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19 September 2024

Michael Smith and Associates
1st Floor, 407 Whitehorse Road, Balwyn, Victoria 3103.

Our Ref: **23-0117**
Re: **Woolamai to Nyora Rail Trail Feasibility Study – Civil Engineering**

OPS Engineers has been engaged to conduct a site review and prepare a civil engineering feasibility report for the proposed Woolamai to Nyora Rail Trail project.

Several site visits of the Woolamai to Nyora former railway formation were carried out by this office in June and July 2024 to determine the feasibility of using the former railway formation as a rail trail.

Key points of the study

From a site assessment of the crown land reserve accessed through 25 private properties, review of drone footage and available survey data, from a civil engineering perspective:

- The existing rail formation appears to be generally suitable for re-use. Predominately the existing former railway formation is low lying or level with the surrounding natural ground, requiring some earthworks to build formation levels back up with regular installation of drainage culverts and re-shaping of open drains to accommodate overland flow paths for surface water.
- The original earthworks constructed for the railway link between Nyora and Woolamai appear to have been of a good standard to support the original railway design loadings and may reasonably be expected to require little additional compaction work (subject to future geotechnical investigation and advice).
- In areas where the formation remains at a high level it will generally require minimal additional earthworks to convert for shared use.
- In the areas where the crown land reserve is flat and low lying, additional drainage and earthworks will be required to raise the proposed trail level and enable surface water to cross at the base of the formation (refer to the landscape architect's plans for identification of these areas).
- Refer to separate specialist bridge engineering report by others for advice on the re-use or replacement of existing bridge structures.

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Introduction

The existing Crown land reserve extends along the low-lying farmland in the valley between Nyora and Woolamai, generally following the Bass River, and is approximately 25 kilometres in length.

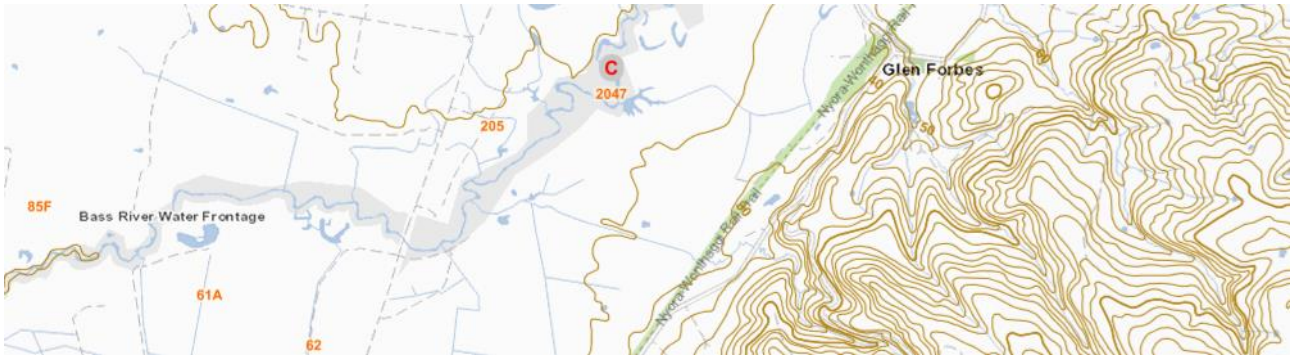

Figure 1 – typical topology of the rail route showing the hills to the east and the low plains where the rail formation is located. (trail in green, with the Bass River to the west).

The railway was originally used for both passenger and freight transport to link Wonthaggi to Nyora. With closure of this railway route, the rails, timber sleepers and ballast along most of the length were removed with the earth formation left in place. Currently, the Crown land reserve is predominately used for farm access and grazing.

In most areas the formation is low lying (i.e. current top of formation is no greater than 500 millimeters above surrounding ground level), in other areas it has been built up well above above surrounding ground level. Along the approximately 25 kilometre length are several major waterway crossings and many smaller drainage culverts. There are also three short cuttings through low hills along the route.

