Phase	Monitoring requirements	Responsibility
Pre-Construction	• 'No-go' areas maintained, and frog habitat protected • Implementation and maintenance of sediment and erosion controls • Need to collect baseline data for all factors identified in the nominated monitoring objectives	Site foreman/ Ecologist and/or appointed contractors
Construction	• 'No-go' areas maintained, and frog habitat protected • Water quality • Weed control • Implementation and maintenance of sediment and erosion controls	Site foreman/ Ecologist and/or appointed contractors
	• Monitoring of compensatory habitat areas	Ecologist
Occupation (Five years)	• Water quality • 'No-go' areas maintained, and frog habitat protected • Water quality • Weed control • Pest species control • Hydrology – water level loggers in constructed WF breeding ponds	Ecologist

An example of the monitoring pro-forma is attached (refer Appendix C).

If no Wallum Froglets are recorded within either of the compensatory habitat areas within two years following monitoring commencement, (and prevailing climatic conditions are considered suitable for frog activity) more intensive sampling using pitfall trapping should be completed for three nights in succession, three times annually. If Wallum Froglets are detected by this means, sampling may revert to aural detection methods as implemented previously after the completion of the three pitfall trapping events. A comparable level of pitfall trapping will be undertaken during the collection of pre-construction baseline data to generate a comparable pre-disturbed dataset.

In the event of the failure of compensatory habitat areas to establish, an adaptive response should be maintained, with the developer having the option to complete further habitat works where suitable donor material remains in undeveloped portions of the site, or planting of tubestock (refer species schedule at Appendix B). A combination of both approaches will be utilised following advice from the project ecologist.

Table 6.2 Monitoring tasks during maintenance period

Area to be Monitored	Monitoring Tasks	Frequency, timing and length
Measure pond water quality and hydroperiod	At six monthly intervals the quality of water will be measured in all created and retained Wallum Sedgefrog/acid frog habitat ponds/polygons. Hydroperiod data from the six installed loggers will also be downloaded biannually	Six monthly
Survey Vegetation	A sample of created Wallum Sedgefrog/acid frog habitat ponds will be surveyed every six (6) months, randomly selected from the created Wallum Sedgefrog/acid frog ponds. Vegetation type and cover will be assessed within each pond, of which is defined from top of bank to top of bank. A sample of 20m ² nested vegetation monitoring quadrats will be permanently established and monitored on a six (6) monthly basis for % cover of native and non-native species consistent with Success Criteria 7 and 8. Photographic monitoring locations will be established on the north-east corner of each quadrat, shooting to the south-west.	
Wallum Froglet monitoring	Survey both created and retained Wallum Sedgefrog habitats for the presence of Wallum Sedgefrog/acid frog or predator/ competitor species.	
Wallum Froglet presence assessment	Undertake Wallum Froglet presence/absence assessment to determine the extent of habitat use.	Biannually, between October and April depending on climatic conditions. Monitoring period of 3 years or until KPI's are addressed (refer to Table 7.3)
Vegetation assessment	Undertaken quantitative vegetation assessment of to ensure created compensatory Wallum Froglet habitat supports semi erect semi-aquatic emergent vegetation consistent with a vegetation community consistent with that measured within existing Wallum Froglet habitat (as per methods outlined in Table 7.1).	
Water quality assessment and hydroperiod	Undertake pH, conductivity and Tannin measurements of water within both created compensatory and existing retained Wallum Froglet habitat area to confirm suitability. Download data from the hydroperiod loggers	

6.3 Performance Criteria

To ensure monitoring results achieve desired objectives, performance criteria are required to determine success or otherwise. Recommended performance criteria for the monitoring program are summarised in Table 6.3 and may be adapted for pre-construction, construction and occupation periods of the development. Monitoring will be conducted over several breeding seasons after completion of the urban development to detect potential impacts of the completed urban stormwater design at full capacity on surface and groundwater hydrology and water quality. Monitoring will be performed for five consecutive years after completion of the final project stage to ensure that such potential impacts have been assessed adequately.

Performance criteria must consider prevailing climatic conditions which may adversely affect created habitat and Wallum Froglet populations. There is a strong possibility that no individuals will be detected during low rainfall periods.

Note that management of frog habitat zones will become the responsibility of Council after initial restoration and monitoring works by the developer.

Table 6.3 Summary of monitoring performance criteria

Item	Performance Criteria	Responsibility
Retained habitat areas		
Water quality	Water chemistry: pH in a range of 3 – 5, and low values/concentrations of turbidity, salinity (conductivity), and nutrients Water quality monitoring includes both surface and groundwater	Appointed ecologist/consultant
Vegetation	Native vegetation continues to persist and is not degraded or disturbed. The results of the vegetation monitoring collected as part of the VMP will be referred to when analysing the results of the wallum froglet population and habitat monitoring.	Appointed ecologist/consultant
Weed control	Environmental weeds comprise < 10% total within each Wallum Froglet habitat area	Appointed contractor for implementation of the VMP
Wallum Froglet populations	Existing/known habitat areas continue to be utilised by Wallum Froglets.	Appointed ecologist/consultant
Cane Toads	Threshold numbers remain low, appropriate control measures are implemented if required.	Appointed ecologist/consultant
Mosquito Fish	Monitor Mosquito Fish population – to include the drying out of water courses to control fish numbers.	Appointed ecologist/consultant
Constructed habitat areas		
Water quality	As above	Appointed ecologist/consultant
Weed control	Environmental weeds comprise < 10% total within each identified frog compensation area per precinct.	Appointed contractor for implementation of the VMP
Habitat establishment	Survival rate of greater than 90% of all plantings and translocated material	Appointed contractor for implementation of the VMP
Wallum Froglet populations	Utilisation by Wallum Froglets and persistence at constructed habitat areas over time.	Appointed ecologist/consultant
Cane toads	Exclusion buffer plantings correctly installed with 90% survival rate achieved.	Appointed contractor for implementation of the VMP

7 Compliance

This WFMP address requirements of the Concept Approval and Statement of Commitments, through the various actions prescribed. A summary response to WFMP requirements is provided at Table 7.1.

Table 7.1 Compliance with Concept Approval

Requirement	Demonstration of Compliance
Concept Approval	
<i>B4</i> A revised Stormwater Concept for the project must be prepared by a suitably qualified person in consultation with council to achieve the following objectives: a) retention of the existing north-south drain alignment with a buffer of 20m either side of the channel such that the existing wallum froglet habitat in this area is conserved and enhanced. Minor infringements of up to 5m into the buffer area can occur provided they are offset on the other side of the channel. For example, a buffer may be 15m on one side of the channel provided this is offset by increasing the other side to 25m (i.e. a total width of 40m plus channel width) b) the buffer areas should not contain stormwater management facilities other than a stormwater treatment basin at the southern end of the channel, where required c) no significant change to the flow regimes from the pre-development regime.	Refer Stormwater Management Plan (Martens (2021) and part of CivilTech (2022) Engineering Plans for DA (Appendix A).
<i>B5</i> The existing north-south drain alignment and buffer (as determined under modification B4 of this approval) is to become a public reserve.	Refer Figure 1.2 and CivilTech (2022) Engineering Plans for DA (Appendix A).
Statement of Commitments	
<i>S1</i> Development to be generally in accordance with the concept application plans and the recommendations of the appendices of the Environmental Assessment and Preferred Project Report, including but not limited to: a) development footprint not extending outside the 2(a) Residential zone pursuant to Byron LEP 1988; b) the number of lots; c) the mixture of lot sizes; d) conservation of ecologically sensitive areas;	Refer CivilTech (2022) Engineering Plans for DA (Appendix A).

Requirement	Demonstration of Compliance
<i>e) location and dimensions of Park 1 and Park 2;</i> <i>f) retention of trees on public land including road reserves and drainage reserves;</i> <i>g) location of stormwater treatment and disposal areas; and</i> <i>h) extent of earthworks.</i>	
B1 <i>The width of the road corridors will be minimised where roads traverse significant habitats and vegetation.</i>	Refer CivilTech (2022) Engineering Plans for DA (Appendix A).
B3 <i>An area of constructed Wallum Froglet habitat is proposed within reserves which will be dedicated to Council. Those areas will be incorporated into the Stormwater management plan and will result in the net gain of almost 3000m² of Wallum Froglet habitat. A Wallum Froglet Compensatory Management Plan will guide the construction and management of this habitat.</i>	A 7000m ² (0.7ha) net gain in Wallum Froglet habitat is proposed, refer Section 3 and Table 3.1.
B4 <i>A Wallum Froglet Compensatory Habitat Plan will be prepared to the satisfaction of the Office of Environment and Heritage prior to approval of the first stage construction certificate. The WFCHP is to be generally in accordance with information prepared by James Warren and Associates and submitted for approval prior to the release of the CC.</i>	This document incorporates a plan for compensatory Wallum Froglet habitat.
SW4 <i>Prepare resident information package regarding prevailing soil conditions the most ecologically sustainable methods for gardening in these conditions and any other sensitivities of the local ecosystem, including information on local endangered species such as the Wallum Froglet.</i>	To be provided at Subdivision Works Certificate stage.
SW7 <i>In the event that excavations are required outside of the proposed development footprint or below 2.0m below surface level within the building envelope additional testing should be considered by the consent authority.</i>	N/A to this plan.

8 References

Australian Wetlands Consulting (2013). *Stormwater and Acid Frog Habitat Management Strategy*. Concept Design Report to Codlea Pty Ltd.

Australian Wetlands Consulting (2014) *Bayside Brunswick Estate Water Monitoring Report*. Report to Codlea Pty Ltd.

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Martens Consulting Engineers (2021) *Concept Stormwater Management Plan: Proposed Subdivision, 15 Torakina Road, Brunswick Heads, NSW*. Prepared for Clarence Property Pty Ltd

Meyer, E., Hero, J-M., Shoo, L. & Lewis, B. (2006) *National recovery plan for the wallum sedge frog and other wallum-dependent frog species*. Report to Department of the Environment and Water Resources, Canberra. Queensland Parks and Wildlife Service, Brisbane.

Appendix A

Concept Plan (CivilTech, 2022)



● Subdivision Design ● Civil Engineering ● Town Planning ● Project Management

BAYSIDE BRUNSWICK

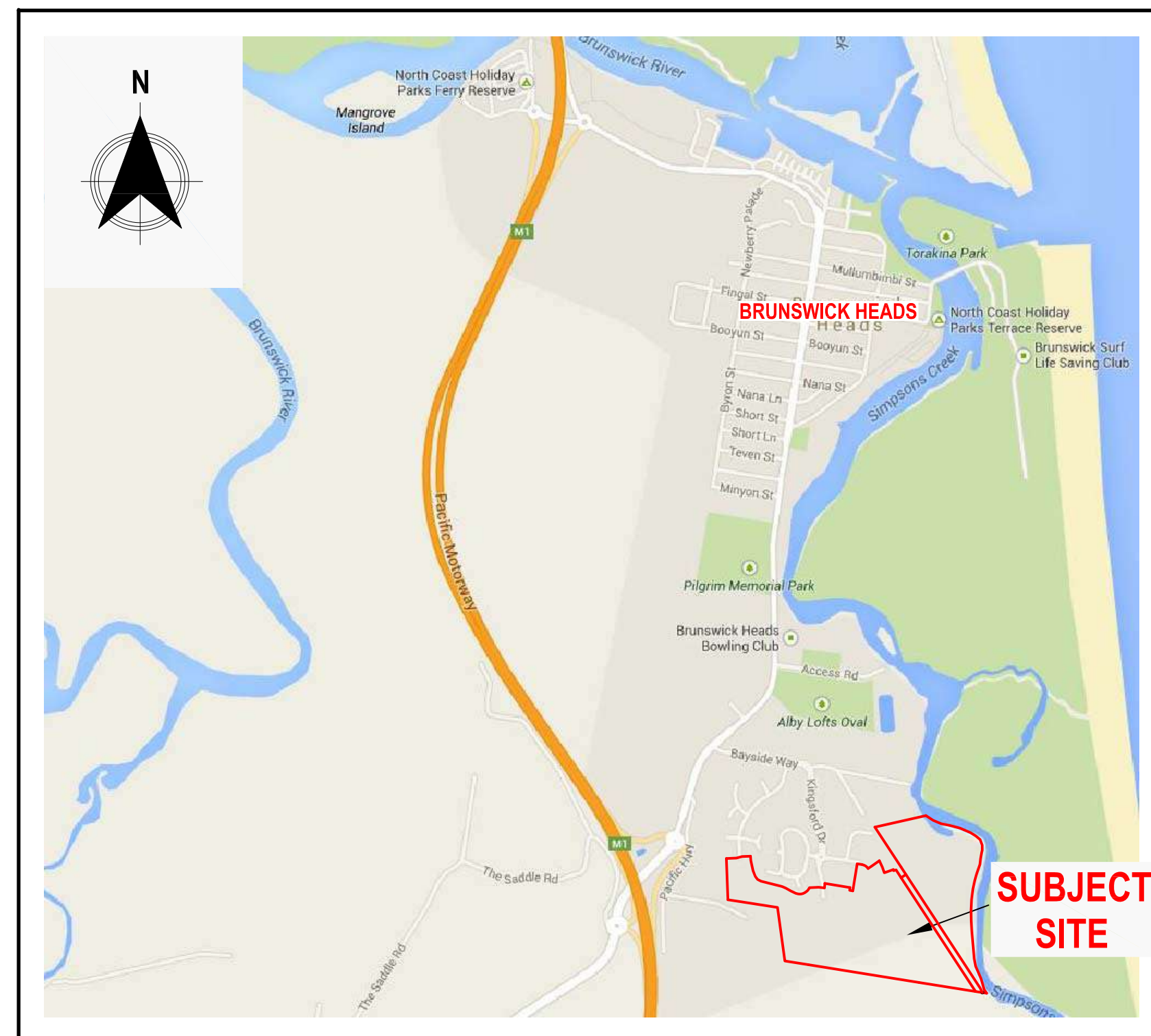
130 Lot Residential Subdivision

15 Torakina Road, Brunswick Heads

Lot 13 DP 1251383

for
BAYSIDE BRUNSWICK Pty Ltd

LOCALITY PLAN:



INDEX:

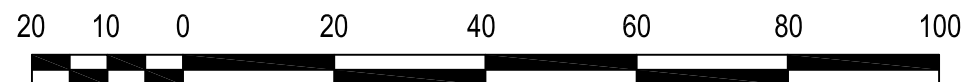
ROADS & DRAINAGE	
SHEET 1	DA1 DRAWING COVER SHEET
SHEET 2	DA2 SUBJECT SITE AERIAL OVERLAY
SHEET 3	DA3 SUBDIVISION LAYOUT PLAN
SHEET 4	DA4 STAGING PLAN
SHEET 5	DA5 BULK EARTHWORKS CUT FILL PLAN
SHEET 6	DA6 ROADWORKS PLAN
SHEET 7	DA7 STORMWATER DRAINAGE LAYOUT PLAN
SHEET 8	DA8 STORMWATER DRAINAGE CATCHMENT PLAN
SHEET 9	DA9 GRAVITY SEWER & LPS CONCEPT LAYOUT
SHEET 10	DA10 WATER, ELEC & COMMS SCHEMATIC CONCEPT
SHEET 11	DA11 N-S DRAIN REALIGNMENT PLAN AND SECTIONS
SHEET 12	DA12 LOCAL AREA TRAFFIC MANAGEMENT PLAN
SHEET 13	DA13 ROAD 1 LONG SECTION & CROSS SECTIONS
SHEET 14	DA14 ROAD 2 LONG SECTION - START TO CH600
SHEET 15	DA15 ROAD 2 LONG SECTION - CH600 TO END
SHEET 16	DA16 ROAD 2 CROSS SECTIONS - START TO CH500
SHEET 17	DA17 ROAD 2 CROSS SECTIONS - CH550 TO END
SHEET 18	DA18 ROAD 3 LONG SECTION & TYPICAL SECTION
SHEET 19	DA19 ROAD 3 CROSS SECTIONS
SHEET 20	DA20 ROAD 4 LONG SECTION & TYPICAL SECTION
SHEET 21	DA21 ROAD 4 CROSS SECTIONS
SHEET 22	DA22 ROAD 5 LONG SECTION & TYPICAL SECTION
SHEET 23	DA23 ROAD 5 CROSS SECTIONS
SHEET 24	DA24 ROAD 6 LONG SECTION & TYPICAL SECTION
SHEET 25	DA25 ROAD 6 CROSS SECTIONS
SHEET 26	DA26 ROAD 7 LONG SECTION & TYPICAL SECTION
SHEET 27	DA27 ROAD 7 CROSS SECTIONS
SHEET 28	DA28 TYPICAL SECTIONS & ENGINEERING DETAILS 1
SHEET 29	DA29 TYPICAL SECTIONS & ENGINEERING DETAILS 2

CIVIL ENGINEERING

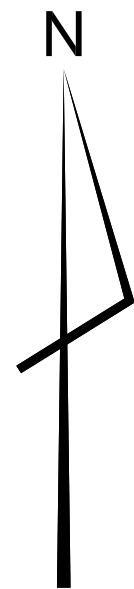
DEVELOPMENT APPLICATION

INDEX SHEET
1133-DA1B

August 2022



SCALE 1:1,000 AT A1, 1:2,000 AT A3



LEGEND

- SUBJECT SITE BOUNDARY
- B18 450m² NEW LOT POLYGON & LOT AREA
- EASEMENT (PROPOSED TBC)
- PUBLIC ROAD PAVEMENT (PROPOSED)

LOT AREAS AND DIMENSIONS SUBJECT TO D.A. APPROVAL AND DETAILED DESIGN AS PART OF SUBDIVISION WORKS CERTIFICATE

B	FOR RE-SUBMISSION	WF	WF	15.08.2022
A	FOR SUBMISSION	WF	WF	01.08.2021
Iss Description		Des Drw Date Appd		

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BAYSIDE BRUNSWICK Pty. Ltd.
ENGINEERING PLANS FOR D.A.
130 LOT SUBDIVISION OF LOT 13 DP 1251383
15 TORAKINA ROAD, BRUNSWICK HEADS

SUBDIVISION LAYOUT PLAN

Scale: 1:2,000 at A3 CAD file: 1133-DA3B.dwg
Datum: AHD CivilCAD file: 1133-ENG



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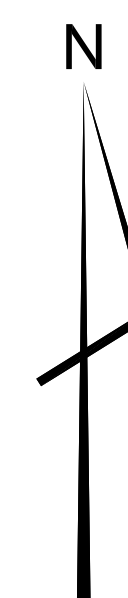
Dwg. No.
1133-DA3

Issue

B



SCALE 1:1,000 AT A1, 1:2,000 AT A3



LEGEND

	SUBJECT SITE BOUNDARY
	CONSTRUCTION STAGE BOUNDARY
STAGE 1	53 LOTS + 3 M.D. LOTS
STAGE 2	33 LOTS
STAGE 3	37 LOTS + P1, P2, P3 & B128

EASTERN PRECINCT EARTHWORKS & N-S-
DRAIN TO BE CONSTRUCTED IN STAGE 1

WESTERN PRECINCT EARTHWORKS
TO BE CONSTRUCTED IN STAGE 3

B	FOR RE-SUBMISSION	WF	WF	15.08.2022	
A	FOR SUBMISSION	WF	WF	01.08.2021	
Iss	Description	Des	Drw	Date	Appd

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ENGINEERING PLANS FOR D.A.
130 LOT SUBDIVISION OF LOT 13 DP 1251383
15 TORAKINA ROAD, BRUNSWICK HEADS

SUBDIVISION STAGING PLAN

Scale: 1:2,000 at A3 CAD file: 1133-DA4B.dwg
Datum: AHD CivilCAD file: 1133-ENG



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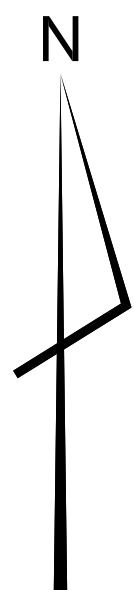
1133-DA4

Issue

B

20 10 0 20 40 60 80 100

SCALE 1:1,000 AT A1, 1:2,000 AT A3



LEGEND

- SUBJECT SITE BOUNDARY
- EXISTING NORTH SOUTH DRAIN INVERT
- REALIGNED NORTH SOUTH DRAIN
- EXTENT OF EARTHWORKS
- CUT DEPTH
- FILL DEPTH

EARTHWORKS VOLUMES

CUT	+ 8,990 m³
FILL	- 53,010 m³
TOPSOIL IMPORT (100mm)	+ 8,020 m³
ROAD PAVEMENT (425mm)	+ 9,590 m³
FILTER MEDIA (400-600mm)	+ 3,520 m³
CLEAN SAND TO IMPORT	22,890 m³

PRELIMINARY EARTHWORK VOLUMES ONLY. NO ALLOWANCE HAS BEEN MADE FOR STRIPPING, COMPACTION, BULKING, UNSUITABLE OR TRENCHING EFFECTS.

EARTHWORKS VOLUMES AND EXTENT TO CONFIRMED BY DETAILED DESIGN AS PART OF SUBDIVISION WORKS CERTIFICATE APPLICATION.

B	FOR RE-SUBMISSION	WF	WF	01.08.2022	
A	FOR SUBMISSION	WF	WF	1.09.2021	
Iss	Description	Des	Drw	Date	Appo

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ENGINEERING PLANS FOR D.A.
130 LOT SUBDIVISION OF LOT 13 DP 1251383
15 TORAKINA ROAD, BRUNSWICK HEADS

EARTHWORKS CUT FILL PLAN

0.2m DESIGN CONTOURS

Scale: 1:2,000 at A3 CAD file: 1133-DA5B.dwg
Datum: AHD CivilCAD file: 1133-ENG



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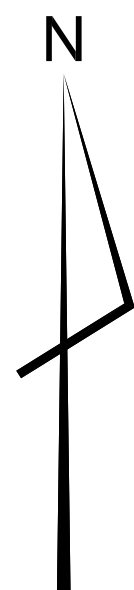
1133-DA5

Issue

B

20 10 0 20 40 60 80 100

SCALE 1:1,000 AT A1, 1:2,000 AT A3



LEGEND

- SUBJECT SITE BOUNDARY
- ROAD CENTRELINE
- ROAD PAVEMENT
- BIO-RETENTION SWALE
- LOCAL STREET TRAFFIC CALMING (SEE DETAIL ON 1133-DA12)
- BUS ROUTE TRAFFIC CALMING (SEE DETAIL ON 1133-DA12)
- 1.2m CONCRETE PEDESTRIAN FOOTPATH
- 2.0m GRAVEL PEDESTRIAN PATH
- EXTENT OF EARTHWORKS
- EXISTING NORTH SOUTH DRAIN INVERT
- REALIGNED NORTH SOUTH DRAIN

REFER TO CIVILTECH PLANS 1133-DA13 TO 1133-DA27 FOR ALL ROAD LONG SECTIONS, TYPICAL SECTIONS & CROSS SECTIONS

DETAILED DESIGN OF ROADWORKS & EARTHWORKS TO BE UNDERTAKEN AS PART OF SUBDIVISION WORKS CERTIFICATE APPLICATION.

B	FOR RE-SUBMISSION	WF	WF	01.08.2022
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Iss Description		Des	Drw	Date Appd

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ENGINEERING PLANS FOR D.A.
130 LOT SUBDIVISION OF LOT 13 DP 1251383
15 TORAKINA ROAD, BRUNSWICK HEADS

ROADWORKS PLAN

0.2m DESIGN CONTOURS

Scale: 1:2,000 at A3 CAD file: 1133-DA6B.dwg
Datum: AHD CivilCAD file: 1133-ENG



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Dwg. No.

1133-DA6

Issue

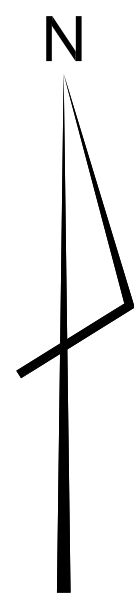
B



CONCRETE CARPARK WITH 8 SPACES. 2.6m WIDE AND 5.4m LONG. FALL SOUTH TO BIO-RETENTION SWALE.

20 10 0 20 40 60 80 100

SCALE 1:1,000 AT A1, 1:2,000 AT A3



LEGEND

- SUBJECT SITE BOUNDARY
- EXISTING NORTH SOUTH DRAIN INVERT
- REALIGNED NORTH SOUTH DRAIN
- FINISHED SURFACE LEVEL
- CROWNED ROAD WITH KERB & GUTTER
- ROAD WITH ONE-WAY CROSSFALL OUT TO BIO-RETENTION SWALE
- ROAD WITH ONE-WAY CROSSFALL AND KERB & GUTTER
- BIO-RETENTION SWALE WITH NO UNDER DRAIN (REFER DA28)
- BIO-RETENTION SWALE WITH UNDER DRAIN (REFER DA28)
- SWALE UNDER DRAINAGE OUTLET (TBC) (AGGREGATE WRAPPED IN GEOFABRIC)

NO STORMWATER PIPES OR PIT NETWORKS TO BE CONSTRUCTED. ALL SURFACE STORMWATER FLOWS WILL DRAIN TO PERIMETER BIO-RETENTION SWALES VIA KERB & GUTTERS, DISH DRAINS & ONE-WAY CROSSFALL ROADS.

ROOF WATER FROM DWELLINGS TO BE DETAINED IN DETENTION TANKS BEFORE DRAINING TO RUBBLE INFILTRATION PITS (DETAILS TBC). PITS THAT SURCHARGE IN LARGE EVENTS WILL BE DRAINED TO KERB VIA RHS PIPES.

DETAILED DESIGN OF STORMWATER MANAGEMENT AND SWALES TO BE UNDERTAKEN AS PART OF SUBDIVISION WORKS CERTIFICATE APPLICATION.

B FOR RE-SUBMISSION WF WF 01.08.2022
A FOR SUBMISSION WF WF 01.09.2021

Iss Description Des Drw Date Appd

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ENGINEERING PLANS FOR D.A.
130 LOT SUBDIVISION OF LOT 13 DP 1251383
15 TORAKINA ROAD, BRUNSWICK HEADS

STORMWATER MANAGEMENT PLAN

0.2m DESIGN CONTOURS

Scale: 1:2,000 at A3 CAD file: 1133-DA7B.dwg
Datum: AHD CivilCAD file: 1133-ENG



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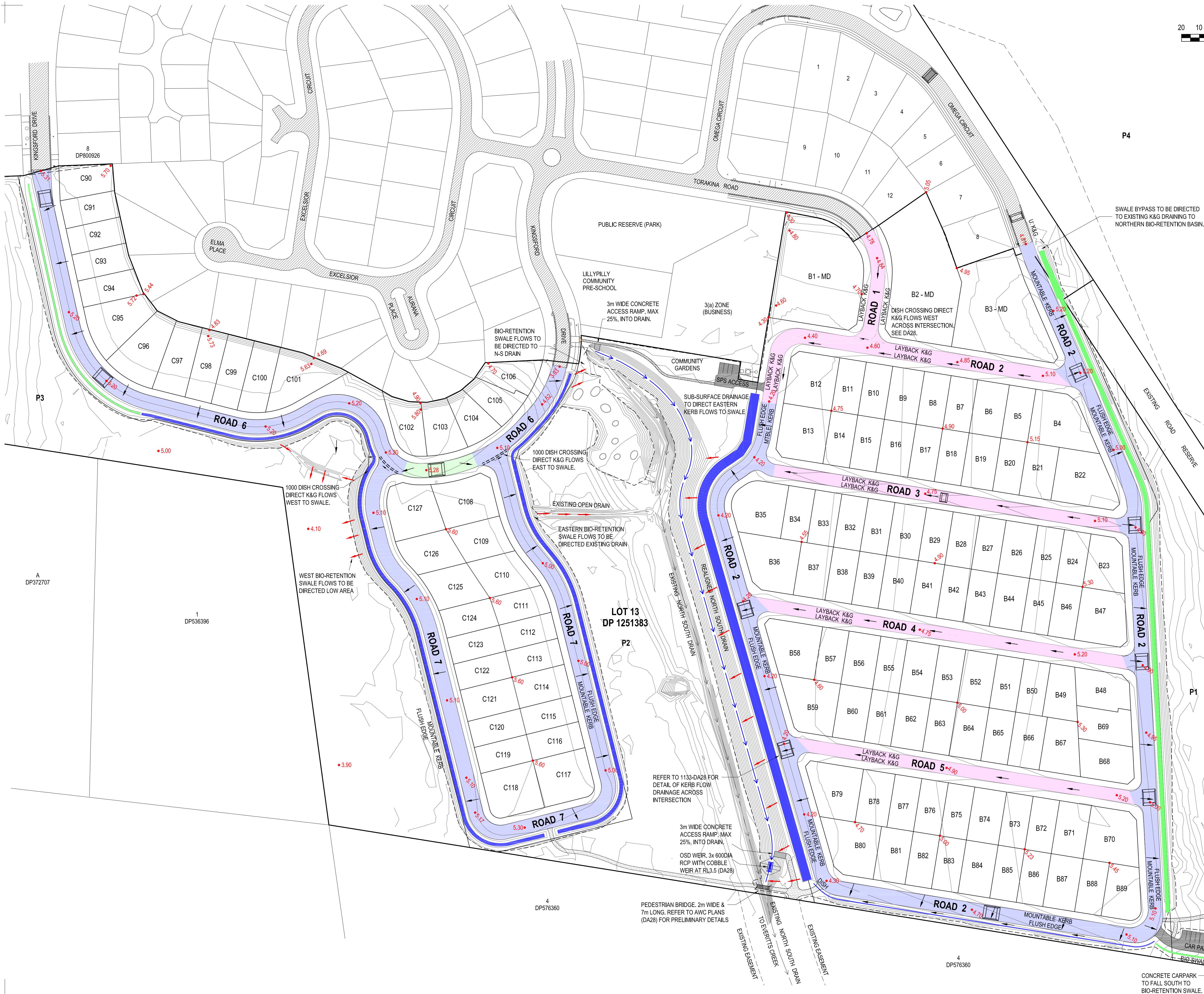
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1133-DA7

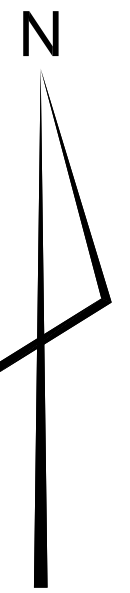
Issue

B





SCALE 1:1,000 AT A1, 1:2,000 AT A3



LEGEND

- SUBJECT SITE BOUNDARY
- STORMWATER CATCHMENT BOUNDARY, AREA & FLOW DIRECTION
- EXISTING N-S DRAIN INVERT
- REALIGNED N-S DRAIN INVERT
- BIO-RETENTION SWALE

B	FOR RE-SUBMISSION	WF	WF	01.08.2022
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ENGINEERING PLANS FOR D.A.
130 LOT SUBDIVISION OF LOT 13 DP 1251383
15 TORAKINA ROAD, BRUNSWICK HEADS

STORMWATER CATCHMENT PLAN
0.2m DESIGN CONTOURS

Scale: 1:2,000 at A3 CAD file: 1133-DA8B.dwg
Datum: AHD CivilCAD file: 1133-ENG



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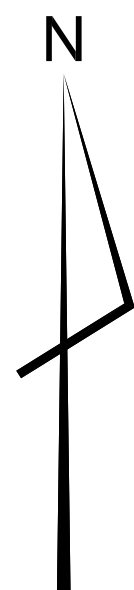
1133-DA8

Issue

B



SCALE 1:1,000 AT A1, 1:2,000 AT A3



LEGEND

- SUBJECT SITE BOUNDARY
- W WATERMAIN (PROPOSED)
- WE WATERMAIN (EXISTING)
- E C SHARED ELEC & COMMS (PROPOSED)
- E O/H ELECTRICITY (TO BE RELOCATED)
- S GRAVITY SEWER (PROPOSED)
- LOW PRESSURE SEWER RM (PROPOSED)
(BOUNDARY KITS TO EACH LPS LOT WITH PUMP, POD & TELEMETRY BY OTHERS)
- SE GRAVITY SEWER (EXISTING)
- INDICATIVE EASEMENT (PROPOSED)
- EXISTING NORTH SOUTH DRAIN INVERT
- REALIGNED NORTH SOUTH DRAIN

DETAILED DESIGN OF EASEMENTS, GRAVITY SEWER, LOW PRESSURE SEWER & SPS STORAGE TO BE UNDERTAKEN AS PART OF SUBDIVISION WORKS CERTIFICATE APPLICATION.

B	FOR RE-SUBMISSION	WF	WF	01.08.2022	
A	FOR SUBMISSION	WF	WF	19.08.2021	
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ENGINEERING PLANS FOR D.A.
130 LOT SUBDIVISION OF LOT 13 DP 1251383
15 TORAKINA ROAD, BRUNSWICK HEADS

GRAVITY SEWER AND LPS CONCEPT PLAN

Scale: 1:2,000 at A3 CAD file: 1133-DA9B.dwg
Datum: AHD CivilCAD file: 1133-ENG



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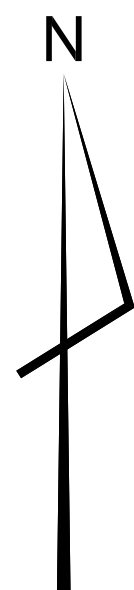
Dwg. No.
1133-DA9

Issue

B

20 10 0 20 40 60 80 100

SCALE 1:1,000 AT A1, 1:2,000 AT A3



LEGEND

- SUBJECT SITE BOUNDARY
- 1000 WATERMAIN (PROPOSED)
- HYDRANTS AT MAX. 60m SPACINGS
- WATERMAIN (EXISTING)
- WE
- SHARED ELEC & COMMS (PROPOSED)
- E
- O/H ELECTRICITY (TO BE RELOCATED)
- S
- GRAVITY SEWER (PROPOSED)
- SE
- GRAVITY SEWER (EXISTING)
- INDICATIVE EASEMENT (PROPOSED)
- EXISTING NORTH SOUTH DRAIN INVERT
- REALIGNED NORTH SOUTH DRAIN

DETAILED DESIGN OF RETICULATED WATER, ELECTRICAL, COMMUNICATIONS & STREET LIGHTS TO BE UNDERTAKEN AS PART OF SUBDIVISION WORKS CERTIFICATE APPLICATION.

B	FOR RE-SUBMISSION	WF	WF	01.08.2022
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ENGINEERING PLANS FOR D.A.
130 LOT SUBDIVISION OF LOT 13 DP 1251383
15 TORAKINA ROAD, BRUNSWICK HEADS

WATER, ELEC & COMMS SCHEMATIC CONCEPT PLAN

Scale: 1:2,000 at A3 CAD file: 1133-DA10B.dwg
Datum: AHD CivilCAD file: 1133-ENG



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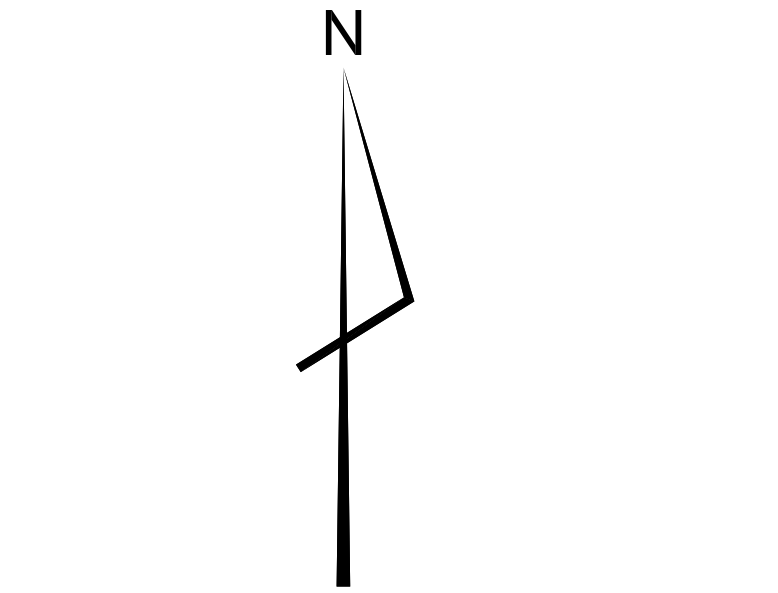
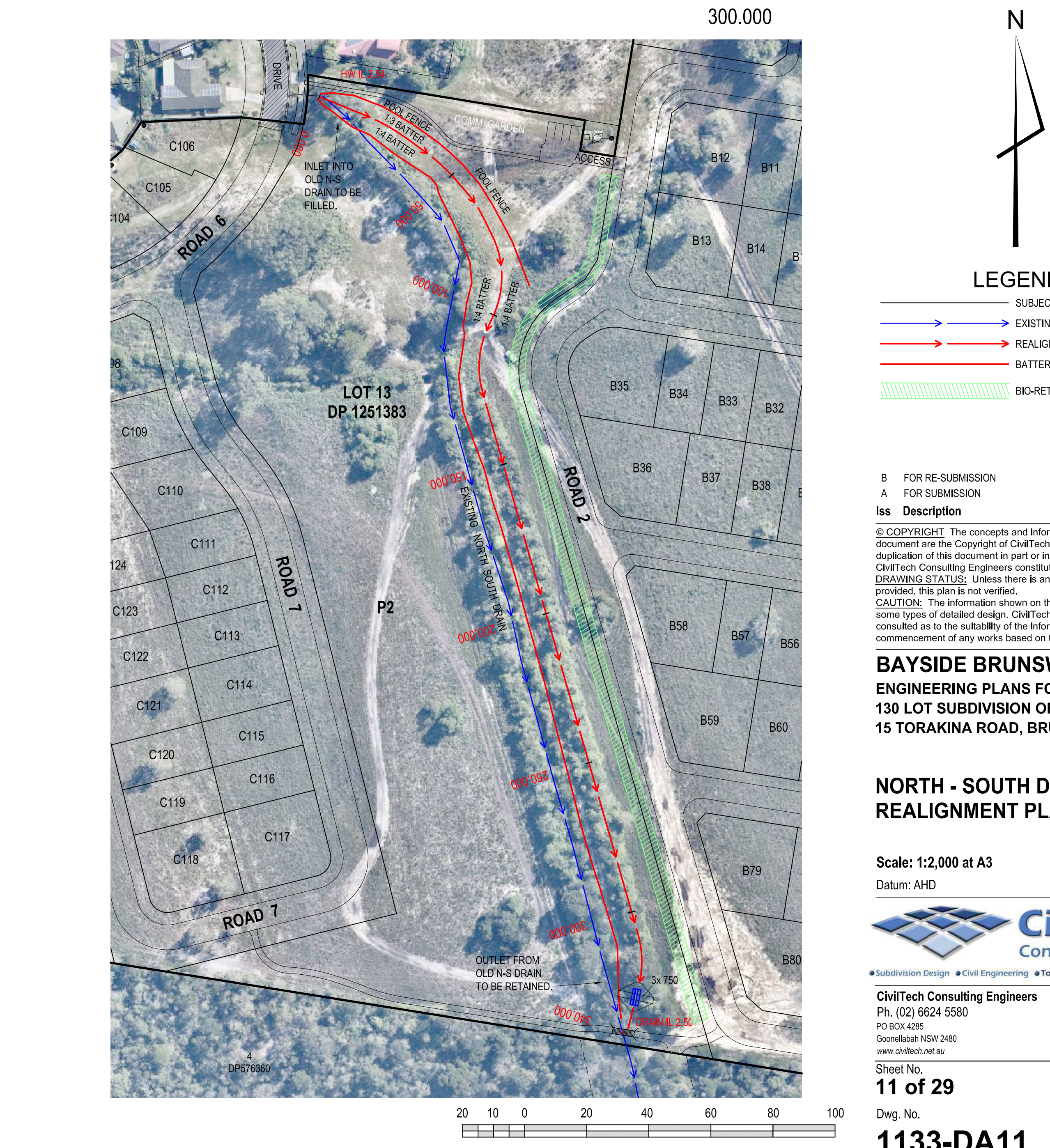
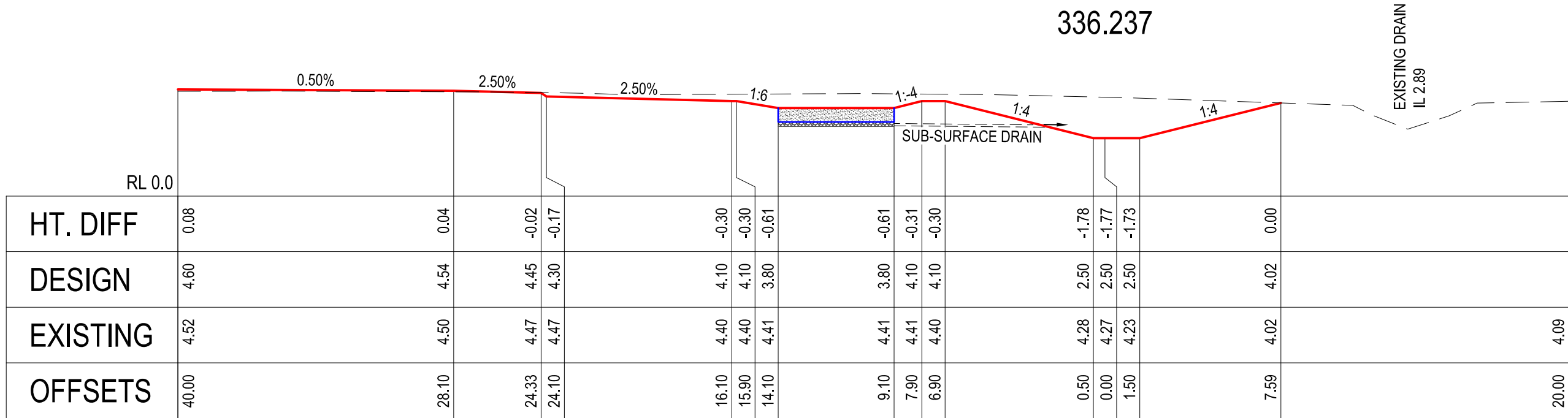
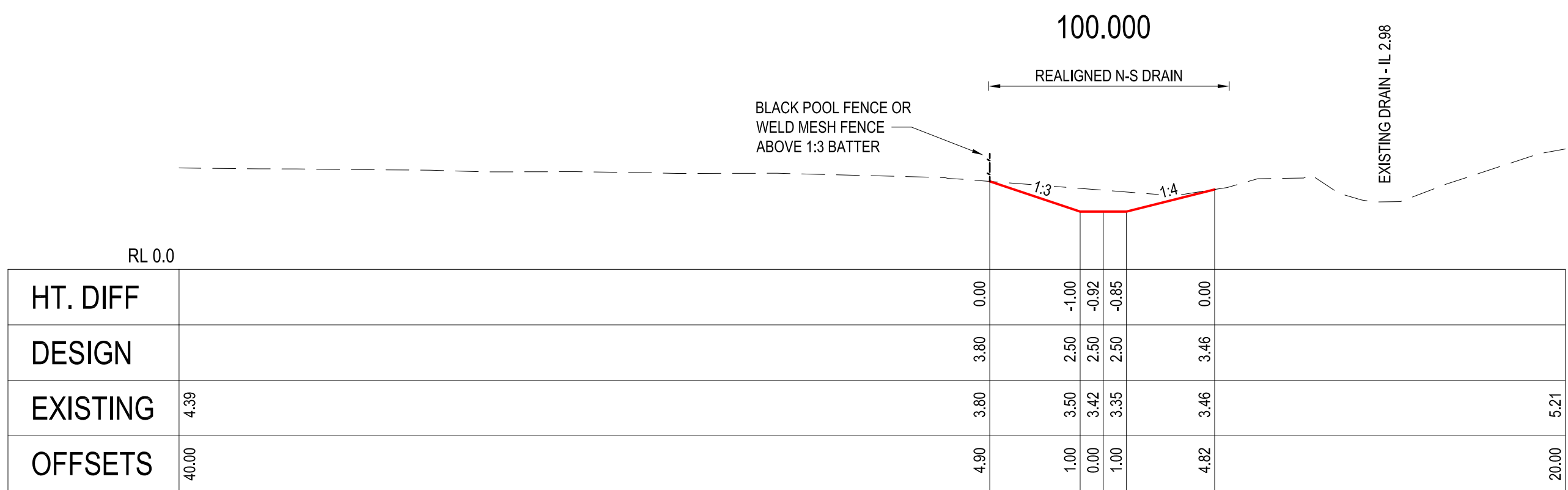
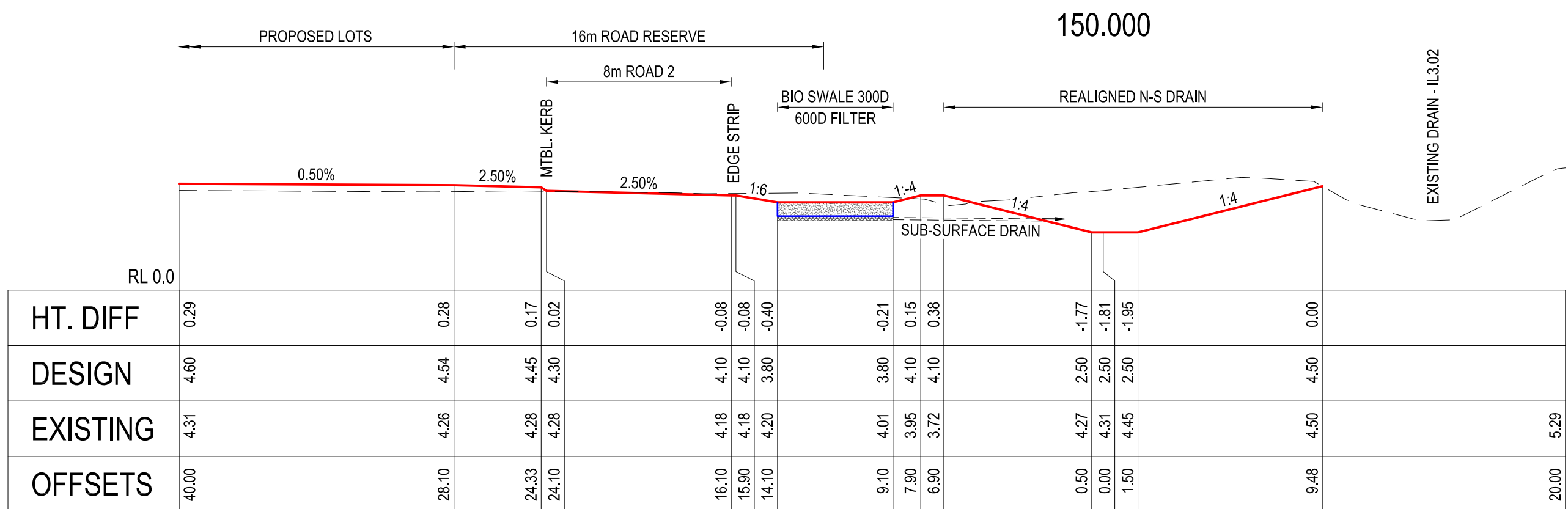
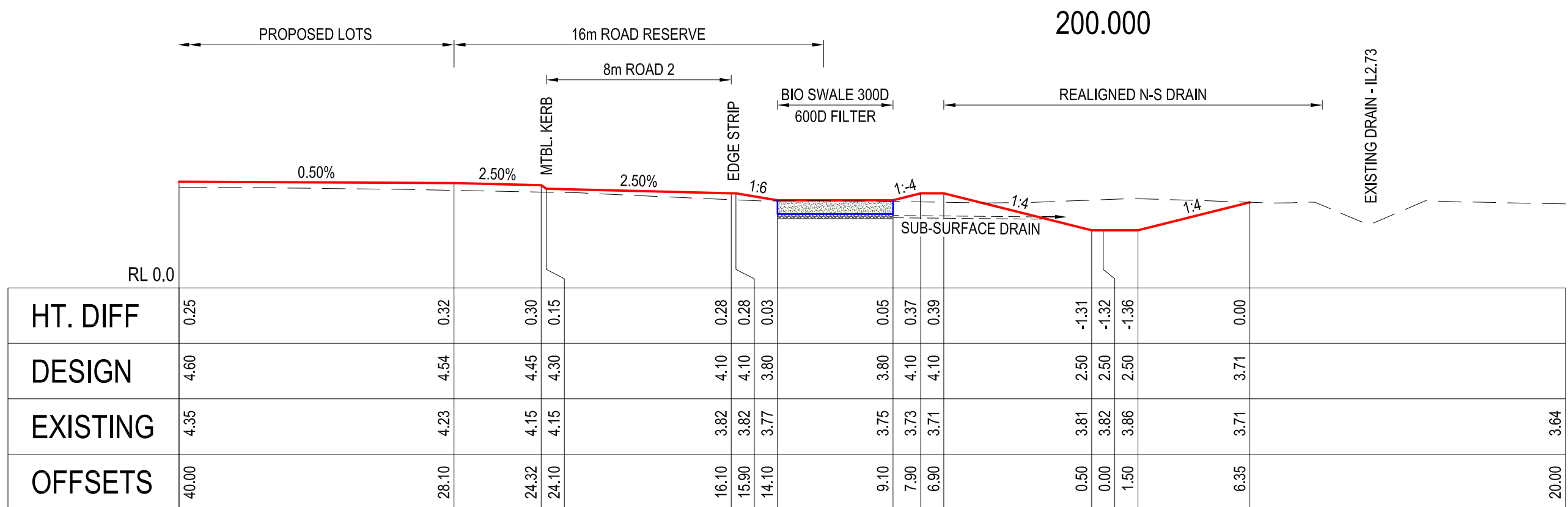
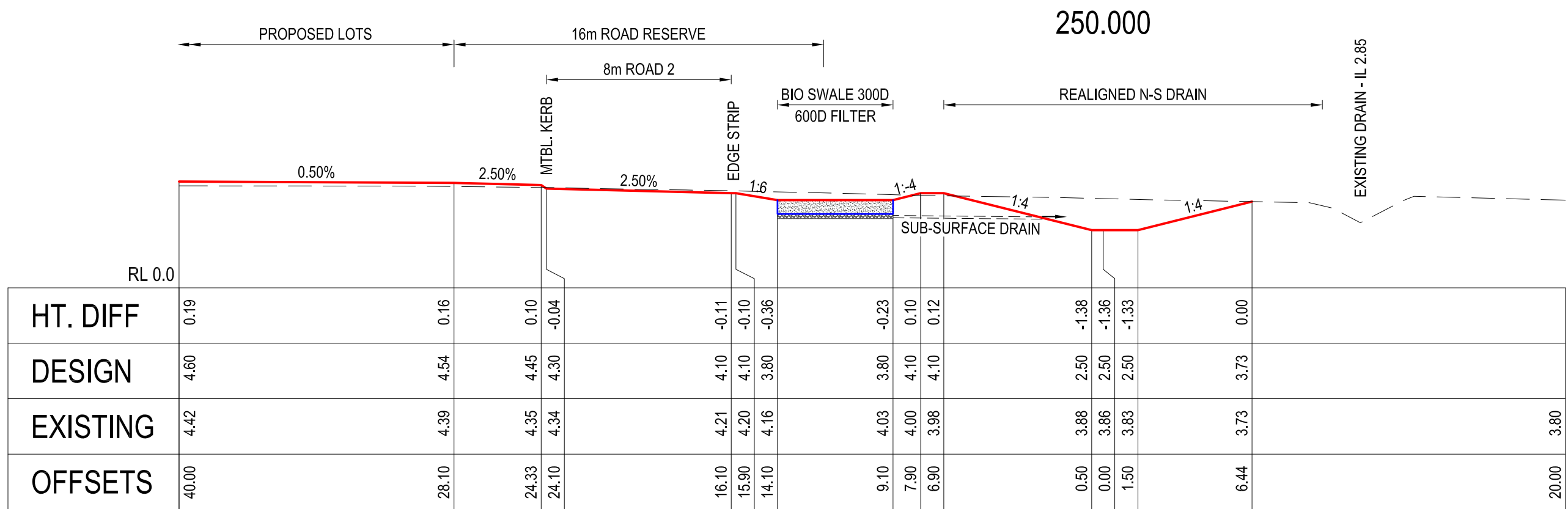
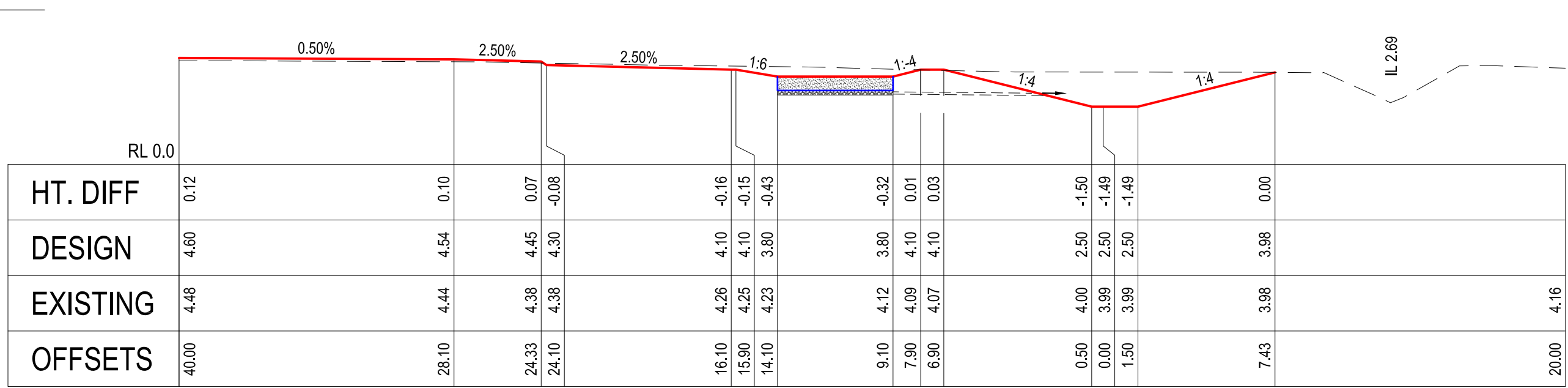
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Dwg. No.