On examination of the rail formation there is evidence of crushed rock at the surface, and from a limited visual inspection, the formation generally appeared to be solid underfoot with few areas of erosion or settlement evident.

This civil engineering feasibility study will examine the current condition of the rail alignment and develop an overview of the necessary civil engineering and stormwater drainage works required to enable the existing rail formation to be converted to a shared cycling, walking and horse-riding trail.

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Civil Engineering Considerations

The height and condition of the rail formation, and the topology of the local area vary significantly along the route and have been broken up into 14 plans by Michael Smith and Associates. The main engineering aspects for consideration are:

Earthworks

Feasibility Assessment

Review the condition of the former railway formation along the route and consider the likely additional earthworks required to provide a suitable surface with regard to compaction, durability, intended width, surface grading and levelling. For any future detailed design, comprehensive geotechnical investigation and reporting will be required regularly along the route and will be necessary at all locations of proposed structures.

Areas of low lying or non-existent formations:

Where the formation is less than 500mm above natural ground level, the construction process will likely involve stripping the topsoil, grass and organic material, proof rolling to confirm compaction of existing formation is adequate and building up a new formation according to the typical detail attached to this report (refer Figure 2).

Areas of high formation:

Where the formation is higher than 500mm and above any local flood risk, the construction process will likely be to strip the topsoil and organic material, proof roll and then construct the finishing pavement layers according to the typical cross section detail attached to this report (refer Figure 4).

Areas through a cutting:

Where the Crown land reserve cuts through a low hill, the Crown land reserve will require the same re-profile and building up of the low-lying sections, with associated longitudinal grading to either side of the trail's formation for drainage.

Drainage

Feasibility Assessment

Assess the existing drainage on and around the Crown land reserve for condition and suitability for ongoing use and where required propose additional drainage works. For any future detailed design stage, feature and level survey information and hydrological modelling will be required to confirm the proposed levels of the formation in low lying areas, and to provide guidance on the likely size and extent of drainage works. It is noted that Melbourne Water are the Catchment Management Authority. It is understood that Melbourne Water have previously provided advice to several property owners who have large farms that cross the Crown land rail reserve.

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Future Design Response

Areas where existing drainage is adequate in size:

Inspect for condition and clean the culverts, clean the surrounding drainage connections (generally open vee-shaped drains) and construct new reinforced concrete wing walls and aprons in accordance with Melbourne Water and Council standard requirements (refer IDM detail 50497 attached to this report for an example).

Areas where existing drainage is not adequate in size:

Where the proposed trail is located in localised low-lying areas and particularly in flood prone sections, there will be a requirement to add further regular drainage crossings. Refer to the typical detail attached to this report (Figure 3). The spacing of these crossings would need to be finalized in any future detailed design stage, in accordance with hydrological modelling and survey data. It was noted during the tour of the general area with local council and Melbourne Water representatives that Melbourne Water will require concrete box culverts in preference to pipes, and that all culverts should have aprons and wing walls, consistent with Melbourne Water's standard design details.

Areas where existing drainage is not adequate in size:

Where the trail crosses a larger waterway such as at a roadside drain, a larger culvert will be required, specified and constructed in accordance with Melbourne Water requirements and based on hydrological modelling in flood prone areas.

Structures

Feasibility Assessment

The assessment of the existing bridge structures has been undertaken by an independent Structural Engineer specialising in timber bridges, so will not be detailed in this report.

Design Response

The size and potential cost of each crossing is such that a specific detailed design will be required for each crossing, with some general commentary provided.

Typical design loading requirements

The anticipated use of the trail would range from pedestrians, cyclists, horses, light ATV maintenance access and infrequent light vehicles (e.g. 4WD utility of approximately 2.5 tonnes) for maintenance. If light vehicles are used for maintenance, consideration should be given to the width of the trail and the width of a typical light vehicle wheel track.

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Engineering Summary of Each Section of Trail

Refer to the landscape architect's drawings for sheet references referred to below.

Sheet L1 – Woolamai Racecourse

Trail type	Low/Non-existent former railway formation (refer typical detail)
Terrain	Flat paddocks, very slight fall to the west.
Earthworks	Formation requires building up to the standard low-profile detail.
Drainage	Roadside table drain runs through an existing concrete pipe which is inadequate and will need to be replaced with a box culvert crossing in accordance with Melbourne Water standard details. Slight fall east to west with existing drains crossing trail to be inspected, cleaned and improved. Existing 3 x 750mm diameter pipes with minimal cover. Existing 2 x 450mm diameter pipes with minimal cover. Existing 3 x 750mm diameter pipes with minimal cover. Low lying formation will require regular drainage box culverts.
Structures	nil

Sheet L2 – North of McKay Road

Trail type	Low / Non-existent former railway formation.
Terrain	Flat, paddocks, very slight fall to west.
Earthworks	Formation requires building up to the standard low-profile detail.
Drainage	Existing ground drains generally from east to west. Existing Blue Mountain Creek crossing, unable to access for review. With reference to drone footage, a new culvert crossing is likely to be required.
Structures	nil

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Sheet L3 – Eden Road

Trail type	Low/Non-existent formation.
Terrain	Open paddocks, slightly undulating, falling to the west noticeably.
Earthworks	Formation requires building up to the standard low-profile detail.
Drainage	South of Eden Road: No existing culverts found on site. Low trail formation will require cross drainage at the base of the formation. North of Eden Road: existing culvert with 3 x 600mm pipes which requires improvement works. Road drainage runs to the west side of the road and between the road and formation. There was no culvert crossing of the Crown land reserve in this location and accounts from property owners in this section indicate a flood issue in wet weather, supporting regular, close spacing of new drainage box culverts at the base of the new formation.
Structures	nil

Sheet L4 – Gorge Creek

Trail type	Low/Non-existent former railway formation.
Terrain	Open paddocks, slightly undulating, falling to the west.
Earthworks	Former railway formation requires building up to the standard low-profile detail.
Drainage	Low former railway formation will require cross drainage.
Structures	Existing former railway brick bridge abutments with steel beams remaining in place. Possible re-use of abutments and beams will require future detailed investigation and design. A limited visual inspection indicates good possibility of re-use with no obvious settlement, no excessive erosion around footings, and steel only lightly corroded. A short area of the former railway in cut will need to be re-constructed to match grades, with some farm waste to be removed at cutting location. A section of former railway at the junction of Eden Road and Dalyston-Glen Forbes Road appears to have been under cultivation and will therefore possibly require a deeper build-up to reconstruct.

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Sheet L5 – Glen Forbes

Trail type	Low/Non-existent former railway formation.
Terrain	Open paddocks, very flat open ground. At 190 Almurta Glen Forbes Road the former railway formation is low lying and can seasonally flood with minimal cross or longitudinal fall to enable drainage. Subject to future hydrological study and consultation with stakeholders, this portion of former railway formation may need to be raised with additional culverts provided to reduce the risk of damage.
Earthworks	Former railway formation requires building up to the standard low-profile detail. The former railway formation within the farm at 190 Almurta-Glen Forbes Road retains sleepers, ties and ballast for approximately 550m of the former railway and requires removal prior to earthworks being undertaken. As the former railway progresses to the north end of the property at190 Almurta-Glen Forbes Road, the natural ground level becomes lower and more prone to flooding seasonally. From local account this is not uncommon in wet years. This area will require further hydrological study to determine a suitable final level of the trail. Although reviewed in a relatively dry season, the former railway formation appeared to be solid and stable with no evidence of erosion or soft areas.
Drainage	The low former railway formation will require cross drainage and re-grading of longitudinal open drains. Two existing culverts that will require upgrading for proposed trail use at property at 200 Almurta Glen Forbes Road. One existing culvert that will require upgrading for proposed trail use at property at 190 Almurta Glen Forbes Road. For the northern end of this sheet, the former railway formation drainage will require careful planning to ensure longitudinal and cross formation drainage are adequate.
Structures	There are two structures on this sheet: Glen Forbes Timber Bridge: Refer to specialist Structural Engineer's commentary for analysis. There is a possible option to re-use adjacent brick abutments which appear to be in a sound condition from a limited visual review on site. No steel beams remain in place. It may be possible to re-build this bridge with provision of prefabricated steel bridge beams or trusses that can be craned into place, then connected and finished on site. If to remain, the existing timber trestle bridge may need works to ensure safety of proposed trail users. A new bridge is required to cross a natural creek and gully at the property at 200 Almurta Glen Forbes Road with the former railway bridge completely removed.