1133-DA10

Issue

B



- LEGEND**
- SUBJECT SITE BOUNDARY
 - EXISTING NORTH SOUTH DRAIN INVERT
 - REALIGNED NORTH SOUTH DRAIN
 - BATTER EXTENT
 - BIO-RETENTION SWALE

B FOR RE-SUBMISSION WF WF 01.08.2022
A FOR SUBMISSION WF WF 23.08.2021

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130 LOT SUBDIVISION OF LOT 13 DP 1251383
15 TORAKINA ROAD, BRUNSWICK HEADS

NORTH - SOUTH DRAIN
REALIGNMENT PLAN & SECTIONS

Scale: 1:2,000 at A3 CAD file: 1133-DA11B.dwg
Datum: AHD CivilCAD file: 1133-ENG



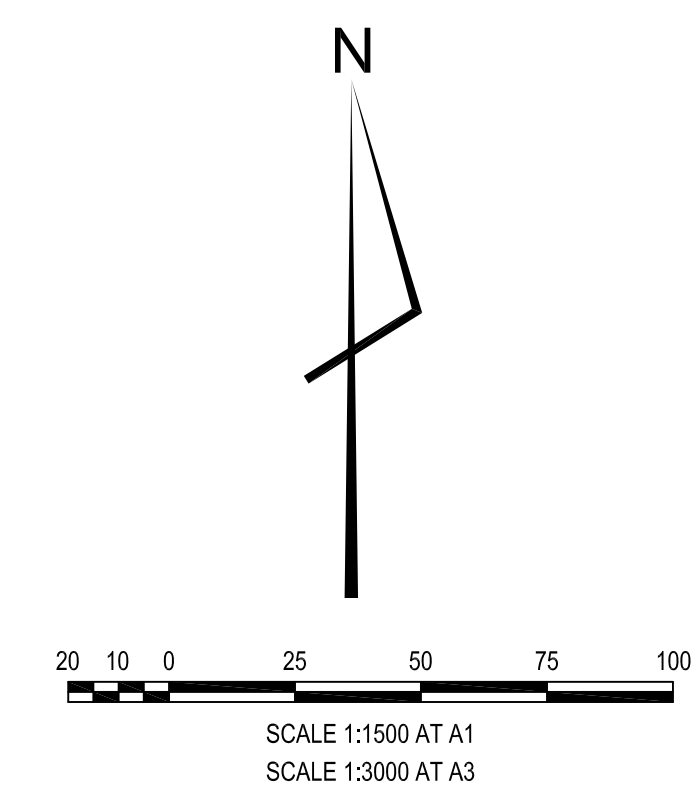
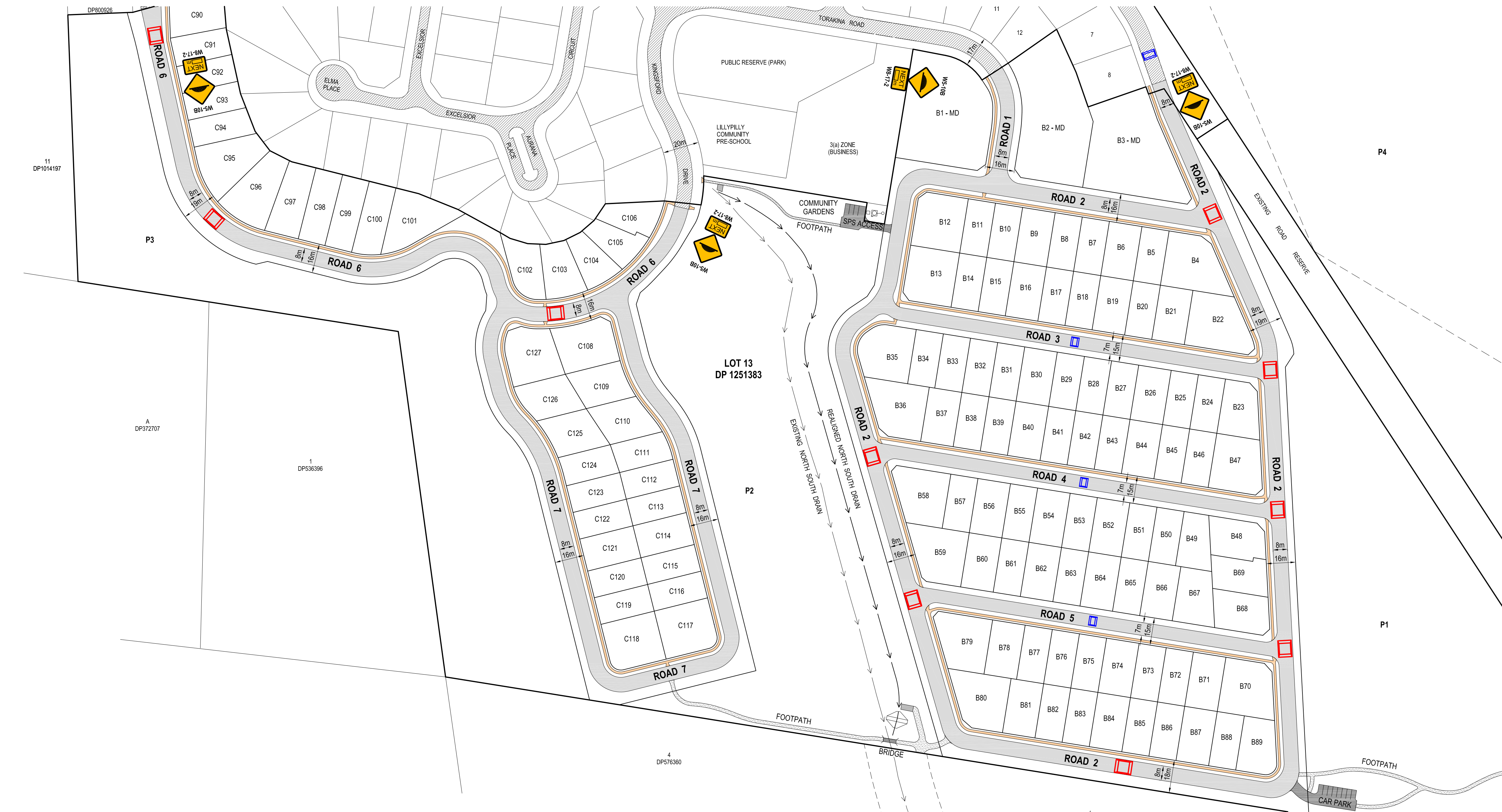
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Dwg. No.
1133-DA11

Issue

B



- LEGEND**
- LOCAL STREET TRAFFIC CALMING
 - BUS ROUTE TRAFFIC CALMING
 - 1.2m CONCRETE PEDESTRIAN FOOTPATH
 - 2.0m GRAVEL PEDESTRIAN FOOTPATH
 - PUBLIC ROAD PAVEMENT (PROPOSED)
- SIGNAGE DETAILS TO BE CONFIRMED AS PART OF CONSTRUCTION CERTIFICATE APPLICATION.
- OLD PACIFIC HIGHWAY INTERSECTION UPGRADE DETAILS TO BE CONFIRMED AS PART OF SUBDIVISION WORKS CERTIFICATE APPLICATION IN ACCORDANCE WITH CONCEPT PLAN APPROVAL.

B	FOR RE-SUBMISSION	WF	WF	01.08.2022	
A	FOR SUBMISSION	WF	WF	01.08.2021	
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BAYSIDE BRUNSWICK Pty. Ltd.
ENGINEERING PLANS FOR D.A.
130 LOT SUBDIVISION OF LOT 13 DP 1251383
15 TORAKINA ROAD, BRUNSWICK HEADS

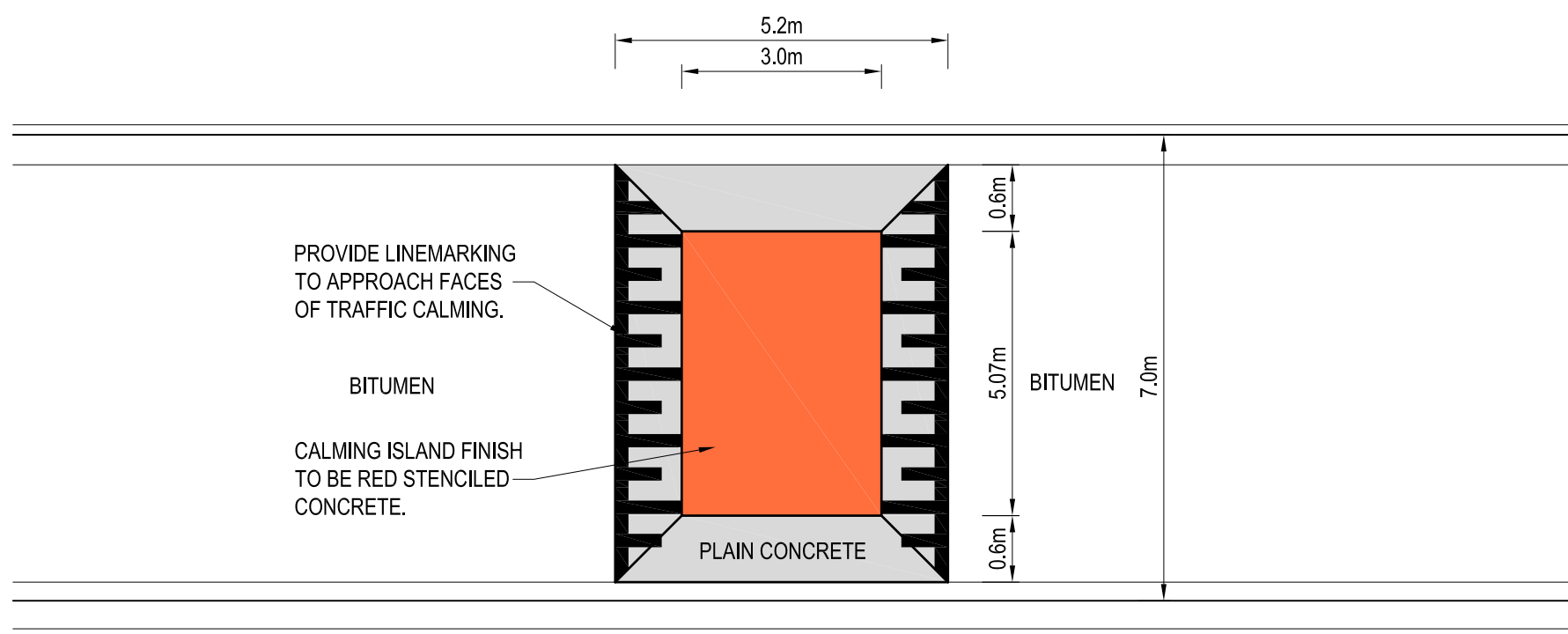
TRAFFIC MANAGEMENT PLAN

Scale: 1:1500 at A1
Datum: AHD
CAD file: 1133-DA12B.dwg
CivilCAD file: 1133-ENG

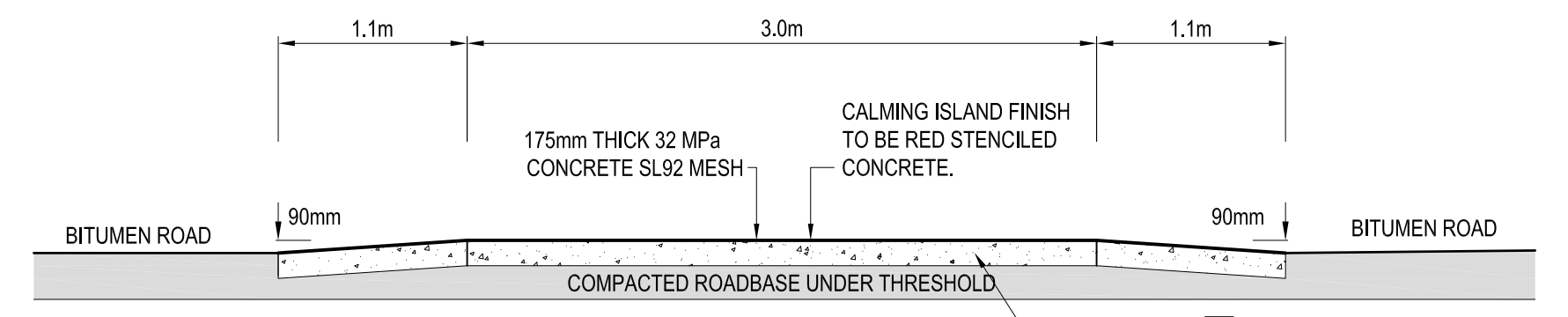


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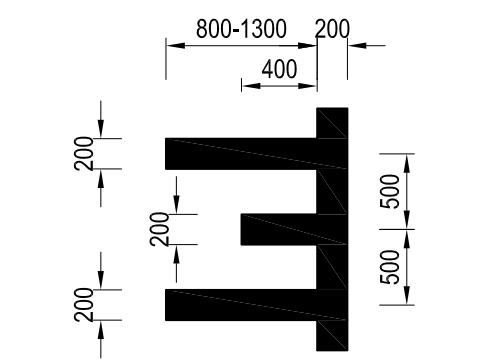
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1133-DA12
Issue
B



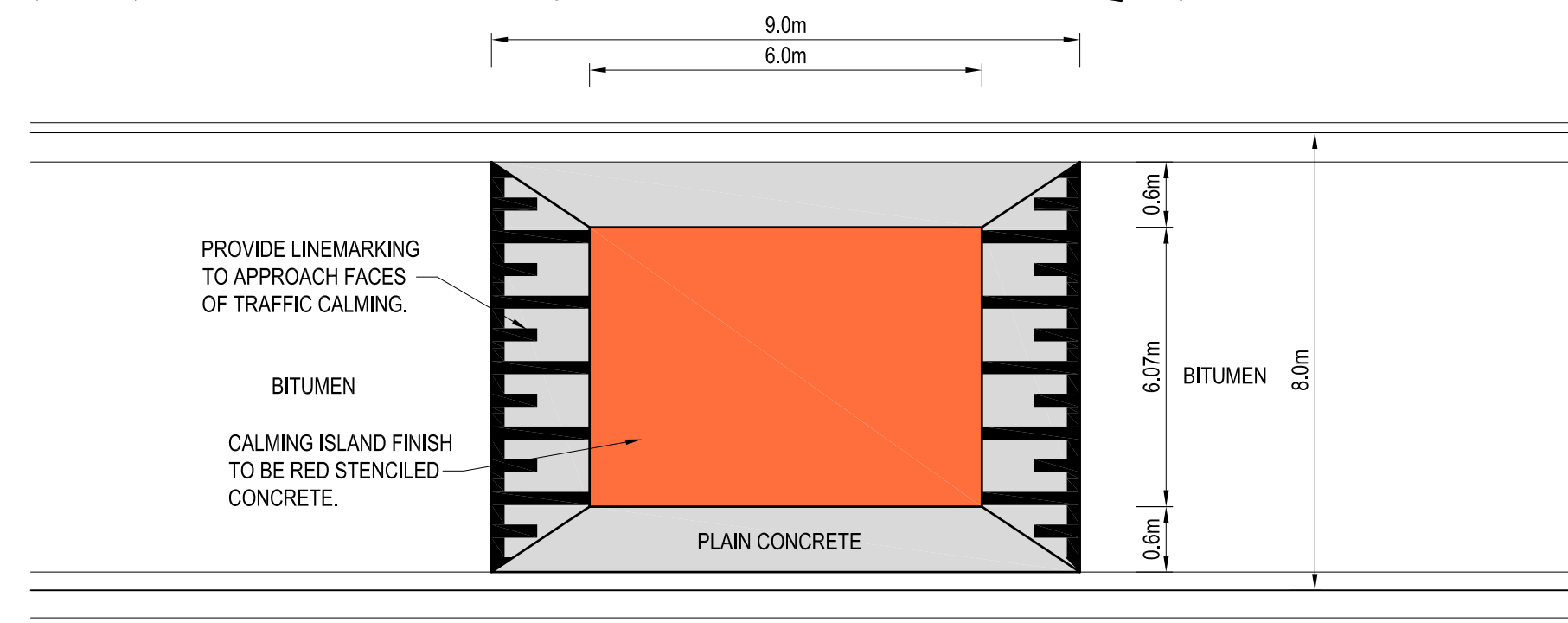
LOCAL STREET - TRAFFIC CALMING - PLAN VIEW



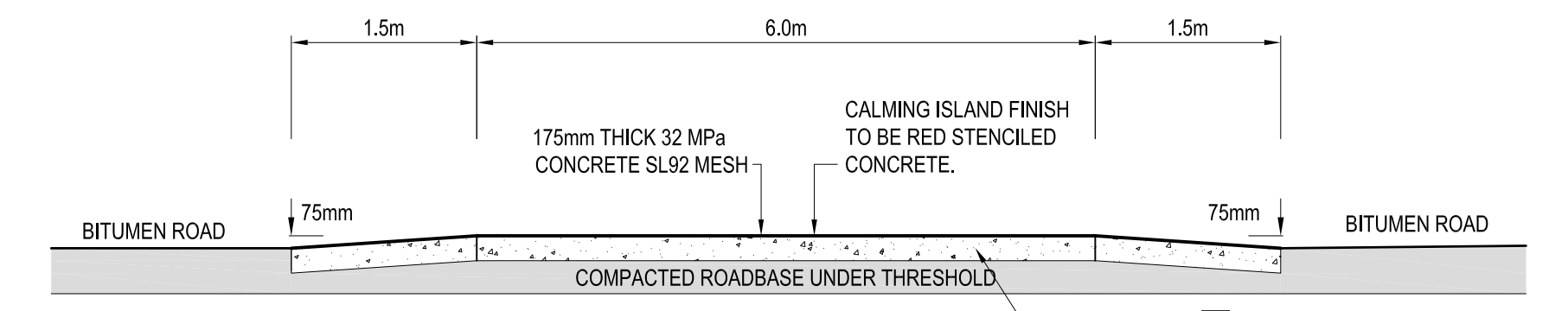
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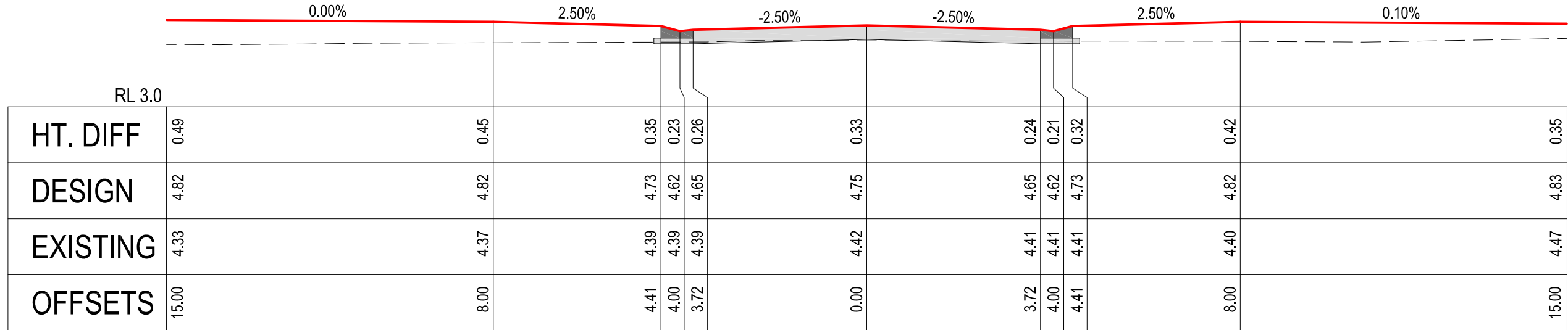
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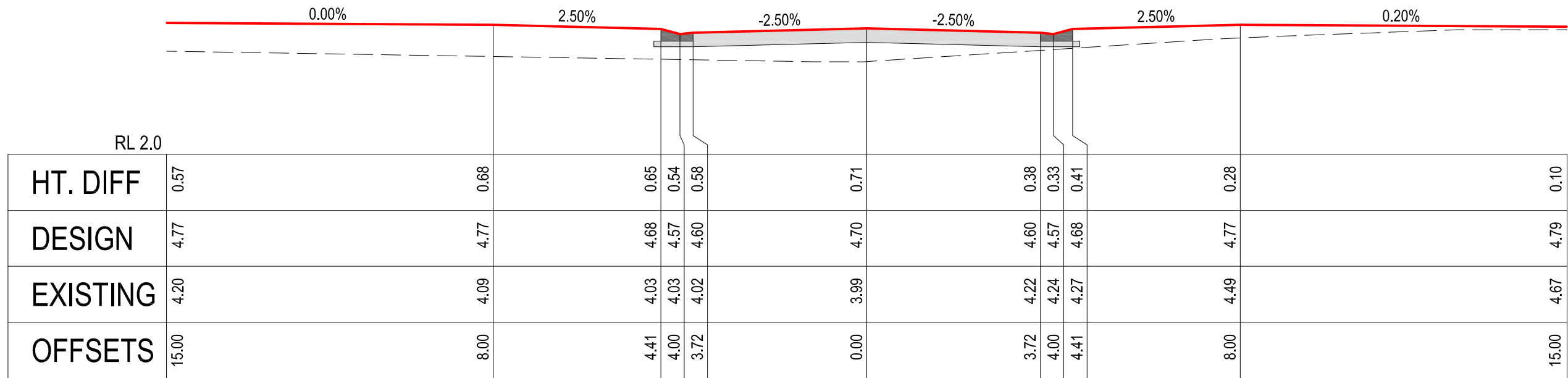
BUS ROUTE - TRAFFIC CALMING - PLAN VIEW



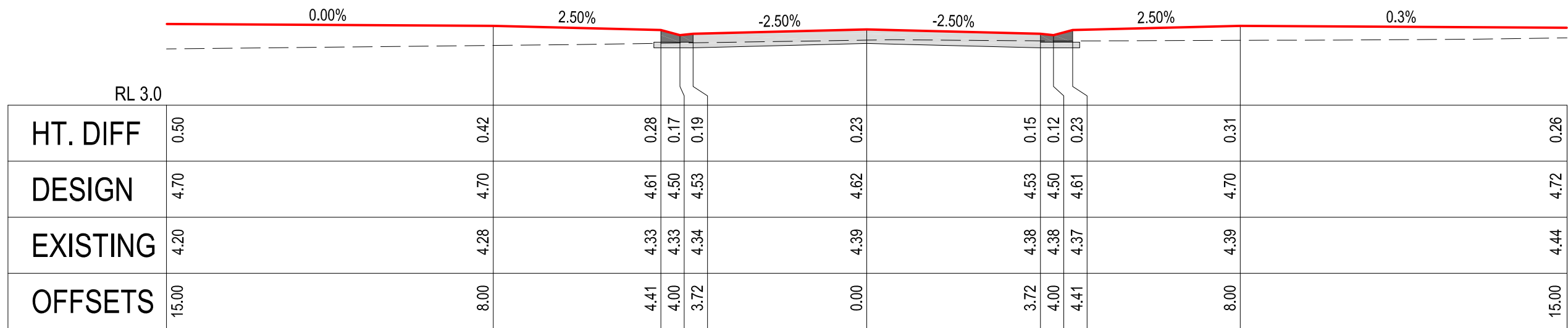
BUS ROUTE - TRAFFIC CALMING - SECTION



30.000



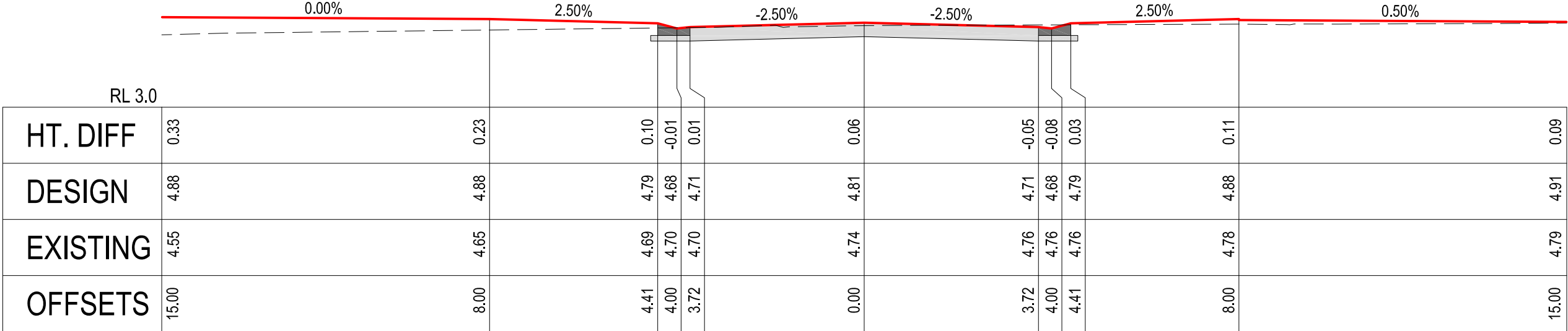
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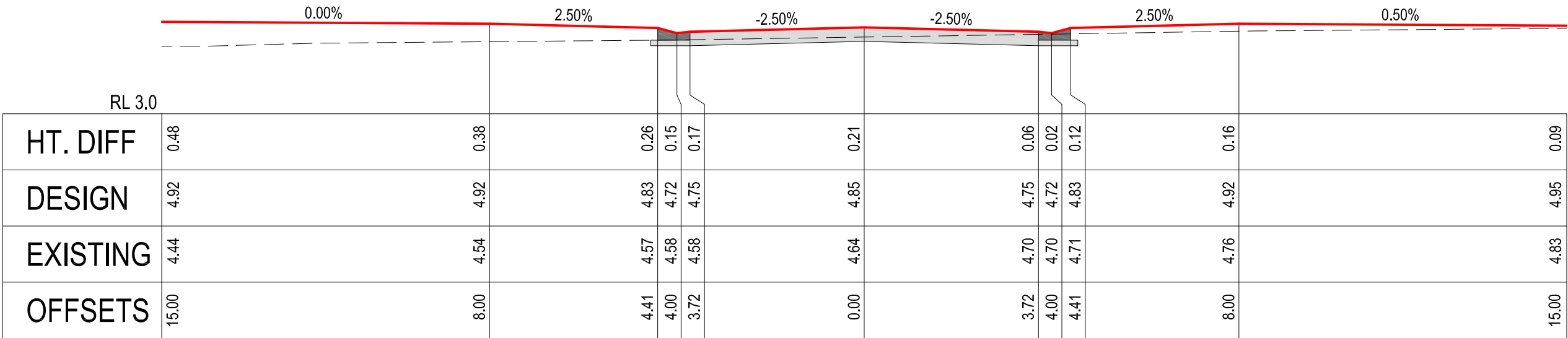
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ROAD 1 - CROSS SECTIONS

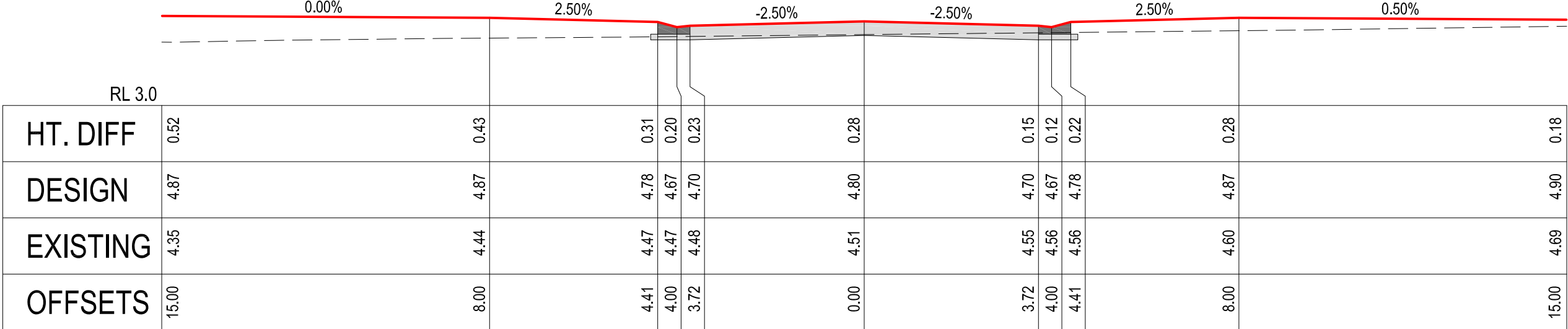
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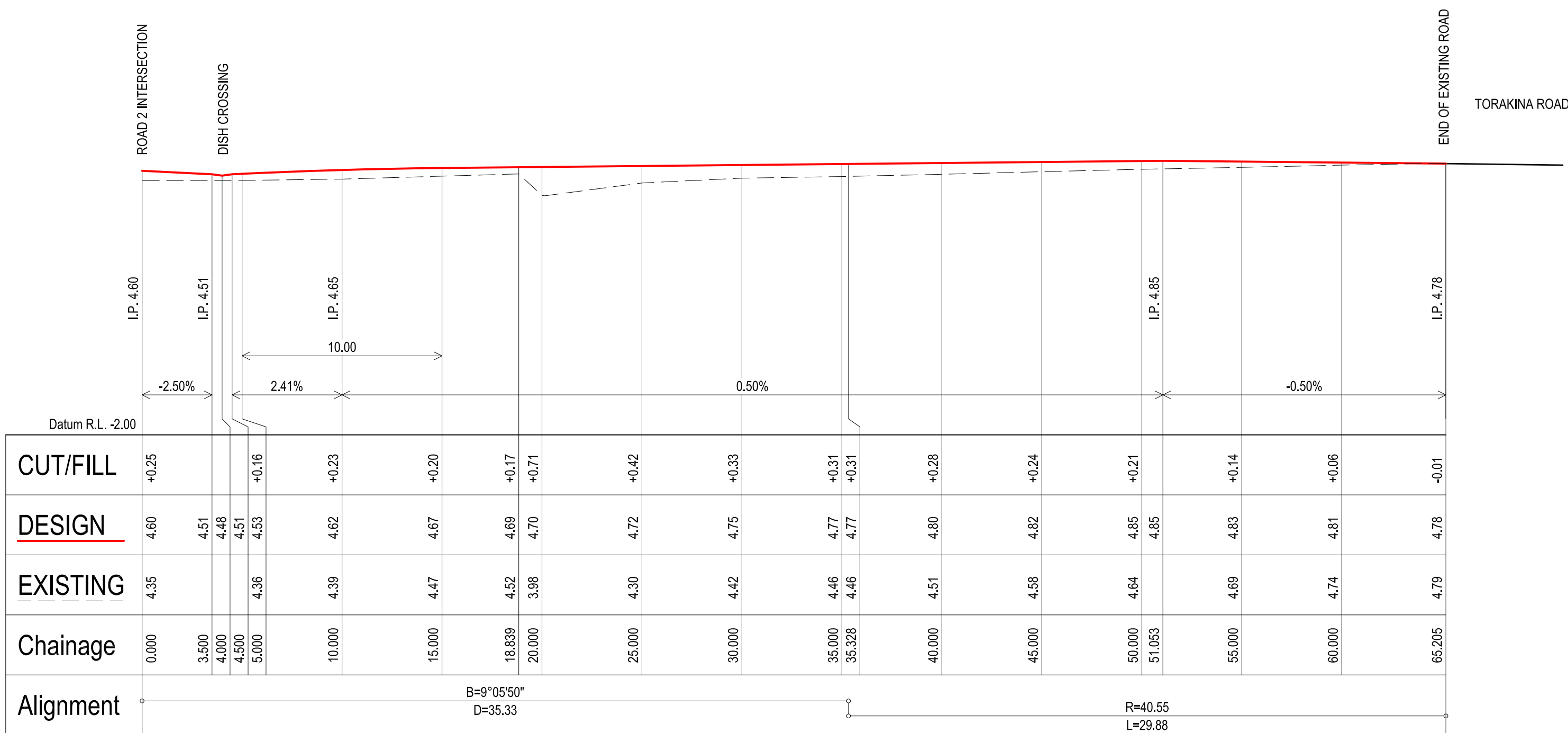
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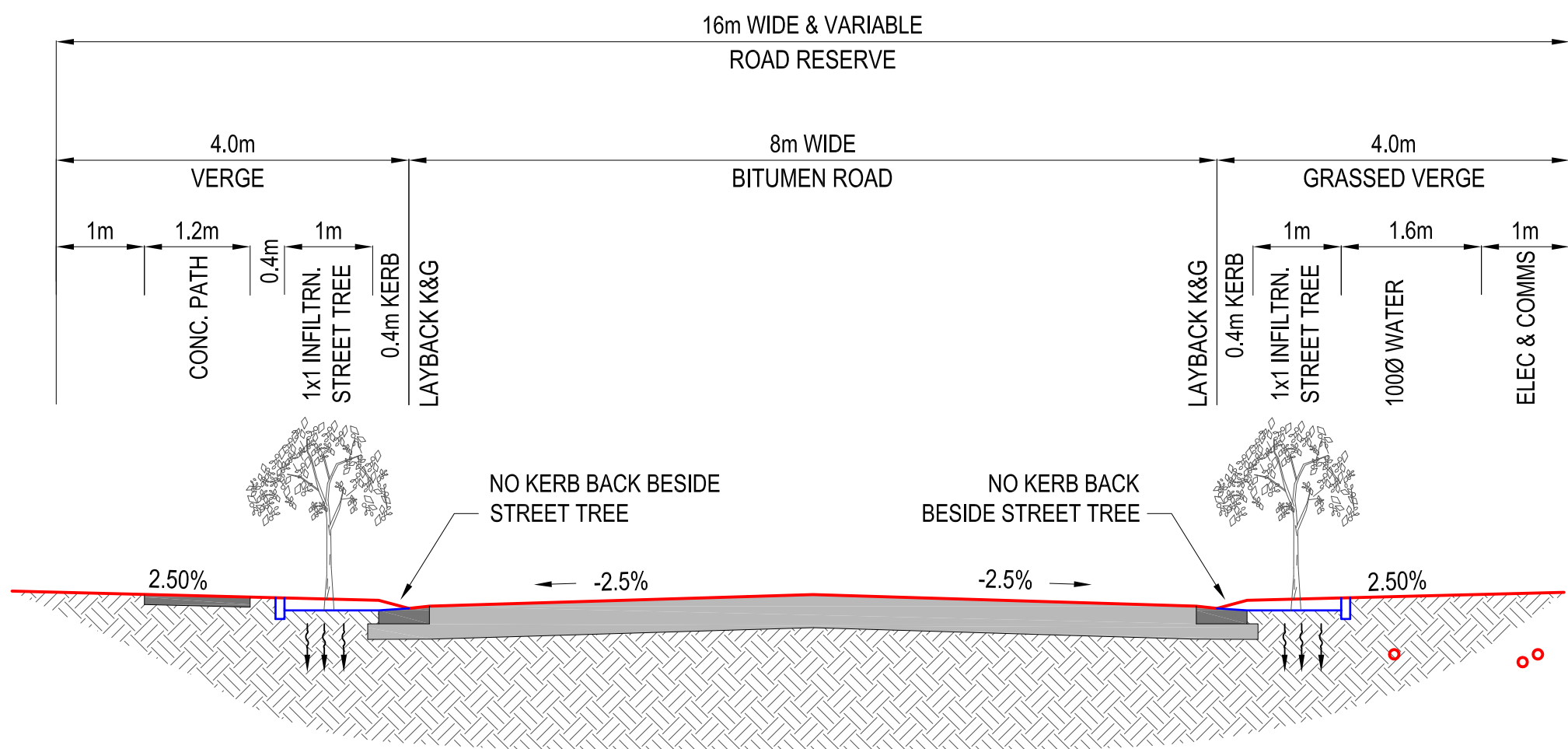


40.000



ROAD 1 - LONG SECTION

Scale Horizontal 1:200 Vertical 1:100



ROAD 1 TYPICAL SECTION

Not to Scale

B	FOR RE-SUBMISSION	WF	WF	01.08.2022	
A	FOR SUBMISSION	WF	WF	01.08.2021	
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130 LOT SUBDIVISION OF LOT 13 DP 1251383
15 TORAKINA ROAD, BRUNSWICK HEADS

ROAD 1 LONG SECTION
& CROSS SECTIONS

Scale: As Shown at A1 CAD file: 1133-DA13B.dwg
Datum: AHD CivilCAD file: 1133-ENG