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	Recommend consideration of a 3-4 span steel truss or flat deck bridge with concrete piers or driven piles located out of the main stream to prevent flow restriction, with an approximate combined span of 35m. An alternative may be to construct a multi-cell box culvert and ramp the proposed trail down to the crossing. Acceptable crossing types would be subject to future detailed design, consultation with Melbourne Water and other stakeholders.

Sheet L6 – Almurta (Tennant Creek Crossing)

Trail type	Low/Non-existent former railway formation.
Terrain	Open paddocks, low lying flat ground. The Crown land reserve widens at the old station platform location immediately south of Grantville-Glen Alvie Road.
Earthworks	The former railway formation requires building up to the standard low-profile detail. There will be additional earthworks required to match into a new crossing point for Tennant Creek. Subject to a comprehensive hydrological study and consultation with stakeholders, the southern portion of the proposed trail on this sheet may need to be raised with additional concrete box culverts constructed. Immediately north of the Grantville – Glen Alvie Road crossing a substantial amount of earthworks will be required due to the elevation of the road above the adjacent paddocks. The proposed formation would need to accommodate DDA compliant gradients close to the interface of the proposed trail and the existing road profile. The former railway formation at the northern end was partly inaccessible due to overgrowth but appears to be commonly inundated during rainfall, which may require full former railway formation re-construction for approximately 100 lineal metres.
Drainage	South of Tennant Creek: Low former railway formation that requires cross drainage and re-grading of longitudinal open drains. For the southern end of this sheet, former railway formation drainage will require careful planning based on a comprehensive hydrological study to ensure longitudinal and cross drainage are adequate. North of Tennant Creek the former railway formation is low and will require building up. North of Grantville – Glen Alvie Road - Low lying former railway formation will require cross drainage and re-grading of longitudinal open drains and is indicated as a flood prone area. There are five existing cross trail culverts which will require upgrade works, and at the northern end of the sheet an additional major box culvert structure will likely be required.

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	The former railway formation at the northern end is partly inaccessible but appears to be commonly inundated during rainfall, which may require full re-construction for approximately 100 lineal metres.
Structures	Tennant Creek Bridge crossing - Refer to specialist Structural Engineer's commentary for analysis. Tennant Creek flows are downstream of Candowie Reservoir. The existing timber trestle bridge may not be suitable for re-use; however, the Crown land reserve is wide enough to offer flexibility in the location of a crossing point for a new bridge or a boardwalk type structure close to the road, enabling retention of the existing bridge. Subject to further investigation, box culverts or a multi-span bridge over the creek may be suitable. The adjacent road crossing over the creek currently uses a corrugated steel culvert structure.