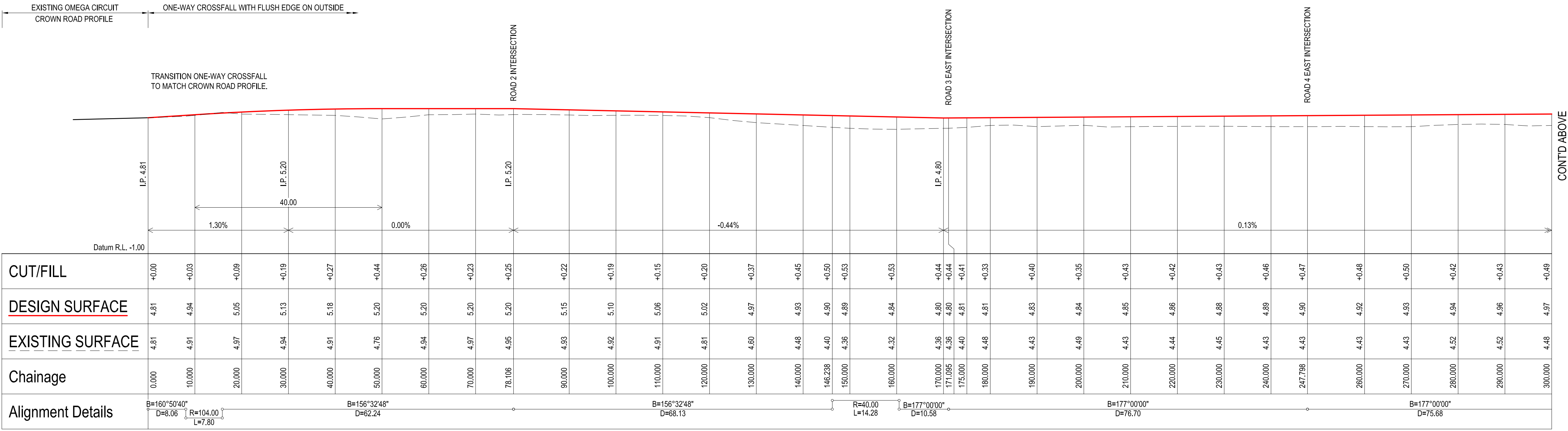
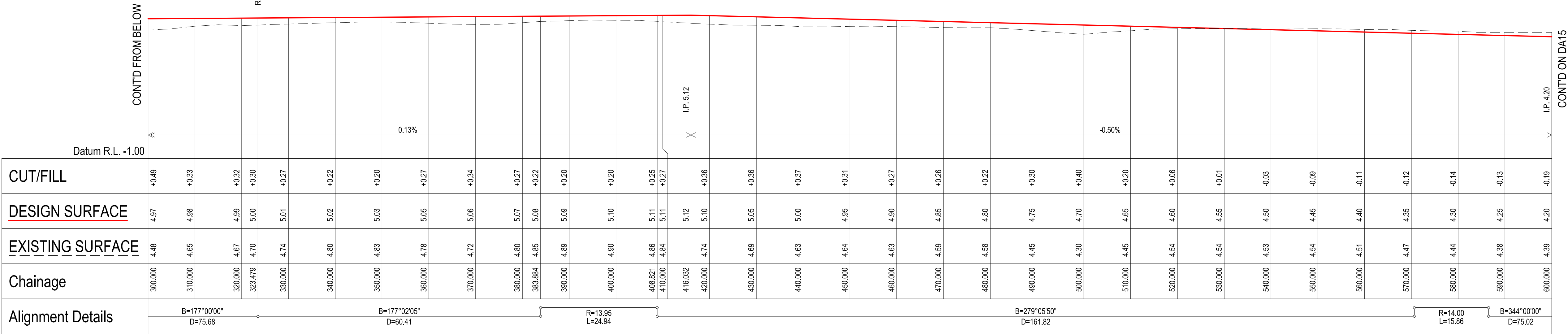
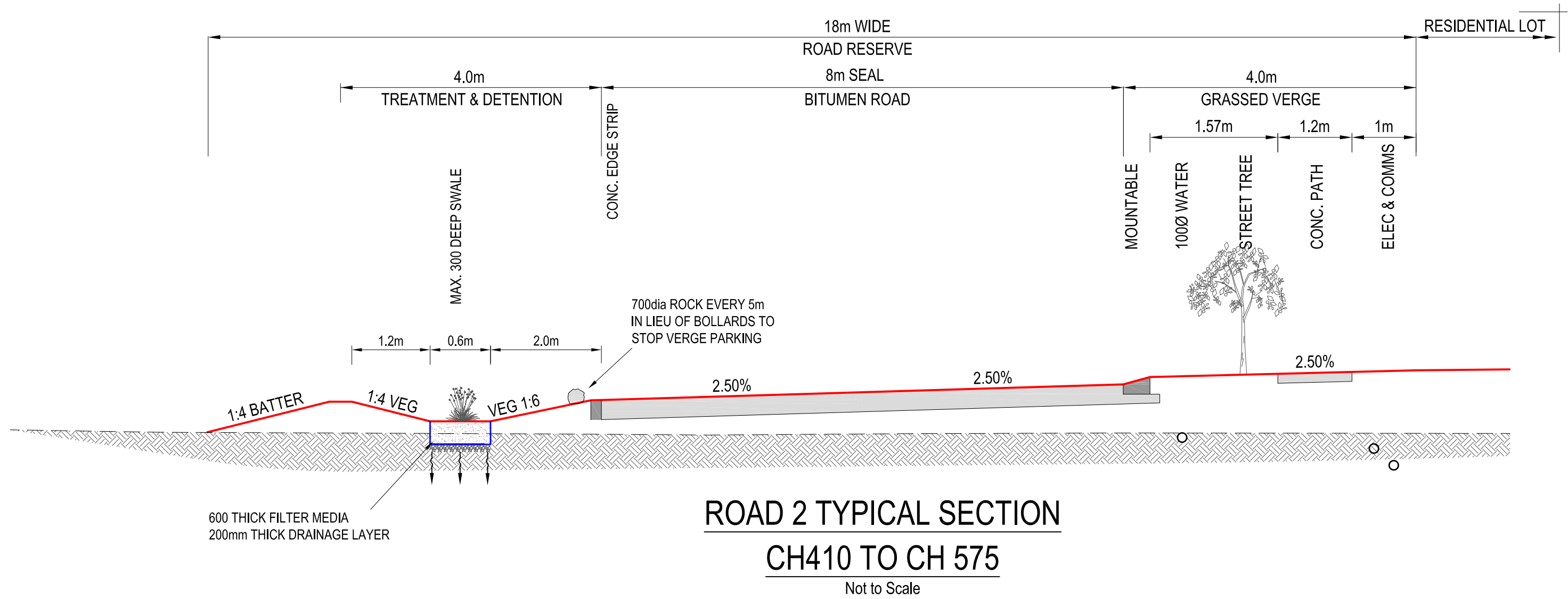
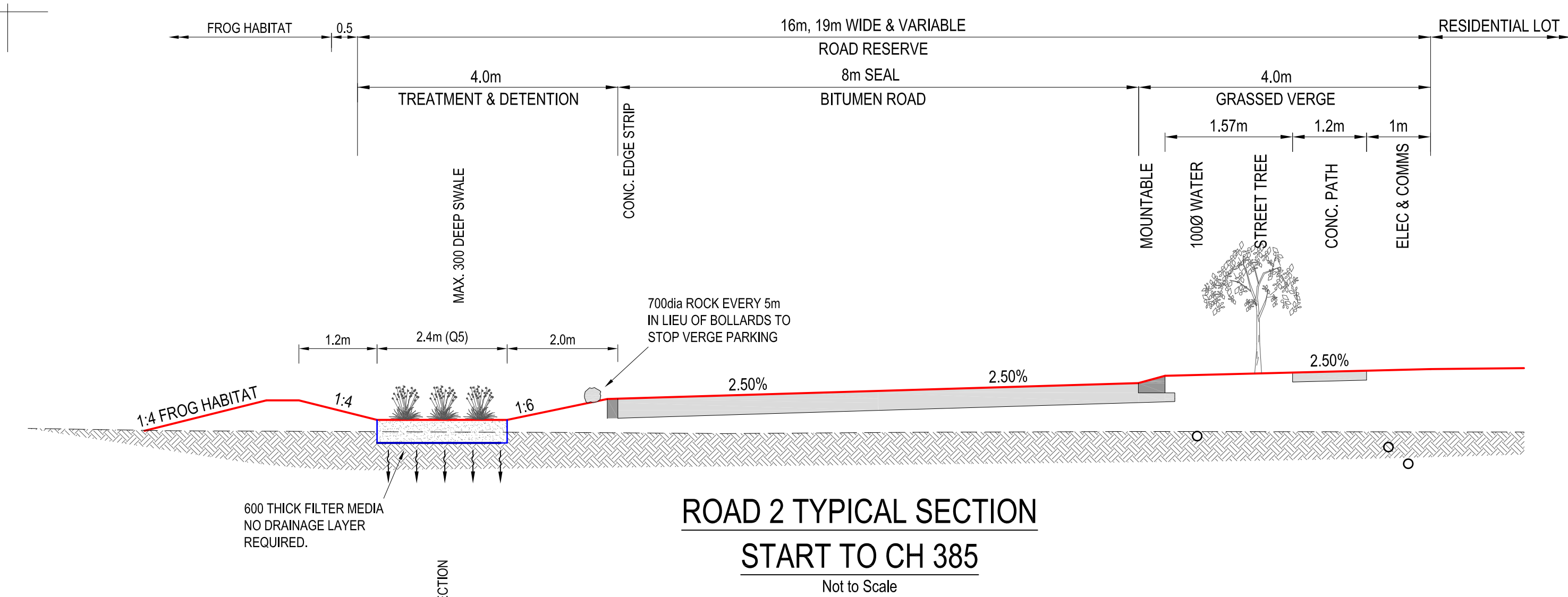
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Dwg. No.
1133-DA13

Issue

B



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A FOR SUBMISSION WF WF 01.09.2021

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130 LOT SUBDIVISION OF LOT 13 DP 1251383
15 TORAKINA ROAD, BRUNSWICK HEADS

ROAD 2 LONG SECTION
START TO CH 600.00

Scale: As Shown at A1 CAD file: 1133-DA14B.dwg
Datum: AHD CivilCAD file: 1133-ENG

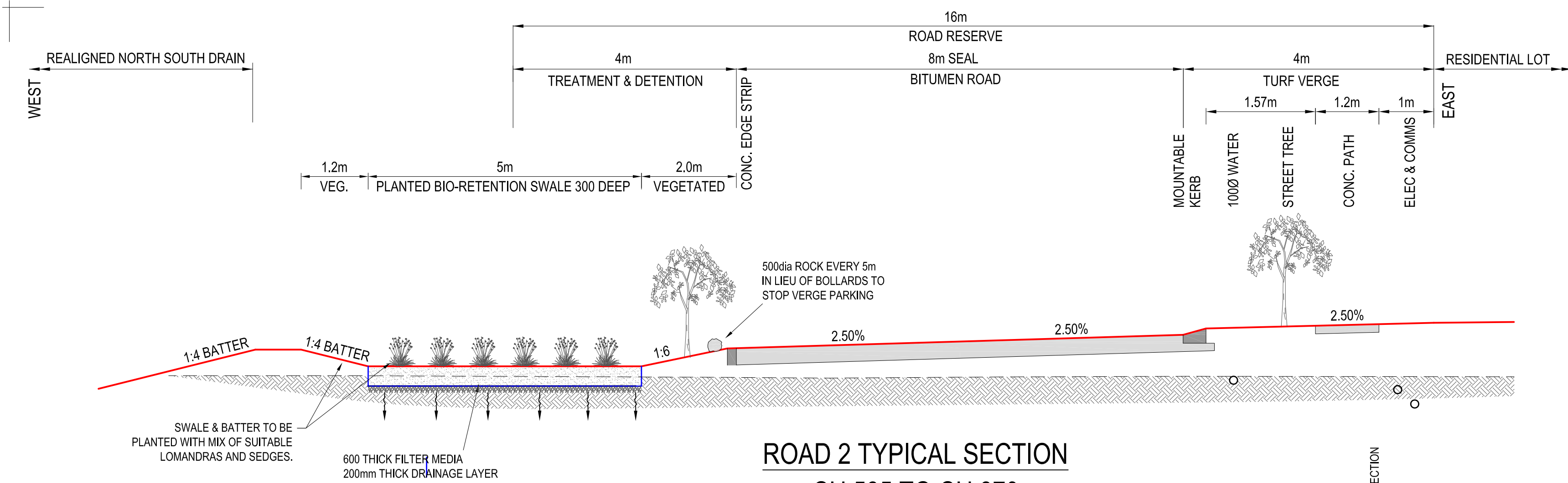


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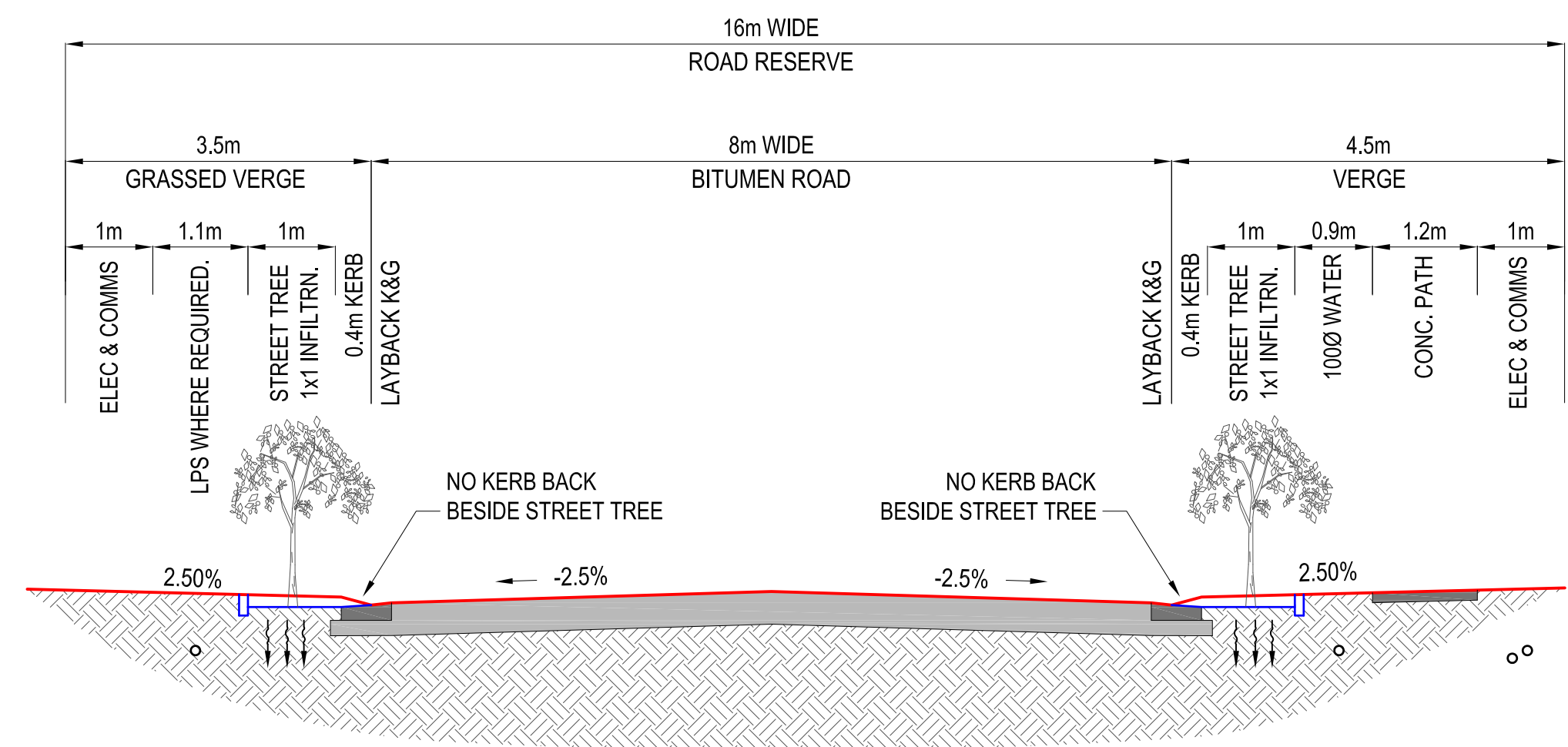
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14 of 29

Dwg. No.
1133-DA14

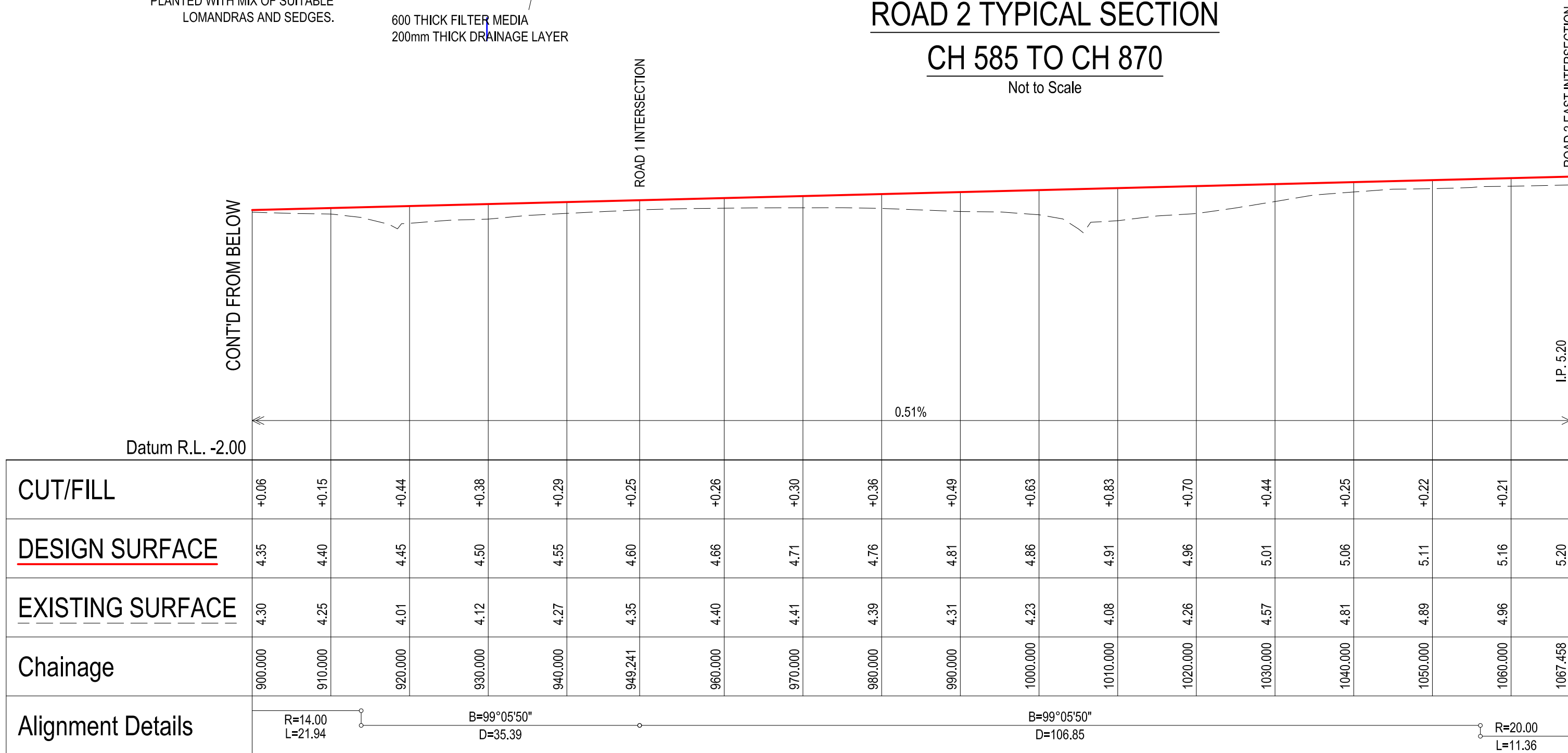
Issue
B



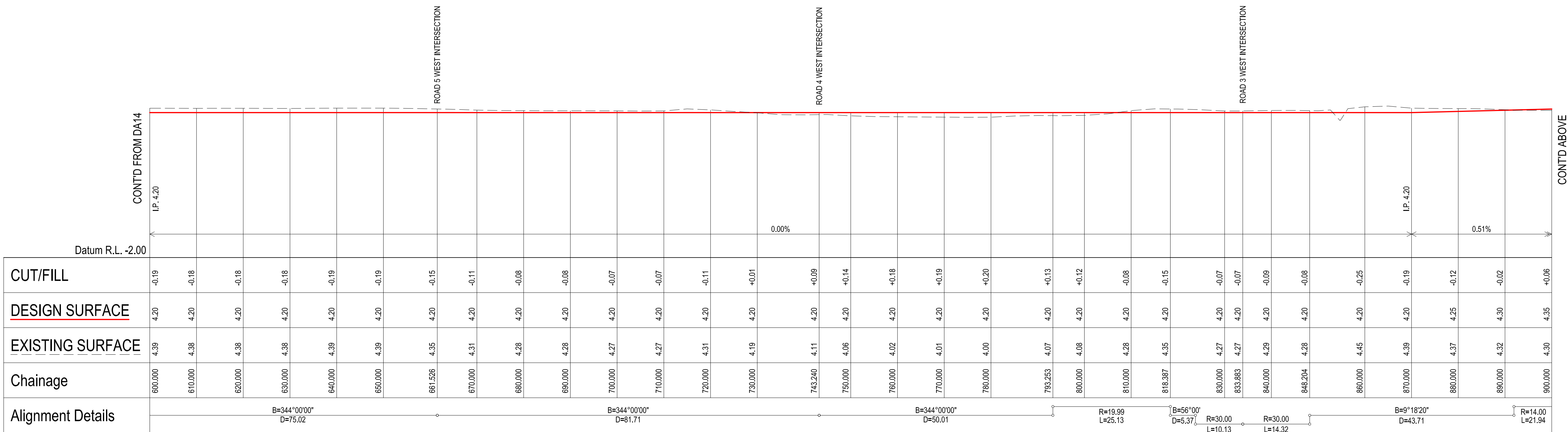
ROAD 2 TYPICAL SECTION
CH 585 TO CH 870
Not to Scale



ROAD 2 TYPICAL SECTION
CH 880 TO END
Not to Scale



ROAD 2 - LONG SECTION cont'd
Scale Horizontal 1:500 Vertical 1:100



ROAD 2 - LONG SECTION cont'd
Scale Horizontal 1:500 Vertical 1:100

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A FOR SUBMISSION WF WF 01.08.2021

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130 LOT SUBDIVISION OF LOT 13 DP 1251383
15 TORAKINA ROAD, BRUNSWICK HEADS

ROAD 2 LONG SECTION cont'd
CH 600.00 TO END

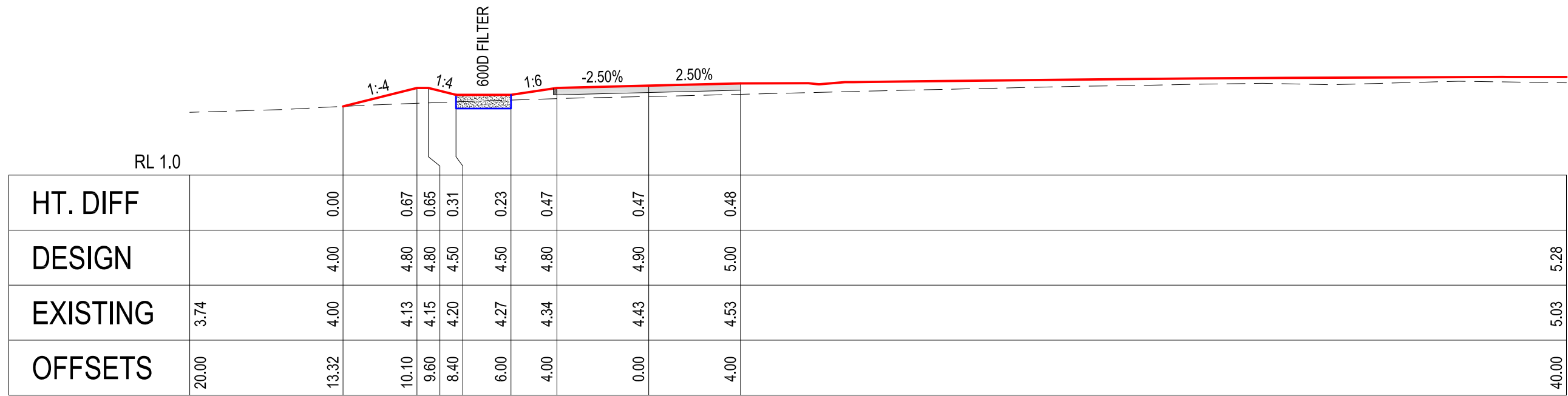
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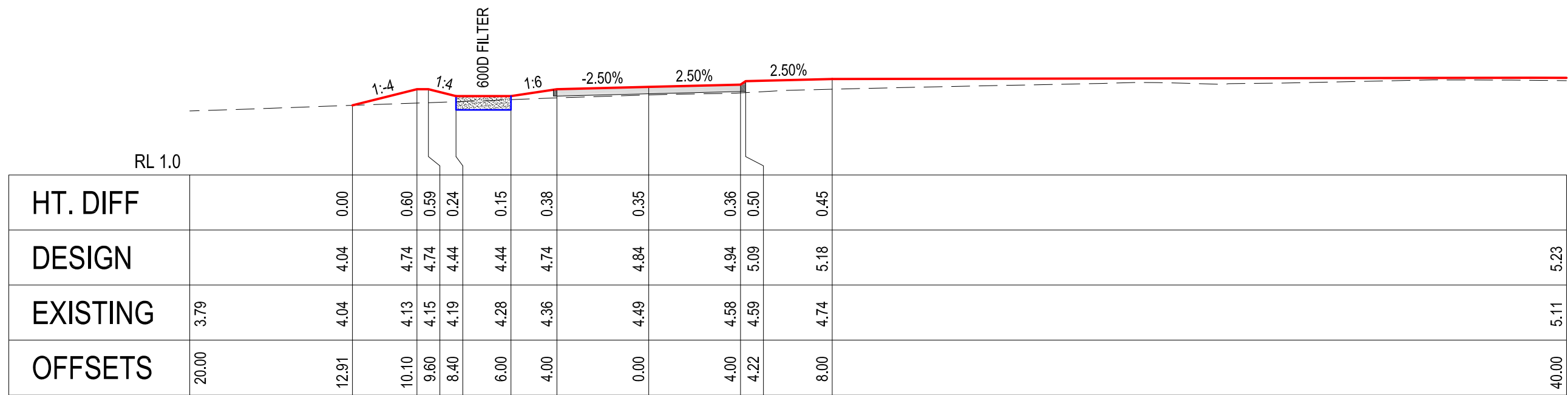
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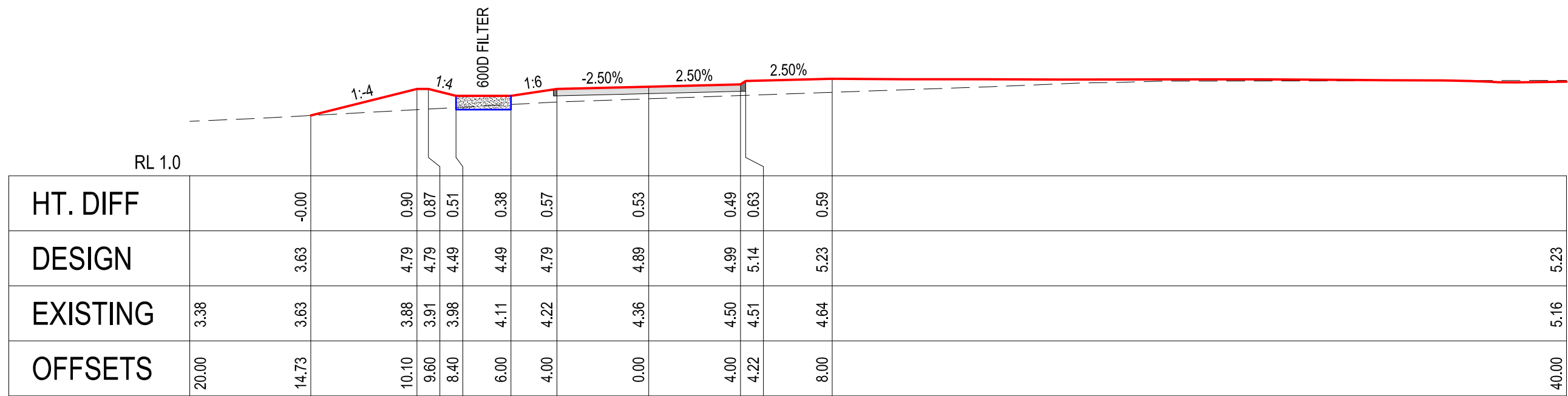
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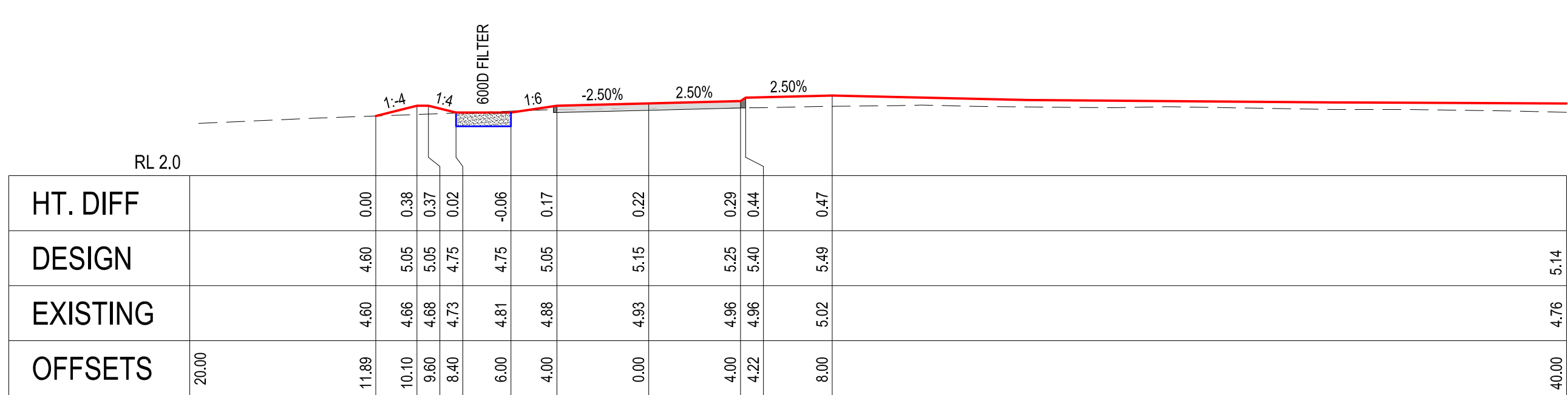
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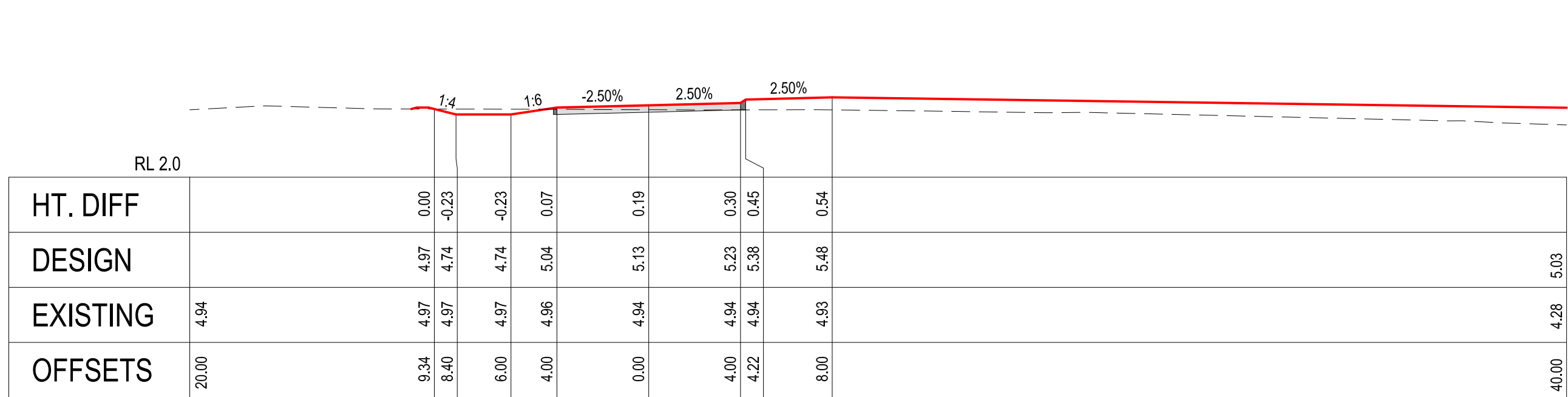
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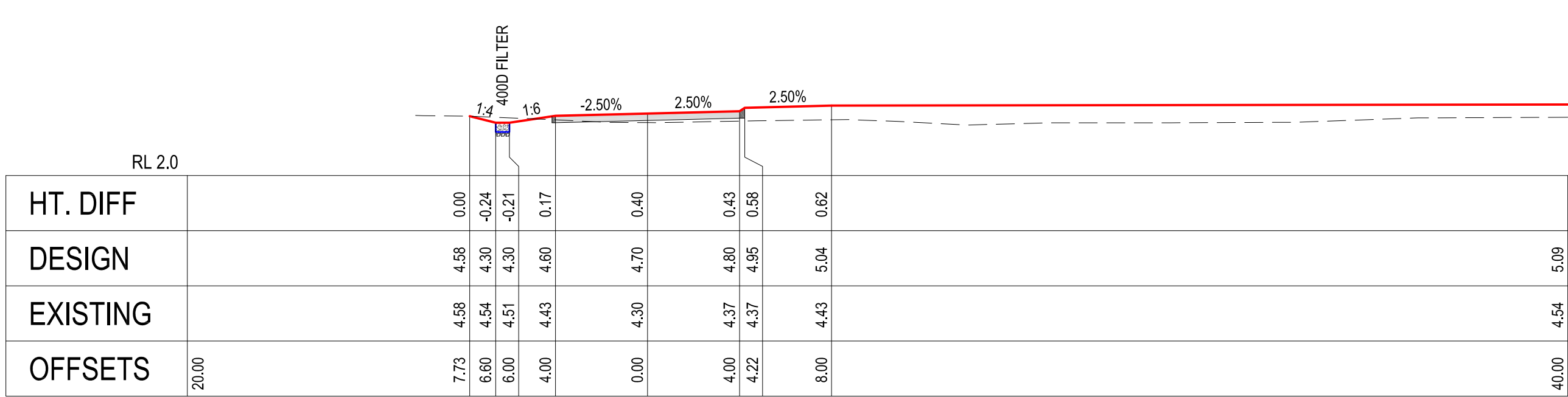
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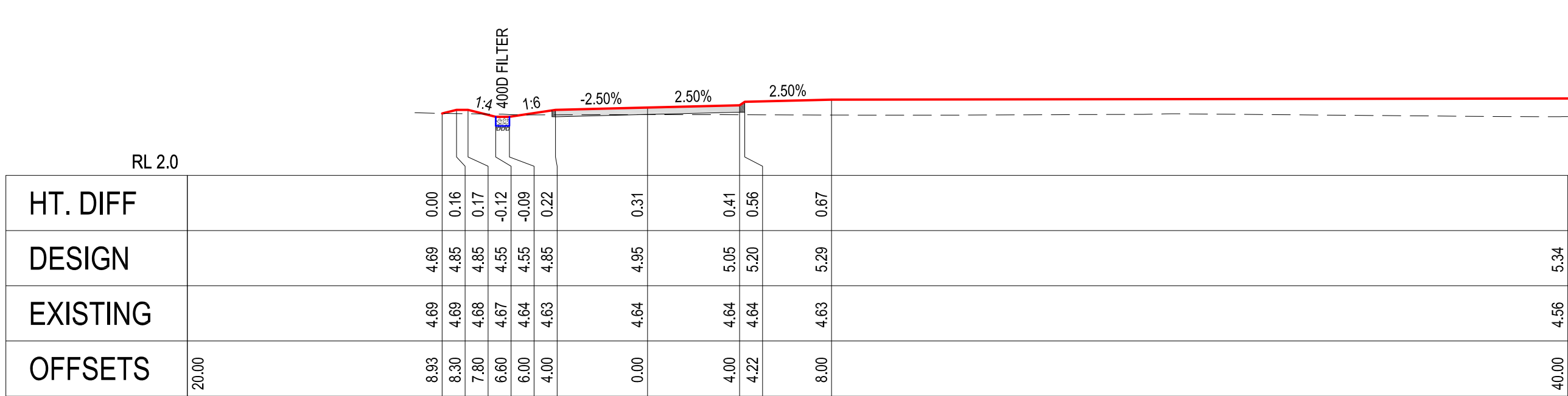
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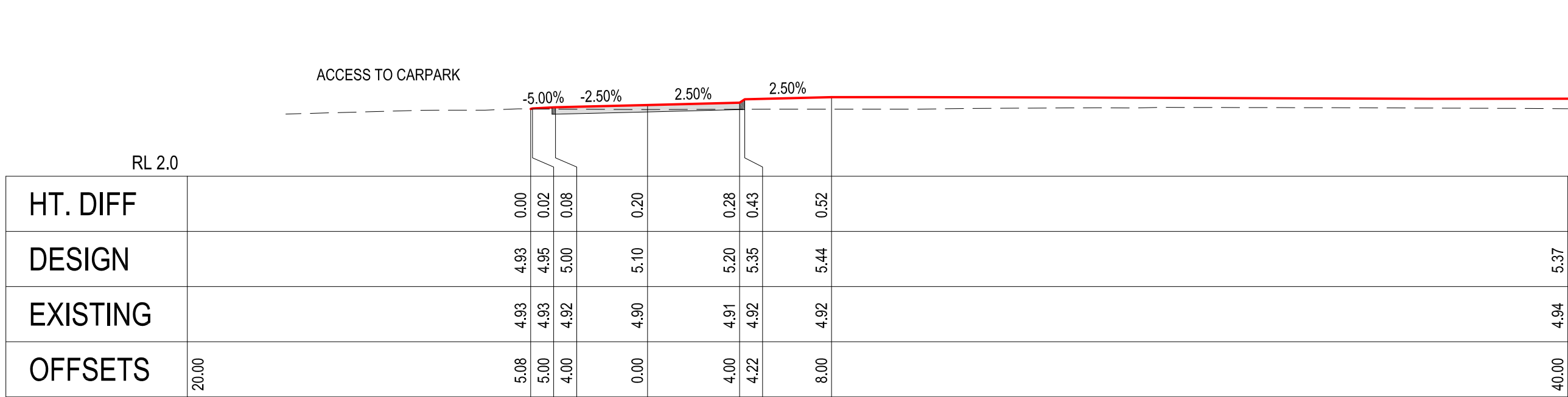
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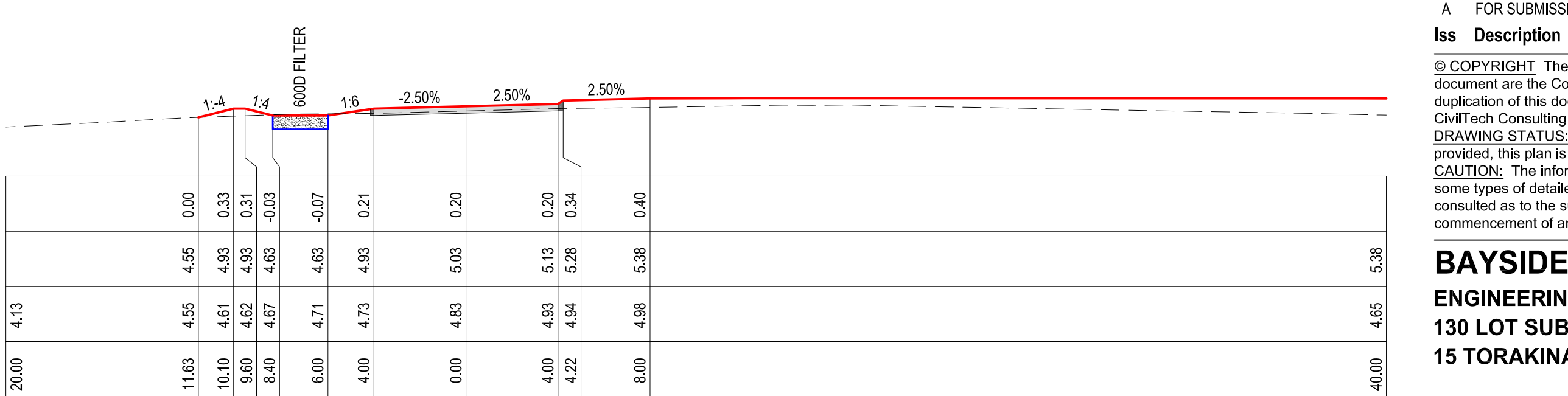
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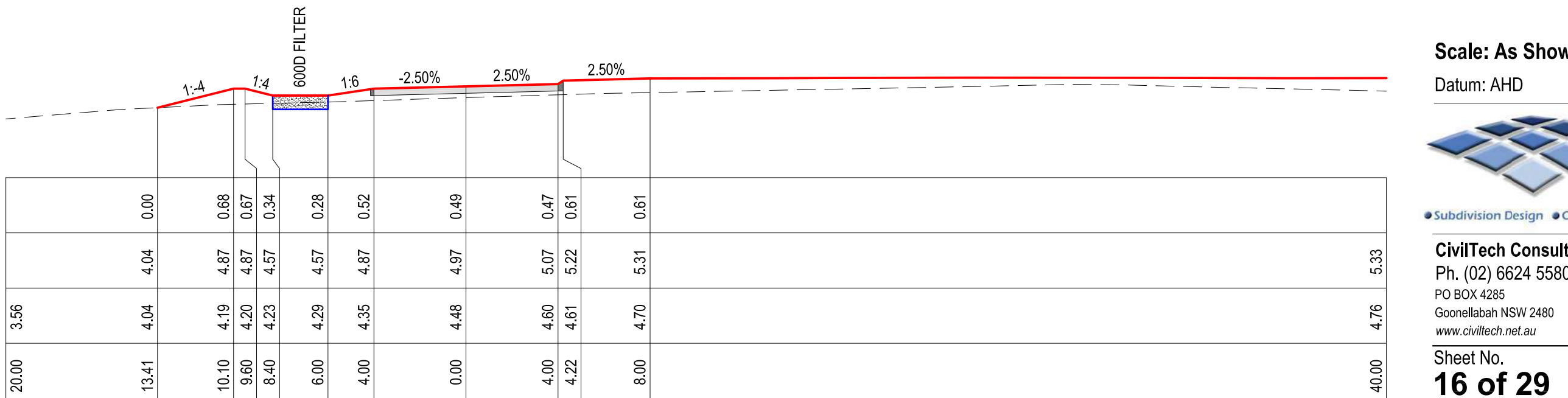
450.000



400.000



350.000



300.000

ROAD 2 - CROSS SECTIONS

Scale Horizontal 1:200 Vertical 1:200

B	FOR RE-SUBMISSION	WF	WF	01.08.2022
A	FOR SUBMISSION	WF	WF	01.09.2021

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15 TORAKINA ROAD, BRUNSWICK HEADS

ROAD 2 CROSS SECTIONS
START TO CH 500

Scale: As Shown at A1 CAD file: 1133-DA16B.dwg
Datum: AHD CivilCAD file: 1133-ENG



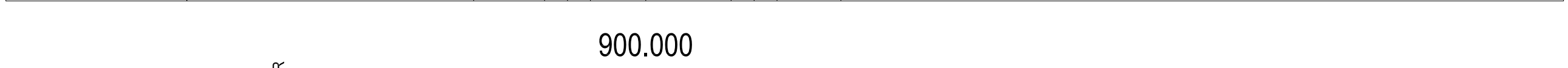
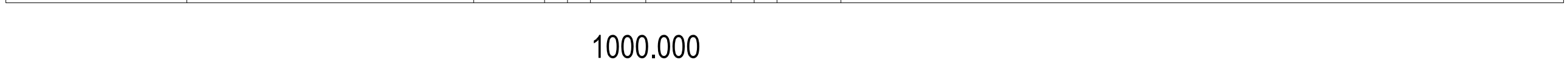
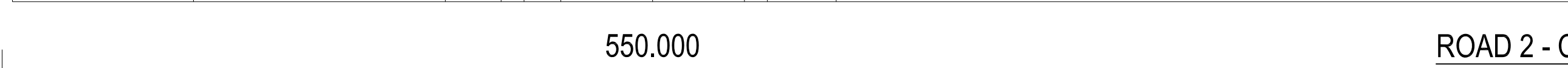
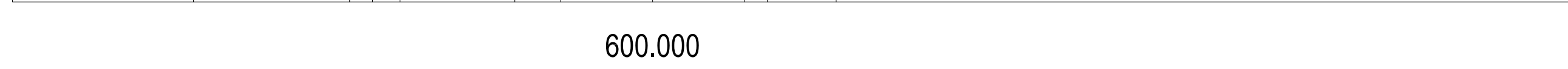
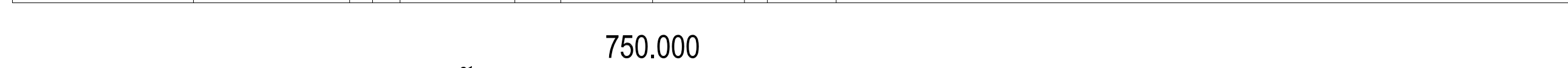
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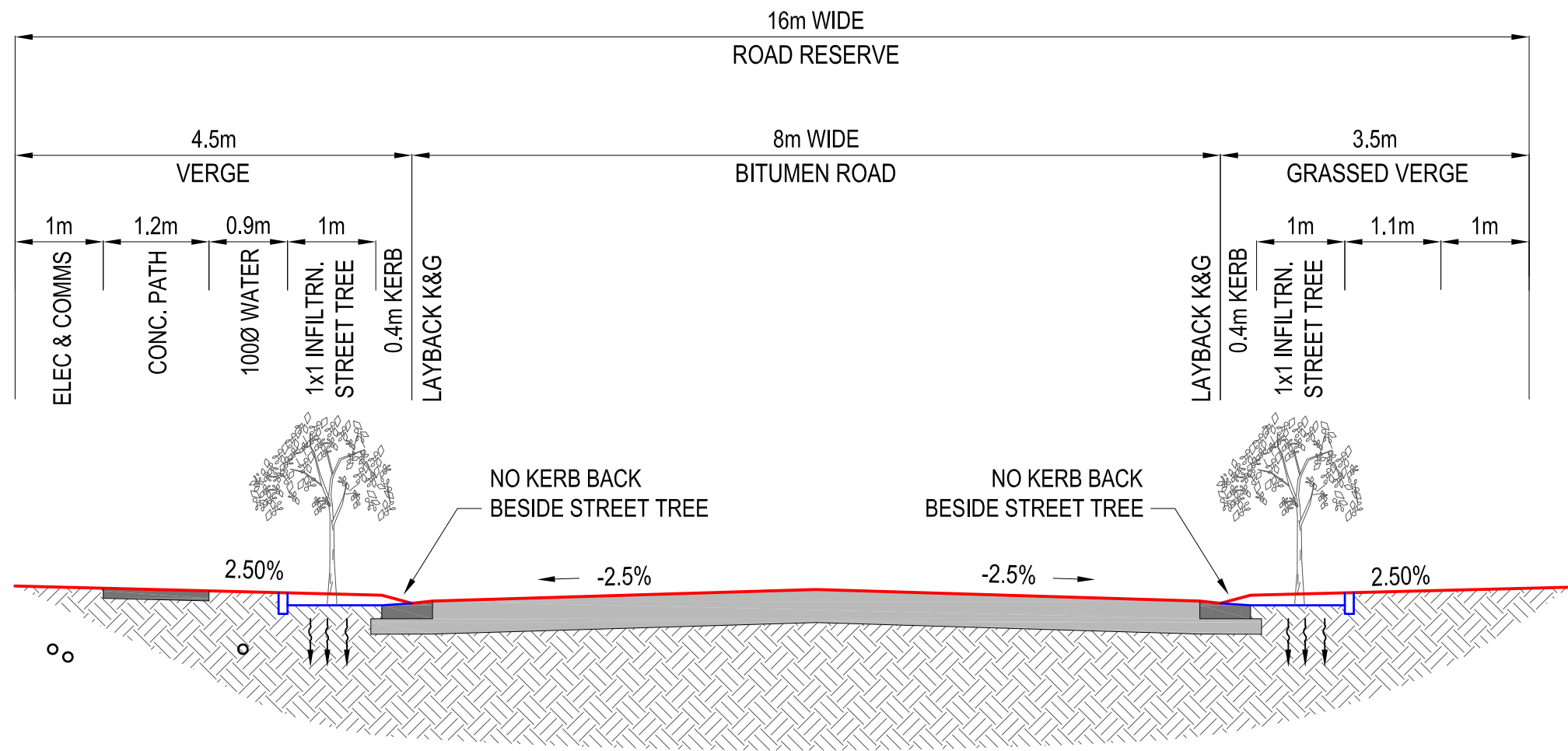
Sheet No.
16 of 29