Sheet L7 – Kernot

Trail type	Low/Non-existent former railway formation (southern half of the sheet) with part high formation leading into the township of Kernot. Through the more densely vegetated area, the trail is partly in a cutting.
Terrain	Open farmland with former railway line running in a mature tree lined Crown land reserve. Predominate gradient is from east to west, towards the Bass River.
Earthworks	Former railway formation requires building up to the standard low-profile detail for low lying trail areas. Where the former railway is already built up, the standard high formation detailing should be followed. There will be significant earthworks required at 16B Campbell Road, Kernot to accommodate a proposed grade separation including approximately 60 lineal metres across the trail to build up and grade back down in the farmland with raising the existing farm access road by approximately one metre; subject to future detailed design and a feature and levels survey. Where the former railway diversion is proposed in Kernot to use an existing timber decked road bridge on Schier Road, there will be a requirement for earthworks to provide engineered fill to level and stabilize the natural soil beside the road for a significant length both north and south of the bridge.
Drainage	Low former railway formation that will require cross drainage and re-grading of longitudinal open drains in accordance with typical details.

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	High level former railway formation has some existing areas which will require maintenance and re-shaping. An existing 16B Campbell Road Kernot drainage pipe which had become constricted by existing trees will require duplication in a more suitable area nearby. For the proposed re-routing of the proposed trail onto Schier Road there will be a requirement for concrete box culverts where crossing existing table drains beside Schier road.
Structures	There is an existing farm crossing at 16B Campbell Road Kernot that will require a grade separation constructed to enable proposed trail users to pass under. This may be best achieved with large concrete box culverts. There will be some associated earthworks to re-work the grade of the farm access road. At Kernot township, the existing rail bridge over a Bass River tributary is proposed to be bypassed by diverting the trail around onto Schier Road and using the existing timber decked road bridge. From an engineering perspective, there appears to be no issue with this, however the deck timbers would need to be upgraded to prevent hazard to bicycle riders from longitudinal gaps.

Sheet L8 – Wattle Creek / Gaws Road

Trail type	Part low height former railway formation to the south at Kernot / Part high former railway formation to the north, which then merges back down to a low height former railway formation towards Wattle Creek.
Terrain	The Crown land reserve runs through overgrown bush from Kernot, giving way to open paddocks with slight longitudinal falls. On the north side of Wattle Creek, there is a cutting, with the trail then rising back to a high former railway formation.
Earthworks	The former railway formation requires building up to the standard low-profile detail for low lying trail areas. Where the trail is high, the standard high former railway formation detailing should be followed.
Drainage	The low former railway formation will require cross drainage and re-grading of longitudinal open drainage channels in accordance with typical details. The former railway high level formation has some existing areas which will require maintenance and re-shaping. The existing drainage culvert to the south will require upgrading per typical details. (unable to access) Existing drainage culvert at the centre of sheet will require upgrading (not accessed).

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	The existing two 750 diameter pipes under the existing railway formation will require upgrading. The area of former railway formation through the cutting appears to have adequate longitudinal fall to ensure adequate drainage.
Structures	Wattle Creek Bridge – refer to Structural Engineer's report for recommendation. There is an existing 15m concrete bridge at the north end of sheet – refer to specialist engineer's report for recommendation. Currently used by farm machinery regularly.

Sheet L9 – Wattle Creek North

Trail type	Low/Non-existent former railway formation.
Terrain	Open paddocks with minor drains crossing former railway formation.
Earthworks	Former railway formation requires building up to the standard low-profile detail for low lying trail areas.
Drainage	Existing former railway drainage relies on pipe culverts and tributaries running west to the Bass River. Standard low-lying drainage is recommended in all areas where there is no longitudinal drainage.
Structures	An existing 12 metre span former railway concrete bridge is in a state of collapse and would require bridge replacement or duplication with a large multi cell box culvert structure. Refer to Structural Bridge Engineer's recommendations on the bridge structure.

Sheet L10 – Woodleigh-St. Helier Road

Trail type	Low/Non-existent former railway formation.
Terrain	Open paddocks with minor drains crossing former railway formation. At the southern part of the former railway formation the Crown land reserve widens at the former Woodleigh Railway Station. Some precast concrete retaining wall columns remain.
Earthworks	The former railway formation requires building up to the standard low-profile detail for low lying former railway formation areas.