Dwg. No.
1133-DA16

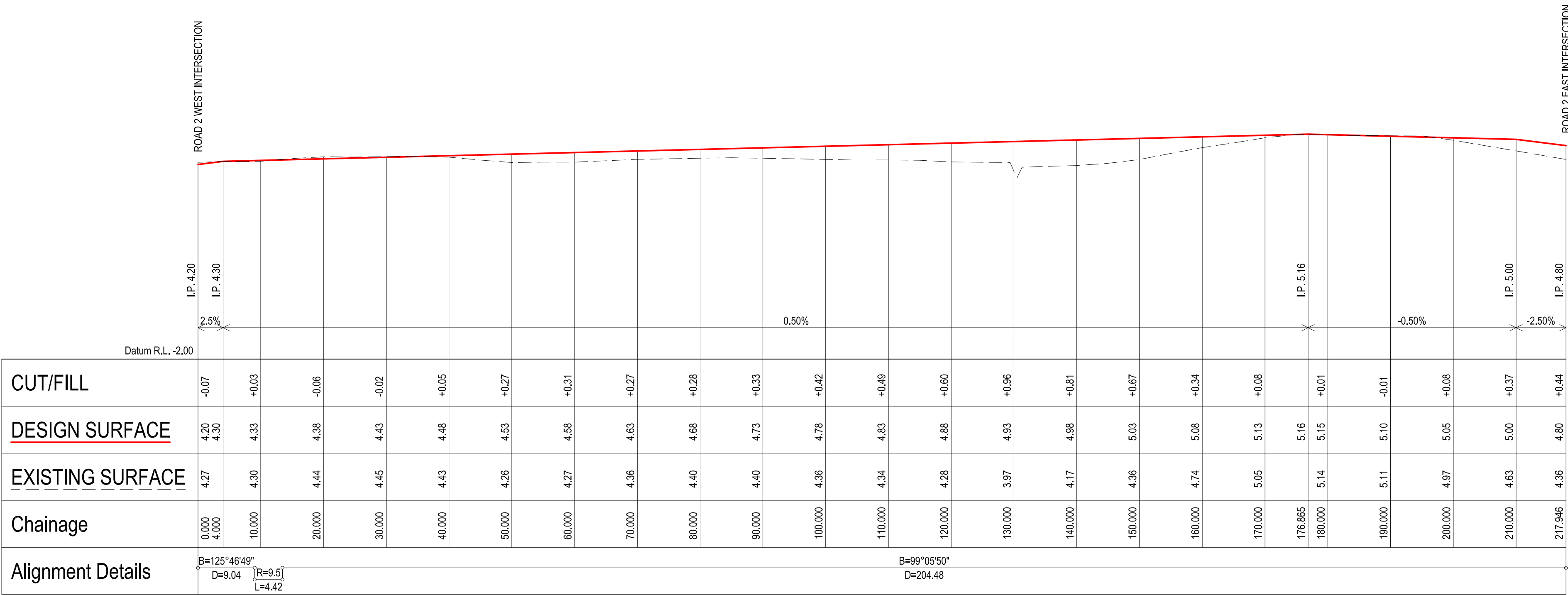
Issue

B





ROAD 3 TYPICAL SECTION
Not to Scale



ROAD 3 - LONG SECTION
Scale Horizontal 1:500 Vertical 1:100

B	FOR RE-SUBMISSION	WF	WF	01.08.2022	
A	FOR SUBMISSION	WF	WF	01.08.2021	
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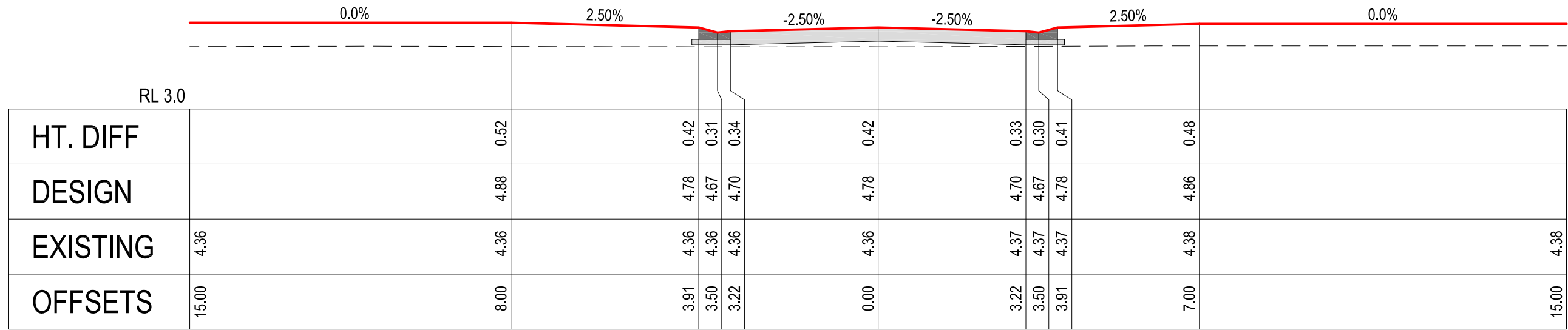
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130 LOT SUBDIVISION OF LOT 13 DP 1251383
15 TORAKINA ROAD, BRUNSWICK HEADS

**ROAD 3 LONG SECTION
& TYPICAL SECTION**

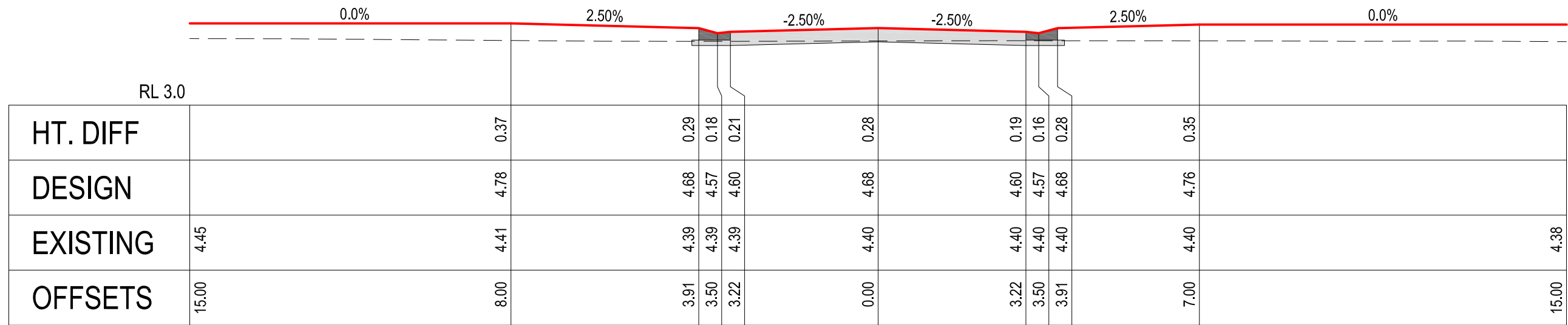
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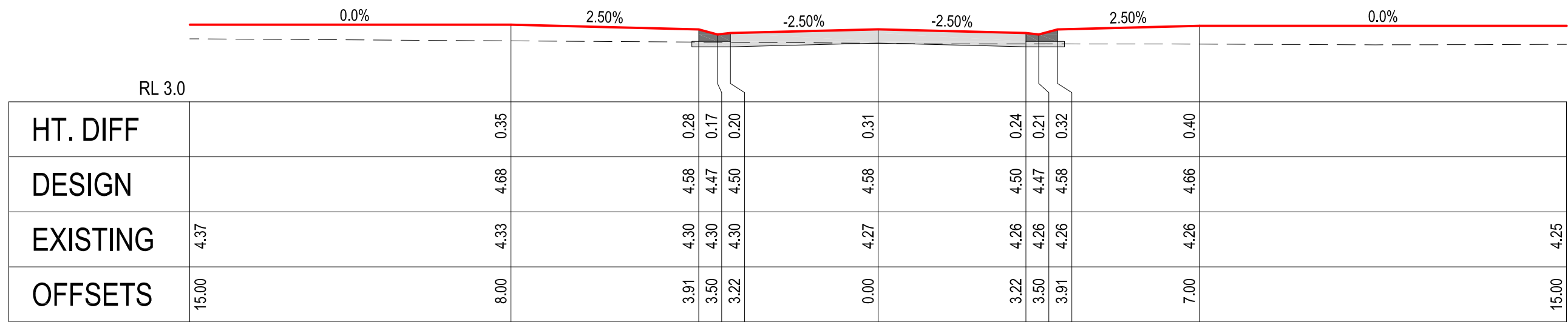
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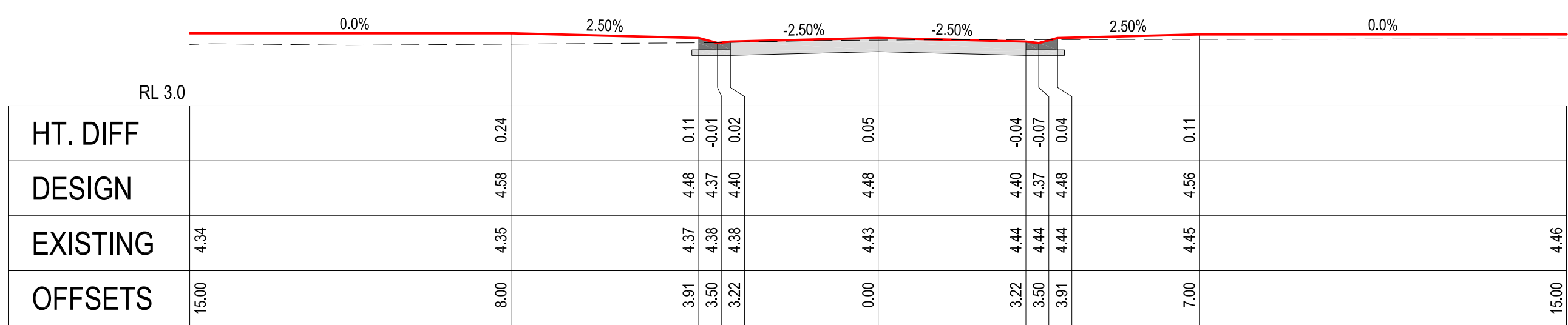
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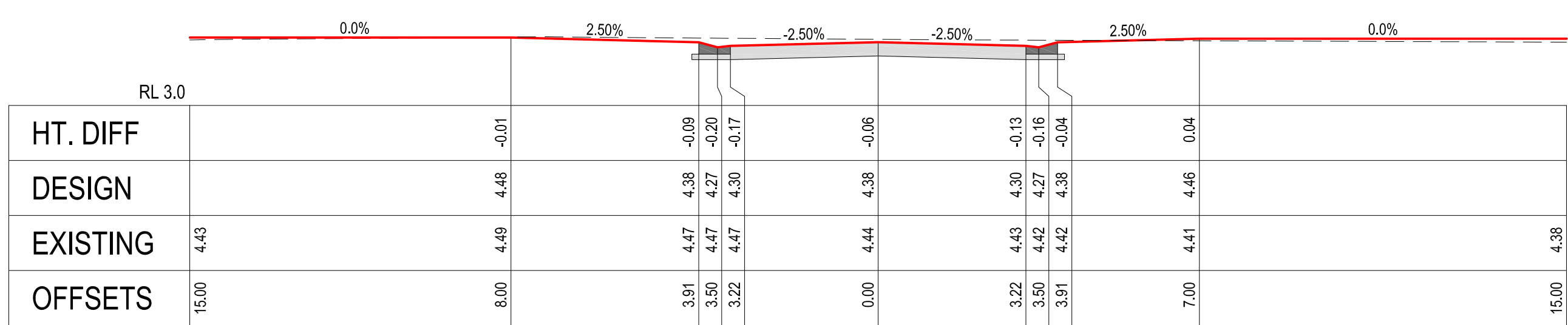
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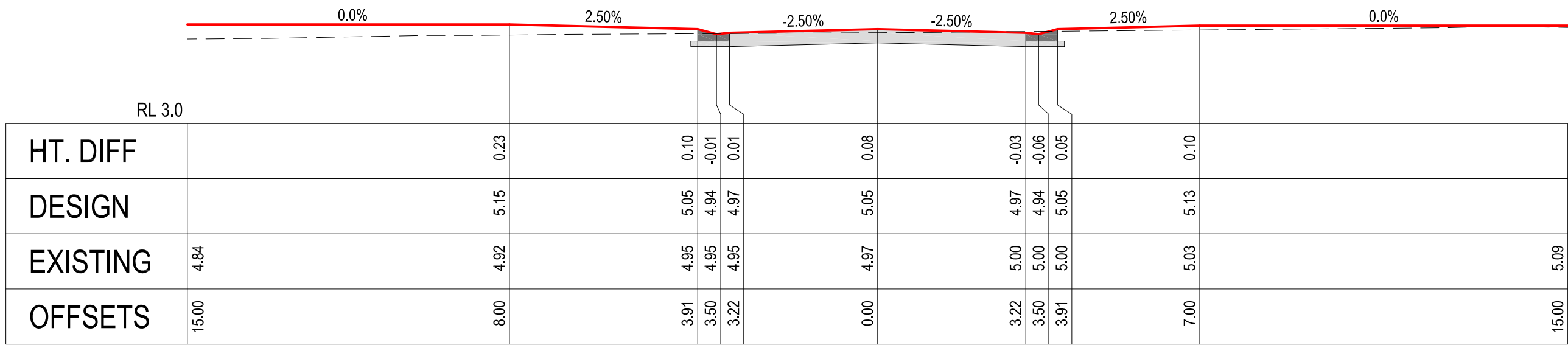
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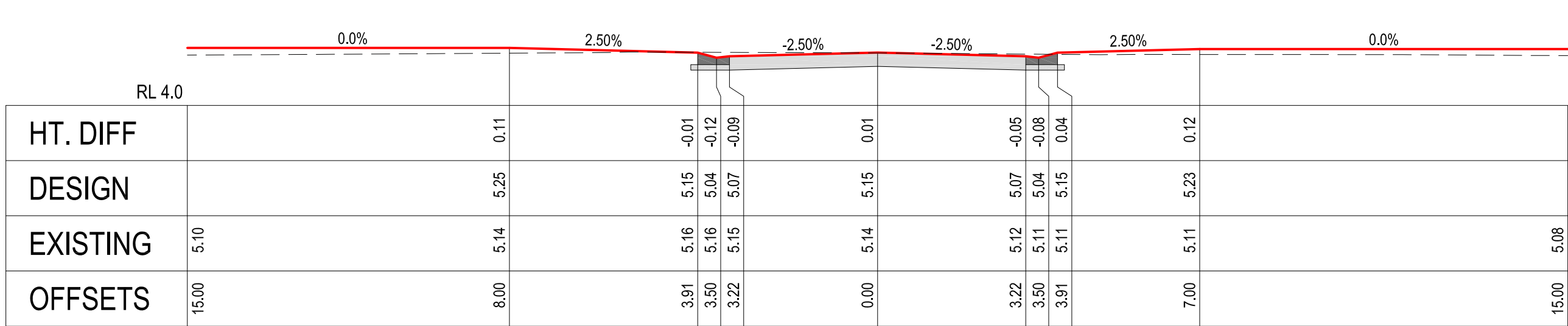
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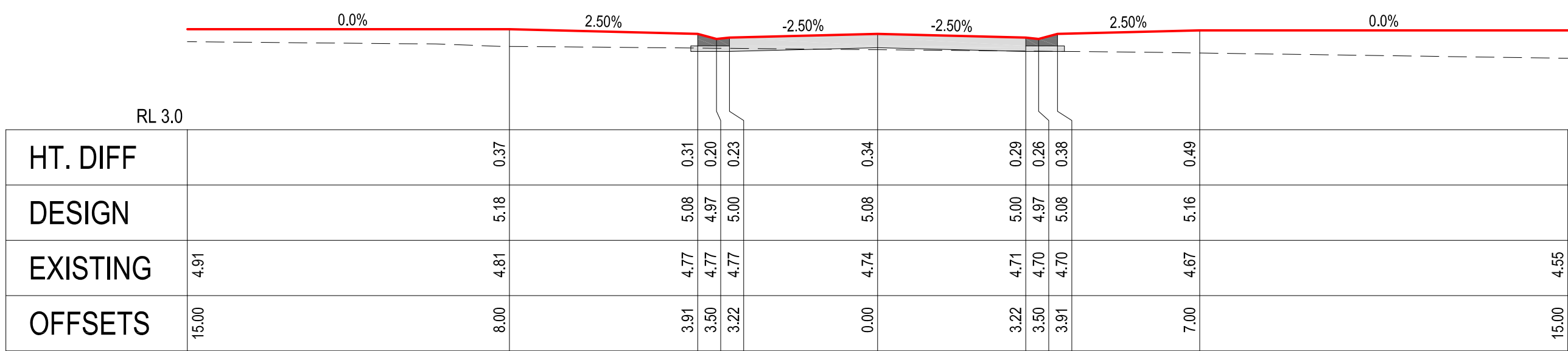
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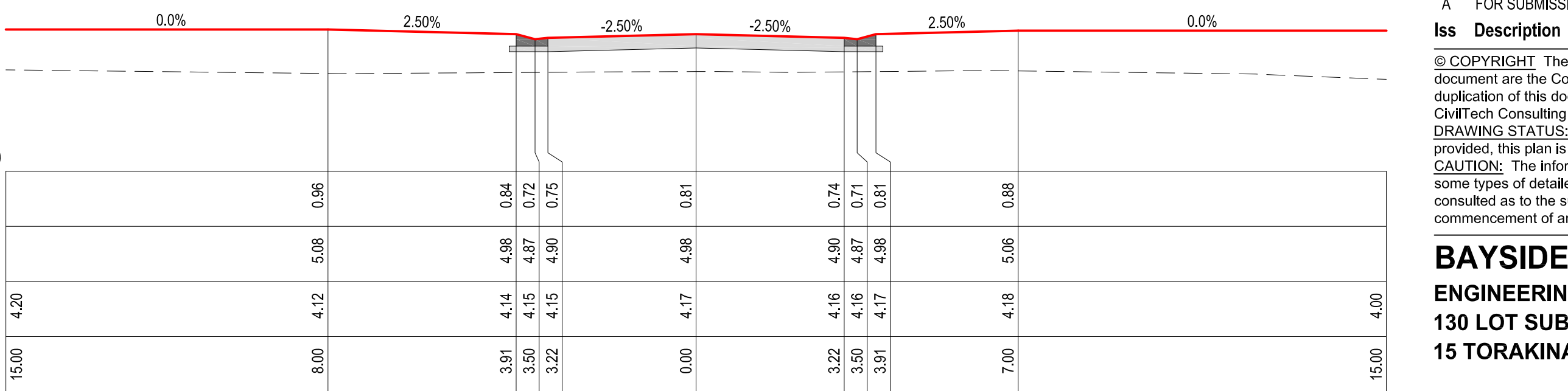
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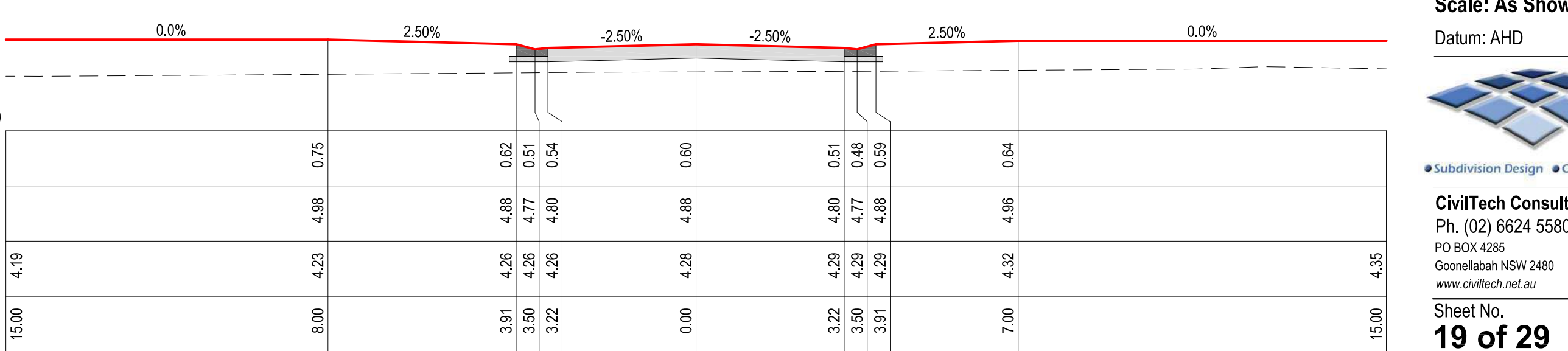
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160.000



140.000



120.000

ROAD 3 - CROSS SECTIONS

Scale Horizontal 1:200 Vertical 1:200

B	FOR RE-SUBMISSION	WF	WF	01.08.2022
A	FOR SUBMISSION	WF	WF	01.08.2021

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15 TORAKINA ROAD, BRUNSWICK HEADS

ROAD 3 CROSS SECTIONS

Scale: As Shown at A1 CAD file: 1133-DA19B.dwg
Datum: AHD CivilCAD file: 1133-ENG



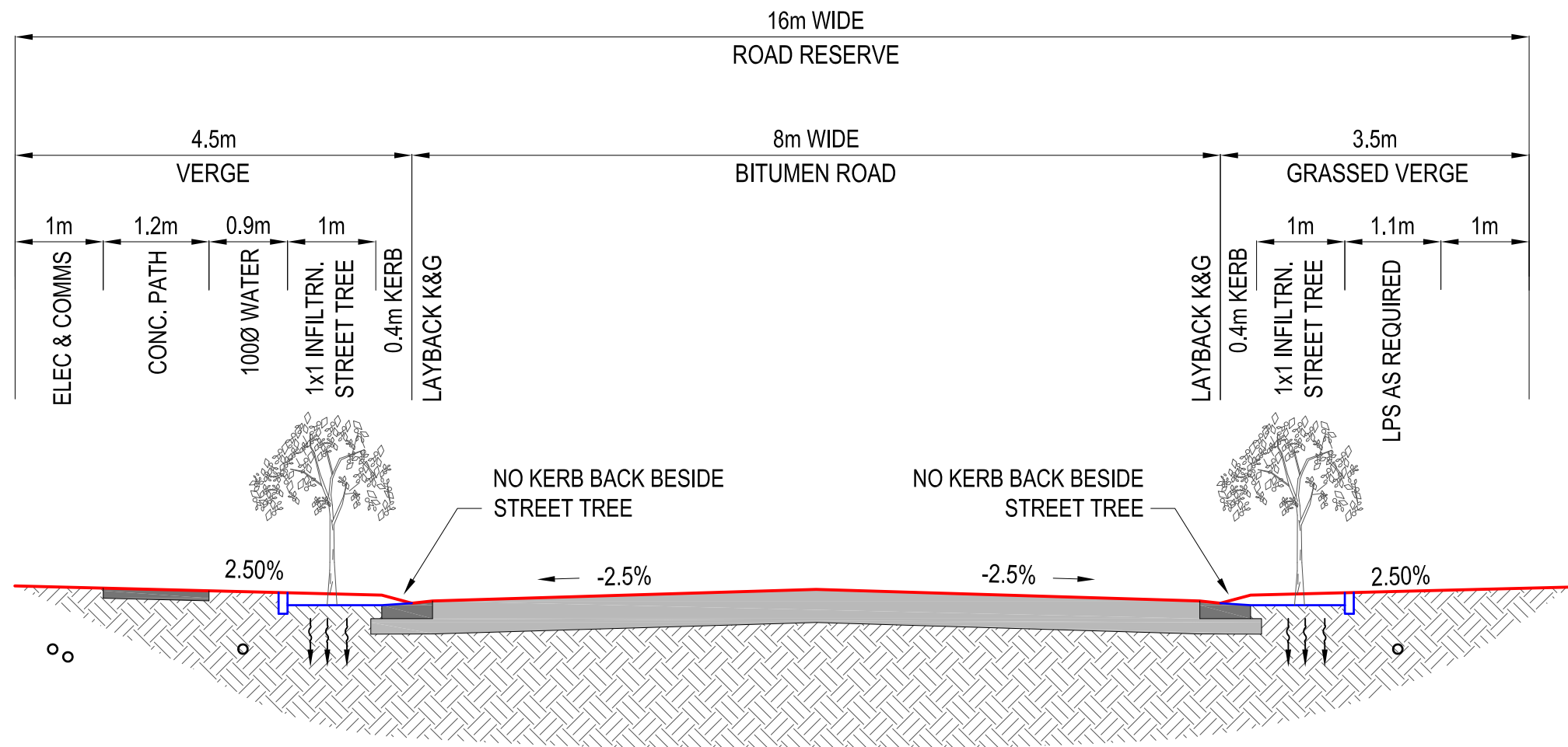
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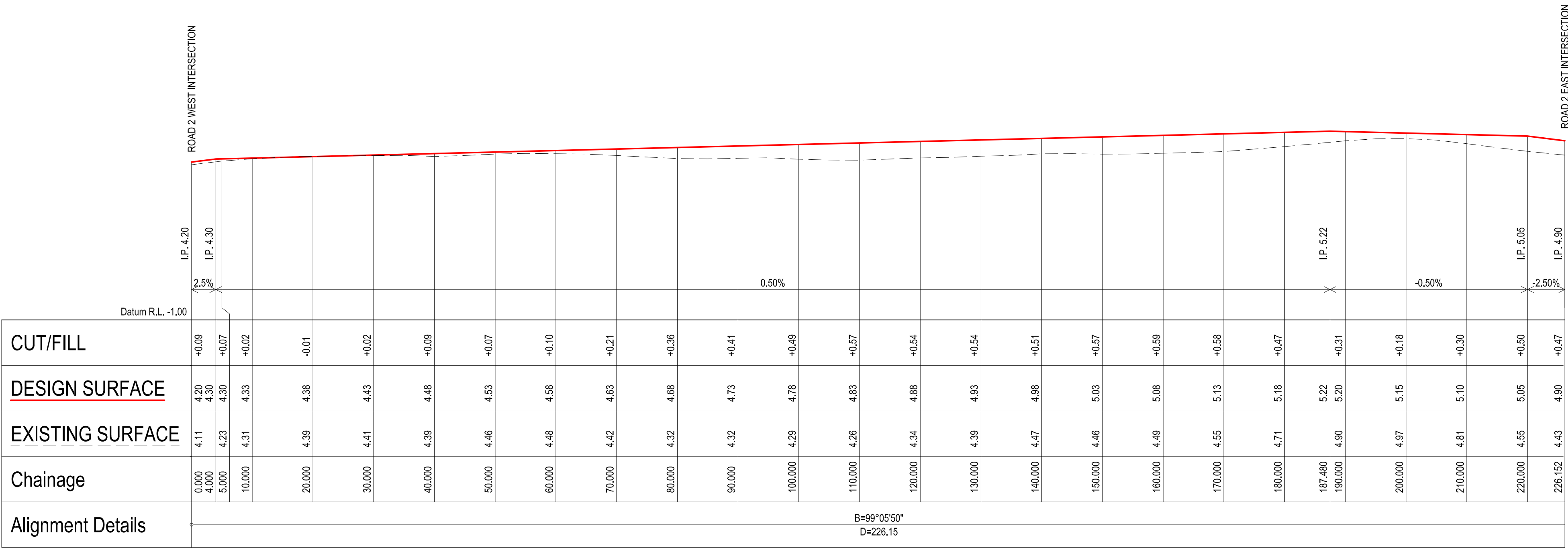
Dwg. No.
1133-DA19

Issue

B



ROAD 4 TYPICAL SECTION
Not to Scale



ROAD 4 - LONG SECTION
Scale Horizontal 1:500 Vertical 1:100

B	FOR RE-SUBMISSION	WF	WF	01.08.2022	
A	FOR SUBMISSION	WF	WF	01.08.2021	
Iss	Description	Des	Drw	Date	Appd

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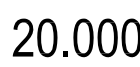
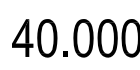
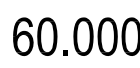
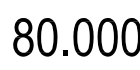
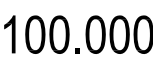
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130 LOT SUBDIVISION OF LOT 13 DP 1251383
15 TORAKINA ROAD, BRUNSWICK HEADS

**ROAD 4 LONG SECTION
& TYPICAL SECTION**

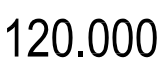
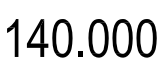
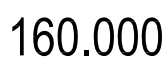
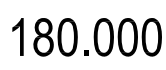
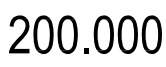
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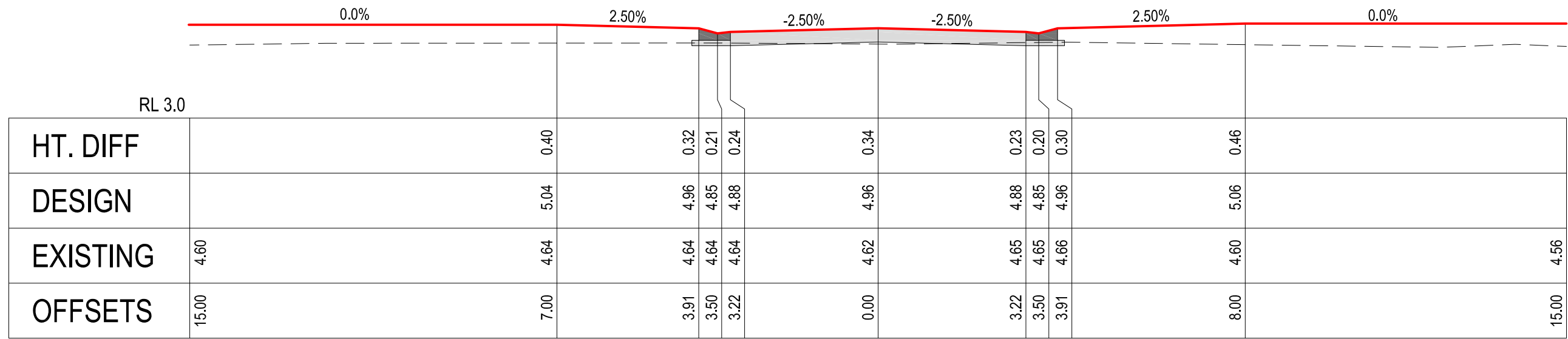
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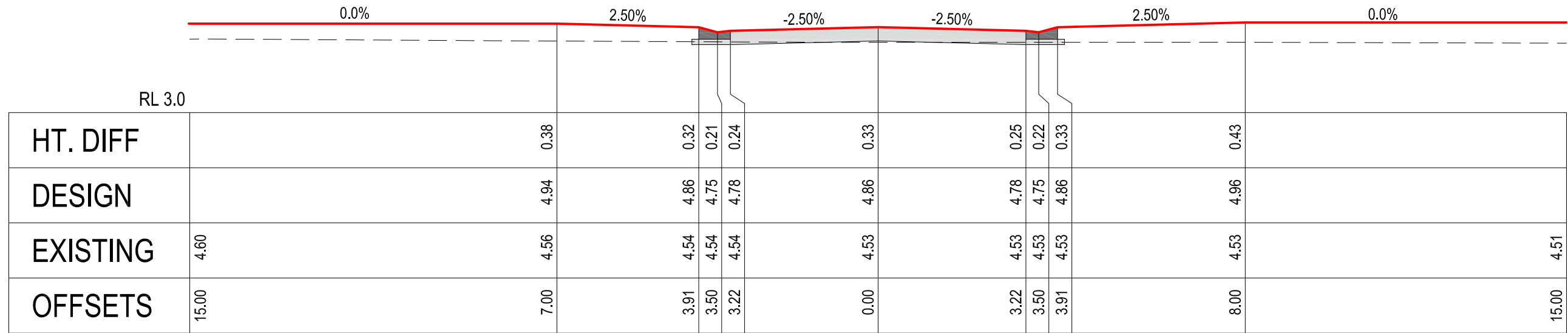
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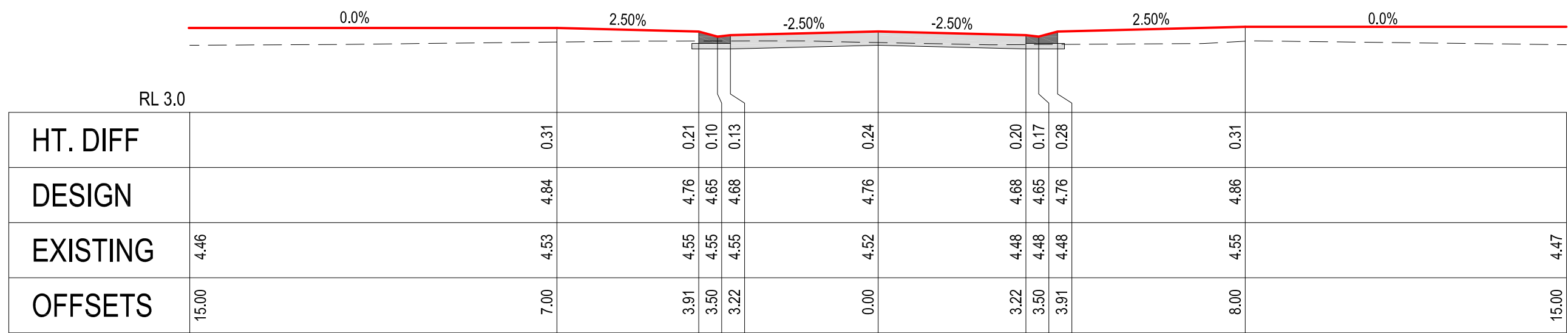
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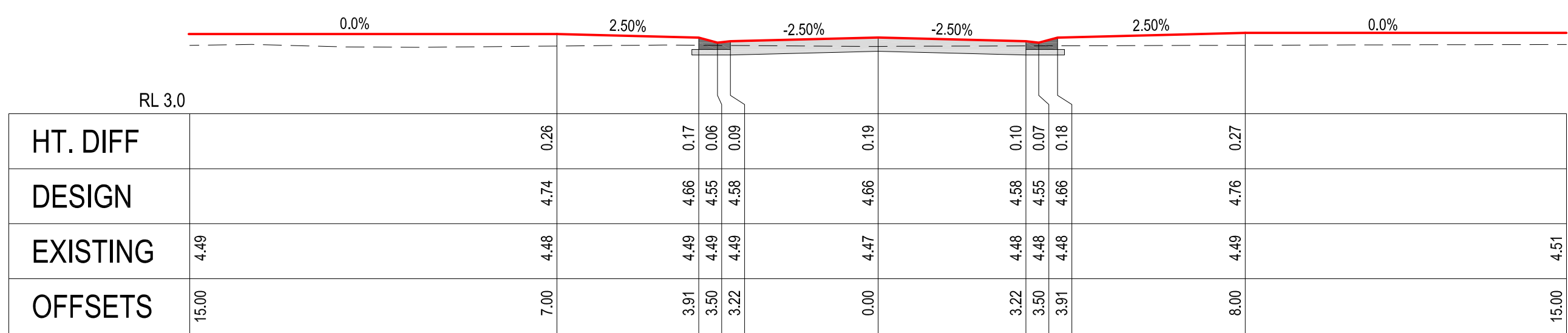
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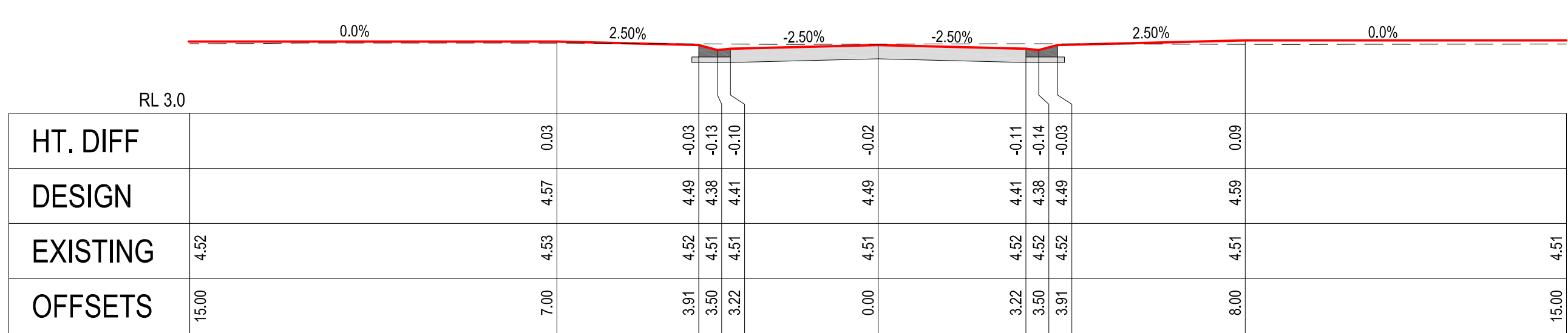
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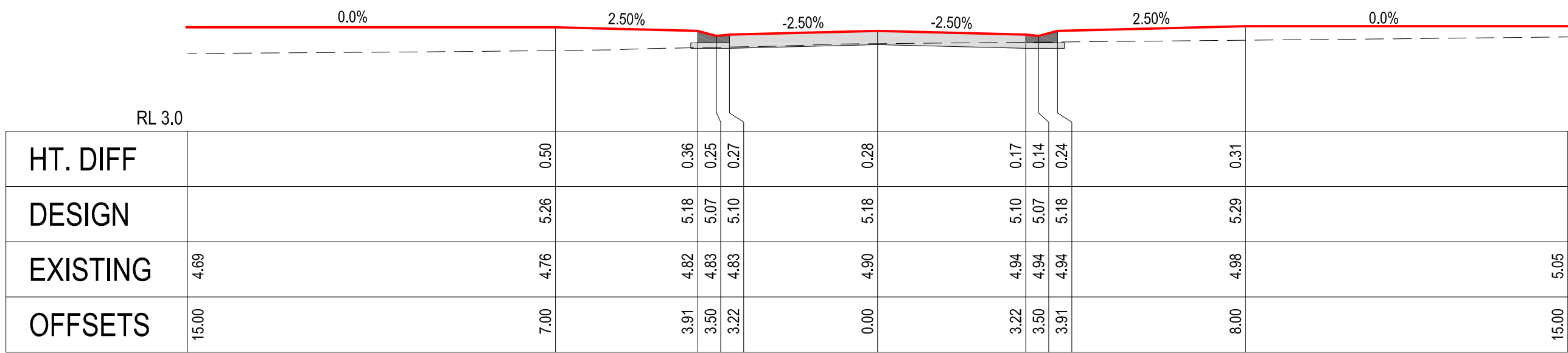
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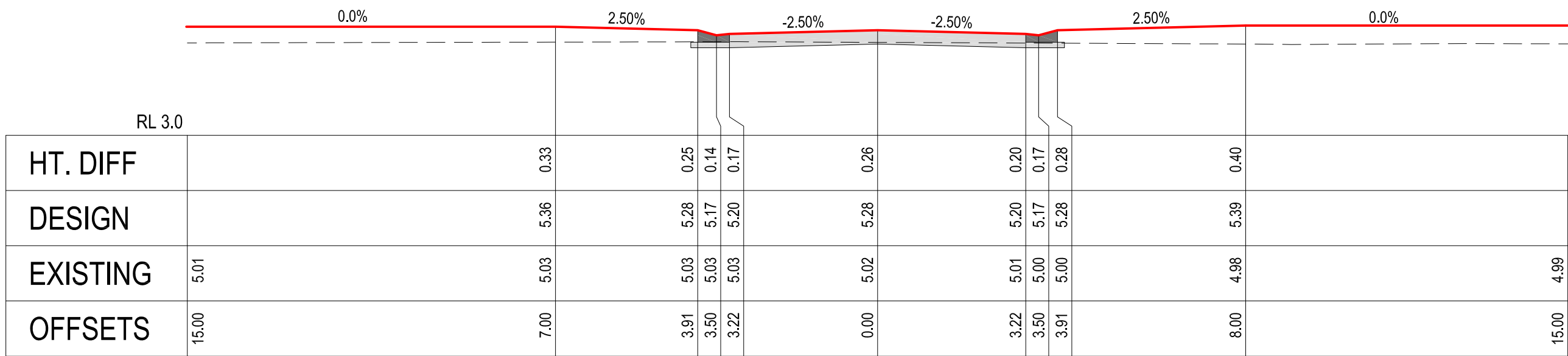
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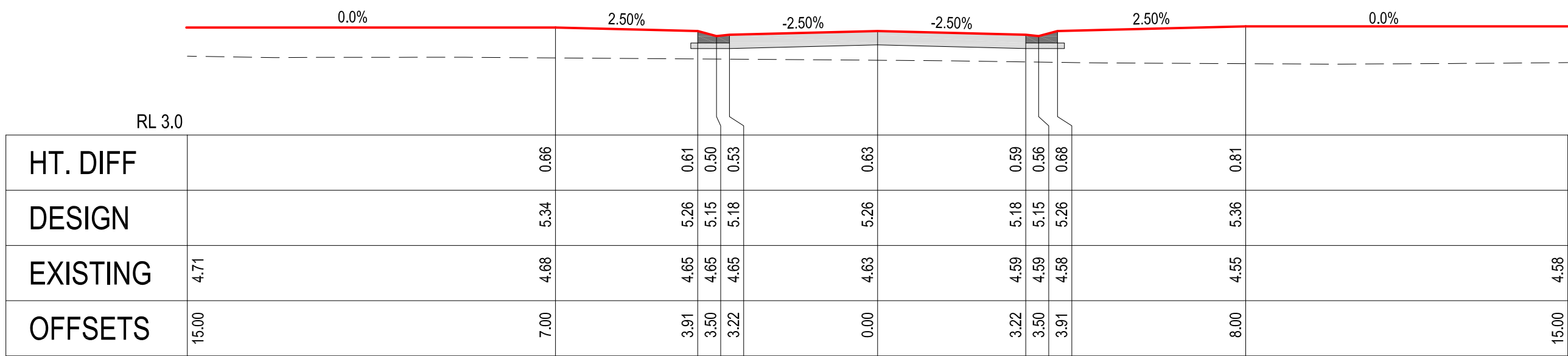
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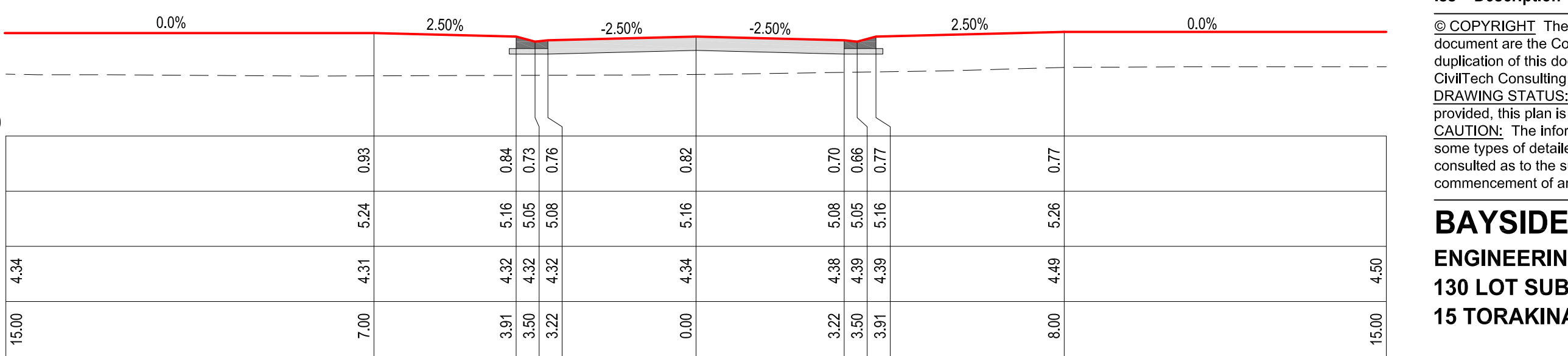
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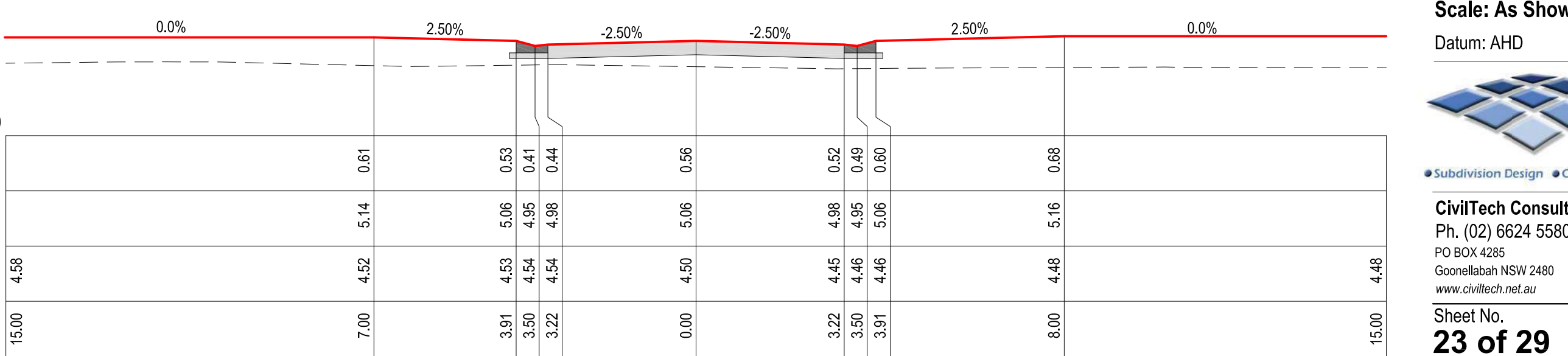
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160.000



140.000



120.000

ROAD 5 - CROSS SECTIONS

Scale Horizontal 1:200 Vertical 1:200

B	FOR RE-SUBMISSION	WF	WF	01.08.2022	
A	FOR SUBMISSION	WF	WF	01.08.2021	
Iss	Description	Des	Drw	Date	Appd

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ENGINEERING PLANS FOR D.A.
130 LOT SUBDIVISION OF LOT 13 DP 1251383
15 TORAKINA ROAD, BRUNSWICK HEADS

ROAD 5
CROSS SECTIONS

Scale: As Shown at A1 CAD file: 1133-DA23B.dwg
Datum: AHD CivilCAD file: 1133-ENG