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	For the Crown land reserve adjacent to 20 Makeham Road, the former railway formation appears to be very low and will therefore require building up from the natural ground level for an estimated 500 lineal metres. There is a new longitudinal farm drain cut in the Crown land reserve for part of this length. At the northern end adjacent to 20 Makeham Road the Crown land reserve falls east to west. Trail drainage should be re-constructed of the former railway formation, directing water to existing paddock drainage.
Drainage	At the southern end of the sheet, the existing 2 x 1050-millimetre diameter pipes will require improvement works. If a car park is to be constructed in this vicinity, the existing culvert would require extending to direct water away from this area (falls permitting). A large concrete box culvert will be required immediately north of the existing platform area to maintain the existing drainage crossing the former railway formation. A large box culvert structure will be required to the northern end of the sheet in the existing paddock drainage line.
Structures	nil

Sheet L11 – Makeham Road North

Trail type	A high former railway formation running up to Makeham Road, leading to an equal mix of high- and low-level former railway formation through 215 Loch Kernot Road, and a low/ non-existing former railway formation through the property immediately south of Dilger Road, where the Crown land reserve has significant re-growth of vegetation. Immediately north of Dilger Road, the former railway formation runs through a cutting.
Terrain	Open paddocks with minor drains crossing former railway formation.
Earthworks	The former railway formation requires building up to the standard low-profile detail for low lying former railway formation areas. Where the former railway formation is high, the standard high formation detailing should be followed. Some re-grading and lifting of levels will be required to match into the existing road crossing at Dilger Road. Some re-grading of current levels will be required where the proposed trail is to run through the cutting to ensure the proposed trail formation has cross drainage along the length of the existing cutting.
Drainage	At Makeham Road, the former railway will require a large concrete box culvert to cross the open drain to the northern side of the road.

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	Within the property at 215 Loch-Kernot Road, there are two existing open drains crossing the former railway formation that will require large concrete box culvert crossings. To the Crown land reserve area immediately south of Dilger Road, the former railway formation will require low level, regular cross drainage due to the low-lying flat ground. Immediately north of Dilger Road, the drainage is poor, and some grading and low concrete box culverts will be required to ensure the trail remains serviceable in wet periods.
Structures	No major structures.

Sheet L12 – South Gippsland Highway

Trail type	Low lying former railway formation, entering a short cutting, then returning to a low former railway formation, through a generally open area of farmland.
Terrain	Immediately north of Dilger Road terrain is low lying before entering a short section of cutting through a small hill. The former railway formation transitions to a high level before crossing an existing timber trestle bridge. Refer to specialist bridge engineer report for assessment of this structure. North of the existing timber trestle bridge, the former railway formation is low lying, before meeting South Gippsland Highway. North of the South Gippsland Highway the former railway formation is low height through low lying farmland, close to the existing grade of surrounding paddocks.
Earthworks	The former railway formation requires building up to the standard low-profile detail for low lying proposed trail areas. Through the cutting area, the former railway formation will require re-grading for cross fall and building up consistent with the typical detailing for a formation in a cutting. Minimal earthworks are expected to be required where the former railway formation is at a high-level north of the cutting. In proximity to the existing timber bridge and creek crossing, there will be a need for re-grading to ramp down to a new crossing if using a box culvert structure below the existing levels of approach. Any future detailed engineering design would need to