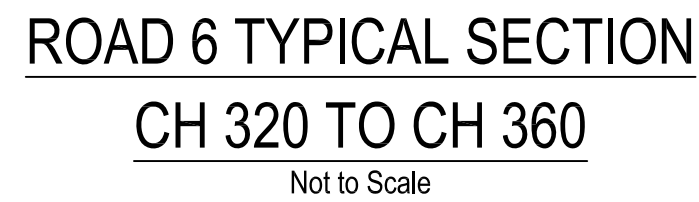
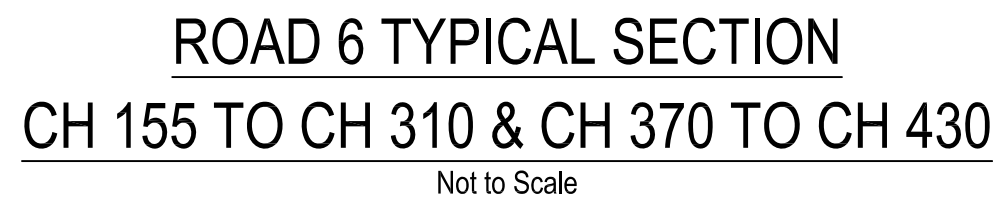
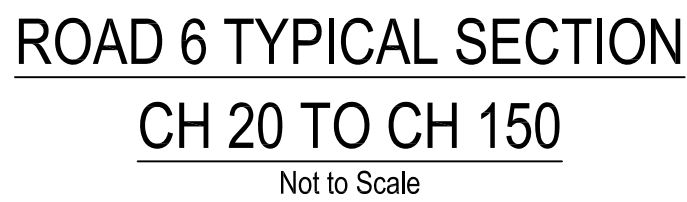
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Sheet No.
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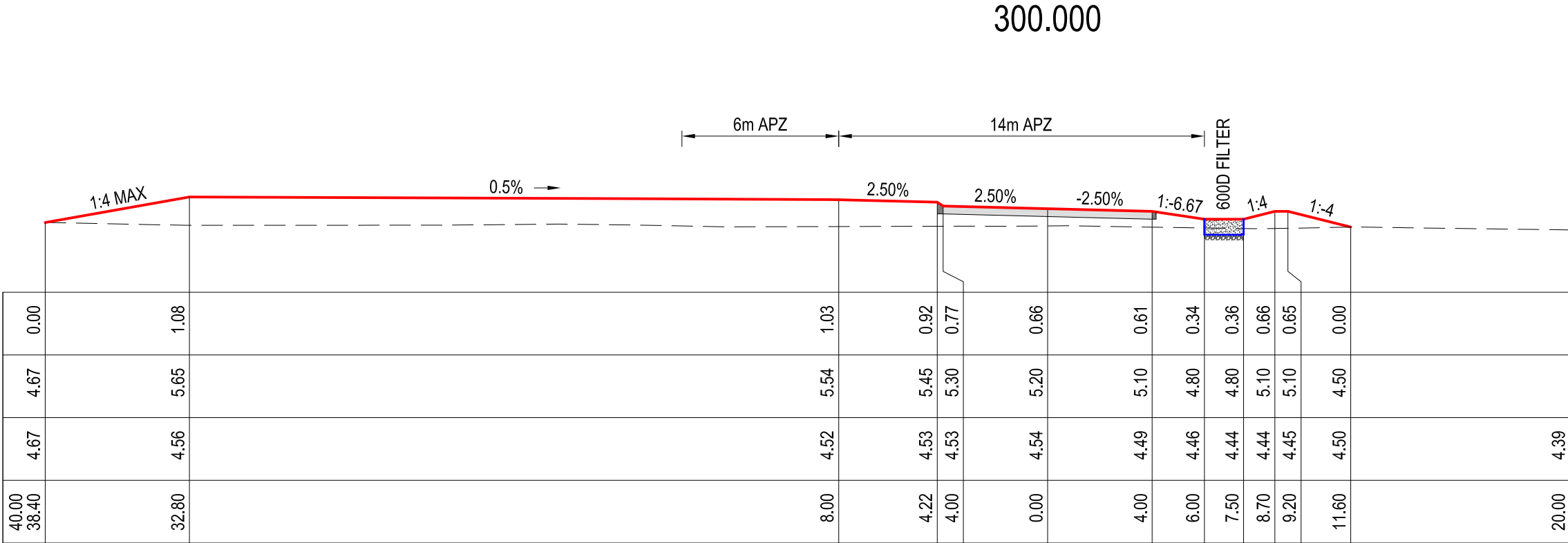
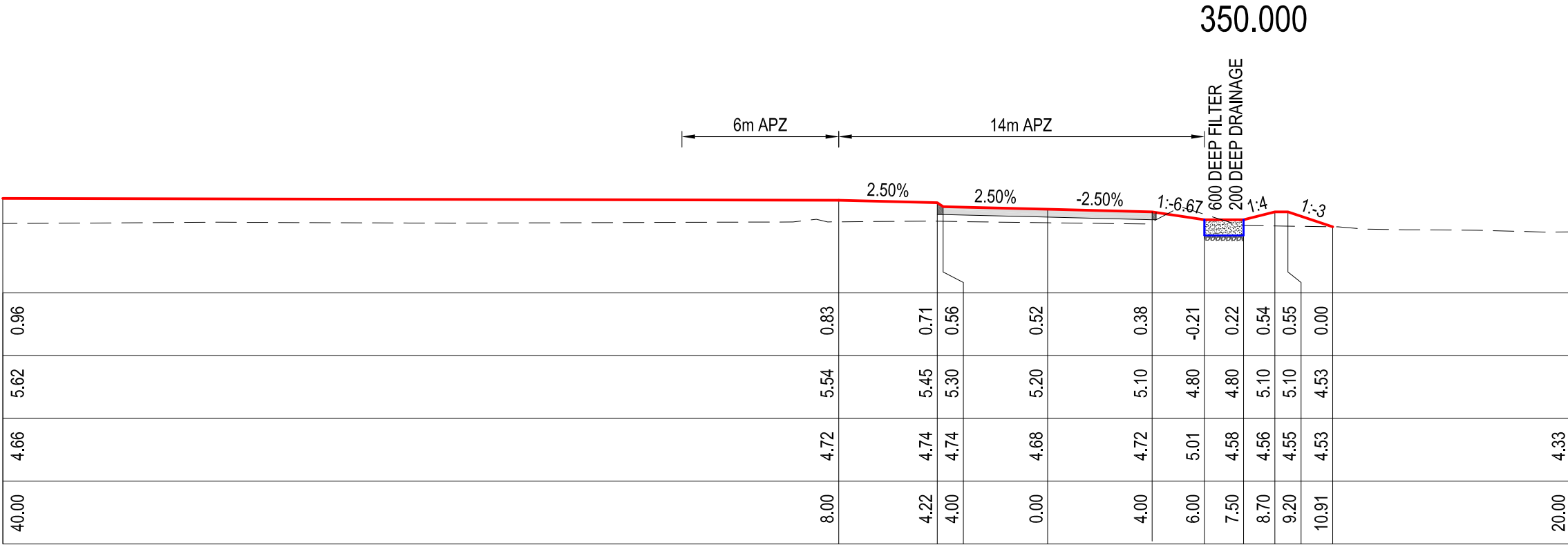
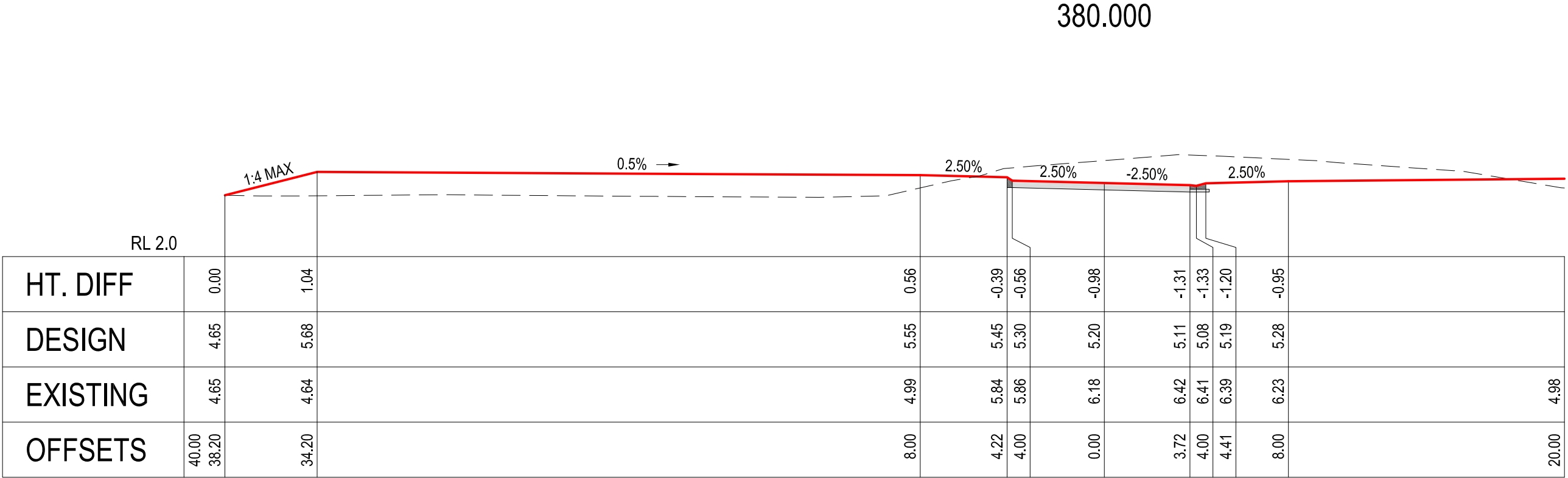
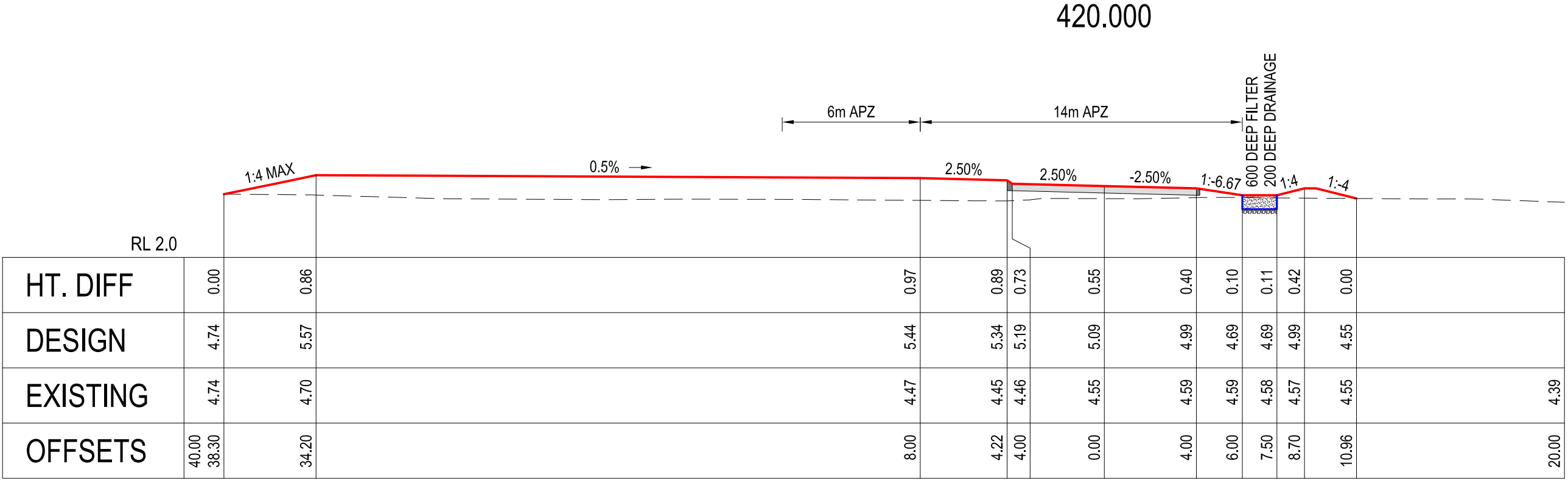
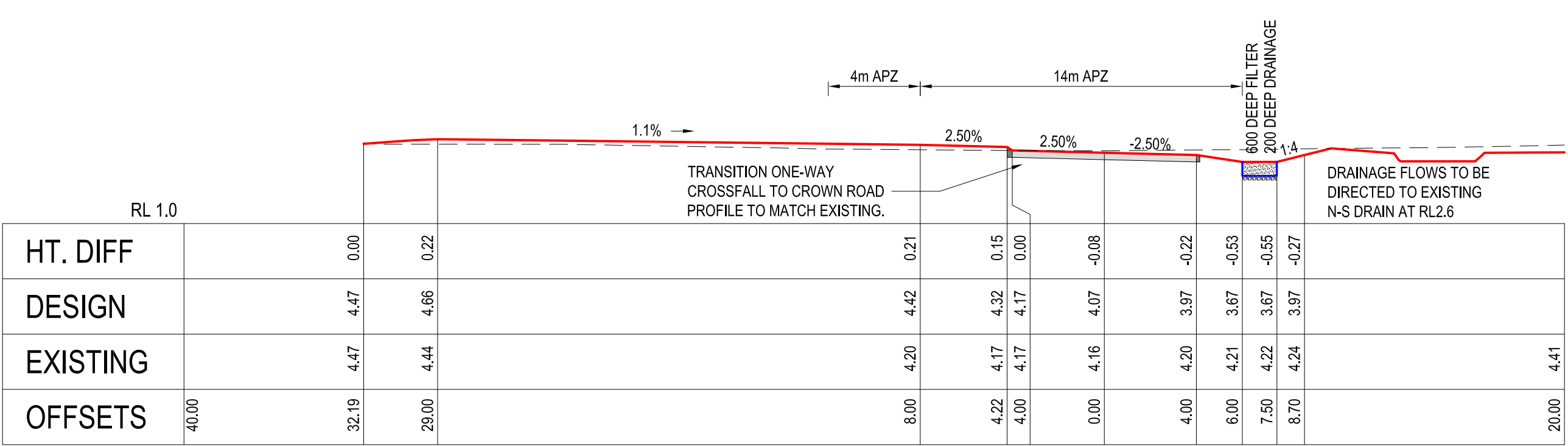
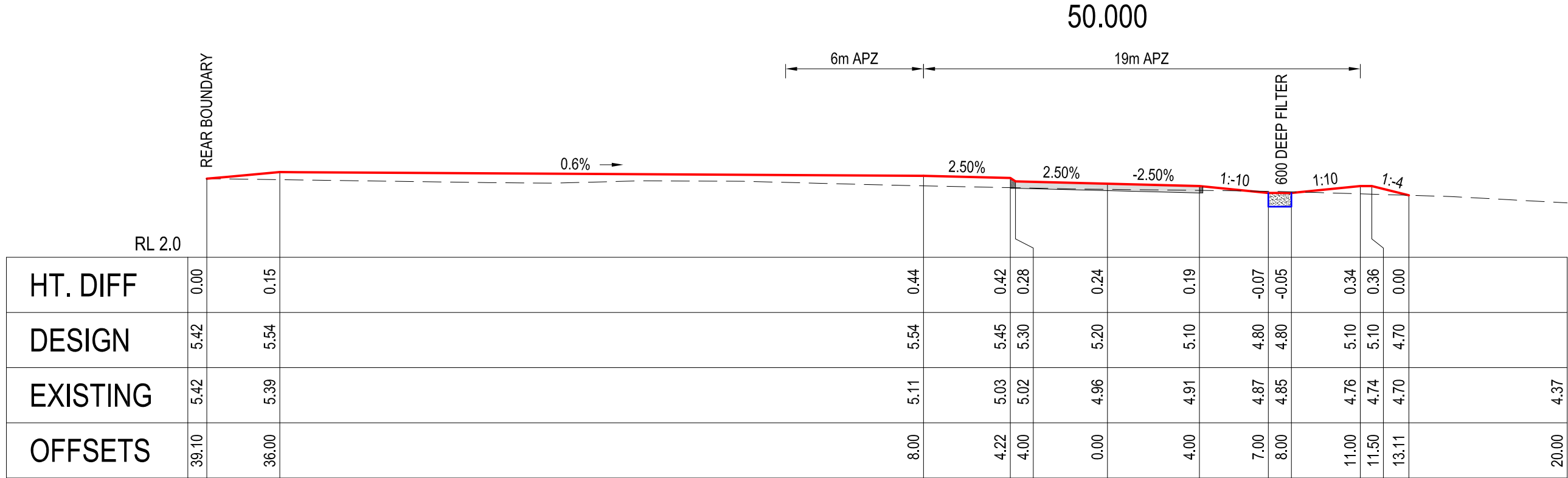
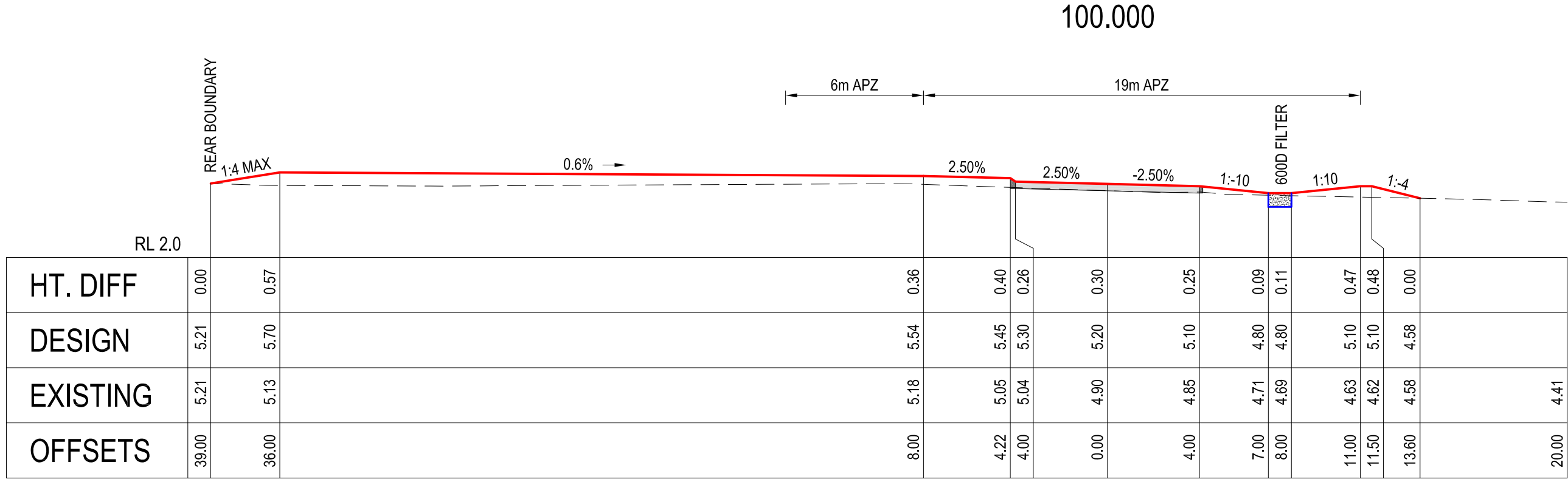
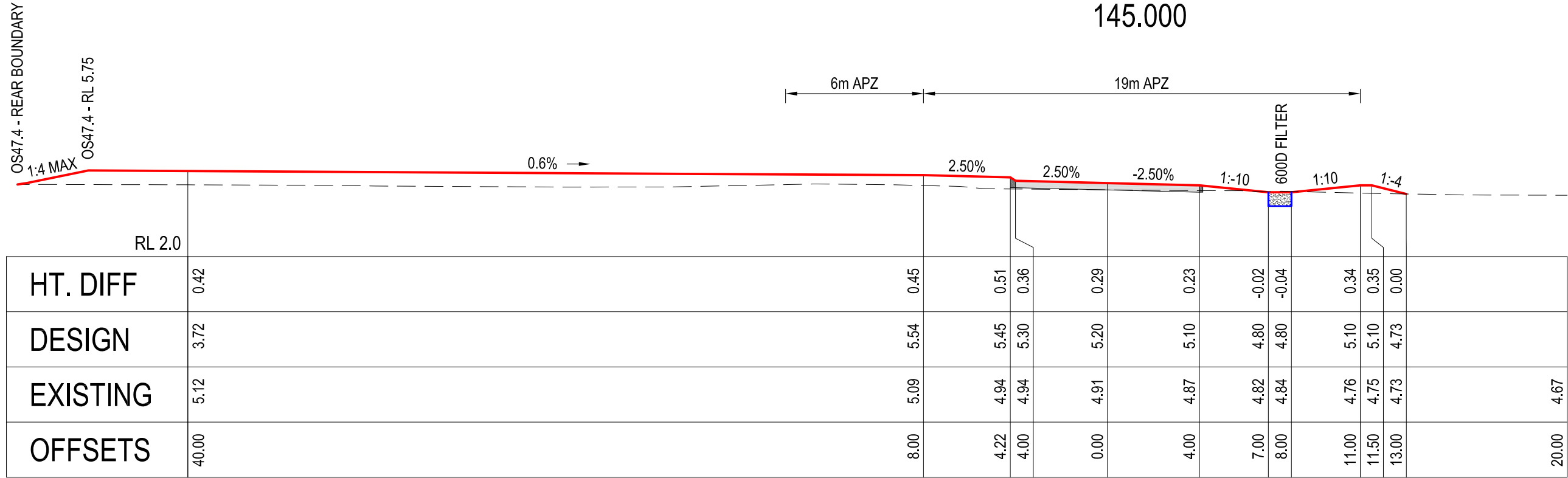
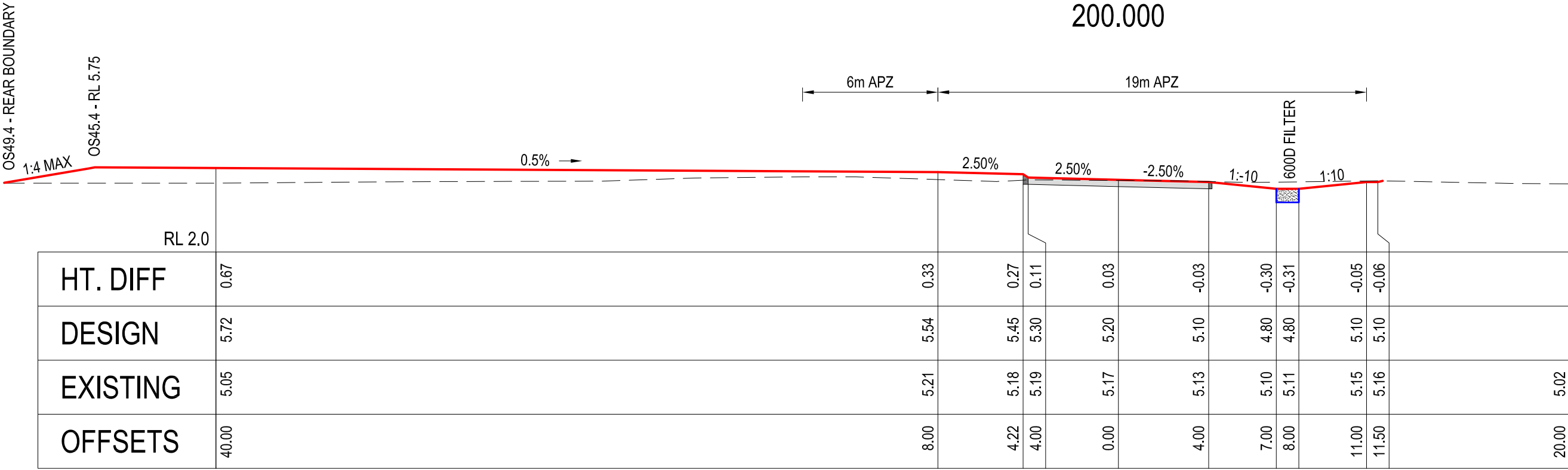
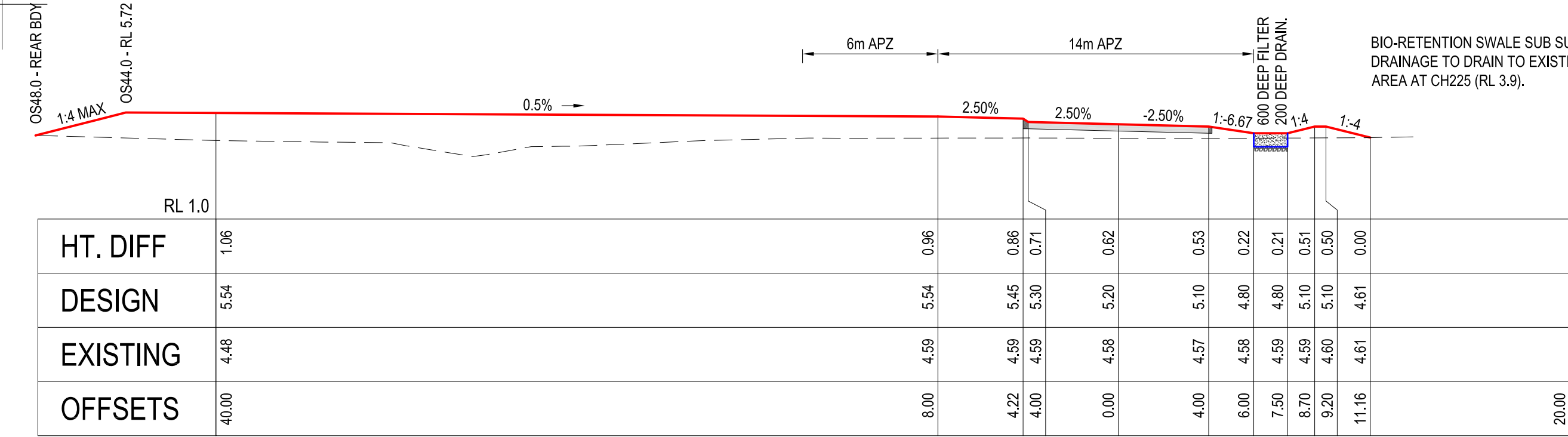
Dwg. No.
1133-DA23

Issue

B



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A	FOR SUBMISSION	WF	WF	01.08.2021	
Iss	Description	Des	Drw	Date	Appd

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BAYSIDE BRUNSWICK Pty. Ltd.
ENGINEERING PLANS FOR D.A.
130 LOT SUBDIVISION OF LOT 13 DP 1251383
15 TORAKINA ROAD, BRUNSWICK HEADS

ROAD 6 CROSS SECTIONS

Scale: As Shown at A1 CAD file: 1133-DA25B.dwg
Datum: AHD CivilCAD file: 1133-ENG



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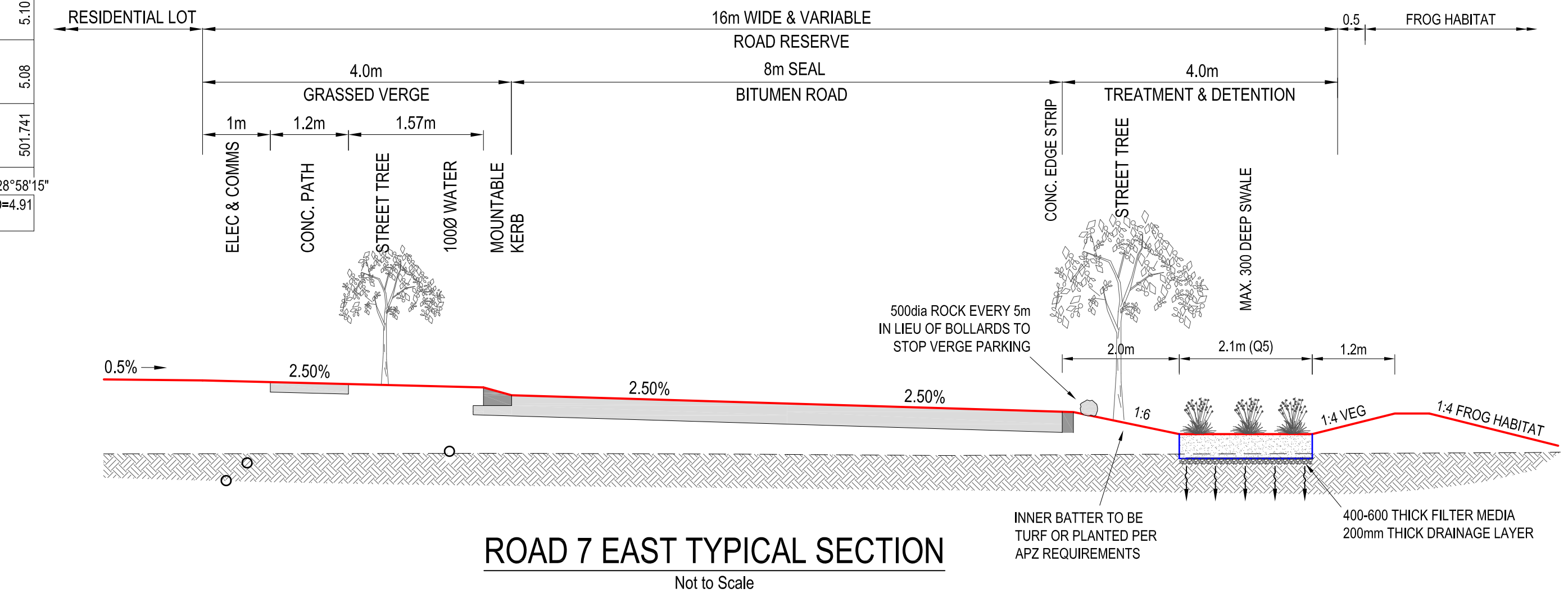
Dwg. No.
1133-DA25

Issue

B

ROAD 6 - CROSS SECTIONS

Scale Horizontal 1:200 Vertical 1:200

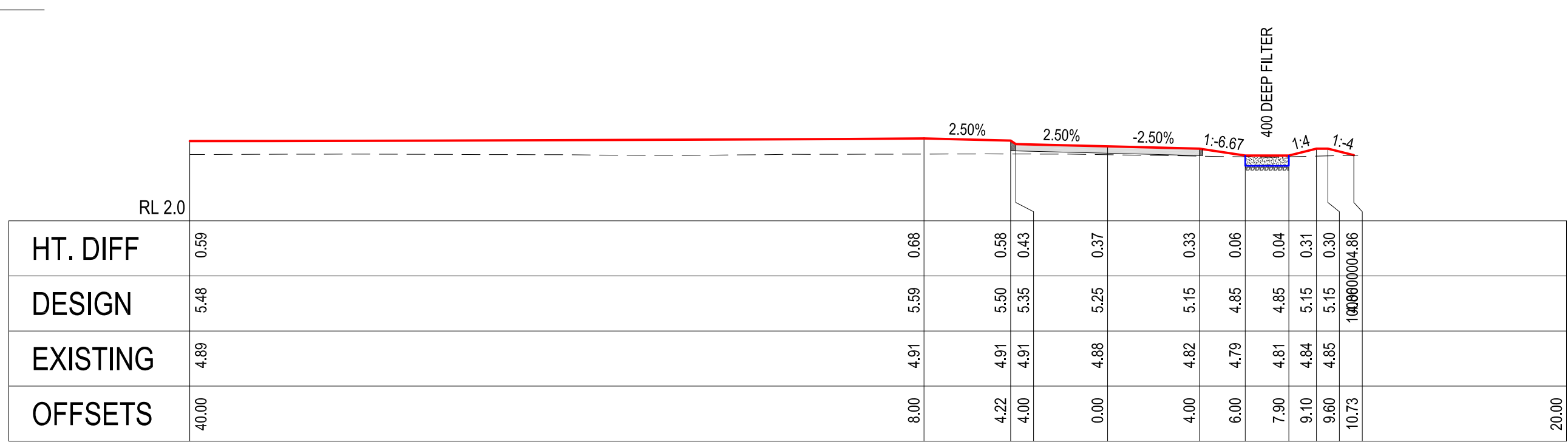


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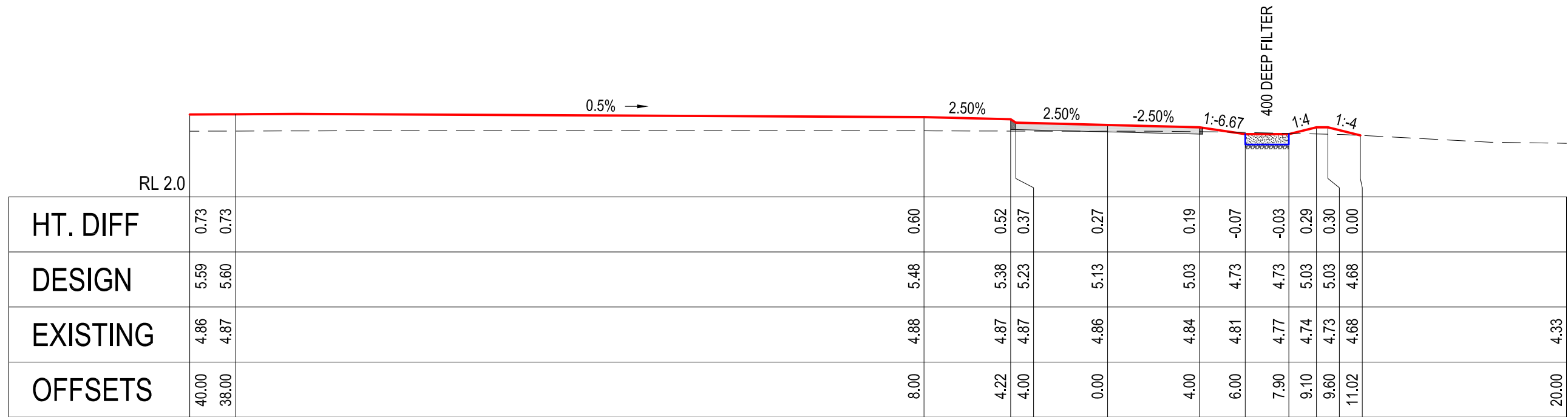
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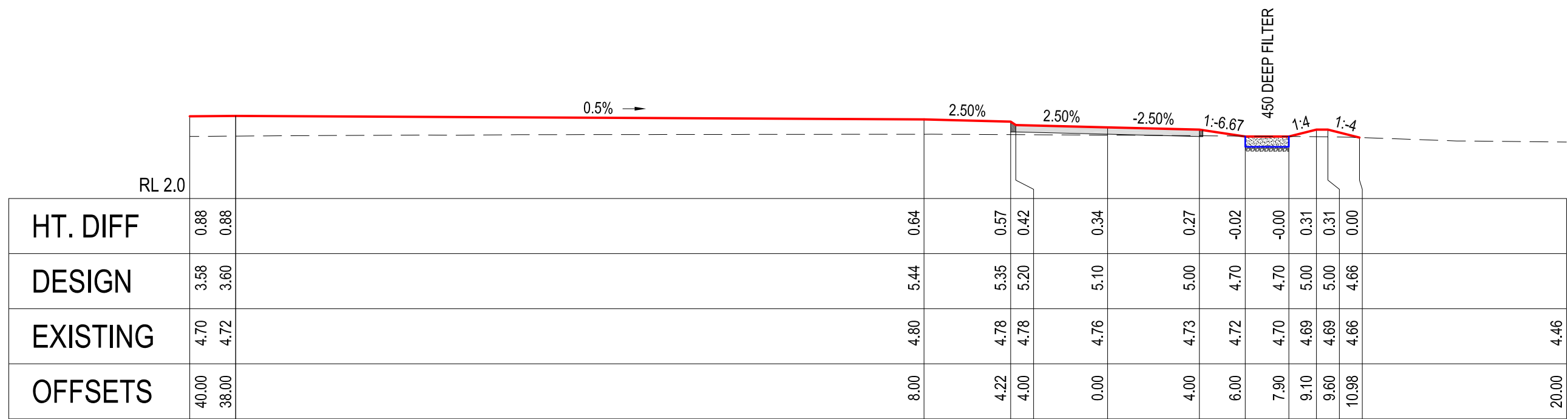
Dwg. No. **1133-DA26** Issue **B**



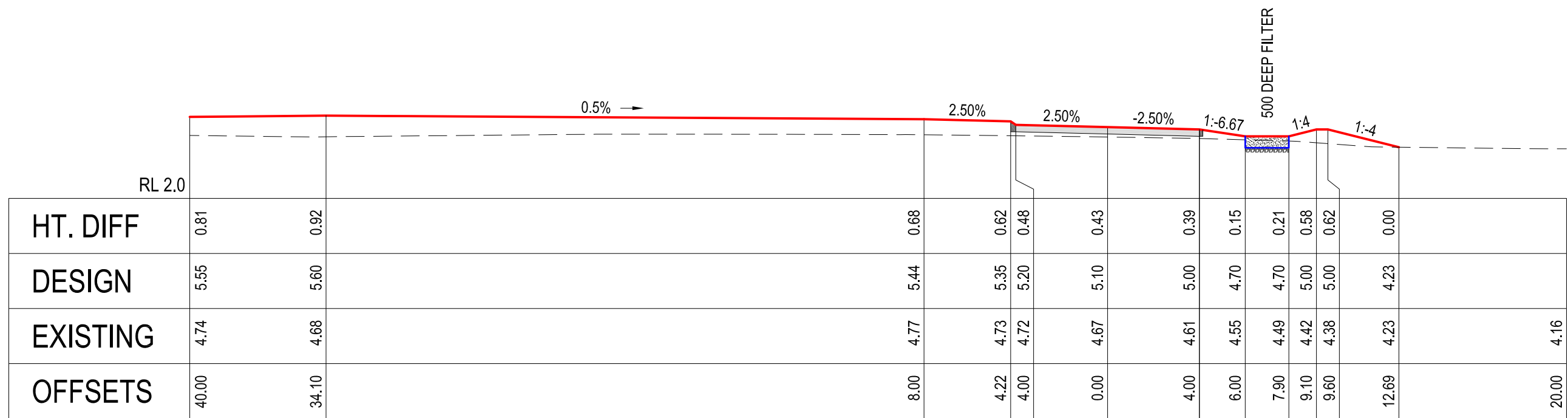
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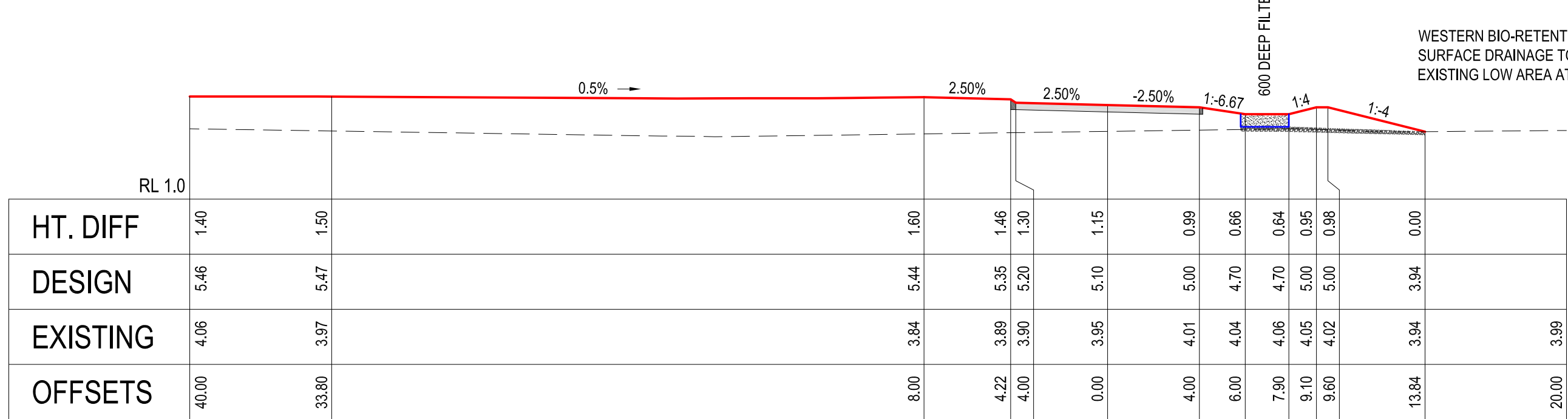
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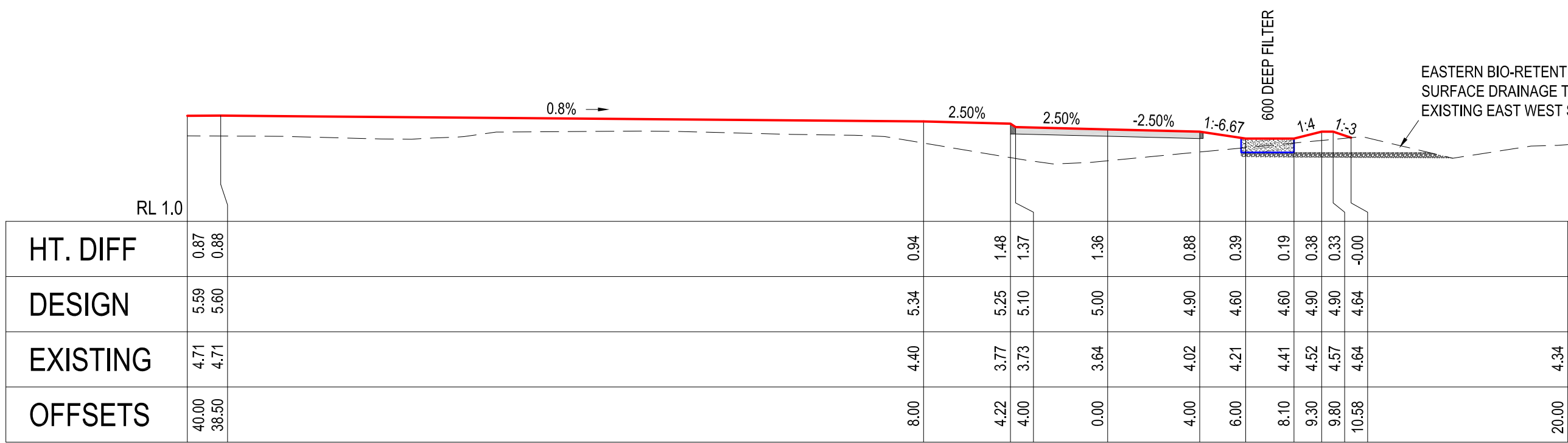
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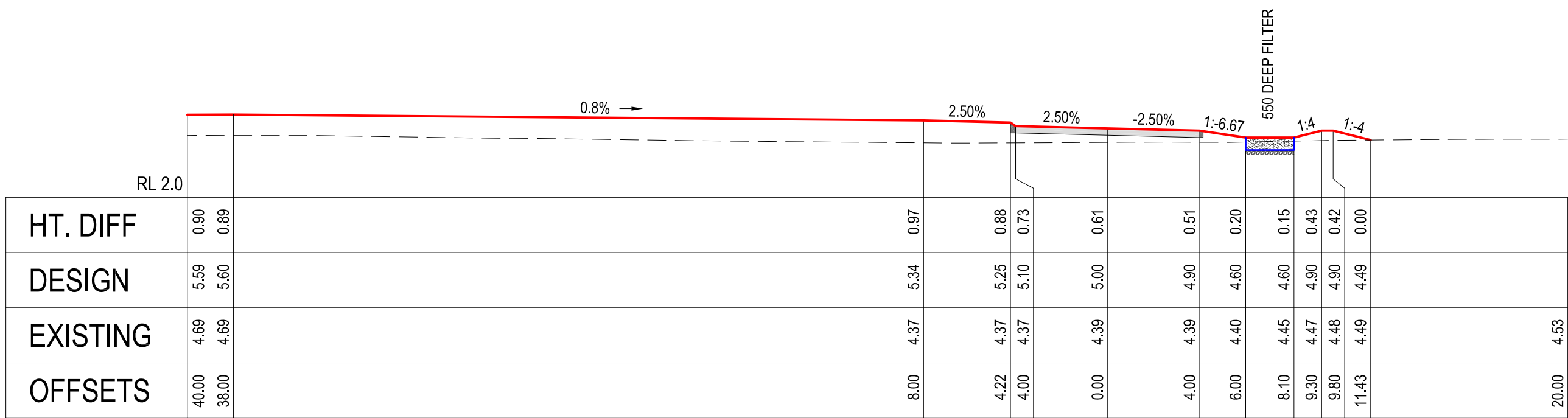
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ROAD 7 - CROSS SECTIONS

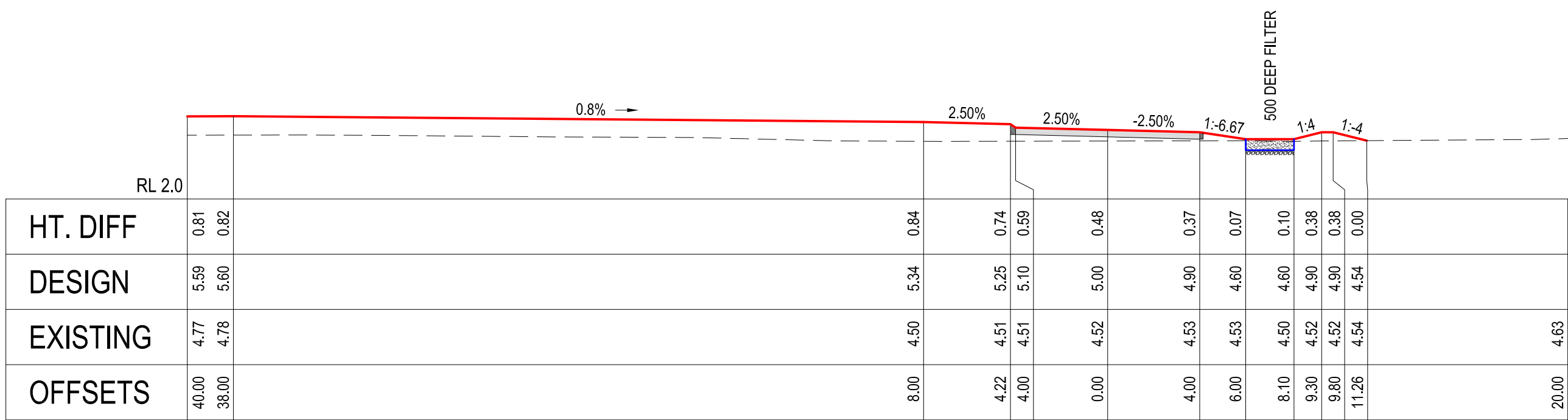
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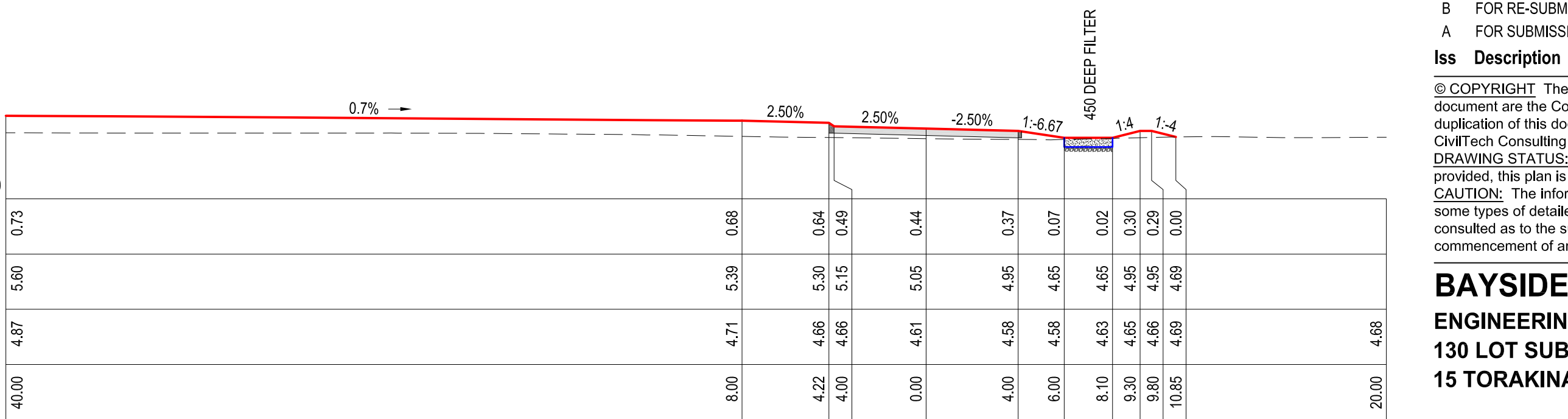
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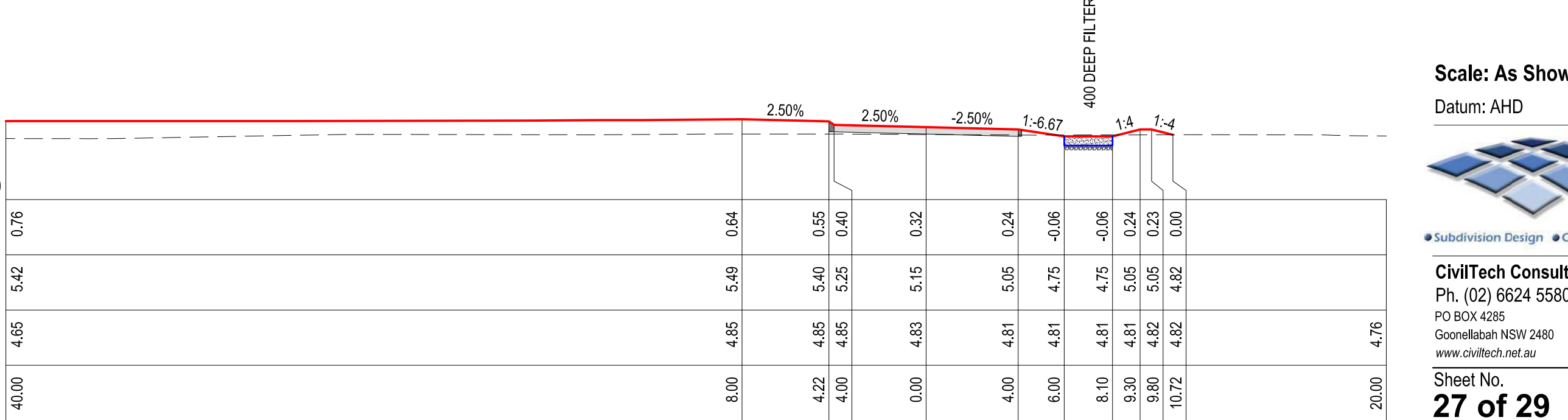
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350.000



300.000



280.000

B	FOR RE-SUBMISSION	WF	WF	01.08.2022	
A	FOR SUBMISSION	WF	WF	01.09.2021	
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ENGINEERING PLANS FOR D.A.
130 LOT SUBDIVISION OF LOT 13 DP 1251383
15 TORAKINA ROAD, BRUNSWICK HEADS

ROAD 7
CROSS SECTIONS

Scale: As Shown at A1 CAD file: 1133-DA27B.dwg
Datum: AHD CivilCAD file: -



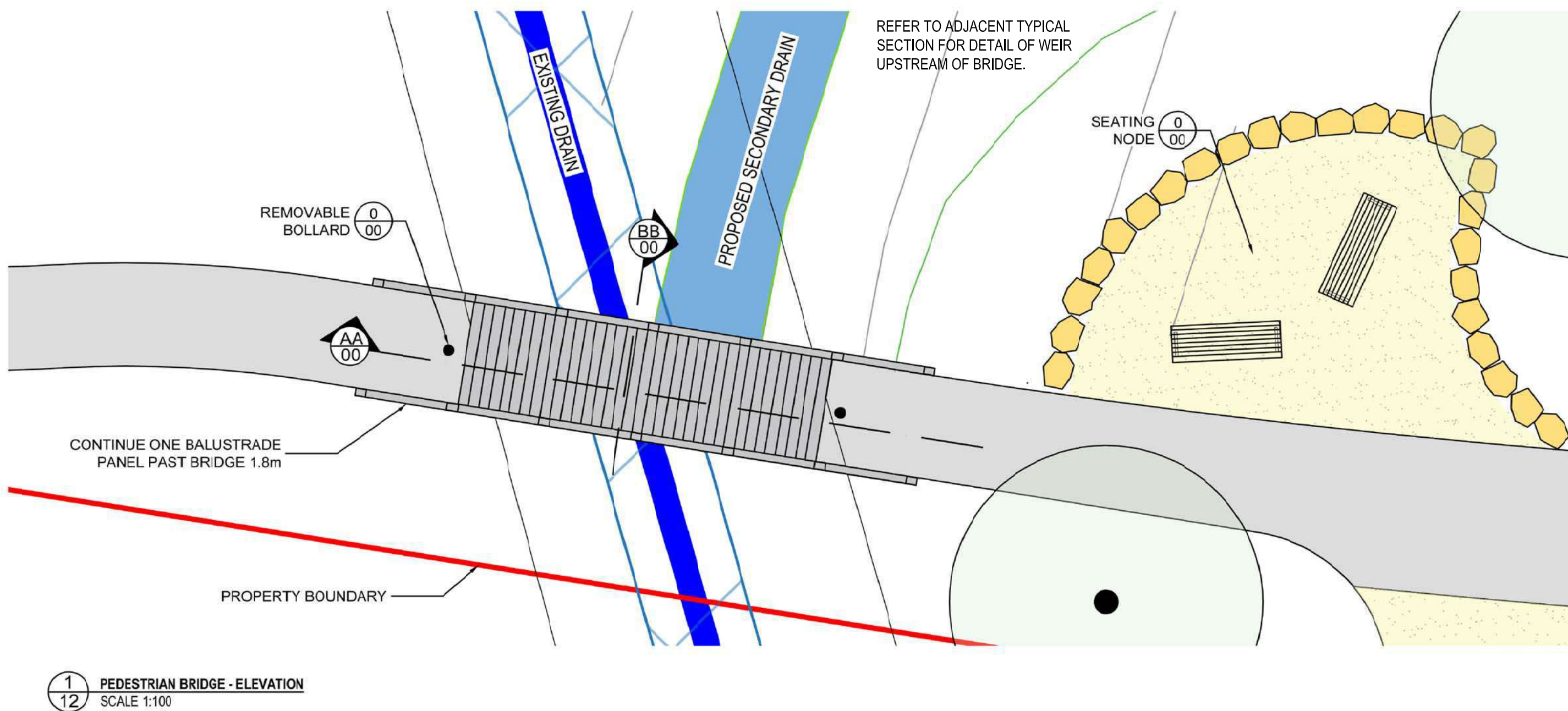
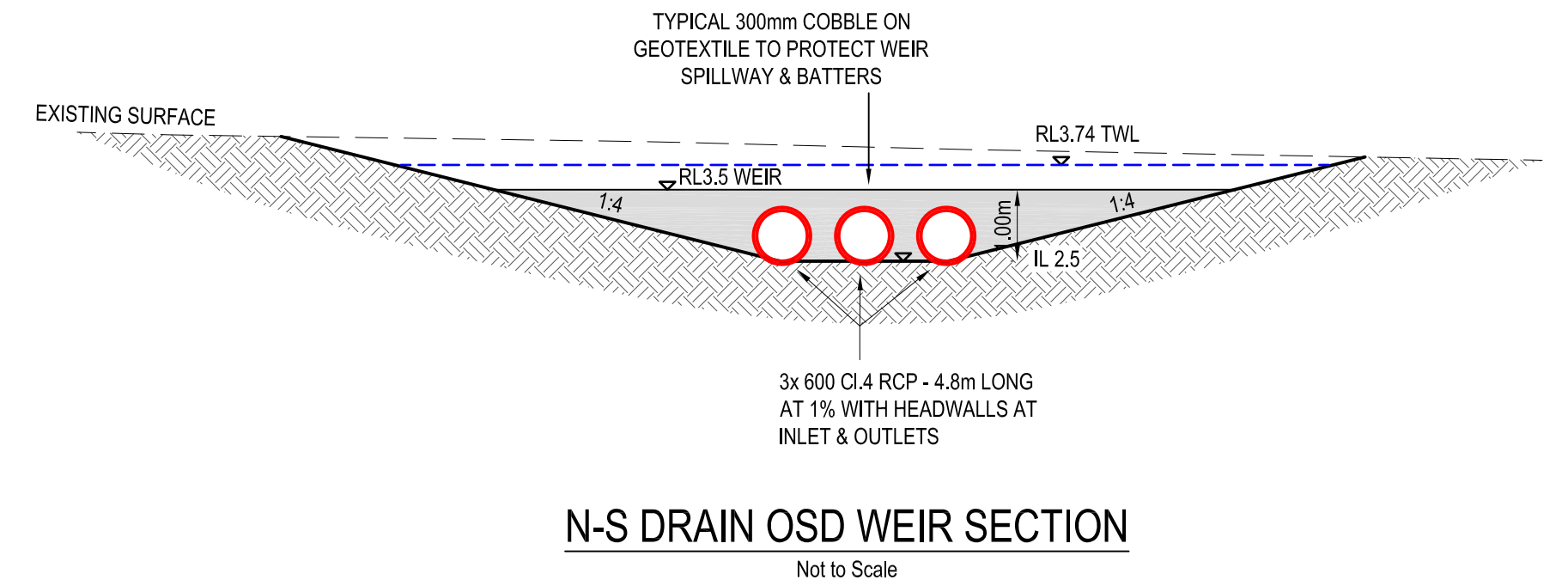
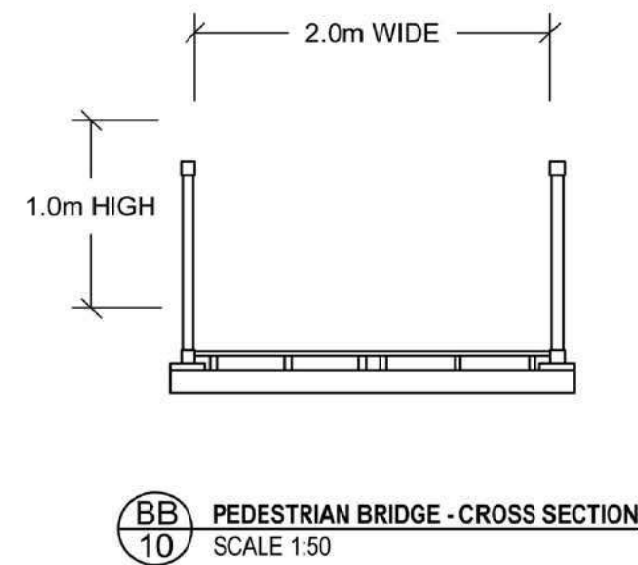
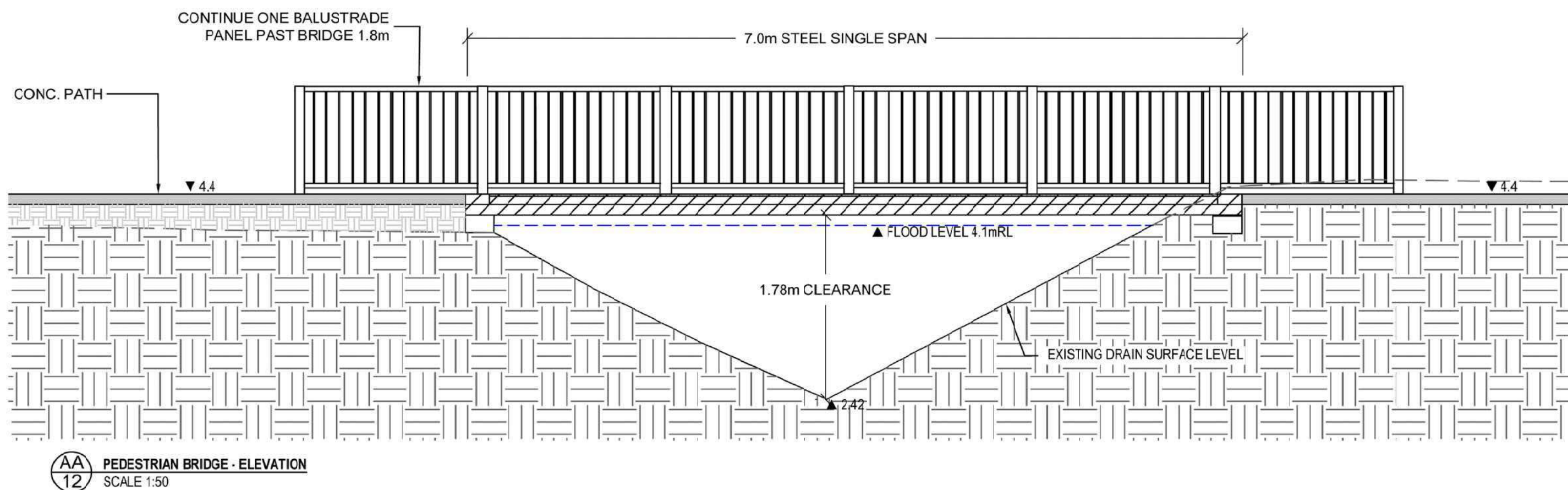
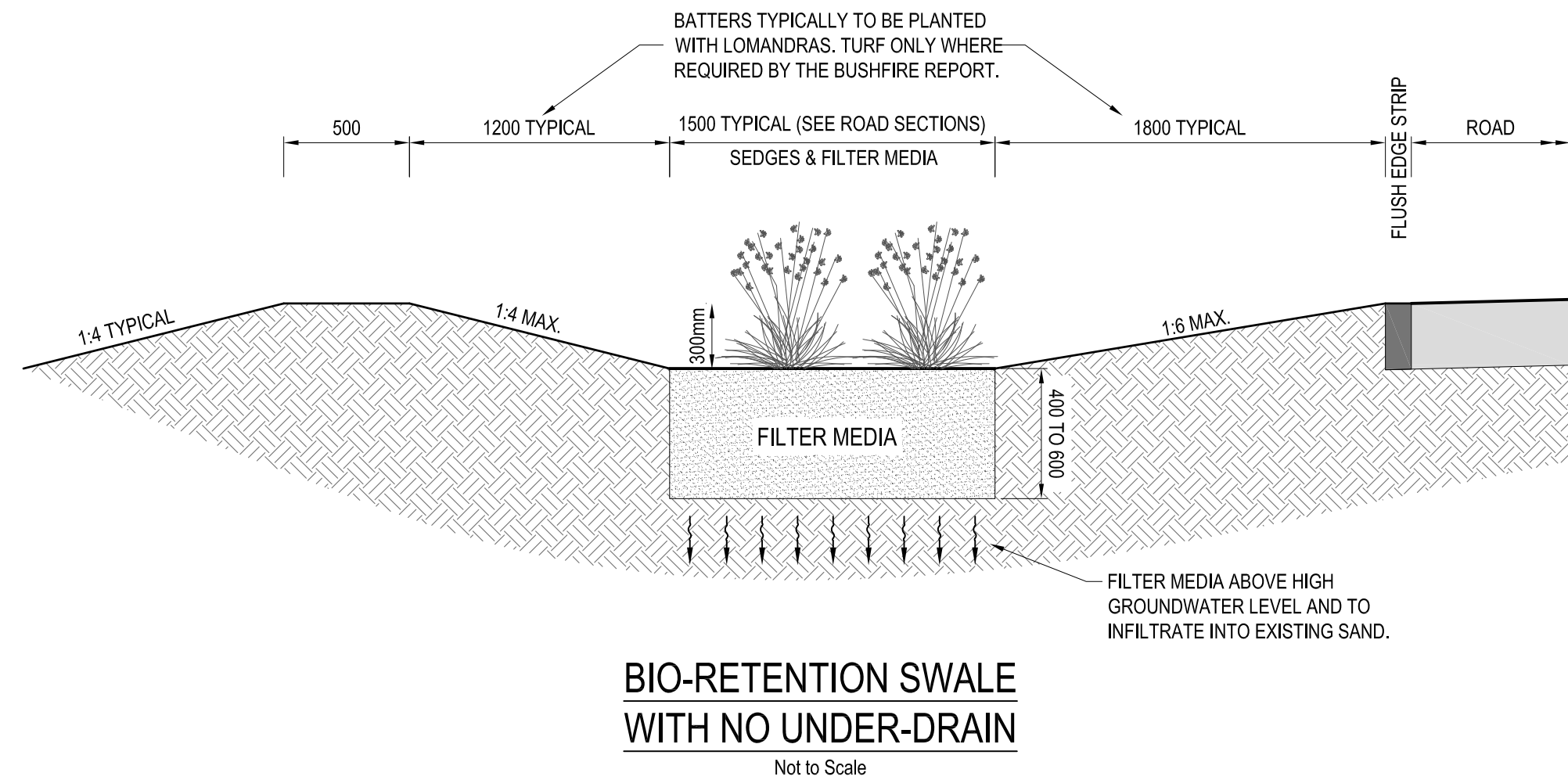
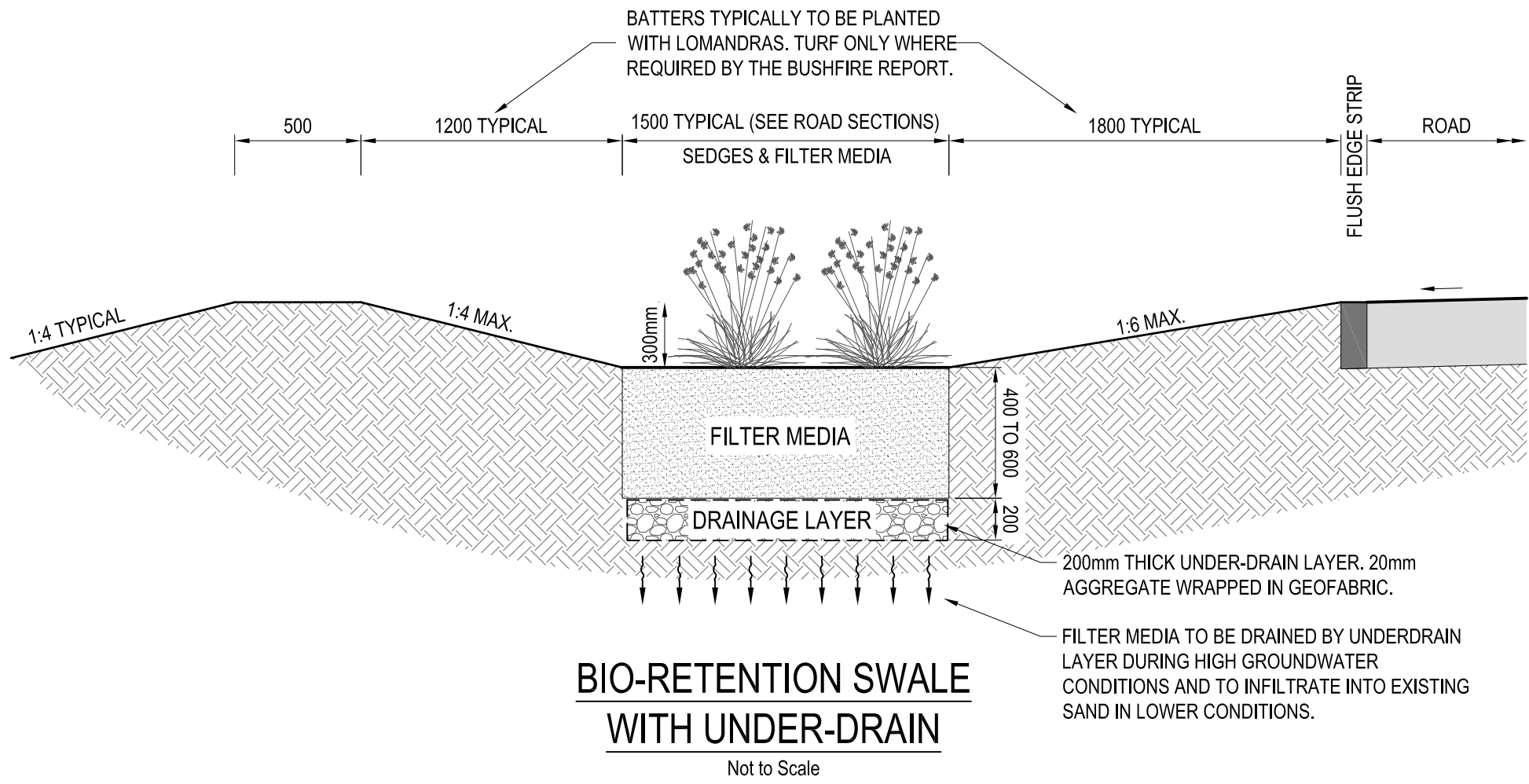
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Dwg. No.
1133-DA27

Issue

B



BRIDGE SPECIFICATION

- CONDAMINE BY LANDMARK PRODUCTS PTY LTD
- 2M WIDE 7M LONG
- LOADING 3kPa (PEDESTRIAN USE ONLY)
- FLAT SINGLE SPAN
- POWDERCOATED DULUX 'SATIN BLACK'
- COMPOSITE TIMBER DECKING

Iss	Description	Des	Drw	Date	Appd
B	FOR RE-SUBMISSION	WF	WF	01.08.2022	
A	FOR SUBMISSION	WF	WF	23.08.2021	

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BAYSIDE BRUNSWICK Pty. Ltd.
ENGINEERING PLANS FOR D.A.
130 LOT SUBDIVISION OF LOT 13 DP 1251383
15 TORAKINA ROAD, BRUNSWICK HEADS

TYPICAL SECTIONS & ENGINEERING DETAILS 1

Scale: As Shown at A1 CAD file: 1133-DA28B.dwg
Datum: AHD CivilCAD file: -



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Dwg. No.
1133-DA28

Issue
B



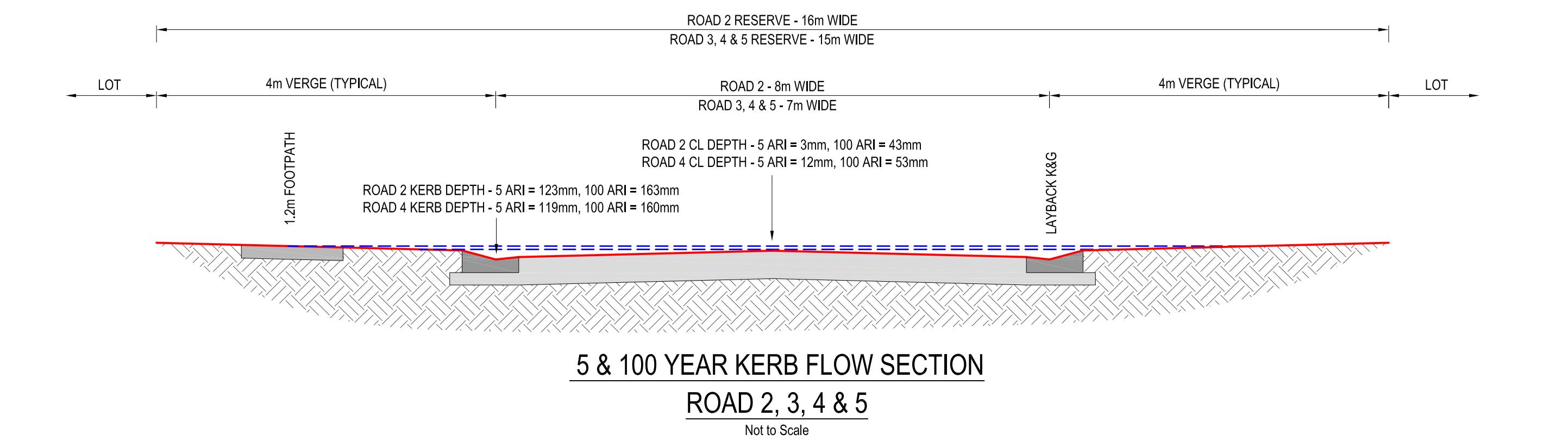
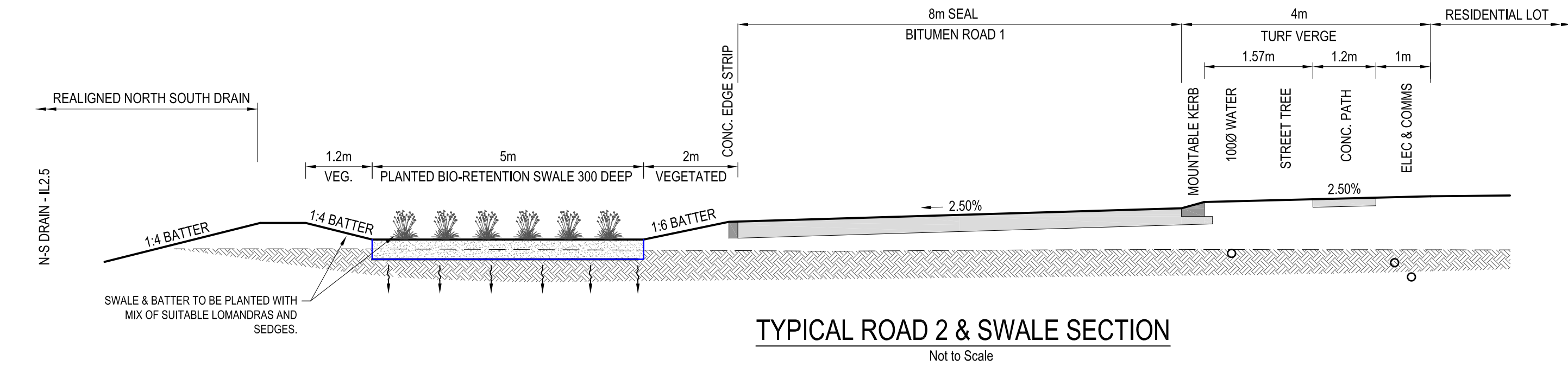
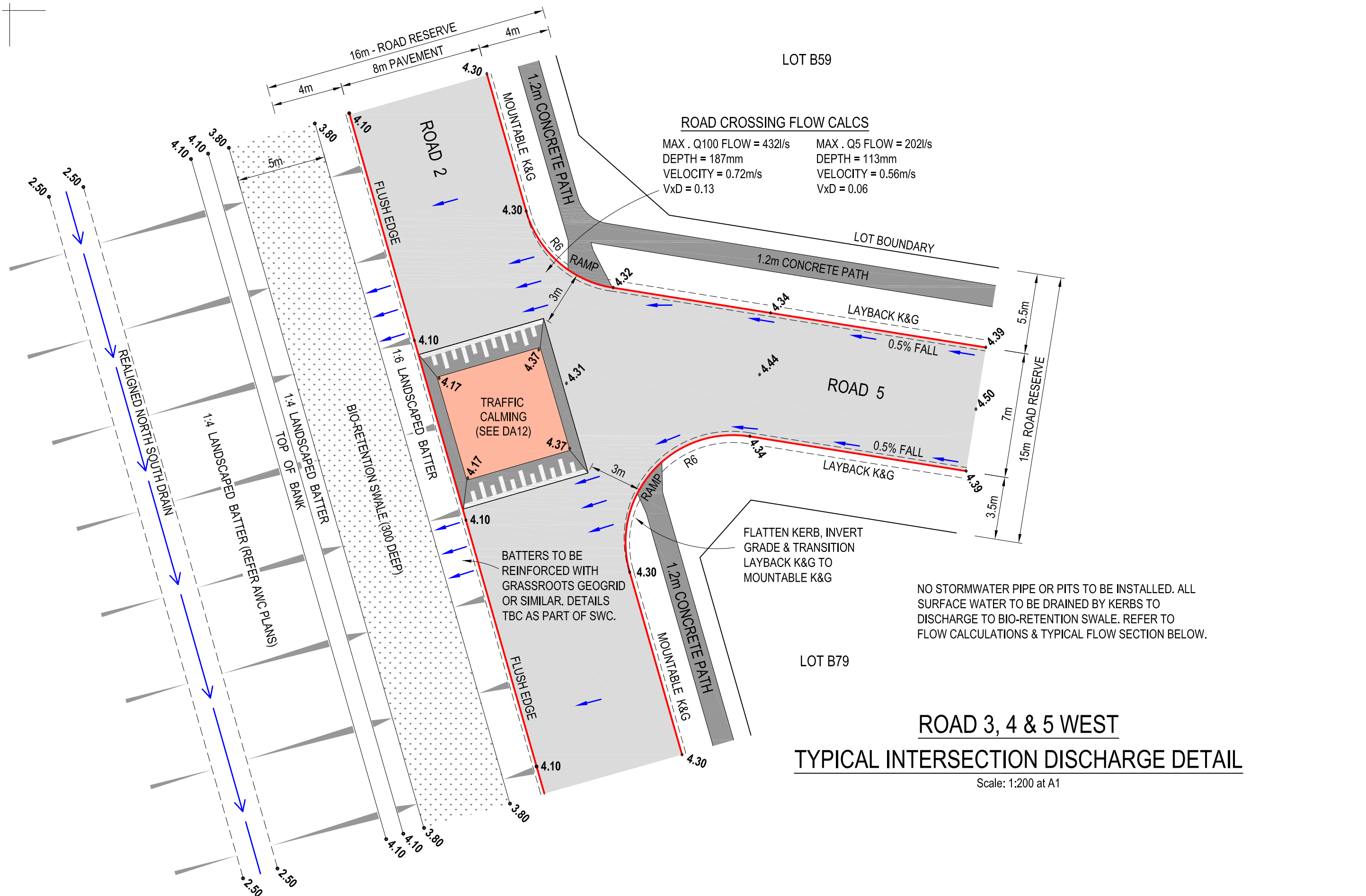
DRAWING: **PEDESTRIAN BRIDGE SOUTHERN DRAIN CROSSING**
PROJECT: **BAYSIDE BRUNSWICK**
LOT 12 DP 1251383, BAYSIDE WAY BRUNSWICK HEADS

REV	ISSUE / AMENDMENTS	DATE
A	FOR DISCUSSION	14.05.21
	WORKING FILE	



DO NOT SCALE FROM PLANS. TO BE ADAPTED ON SITE BY CONTRACTOR & CONFIRMED BY THE PROJECT SUPERVISOR. SIZING CALCULATIONS, STRUCTURES, & COMPACTION TO BE CONFIRMED BY ENGINEER OR SUITABLY QUALIFIED PERSONS. ENGINEERS CERTIFICATE BY OTHERS.

DESIGNED	DWSS	CAD FILE No.
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DRAWN	SS	DWG No.
		1-211400_BAYSIDE_LD_11
CHECKED	DM	



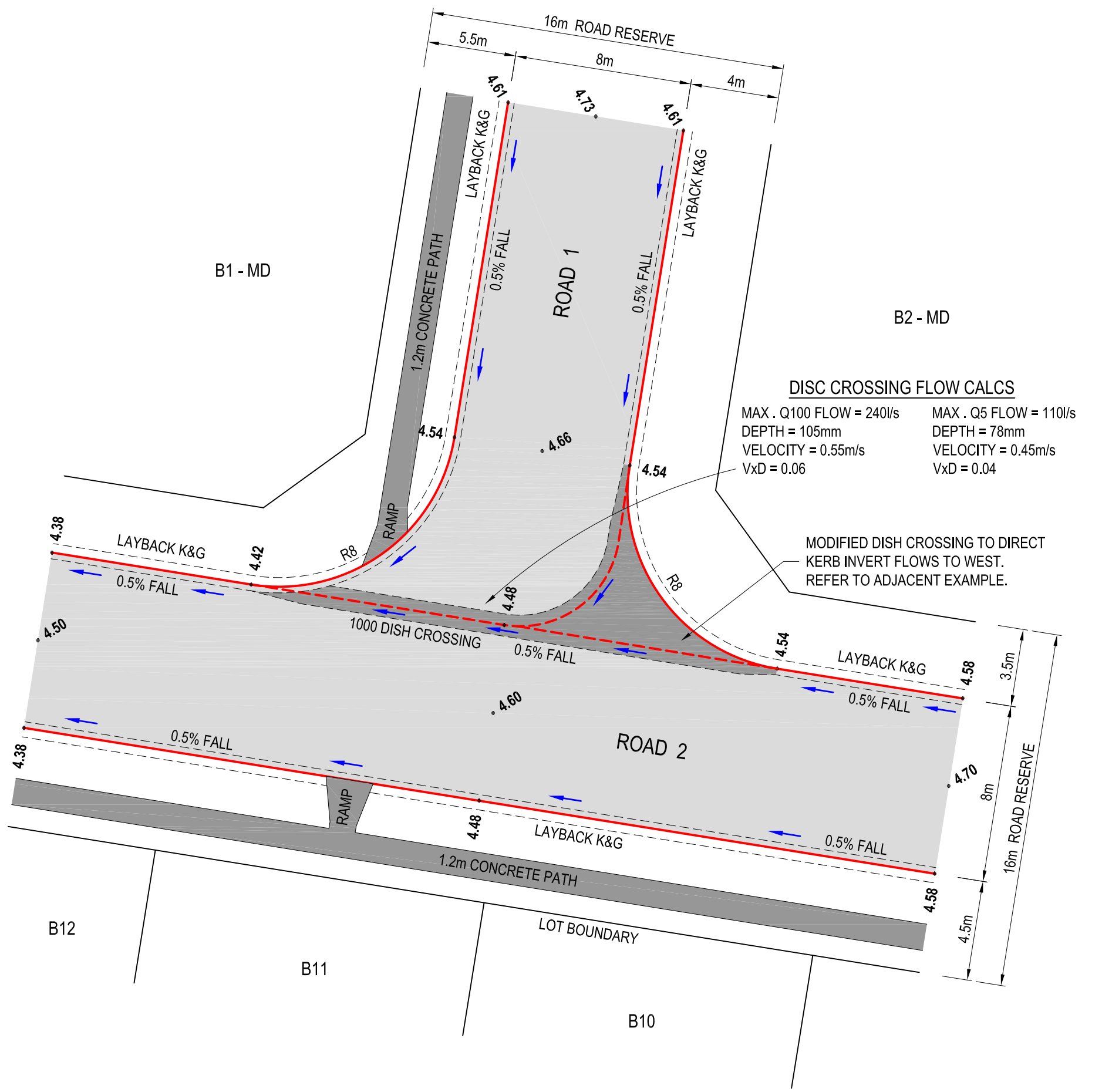
Q5 Catchment Hydrology		
Max Catchment Area (sq.m)	Q5 T/c (mins)	C5
6900	14	0.76
Q100 Catchment Hydrology		
Max Catchment Area (sq.m)	Q100 T/c (mins)	C100
6900	11	0.96

Kerb Flows (half of road catchment)			
ARI	C	Rainfall Intensity (mm/hr)	Flow (l/s)
5	0.76	139	202
100	0.96	235	432

Kerb Hydraulics							
ARI	Kerb Flows (l/s)	Profile Slopes	Min. Longitudinal Grade (%)	Bitumen Mannings Roughness (n)	Flow Depth (mm)	Flow Velocity (m/s)	Vxd
5	202	25% Kerb & 2.5% Road	0.5	NRLG D5.13 - 10.2	123	0.60	0.08
100	432	25% Kerb & 2.5% Road	0.5	0.018	163	0.74	0.12

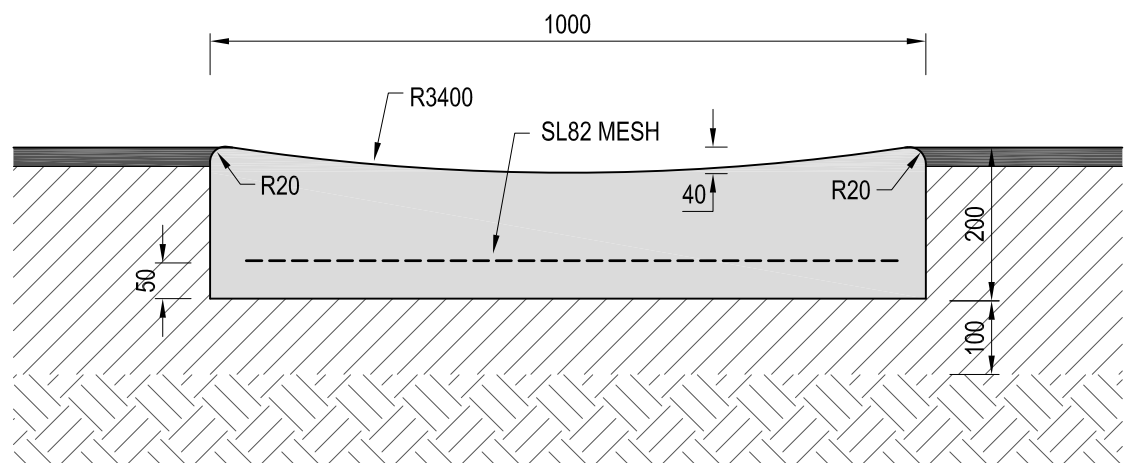


ROAD 1 & 2 INTERSECTION EXAMPLE



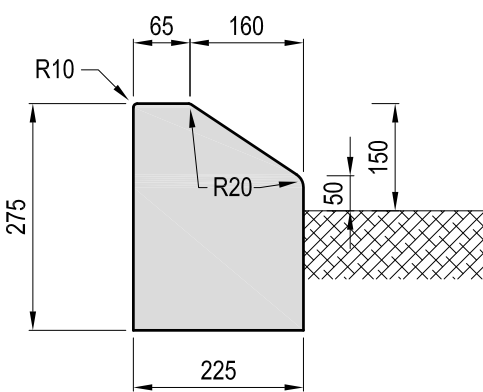
ROAD 1 & 2 INTERSECTION DETAIL

Scale: 1:200 at A1

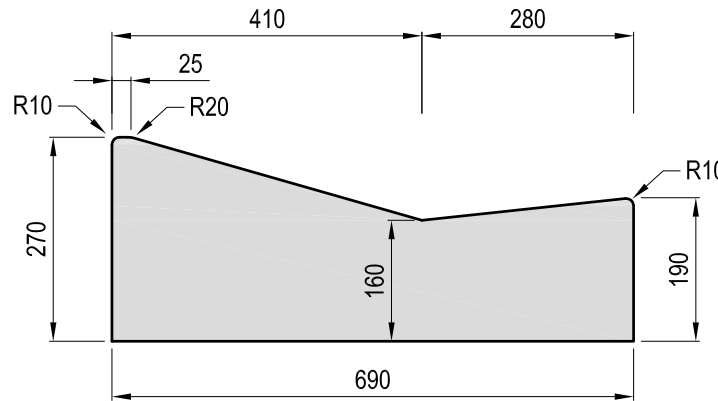


DISH CROSSING DETAIL - ROAD 6 & 7 INTERSECTIONS

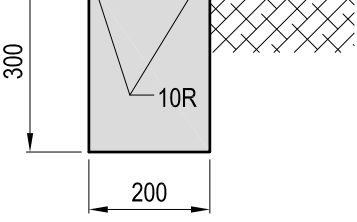
Not to Scale



MOUNTABLE MEDIAN KERB



LAYBACK KERB AND GUTTER



FLUSH EDGE KERB

Iss	Description	Des	Drw	Date	Appd
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A	FOR SUBMISSION	WF	WF	01.08.2021	

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ENGINEERING PLANS FOR D.A.
130 LOT SUBDIVISION OF LOT 13 DP 1251383
15 TORAKINA ROAD, BRUNSWICK HEADS

TYPICAL SECTIONS & ENGINEERING DETAILS 2

Scale: As Shown at A1 CAD file: 1133-DA29B.dwg
Datum: AHD CivilCAD file: -



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Dwg. No. **1133-DA29** Issue **B**

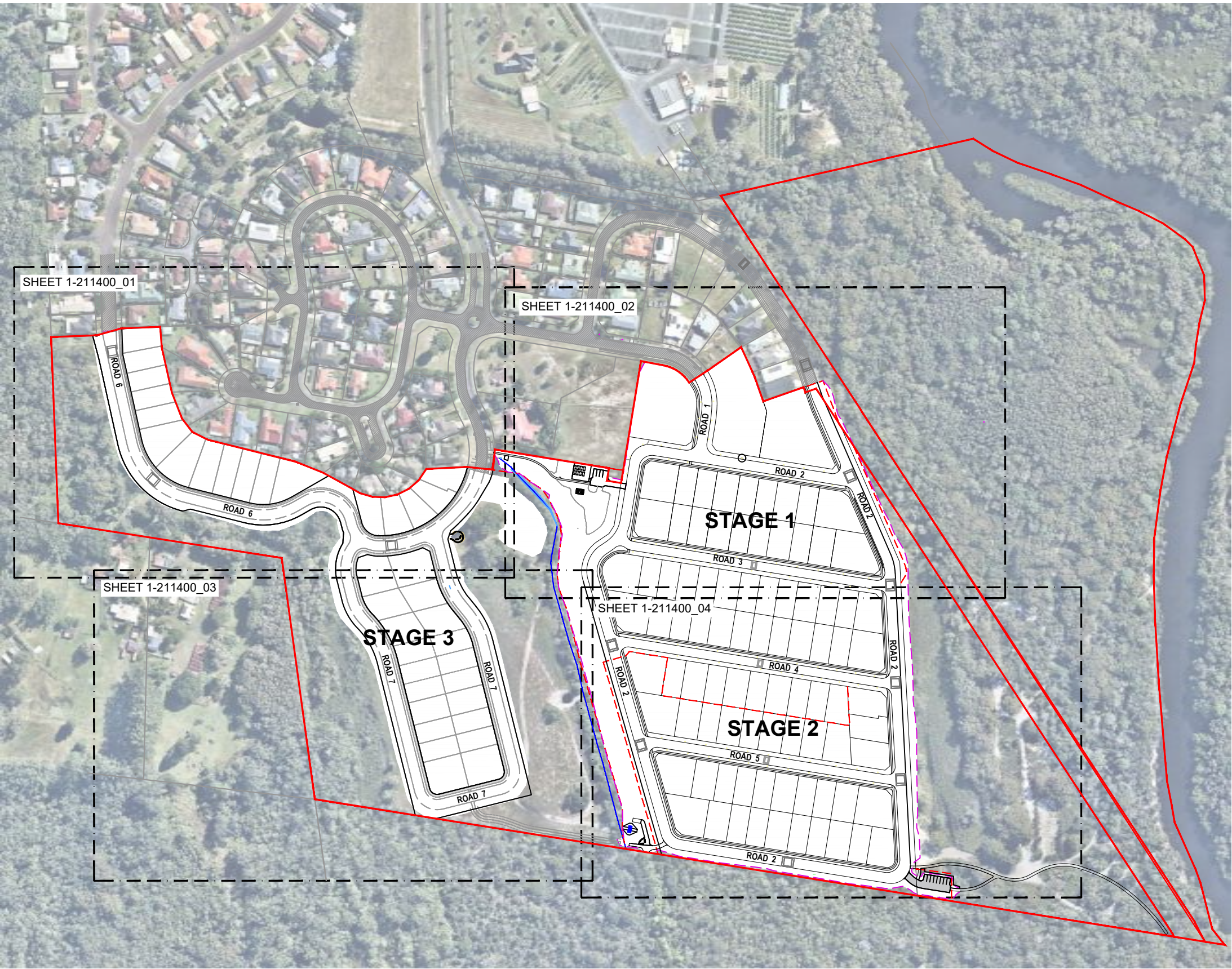
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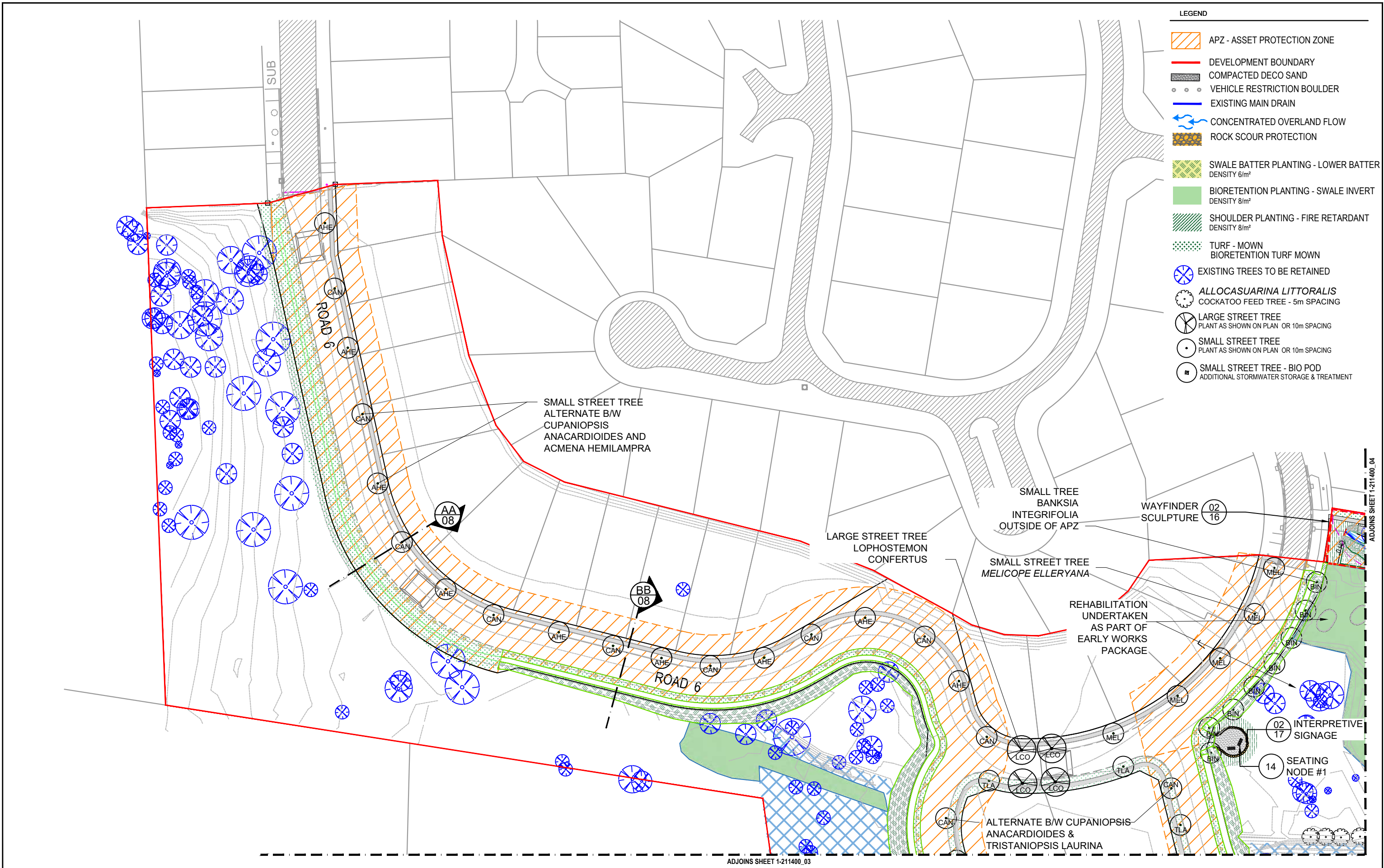
AWC Landscape Documentation and Habitat Creation