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	examine levels to determine the extent of all required earthworks associated with this crossing including the extent of batters and excavation in the creek. The former railway formation requires building up to the standard low-profile detail for low lying trail areas north of the highway crossing through flat farmland.
Drainage	The standard low-lying former railway formation drainage will be required south of the cutting, next to Dilger Road, with extension to cross under Dilger road and continue the natural drainage southwards along the proposed trial. North of Dilger Road, there is an existing pipe culvert approximately halfway between the cutting and the bridge. This culvert will need inspection, cleaning out and upgrading. Subject to future hydrological advice, there may be a requirement for additional culverts at this location. North of the existing timber bridge, drainage consistent with the typical low formation detailing will be required. Standard low-lying former railway formation drainage will be required north of the highway crossing, as well as cleaning and upgrading work to the existing pipe culverts (several sets of concrete pipes along this length that will require further work including wing walls and aprons).
Structures	Refer to specialist Structural Engineering advice for commentary on the existing timber trestle bridge over the small creek south of South Gippsland Highway. It is recommended that cattle are excluded from accessing the base of the existing bridge columns. If required, an alternative structure may consist of either a series of box culverts with earth built up above to match existing formation level, or a duplication of the existing bridge with a multiple span steel or timber bridge adjacent to the existing. If replacing the existing bridge, further significant investigation would be required before a bridge design is determined, including a hydrological study, geotechnical investigation, council input, Melbourne Water's requirements, heritage / cultural heritage and ecological assessment. For a crossing of the South Gippsland Highway, the most economical structure may consist of a long precast concrete box culvert structure installed below the highway level. This would entail ramping levels down for approximately seventy metres on each side of the highway, and associated drainage/ pumping works, with retaining walls and earthworks at the ramps. Any future detailed design and consultation would require further investigation to determine the suitability of this solution. Other options considered are to provide a large bridge over the highway (with associated ramping-up) or diverting to the township of Loch which would require diverting the trial to the east and acquiring land.

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Sheet L13 – Bass River crossing

Trail type	Low former railway formation at the southern end of the sheet, which transitions to a high former railway formation for the northern end after the Bass River Bridge crossing.
Terrain	Low lying, flat open paddocks to both the north and south sides of the Bass River with vegetation around the river area.
Earthworks	The former railway formation requires building up to the standard low-profile detail for low lying former railway formation sections. Where the former railway formation is at a high level, the standard high railway formation detailing should be followed.
Drainage	The low-lying former rail formation will require cross drainage and re-grading of longitudinal open drainage channels in accordance with typical details. High former rail formation sections have longitudinal falls which grade towards existing drainage channels.
Structures	There are two structures on this sheet: An existing bridge over Bass River consisting of multiple spans of steel beams on concrete piers. Refer to specialist engineer's commentary for possible re-use of this bridge, and associated improvement works required. An existing seventeen metre, low level multiple span concrete and steel bridge currently used by farm vehicles over a drainage line. Refer to specialist engineer's commentary for possible re-use of this bridge.

Sheet L14 – Berry's Road

Trail type	High level former railway formation, which runs into a cutting and then becomes a low-lying formation before meeting the existing Great Southern Rail Trail.
Terrain	Undulating paddocks, the former railway formation is elevated for much of this sheet.
Earthworks	Standard high former railway formation earthworks for high formation areas with minimal re-grading to accommodate drainage due to the height and condition of formation north of Berrys Road. Through the cutting, refer to the typical detail with cross fall and longitudinal open drainage to be re-constructed.
Drainage	Further hydrological study may be required for the low-lying former railway formation immediately south of the former railway intersection with Berrys Road to determine drainage requirements – this area appears to hold water on both sides of the existing former railway formation.

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	Low level former railway formation will require cross drainage and re-grading of longitudinal open drains in accordance with typical details. High former railway formation sections have longitudinal falls which grade towards existing open drainage channels and generally appear to be adequate.
Structures	Nil.

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Conclusion and Recommendations

From this engineering feasibility study, most of the former railway formation is low-lying but remains in place and will be able to be re-used with additional grading, drainage and maintenance. The high-level former railway formation areas appear to be in good condition and with additional grading and maintenance works will most likely be suitable for re-use.

Accessibility and constructability will need to be carefully considered during any future detailed design stage. Much of the proposed trail will require careful co-ordination for delivery of materials and equipment, with some areas difficult to work in due to the surrounding vegetation and challenging soil conditions in wetter periods. Construction should be undertaken in drier periods to reduce the effects of construction and prevent access delays where possible.

It is recommended that any future engineering design aims to reduce site works where possible by using pre-fabricated elements and reduce maintenance requirements with durable materials, careful drainage management, and by integrating detailed, quality design information from other consultants.