WALLUM ESTATE
LANDSCAPE DOCUMENTATION
AND HABITAT CREATION
DEVELOPMENT APPLICATION

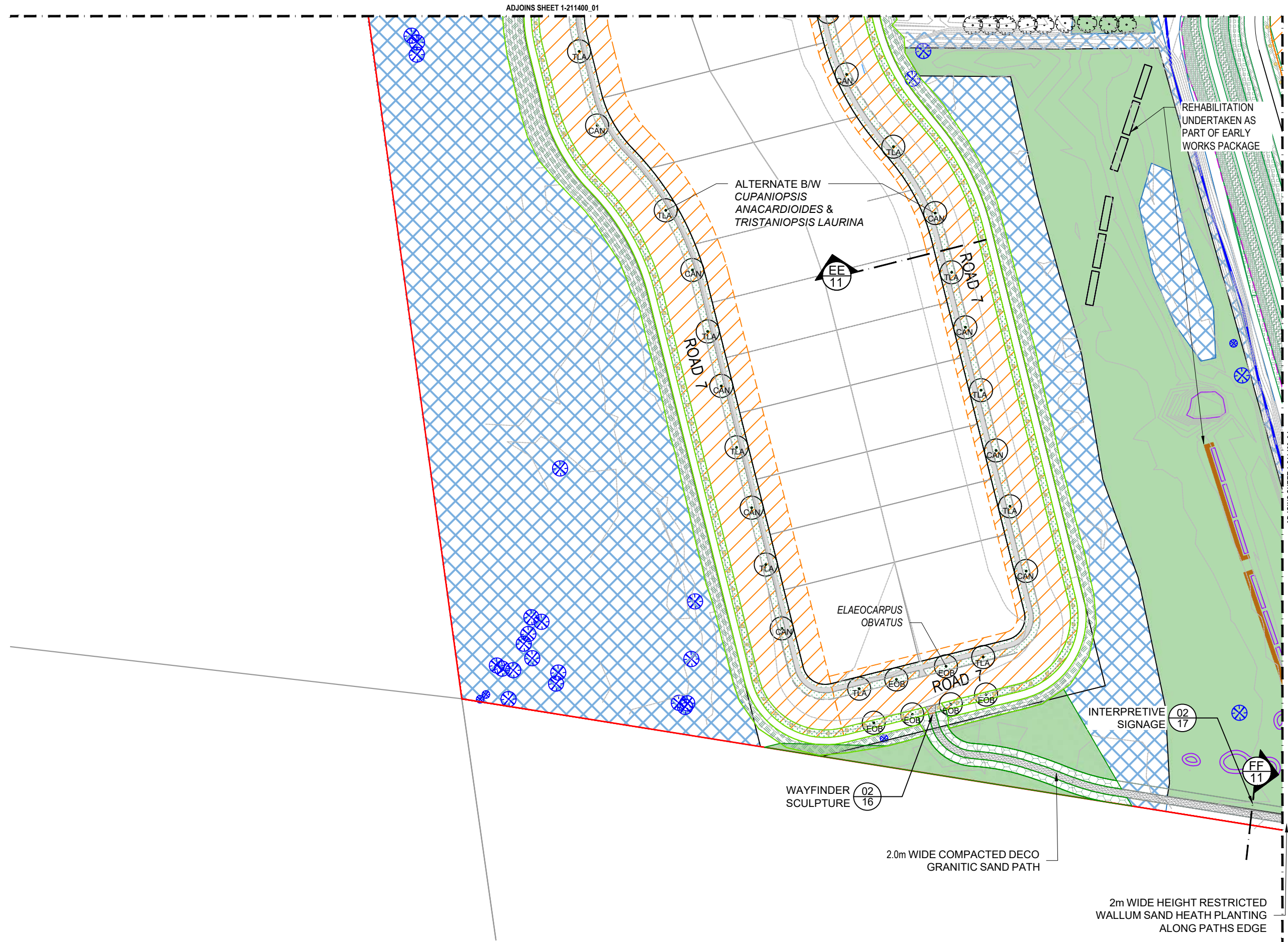
REV F - FOR APPROVAL

- DRAWING LIST
- 1-211400_00 - LOCALITY PLAN & DRAWING INDEX
 - 1-211400_01 - NORTH WEST PLAN
 - 1-211400_02 - NORTH EAST PLAN
 - 1-211400_03 - SOUTH WEST PLAN
 - 1-211400_04 - SOUTH EAST PLAN
 - 1-211400_05 - COMMUNITY GARDENS
 - 1-211400_06 - CENTRAL DRAINAGE CORRIDOR
HABITAT & REHABILITATION ZONE
 - 1-211400_07 - EASTERN HABITAT & REHAB ZONE
 - 1-211400_08 - ROAD 6 - SECTIONS AA - BB
 - 1-211400_09 - ROAD 2 / DRAINAGE CORRIDOR - SEC CC
 - 1-211400_10 - ROAD 3-5 STREET TREE PIT SEC DD
 - 1-211400_11 - ROAD 2 - SECTION EE & EAST WEST -
PEDESTRIAN TRACK
 - 1-211400_12 -ROAD SECTION GG CREEK
PEDESTRIAN TRACK
 - 1-211400_13 - PEDESTRIAN BRIDGE
SOUTHERN DRAIN CROSSING
 - 1-211400_14 - SEATING NODES
 - 1-211400_15 - PLANTING SCHEDULE
 - 1-211400_16 - INTERPRETIVE SIGNAGE PLAN
 - 1-211400_17 - INDIGENOUS SCULPTURE PLAN



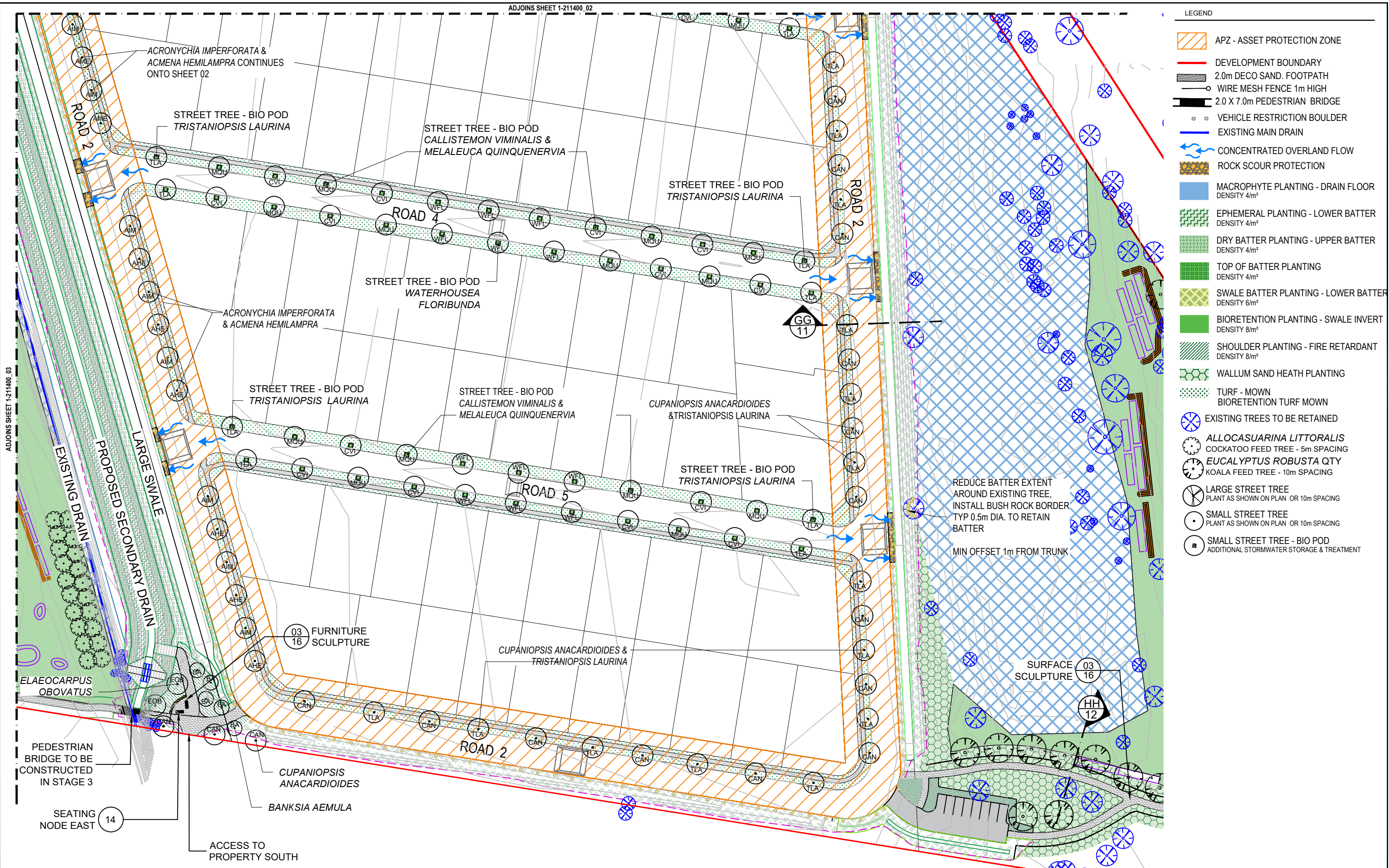


- APZ - ASSET PROTECTION ZONE
DEVELOPMENT BOUNDARY
2.0m DECO SAND. FOOTPATH
WIRE MESH FENCE 1m HIGH
VEHICLE RESTRICTION BOULDER
EXISTING MAIN DRAIN
CONCENTRATED OVERLAND FLOW
ROCK SCOUR PROTECTION
MACROPHYTE PLANTING - DRAIN FLOOR
DENSITY 4/m²
EPHEMERAL PLANTING - LOWER BATTER
DENSITY 4/m²
DRY BATTER PLANTING - UPPER BATTER
DENSITY 4/m²
TOP OF BATTER PLANTING
DENSITY 4/m²
SWALE BATTER PLANTING - LOWER BATTER
DENSITY 6/m²
BIORETENTION PLANTING - SWALE INVERT
DENSITY 8/m²
SHOULDER PLANTING - FIRE RETARDANT
DENSITY 8/m²
WALLUM SAND HEATH PLANTING
TURF - MOWN
BIORETENTION TURF MOWN
EXISTING TREES TO BE RETAINED
ALLOCASUARINA LITTORALIS
COCKATOO FEED TREE - 5m SPACING
LARGE STREET TREE
SMALL STREET TREE
PLANT AS SHOWN ON PLAN OR 10m SPACING



REV.	ISSUE / AMENDMENTS	DATE
A	FOR REVIEW	19.07.21
B	FOR APPROVAL	11.08.21
C	FOR APPROVAL	06.09.21
D	FOR APPROVAL	17.12.21
F	FOR APPROVAL	20.09.22





LEGEND

- APZ - ASSET PROTECTION ZONE
- DEVELOPMENT BOUNDARY
- 2.0m DECO SAND. FOOTPATH
- WIRE MESH FENCE 1m HIGH
- 2.0 X 7.0m PEDESTRIAN BRIDGE
- VEHICLE RESTRICTION BOULDER
- EXISTING MAIN DRAIN
- CONCENTRATED OVERLAND FLOW
- ROCK SCOUR PROTECTION
- MACROPHYTE PLANTING - DRAIN FLOOR
DENSITY 4/m²
- EPHEMERAL PLANTING - LOWER BATTER
DENSITY 4/m²
- DRY BATTER PLANTING - UPPER BATTER
DENSITY 4/m²
- TOP OF BATTER PLANTING
DENSITY 4/m²
- SWALE BATTER PLANTING - LOWER BATTER
DENSITY 6/m²
- BIORETENTION PLANTING - SWALE INVERT
DENSITY 8/m²
- SHOULDER PLANTING - FIRE RETARDANT
DENSITY 8/m²
- WALLUM SAND HEATH PLANTING
- TURF - MOWN
BIORETENTION TURF MOWN
- EXISTING TREES TO BE RETAINED
- ALLOCASUARINA LITTORALIS*
COCKATOO FEED TREE - 5m SPACING
- EUCALYPTUS ROBUSTA* QTY
KOALA FEED TREE - 10m SPACING
- LARGE STREET TREE
PLANT AS SHOWN ON PLAN OR 10m SPACING
- SMALL STREET TREE
PLANT AS SHOWN ON PLAN OR 10m SPACING
- SMALL STREET TREE - BIO POD
ADDITIONAL STORMWATER STORAGE & TREATMENT

CLIENT:

DRAWING:

SOUTH EAST LANDSCAPE PLAN

PROJECT:

**WALLUM ESTATE
LANDSCAPE PACKAGE**

REV.	ISSUE / AMENDMENTS	DATE
A	FOR REVIEW	19.07.21
B	FOR APPROVAL	11.08.21
C	FOR APPROVAL	06.09.21
D	FOR APPROVAL	17.12.21
F	FOR APPROVAL	20.09.22



SCALE 1:1000 @ A3

0 10 20 30 40m

DESIGNED DM/SS

DRAWN SS

CHECKED DM

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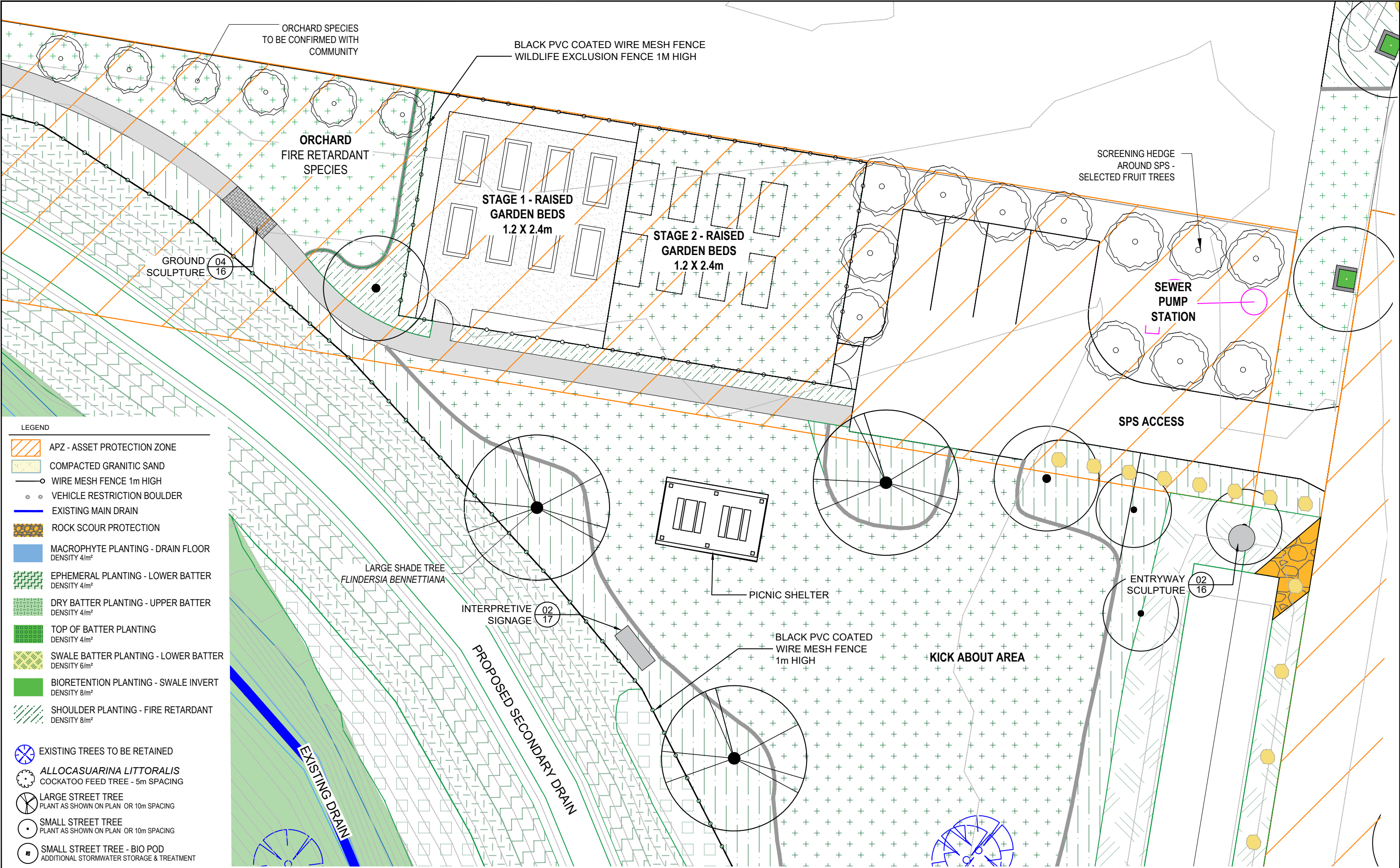
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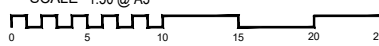
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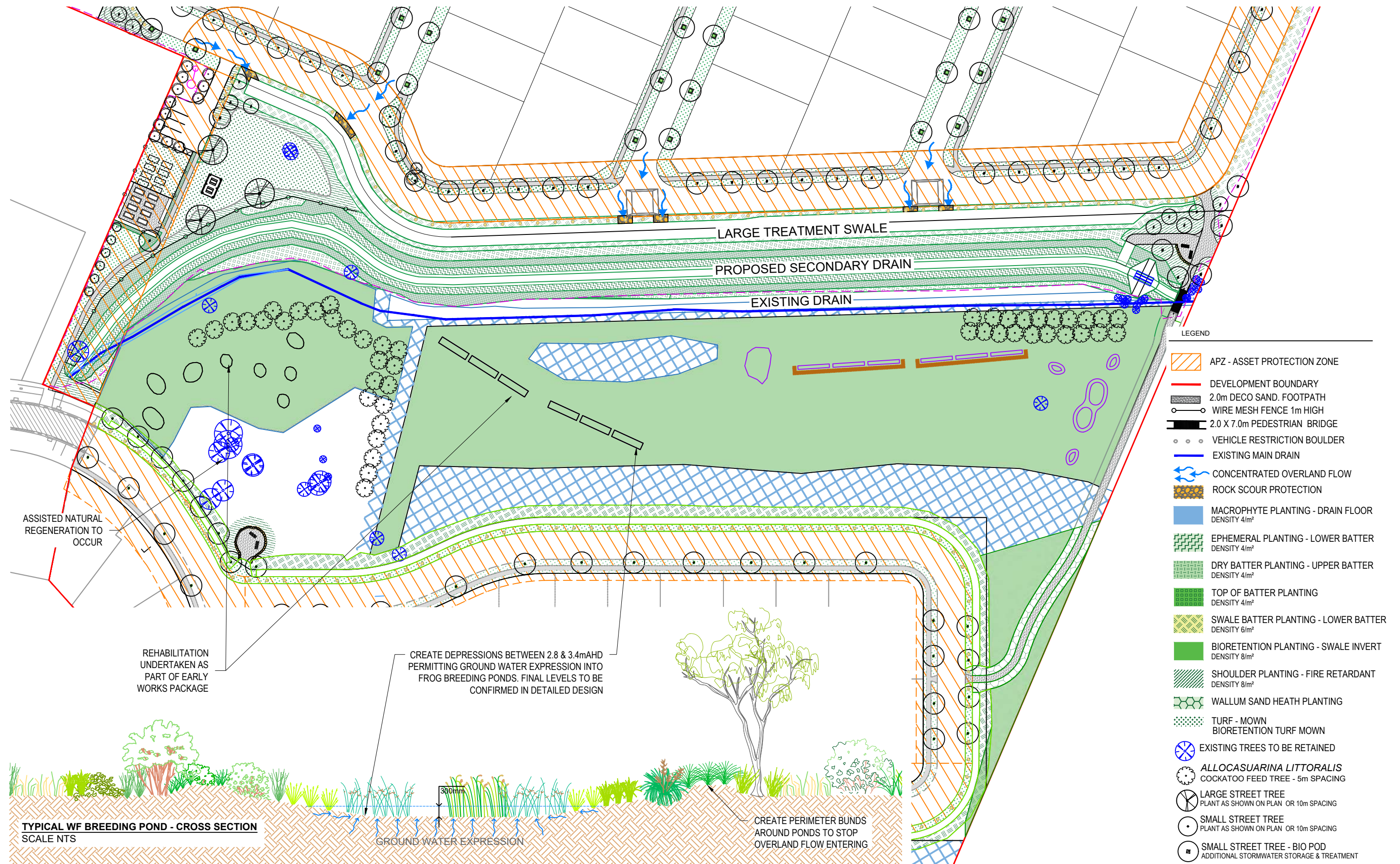
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SCALE 1:50 @ A3		REV. F
		
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TYPICAL WF BREEDING POND - CROSS SECTION
SCALE NTS

GROUND WATER EXPRESSION

CREATE PERIMETER BUNDS
AROUND PONDS TO STOP
OVERLAND FLOW ENTERING

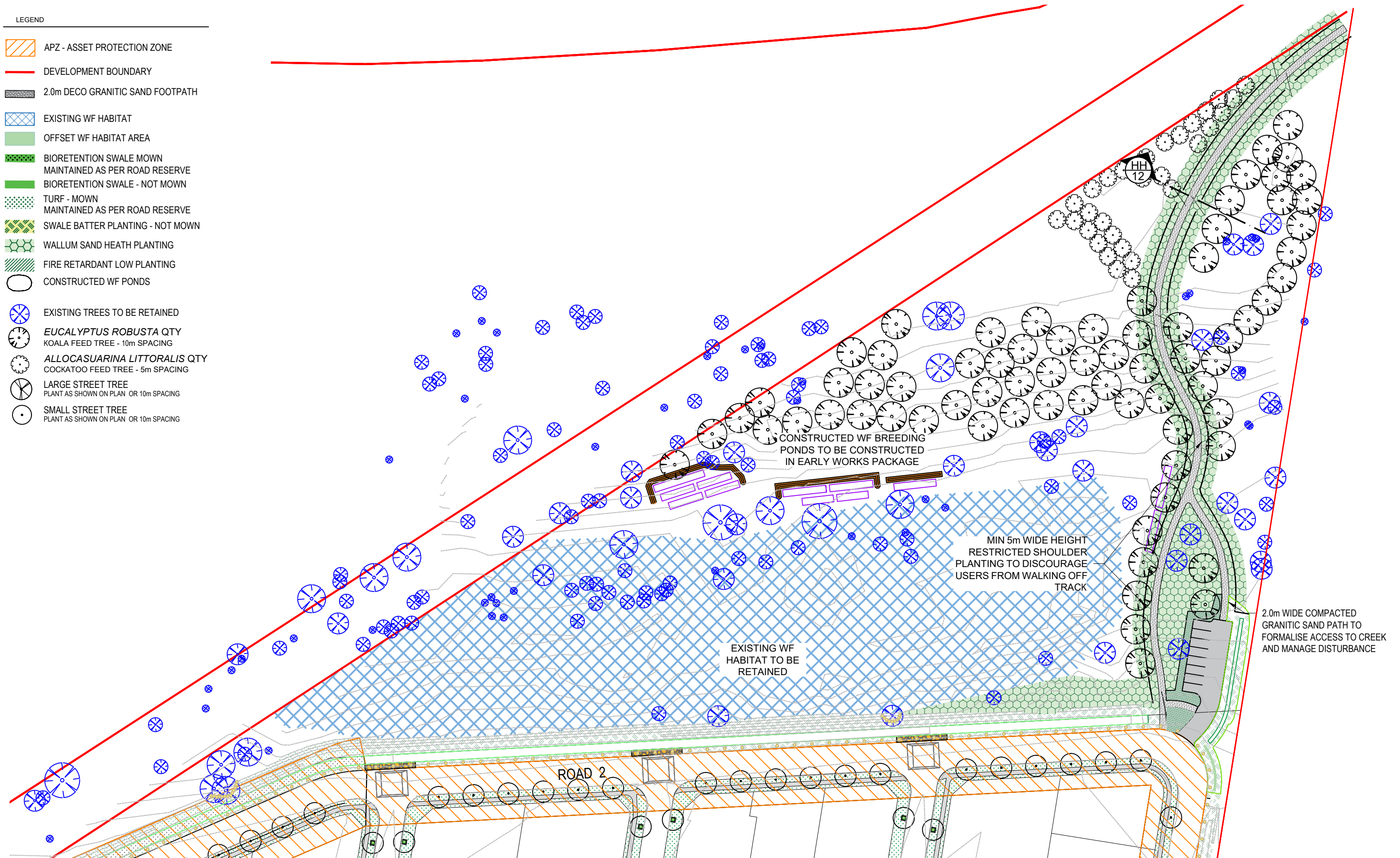
LEGEND

- APZ - ASSET PROTECTION ZONE
- DEVELOPMENT BOUNDARY
- 2.0m DECO SAND, FOOTPATH
- WIRE MESH FENCE 1m HIGH
- 2.0 X 7.0m PEDESTRIAN BRIDGE
- VEHICLE RESTRICTION BOULDER
- EXISTING MAIN DRAIN
- CONCENTRATED OVERLAND FLOW
- ROCK SCOUR PROTECTION
- MACROPHYTE PLANTING - DRAIN FLOOR
DENSITY 4/m²
- EPHEMERAL PLANTING - LOWER BATTER
DENSITY 4/m²
- DRY BATTER PLANTING - UPPER BATTER
DENSITY 4/m²
- TOP OF BATTER PLANTING
DENSITY 4/m²
- SWALE BATTER PLANTING - LOWER BATTER
DENSITY 6/m²
- BIORETENTION PLANTING - SWALE INVERT
DENSITY 8/m²
- SHOULDER PLANTING - FIRE RETARDANT
DENSITY 8/m²
- WALLUM SAND HEATH PLANTING
- TURF - MOWN
BIORETENTION TURF MOWN
- EXISTING TREES TO BE RETAINED
- ALLOCASUARINA LITTORALIS
COCKATOO FEED TREE - 5m SPACING
- LARGE STREET TREE
PLANT AS SHOWN ON PLAN OR 10m SPACING
- SMALL STREET TREE
PLANT AS SHOWN ON PLAN OR 10m SPACING
- SMALL STREET TREE - BIO POD
ADDITIONAL STORMWATER STORAGE & TREATMENT



LEGEND

- APZ - ASSET PROTECTION ZONE
- DEVELOPMENT BOUNDARY
- 2.0m DECO GRANITIC SAND FOOTPATH
- EXISTING WF HABITAT
- OFFSET WF HABITAT AREA
- BIORETENTION SWALE MOWN
MAINTAINED AS PER ROAD RESERVE
- BIORETENTION SWALE - NOT MOWN
- TURF - MOWN
MAINTAINED AS PER ROAD RESERVE
- SWALE BATTER PLANTING - NOT MOWN
- WALLUM SAND HEATH PLANTING
- FIRE RETARDANT LOW PLANTING
- CONSTRUCTED WF PONDS
- EXISTING TREES TO BE RETAINED
- EUCALYPTUS ROBUSTA* QTY
KOALA FEED TREE - 10m SPACING
- ALLOCASUARINA LITTORALIS* QTY
COCKATOO FEED TREE - 5m SPACING
- LARGE STREET TREE
PLANT AS SHOWN ON PLAN OR 10m SPACING
- SMALL STREET TREE
PLANT AS SHOWN ON PLAN OR 10m SPACING



CLIENT:

DRAWING:

**EASTERN HABITAT &
REHABILITATION ZONE**

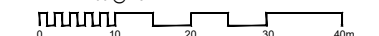
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**WALLUM ESTATE
LANDSCAPE PACKAGE**

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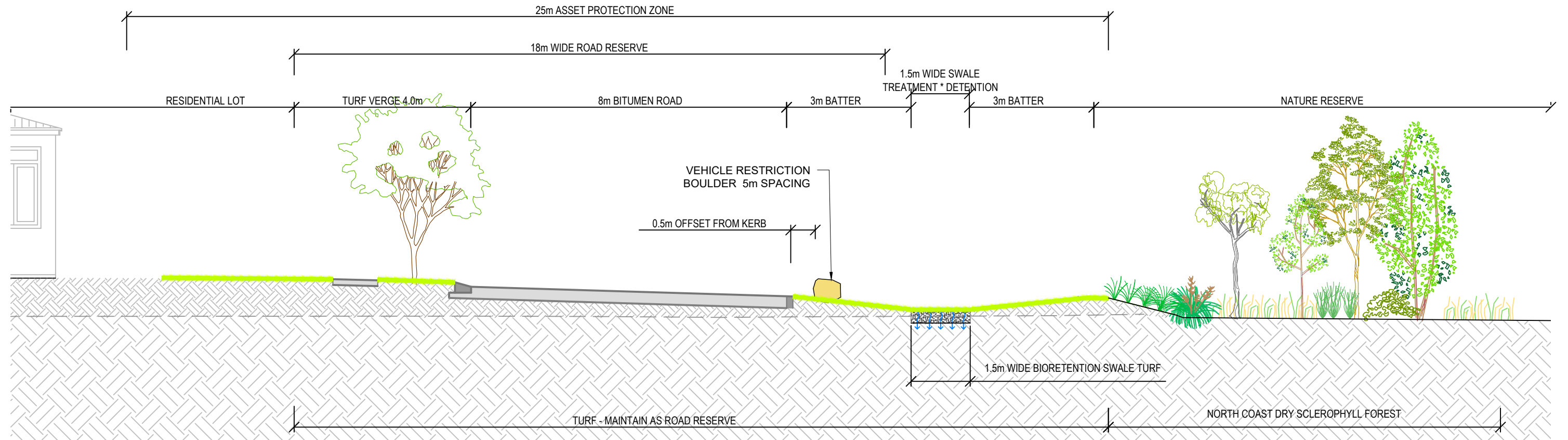


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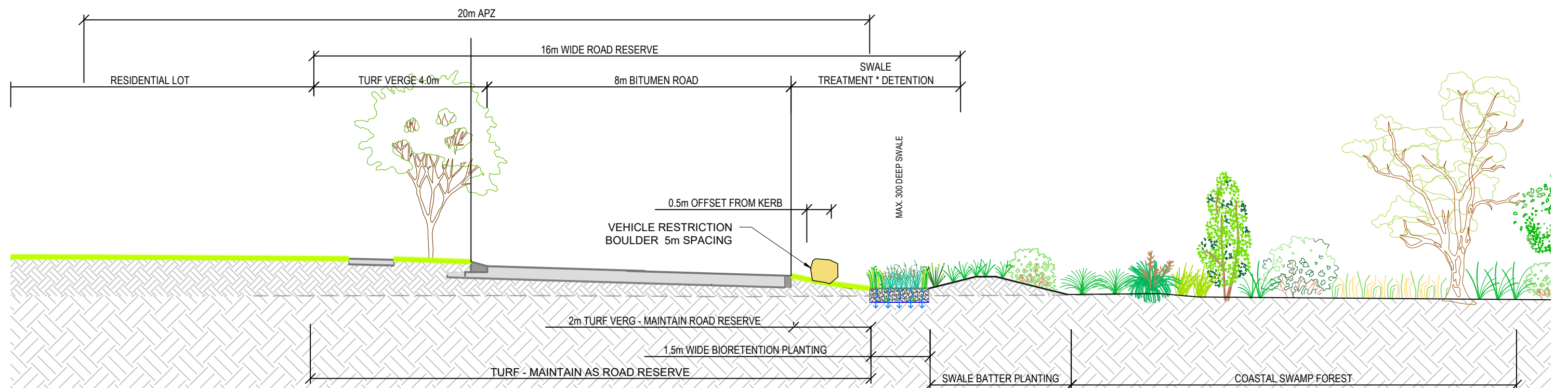
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REV.

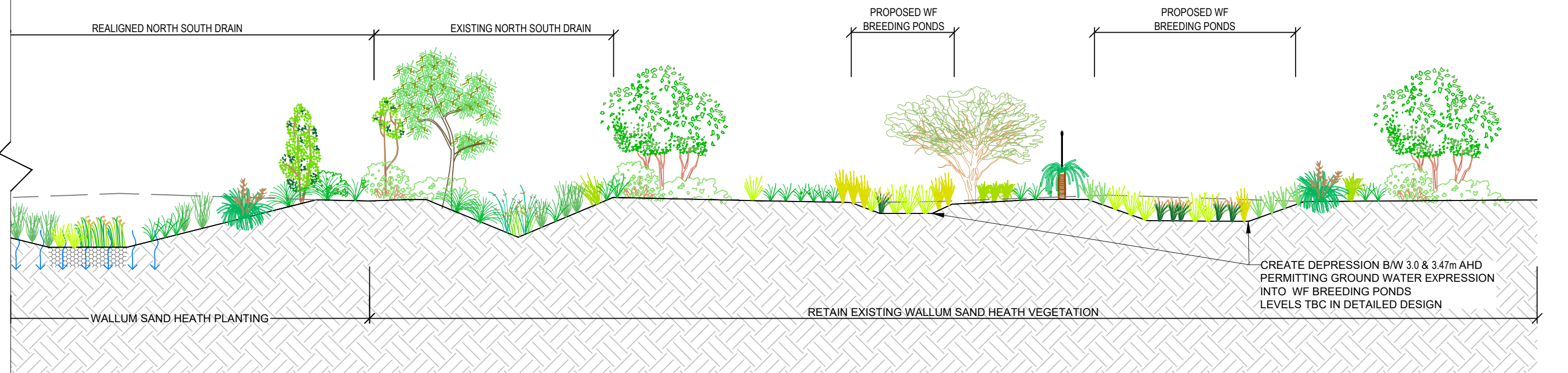
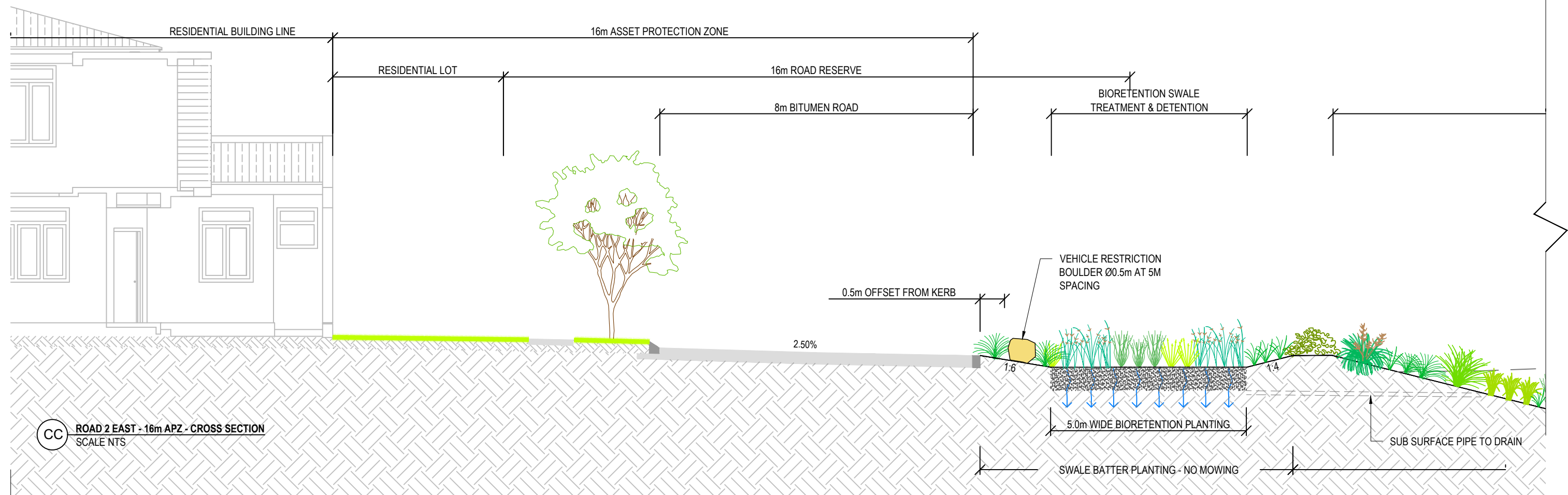
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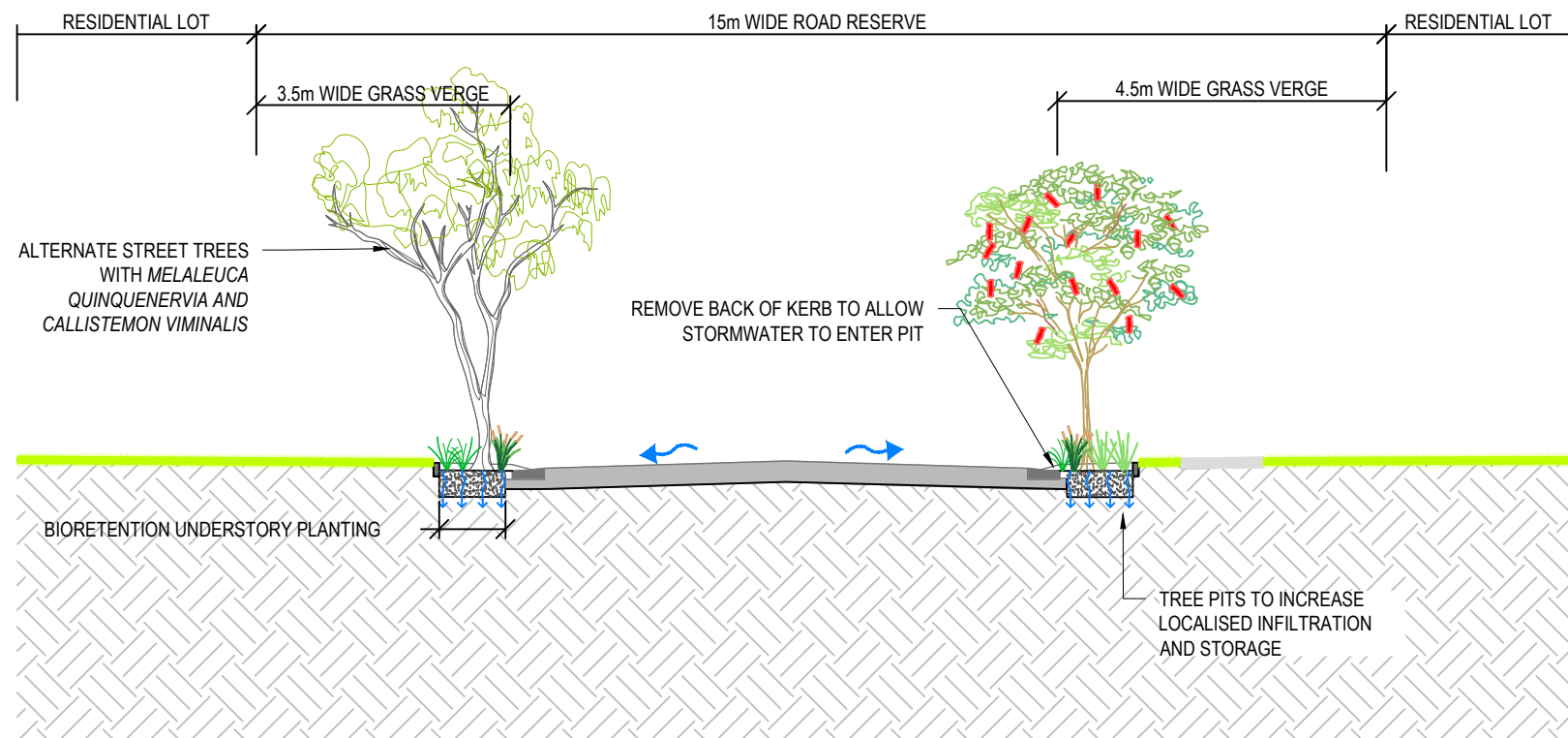


AA ROAD 6 - 25m APZ - CROSS SECTION
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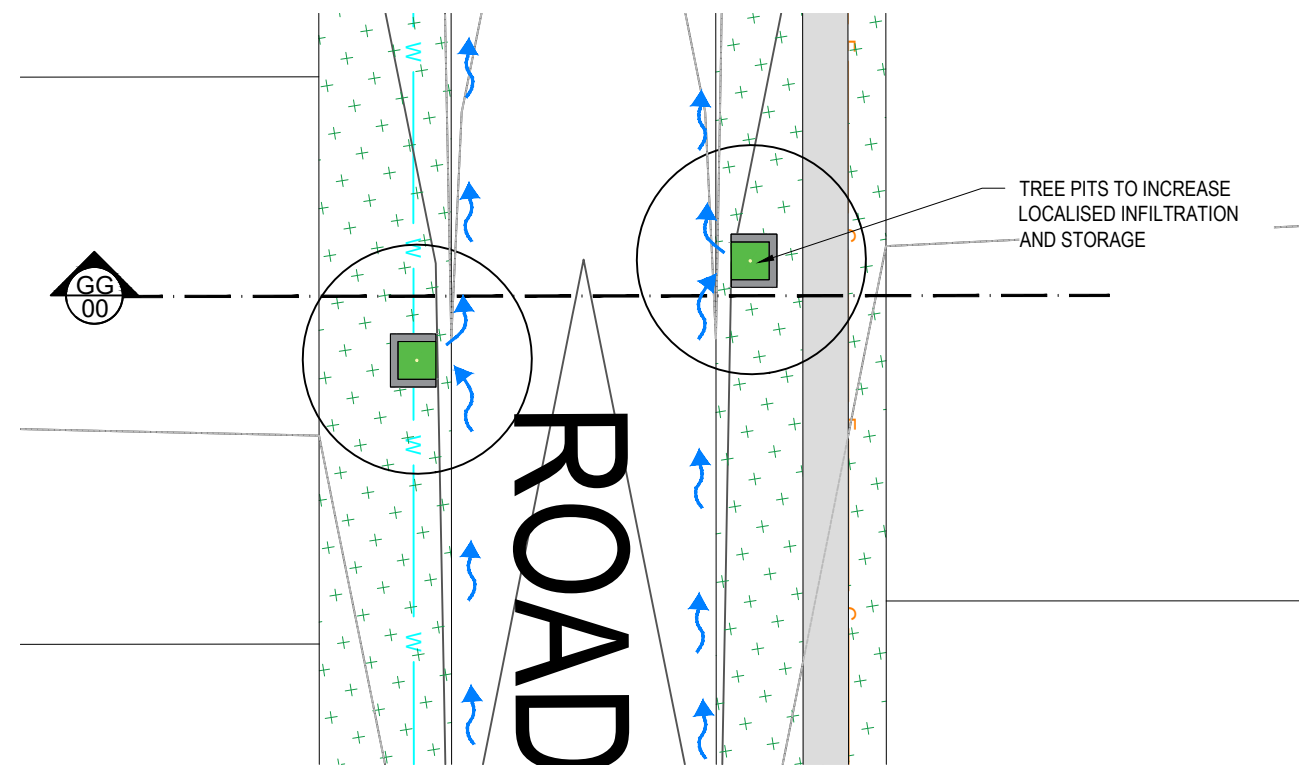


BB ROAD 6 - 20m APZ - CROSS SECTION
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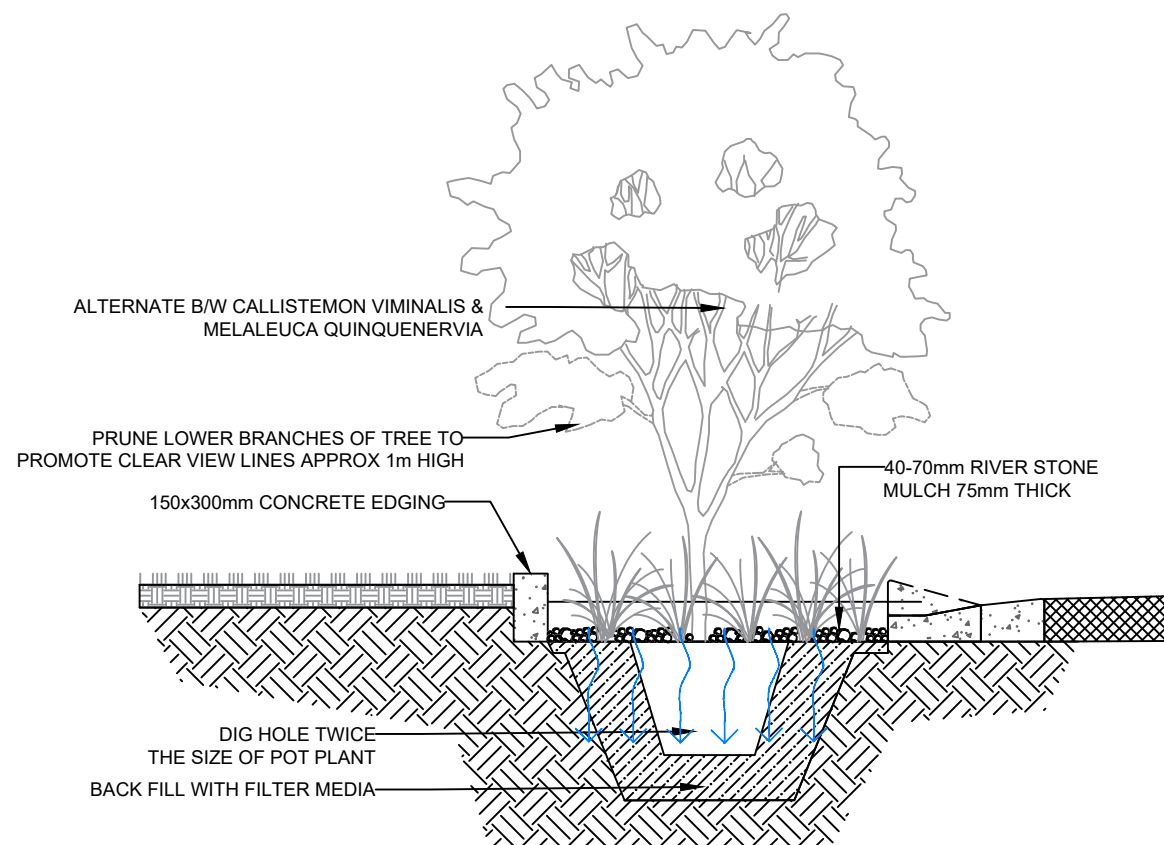




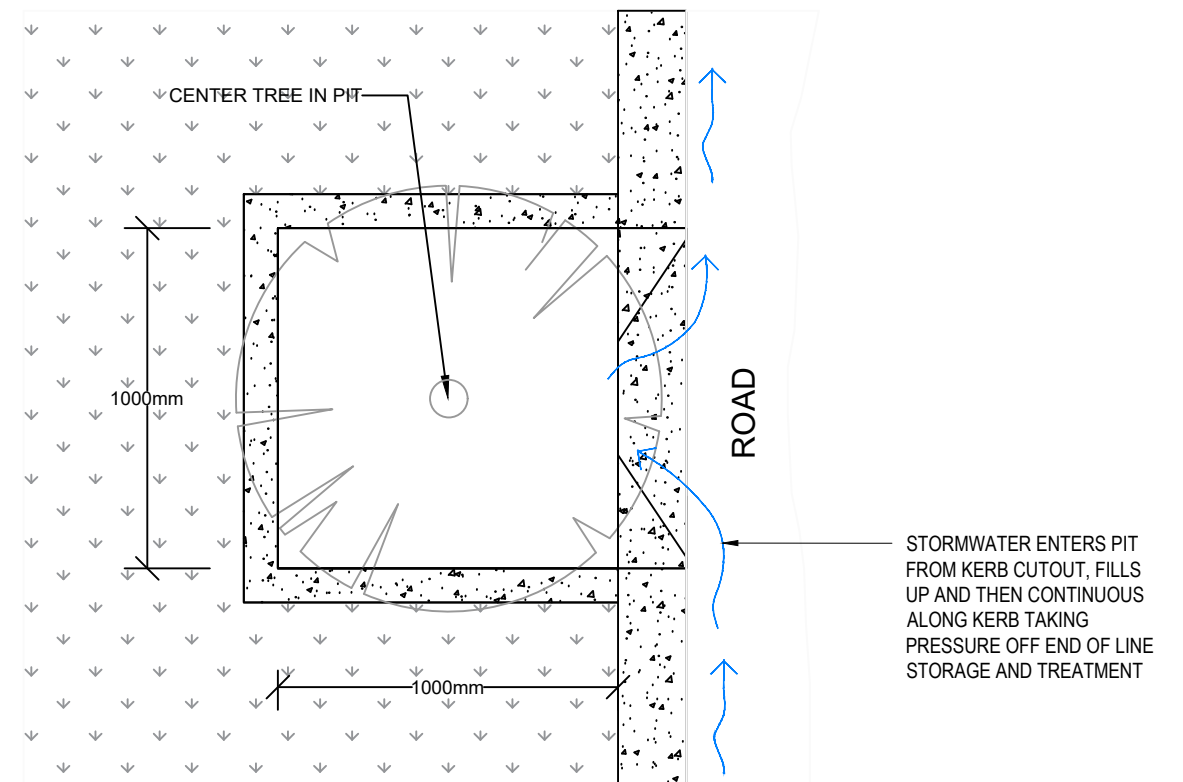
DD ROAD 2-5 - STREET TREE - TREE PITS -CROSS SECTION
SCALE 1:100



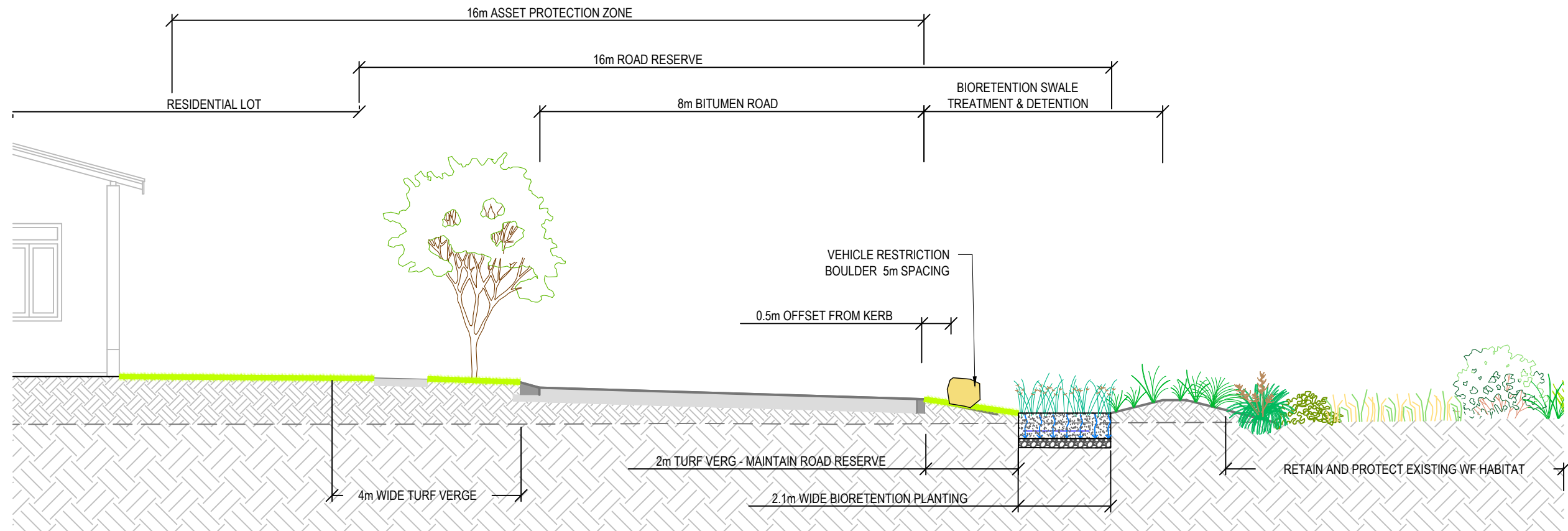
ROAD 2-5 - STREET TREE - TREE PITS - PLAN
SCALE 1:200



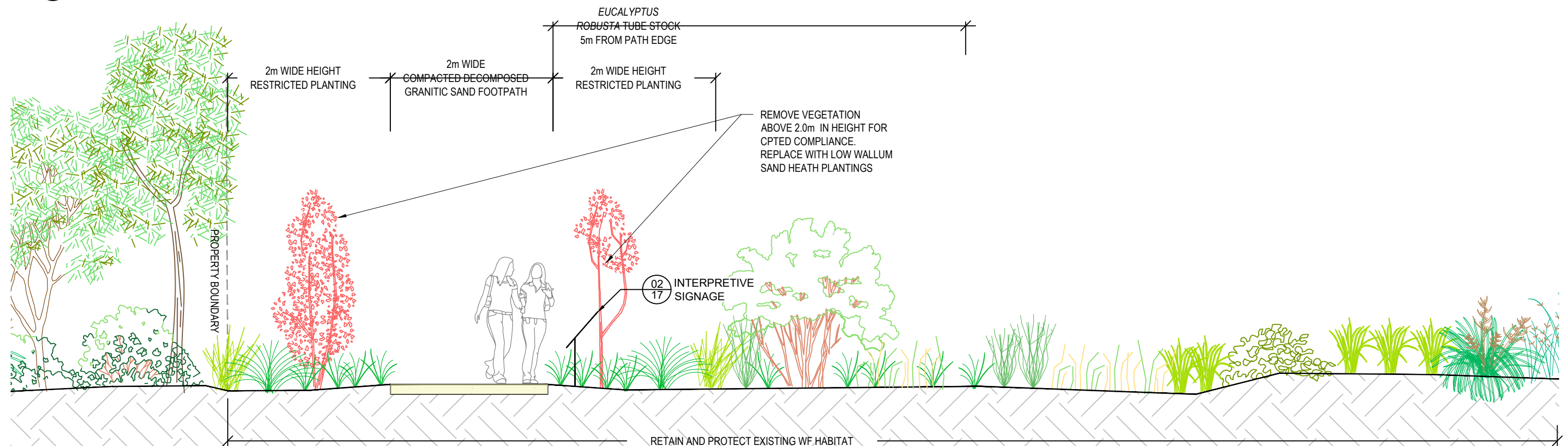
TREE PIT BIO POD - DETAIL CROSS SECTION
SCALE: NTS



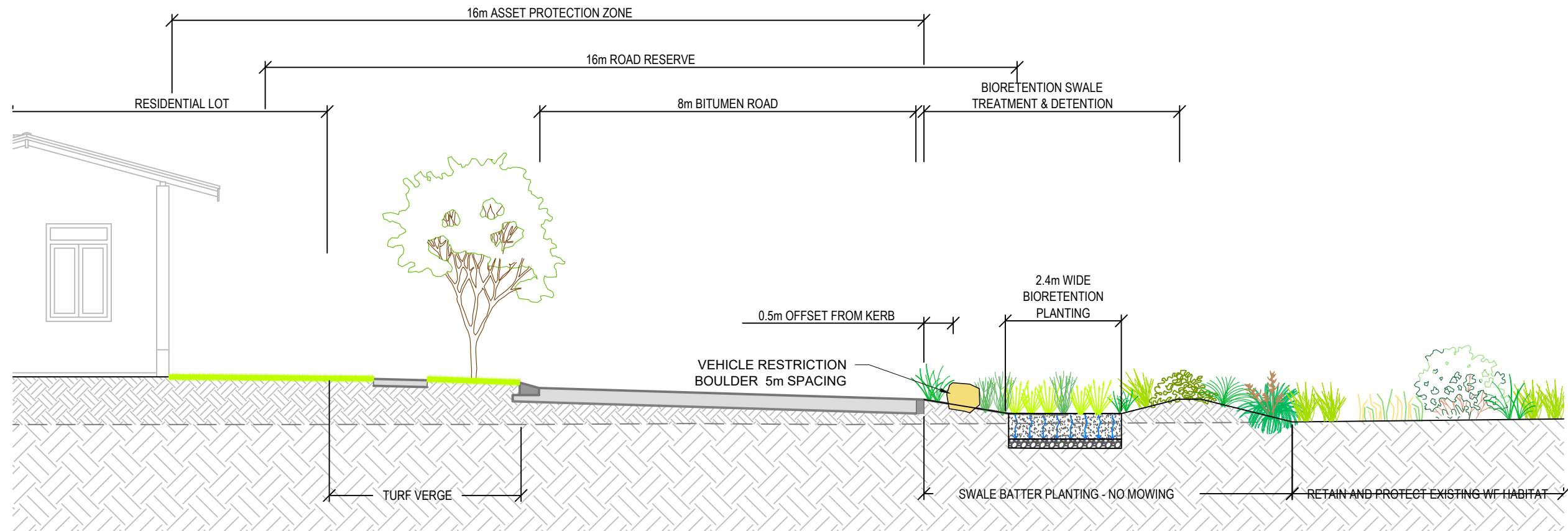
TREE PIT BIO POD - DETAIL PLAN
SCALE: NTS



EE ROAD 7 - 16m APZ - CROSS SECTION
SCALE 1:100



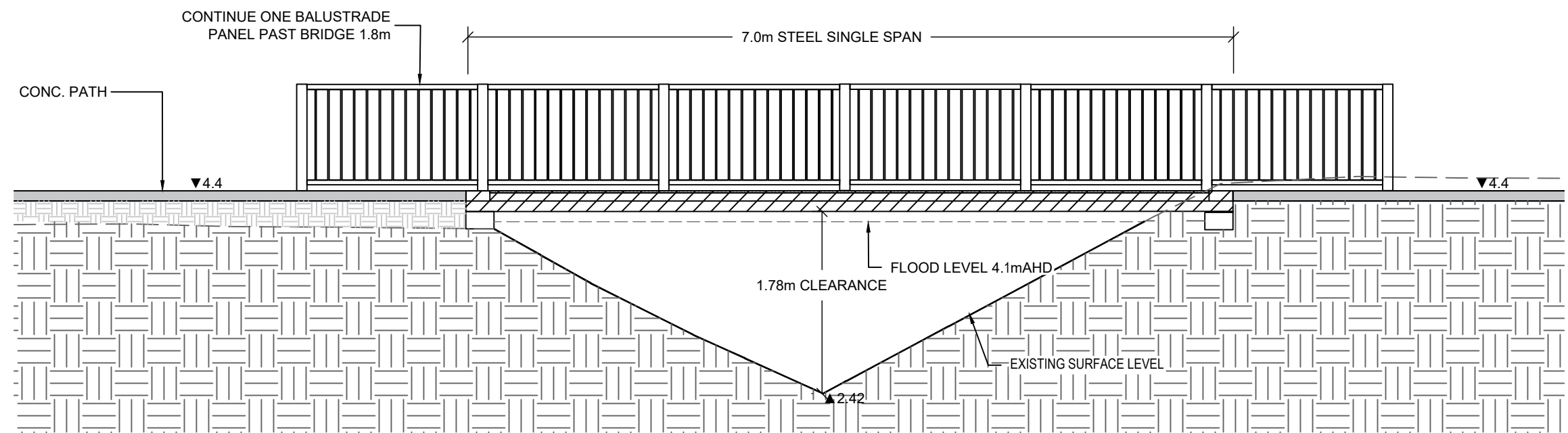
FF EAST WEST - PEDESTRIAN TRACK 2m WIDE
SCALE 1:100



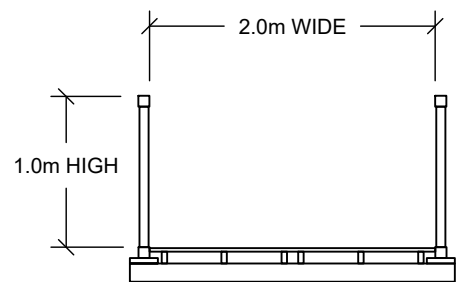
GG ROAD 2 - 16m APZ - CROSS SECTION
SCALE 1:100



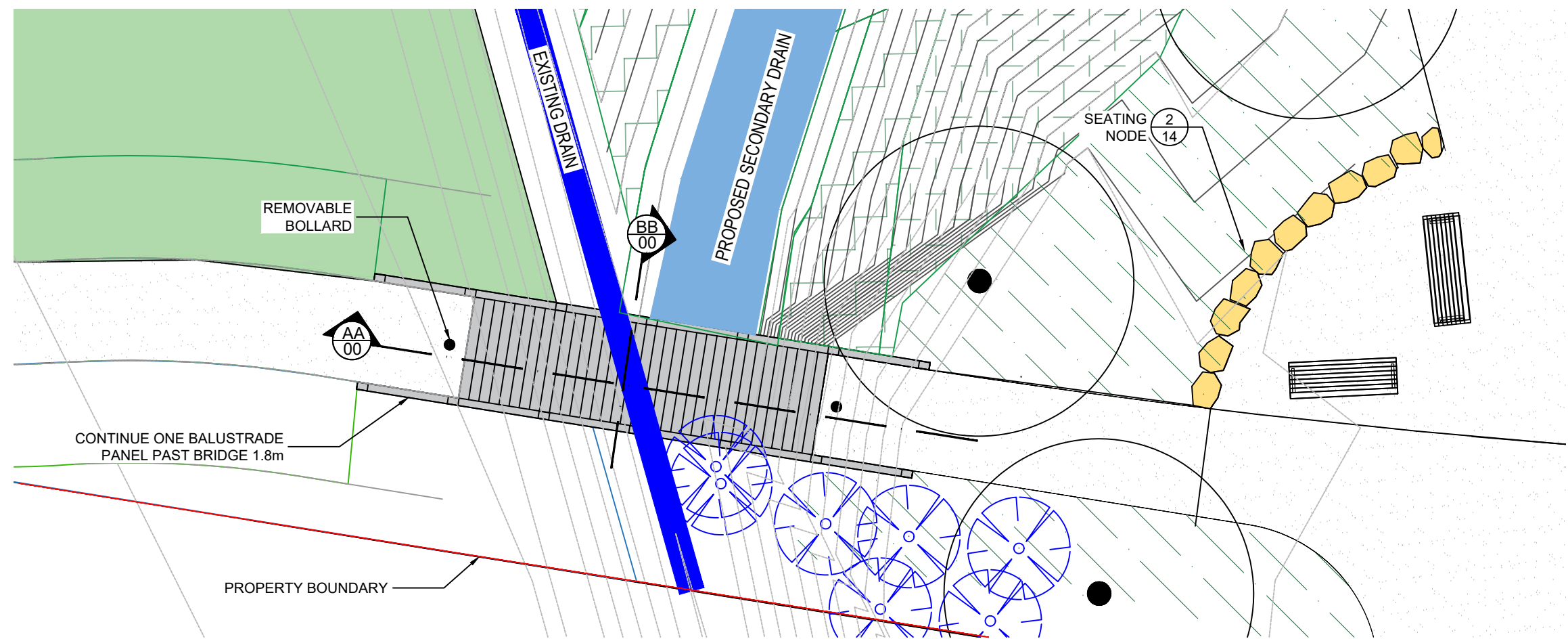
HH CREEK PEDESTRIAN TRACK - CROSS SECTION
SCALE 1:50



AA 13 PEDESTRIAN BRIDGE - ELEVATION
SCALE 1:50



BB 13 PEDESTRIAN BRIDGE - CROSS SECTION
SCALE 1:50



PEDESTRIAN BRIDGE - ELEVATION
SCALE 1:100



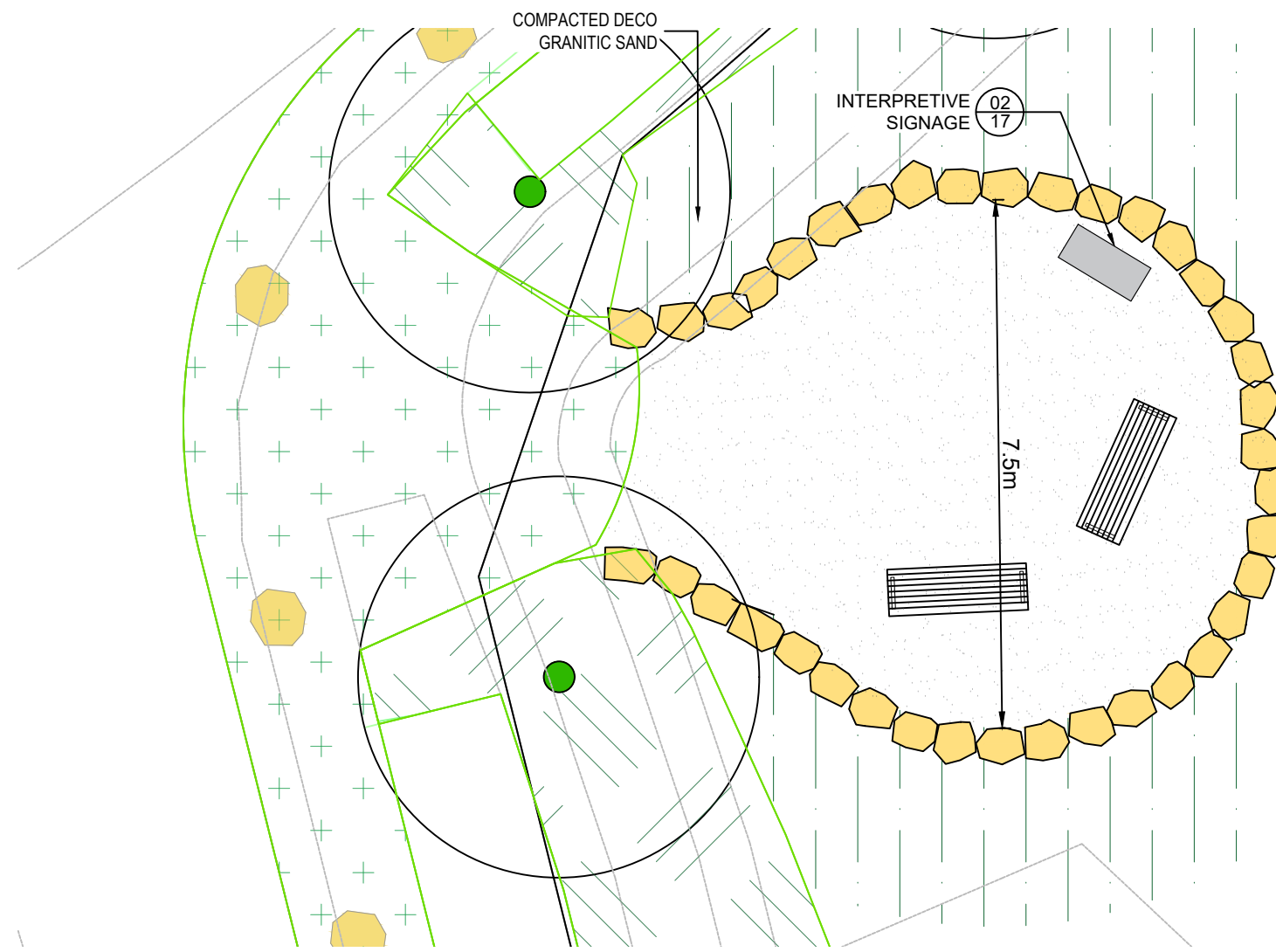
CONDAMINE BRIDGE - PRECEDENT IMAGE

- BRIDGE SPECIFICATION**
- CONDAMINE BY LANDMARK PRODUCTS PTY LTD
 - 2M WIDE 7M LONG
 - LOADING 3kPa (PEDESTRIAN USE ONLY)
 - FLAT SINGLE SPAN
 - POWDERCOATED DULUX 'SATIN BLACK'
 - COMPOSITE TIMBER DECKING

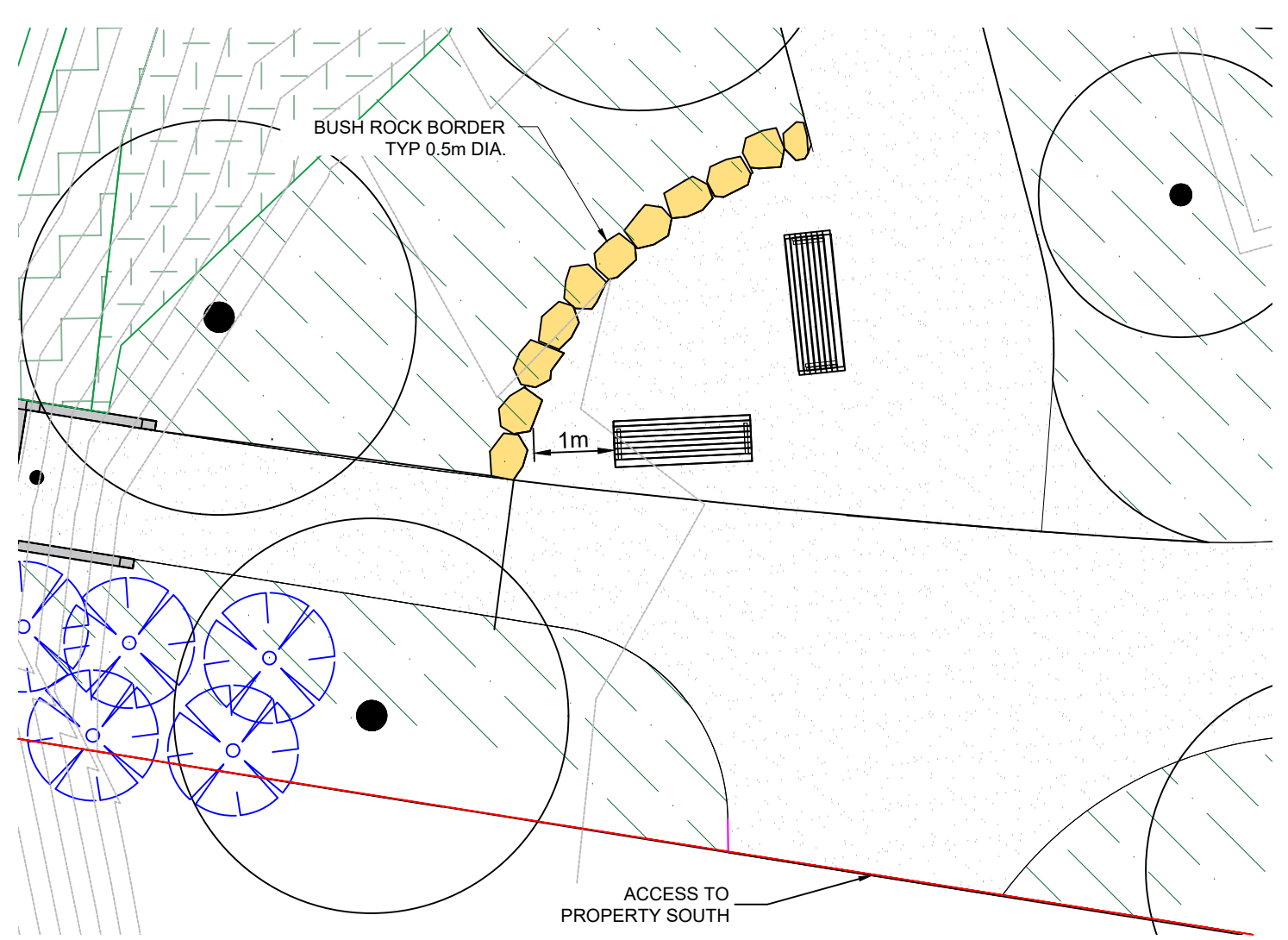
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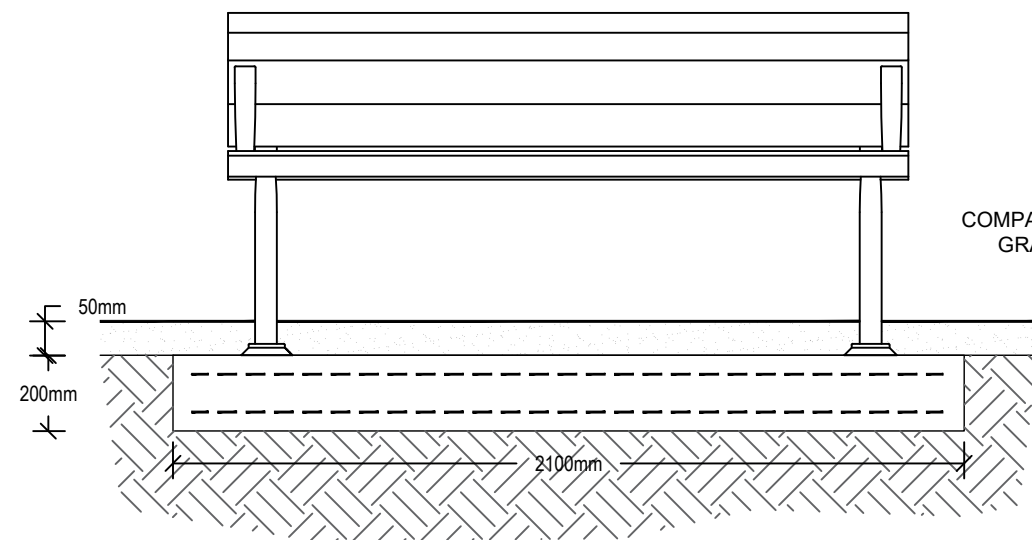
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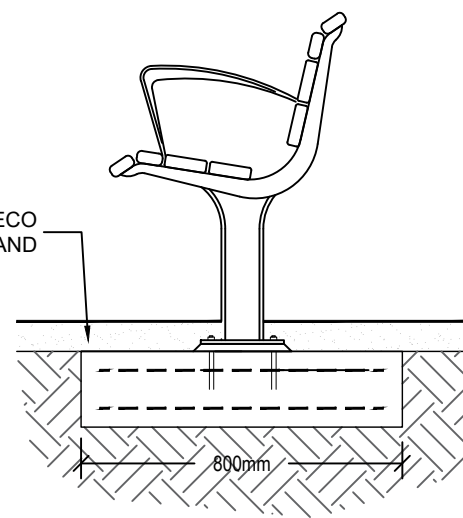
01 SEATING NODE #1
14 SCALE 1:100



02 SEATING NODE #2
14 SCALE 1:100



03 PARK SEAT - ELEVATION
14 SCALE 1:50



04 PARK SEAT - CROSS SECTION
14 SCALE 1:50

BENCH SEAT - PRECEDENT IMAGE

SEAT SPECIFICATION
 TYPE: 'COURTYARD SEAT' DDA VERSION, (520 HIGH)
 BATTERN TYPE: AUSTRALIAN HARDOOD TIMBER BATTERNS
 BATTERN FINISH: QUALITY OUTDOOR TIMBER OIL
 ARMREST: 2 X POWDERCOATED DULUX 'SATIN BLACK'
 LEG TYPE: FLANGE MOUNT (SUB SURFACE MOUNTED)
 FRAME FINISH: POWDERCOAT DULUX 'SATIN BLACK'



WALLUM FROGLET HABITAT PLANTING ZONE						
Scientific name	Common name	Type	Pot Size	Density/m ²	% Prop	QTY
<i>Baloskion pallens</i>	Bog Rush	G	Hiko	4	10	
<i>Baloskion tetraphyllum subsp. meiotachyum</i>	Plume Rush	G	Hiko	4	10	
<i>Baumea rubiginosa</i>	Slender twig rush	G	Hiko	4	10	
<i>Blechnum indicum</i>	Water Fern	G	Hiko	4	10	
<i>Callistemon pachyphyllus</i>	Wallum Bottlebrush	S	Tube	4	10	
<i>Gahnia clarkei</i>	Saw-sedge	G	Hiko	4	10	
<i>Boronia falcifolia</i>	Wallum Boronia	S	Hiko	4	10	
<i>Leptospermum liversidgei</i>	Wallum Tea-tree	S	Tube	4	10	
<i>Melastoma affine</i>	Blue-tongue	G	Hiko	4	10	
<i>Schoenus brevifolius</i>	Zig-zag bog rush	G	Hiko	4	10	
				TOTAL	100	
Distribution of plants should in clumps of 5-10 plants of the same species to ensure propagation can readily occur						
Shrubs to be planted top half of batter not on basin floor. Plant in clumps of 3 or 5						

WALLUM SAND HEATH - PLANTING ZONE - UPPER BATTER						
Scientific name	Common name	Type	Pot Size	Density/m ²	% Prop	QTY
<i>Baloskion tetraphyllum subsp. meiotachyum</i>	Plume Rush	S	Tube	2	30	
<i>Blechnum indicum</i>	Water Fern	S	Tube	4	30	
<i>Schoenus brevifolius</i>	Zig-zag bog rush	S T	Tube	4	40	
				TOTAL	100	

WALLUM SAND HEATH - PLANTING ZONE - TOE OF BATTER						
Scientific name	Common name	Type	Pot Size	Density/m ²	% Prop	QTY
<i>Baloskion tetraphyllum subsp. meiotachyum</i>	Plume Rush	G	Hiko	4	25	
<i>Baumea rubiginosa</i>	Twig-rush	G	Hiko	4	25	
<i>Baumea articulata</i>	Jointed Twig-rush	G	Hiko	4	25	
<i>Lepironia articulata</i>	Grey Rush	G	Hiko	4	25	
				TOTAL	100	

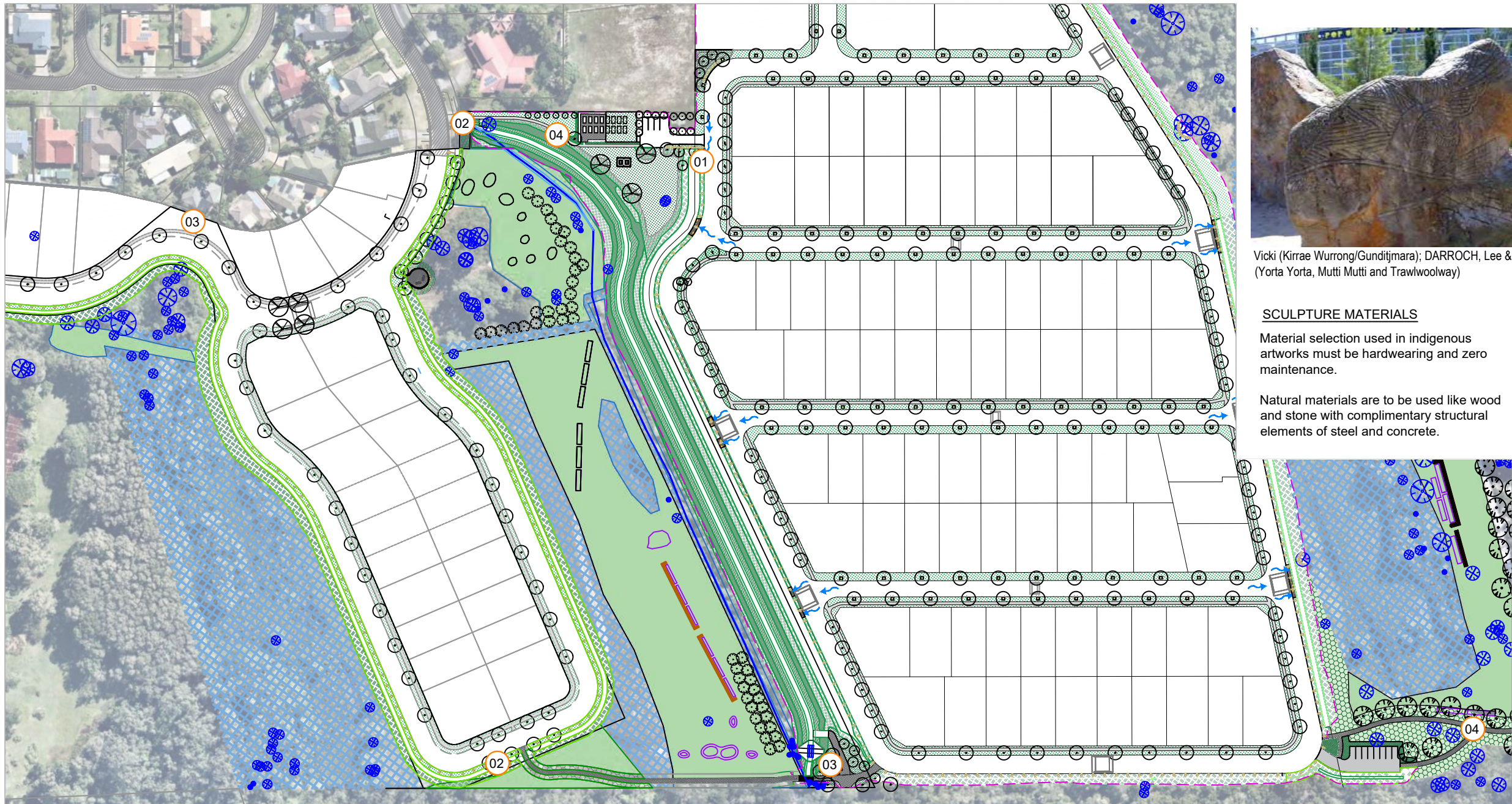
WALLUM SAND HEATH - DRAIN PLANTING ZONE - TOP OF BATTER						
Scientific name	Common name	Type	Pot Size	Density/m ²	% Prop	QTY
<i>Acacia ulicifolia</i>	Prickly Moses	S	Tube	4	3	
<i>Acacia suaveolens</i>	Sweet Wattle	S	Tube	4	3	
<i>Acronychia imperforata</i>	Beach Acronychia	S T	Tube	4	1	
<i>Allocasuarina littoralis</i>	Black She-oak	S	Tube	4	3	
<i>Aotus ericoides</i>	Golden Pea	S	Hiko	4	3	
<i>Aotus lanigera</i>	Hairy Aotus	S	Tube	4	3	
<i>Austromyrtus dulcis</i>	Midyim	S	Tube	4	4	
<i>Baeckea frutescens</i>	Weeping Baeckea	S	Tube	4	3	
<i>Banksia aemula</i>	Wallum Banksia	S	Tube	4	4	
<i>Banksia ericifolia subsp. ericifolia</i>	Heath-leaved Banksia	S	Tube	4	3	
<i>Banksia integrifolia subsp. Integrifolia</i>	Coast Banksia	S	Tube	4	3	
<i>Cupaniopsis anacardioides</i>	Tuckeroo	S T	Tube	4	1	
<i>Dianella caerulea</i>	Flax Lily	G	Hiko	4	20	
<i>Elaeocarpus reticulatus</i>	Blueberry Ash	S T	Tube	4	1	
<i>Gahnia clarkei</i>	Saw-sedge	G	Hiko	4	20	
<i>Leucopogon parviflorus</i>	Beard Heath	S	Tube	4	2	
<i>Leptospermum trinervium</i>	Slender Tea-tree	S T	Tube	4	1	
<i>Lomandra longifolia</i>	Mat-rush	G	Hiko	4	20	
<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	T	Tube	4	1	
<i>Persoonia stradbrokeensis</i>	Geebung	S T	Tube	4	1	
				TOTAL	100	
Tree species should be used sparingly and be spaced around 15m						

STREET TREE PLANTING						
Scientific name	Common name	CODE	Pot Size	Height m	Spread m	QTY
<i>Acmena hemilampra</i> *	Broad Leaf Lily Pilly	AHE	45L	4 - 6m	2 - 3m	
<i>Acronychia imperforata</i> *	Beach Acronychia	AIM	45L	5 - 8m	3 - 4m	
<i>Banksia integrifolia</i>	Coastal banksia	BIN	45L	4 - 15m	1-6m	
<i>Cupaniopsis anacardioides</i> *	Tuckeroo	CAN	45L	8 - 15m	3 - 5m	
<i>Callistemon viminalis</i>	Weeping Bottlebrush	CVI	45L	4 - 6m	3 - 4m	
<i>Elaeocarpus obovatus</i>	Blueberry Ash	ERE	45L	10 - 25m	4 - 10m	
<i>Flindersia bennettiana</i>	Bennetts Ash	FBE	45L	10 - 30m	10 - 15m	
<i>Lophostemon confertus</i>	Brush Box	LCO	45L	10 - 15m	5 - 15m	
<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	MQU	45L	8 - 25 m	5 - 10m	
<i>Tristaniopsis laurina</i> *	Water Gum	TLA	45L	6 - 12m	4 - 6m	
<i>Melicope elleryana</i> *	Pink Euodia	MEL	45L	6 - 10m	3 - 4m	
						TOTAL
*Fire retardant species to be planted within or near an APZ						

FIRE RETARDANT PLANTING ZONE						
Scientific name	Common name	Type	Pot Size	Density/m ²	% Prop	QTY
<i>Austromyrtus dulcis</i>	Midyim Berry	S	Hiko	6	5	
<i>Boronia falcifolia</i>	Wallum Boronia	S	Hiko	6	5	
<i>Dianella caerulea</i>	Flax Lily	G	Tube	6	40	
<i>Lomandra confertifolia</i>	Lomandra confertifolia	G	Tube	6	40	
<i>Melastoma affine</i>	Blue Tongue	S	Hiko	6	5	
<i>Westringia fruticosa</i>	Coastal Rosemary	S	Hiko	6	5	
				TOTAL	100	

BIO RETENTION PLANTING PLANTING ZONE						
Scientific name	Common name	Type	Pot Size	Density/m ²	% Prop	QTY
<i>Baloskion pallens</i>	Bog Rush	G	Hiko	8	11	
<i>Baloskion tetraphyllum subsp. meiotachyum</i>	Plume Rush	G	Hiko	8	11	
<i>Baumea rubiginosa</i>	Slender twig rush	G	Hiko	8	11	
<i>Blechnum indicum</i>	Water Fern	G	Hiko	8	11	
<i>Facinia nodosa</i>	Knobby club-sedge	G	Hiko	8	12	
<i>Gahnia clarkei</i>	Saw-sedge	G	Hiko	8	11	
<i>Imperata cylindrica</i>	Blady grass	G	Hiko	8	11	
<i>Lomandra longifolia</i>	Spiny-headed mat-rush	G	Hiko	8	11	
<i>Schoenus brevifolius</i>	Zig-zag bog rush	G	Hiko	8	11	
				TOTAL	100	
Distribution of plants should in clumps of 5-10 plants of the same species to ensure propagation can readily occur						

TURF					
Scientific name	Common name	G/m2	% Prop	Area	Total kg
<i>Cynodon dactylon</i>	Green Couch	10	100		
Turf to be hydro seeded, confirm g /m2 with manufacturer specification					



Vicki (Kirrae Wurrong/Gunditjmarra); DARROCH, Lee & Treahna (Yorta Yorta, Mutti Mutti and Trawlwoolway)

SCULPTURE MATERIALS

Material selection used in indigenous artworks must be hardwearing and zero maintenance.

Natural materials are to be used like wood and stone with complimentary structural elements of steel and concrete.

LEGEND

- EXISTING TREE TO BE RETAINED AND PROTECTED
- EUCALYPTUS ROBUSTA* KOALA FEED TREE
- ALLOCASUARINA LITTORALIS* COCKATOO FEED TREE
- EXISTING WF HABITAT
- OFFSET WF HABITAT AREA
- CONSTRUCTED WF POND
- BIORETENTION SWALE - NOT MOWN
- WALLUM SAND HEATH PLANTING

- 01 ENTRYWAY SCULPTURE**
Signifying to user they are within Wallum. Interface the road and parkland / community garden space.
- 02 WAYPOINT SCULPTURE**
Positioned at beginning of path. creating link with larger sculpture at park, leading people into Wallum.
- 03 FURNITURE SCULPTURE**
Positioned at beginning of path. Waypoint creating link with larger sculpture at park and theme throughout development.
- 04 GROUND SURFACE SCULPTURE**
Surface details stamped into concrete could be implemented at locations accompanying sculptures or alone on granitic sand tracks creating points of interest and strengthening visual theme of Wallum.



"Totem pole" by Darren Wighton



"Vertical Message" Sticks by Girralang (Carmel Taylor)



"Googar" by Darren Wighton



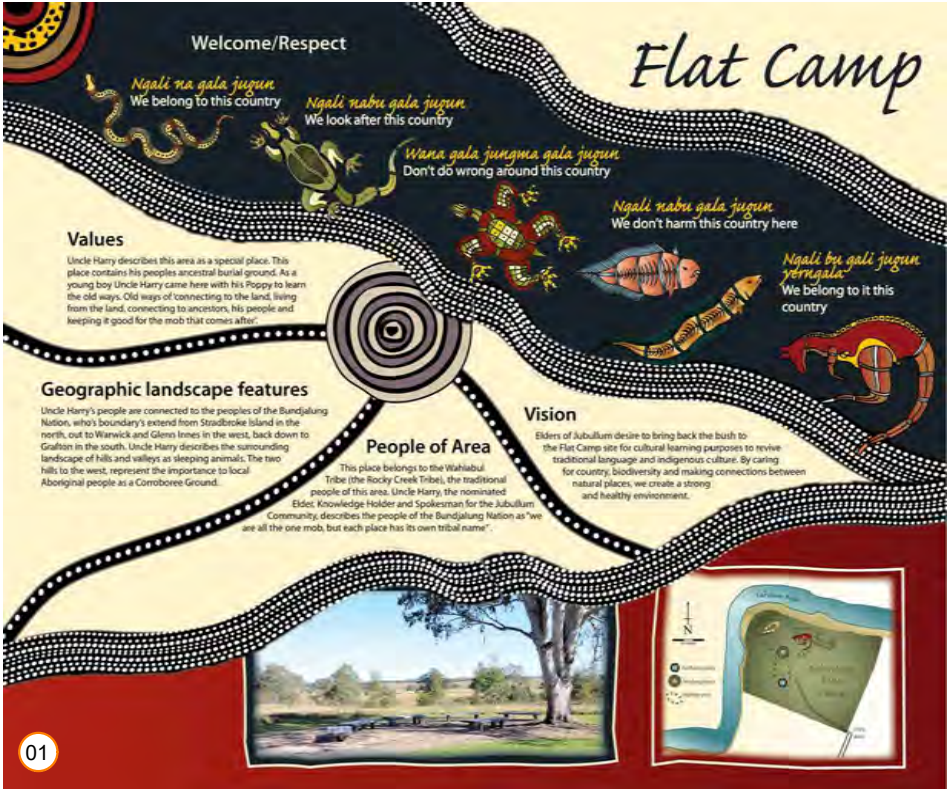
Vicki (Kirrae Wurrong/Gunditjmarra); DARROCH, Lee & Treahna (Yorta Yorta, Mutti Mutti and Trawlwoolway)

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INTERPRETIVE SIGNAGE

The signage will include information on the indigenous history and ecological values of the site and area, making reference to rehabilitation, habitat creation and fee trees where appropriate. Wallum heath flora and fauna



INDIGENOUS HISTORY

Interpretive signage for indigenous culture, could include topics like site importance, bush foods of the Wallum heath, proximately to Simpson creek and coast. Consultation with cultural authorities/knowledge holders will be undertaken in this process.



SIGNAGE MATERIALS

Material selection used in indigenous artworks must be hardwearing and zero maintenance. Natural materials are to be used like wood and stone with complimentary structural elements of steel and concrete.



LEGEND

	EXISTING TREE
	EUCALYPTUS ROBUSTA
	KOALA FEED TREE
	ALLOCASUARINA LITTORALIS
	COCKATOO FEED TREE
	EXISTING WF HABITAT
	OFFSET WF HABITAT AREA
	CONSTRUCTED WF POND
	BIORETENTION SWALE
	WALLUM SAND HEATH PLANTING



WALLUM HEATH ECOLOGICAL COMMUNITY
Content to include information on the flora and fauna that existing in this community and rehabilitation works undergone in this riparian zone



CONSTRUCTED WALLUM BREEDING PONDS
Positioned beside the constructed breeding ponds, this sign can explain the complex habitat required for the Wallum Froglet (Crinia tinnula) or Acid Froglet. Ground water expression and high PH levels



KOALA AND COCKATOO FEED TREES
Located along the path leading down to Simpson Creek. Signage to be installed explaining the plantings of Eucalyptus robusta for Koalas and Allocasuarina littoralis for Glossy Black Cockatoos

PRECEDENT SIGN

The Wallum Sand Heath Ecological Community could be split into. two panels. One describing the physical condition of the site, soil profile and groundwater connectivity, including sections and plans. The second containing a breakdown of flora and fauna and habitat.



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SIGNAGE NOTE:
Final sign locations, content and materials will be developed in detailed design phase. Consultation with cultural authorities/knowledge holders will be undertaken in this process.

Appendix C

Bayside Brunswick: Wallum Froglet Monitoring Pro-forma

Date	
Rainfall	(circle): nil/slight/moderate/heavy
Temp.	
Rel. humidity	
Recorder	

In-situ habitat monitoring (tick)	Created habitat monitoring (tick)
Management Area 2	Management Area 4
Management Area 3	

WATER QUALITY	
pH	
Temp.	
Conductivity	
Turbidity	
Depth (max)	

CALL PLAYBACK – <i>Crinia tinnula</i>	
Time start	
Time finish	
Results	

FROG RECORDS			
Species	Est. no.	Species	Est. no.
<i>Adelotus brevis</i>		<i>Litoria freycineti</i>	
<i>Crinia parinsignifera</i>		<i>Litoria olongburensis</i>	
<i>Crinia signifera</i>		<i>Litoria nasuta</i>	
<i>Crinia tinnula</i>		<i>Litoria peroni</i>	
<i>Limnodynastes dumerilii</i>		<i>Litoria tyleri</i>	
<i>Limnodynastes peroni</i>		<i>Rhinella marina</i> *	
<i>Limnodynastes tasmaniensis</i>			
<i>Litoria fallax</i>			

Notes/observations:

Weeds:

Condition:

Hydrology:



Leading environmental solutions...

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