To inform any future detailed design process for the proposed trail, further discussion, analysis and investigation will be required, including:

- A determination of the acceptable flood risk and subsequent proposed trail design levels in low lying areas which will determine the extents and amount of drainage works.
- The determination of which existing waterway crossing structures are to be refurbished and modified rather than duplicated or demolished and replaced.
- Preferred types and final locations of creek and waterway bridges to be constructed for the proposed trail.
- The number and location of farm crossings and farm access points to the Crown land reserve and the associated drainage and earthworks.
- The desired width of the proposed trail may result in widening of the existing railway formation in some locations, which may add significantly to the earthworks required.
- The extent and route of the proposed trail is particularly relevant where waterway crossings are proposed to be constructed, and where the trail needs to cross the South Gippsland Highway.

For any future detailed engineering design to proceed the required information would include:

- A comprehensive geotechnical investigation along the proposed trail route, with boreholes at regular intervals along the proposed trail. Additional investigation is required at each side of all proposed waterway crossing locations, locations of any elevated walkways, highway crossings and major culverts, to guide design.

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- A feature and level survey along the proposed trail, with detail in areas where structures are to be re-used or will be required to aid design co-ordination and reduce construction issues when on site.
- A hydrological study addressing the low-lying areas of the proposed trail to inform the design of drainage structure types, size, and levels.
- Further direction from the stakeholders and related water / catchment management authorities regarding the tolerable flood risk level, and translation to proposed trail finished levels.

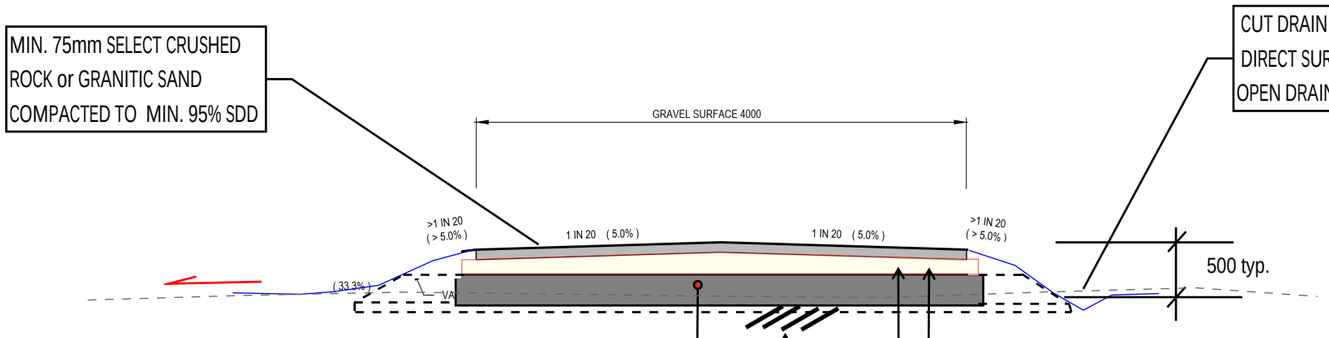
We trust this report provides the information required to develop an understanding of the engineering feasibility of the proposed trail.

Kind Regards,

Jeff Robinson

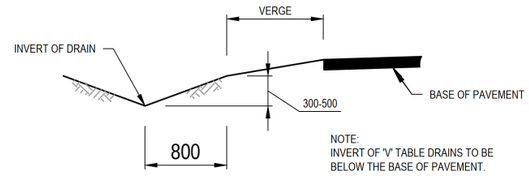
Associate

OPS Engineers



TYPICAL CROSS SECTION

GRAVEL ROAD



'V' CUT TYPE

TYPICAL OPEN TABLE DRAINS

FIGURE 2: TYPICAL LOW FORMATION DETAIL

REFER TO LANDSCAPE ARCHITECT'S DRAWINGS FOR LOCATIONS.

CONCEPT SKETCH ONLY

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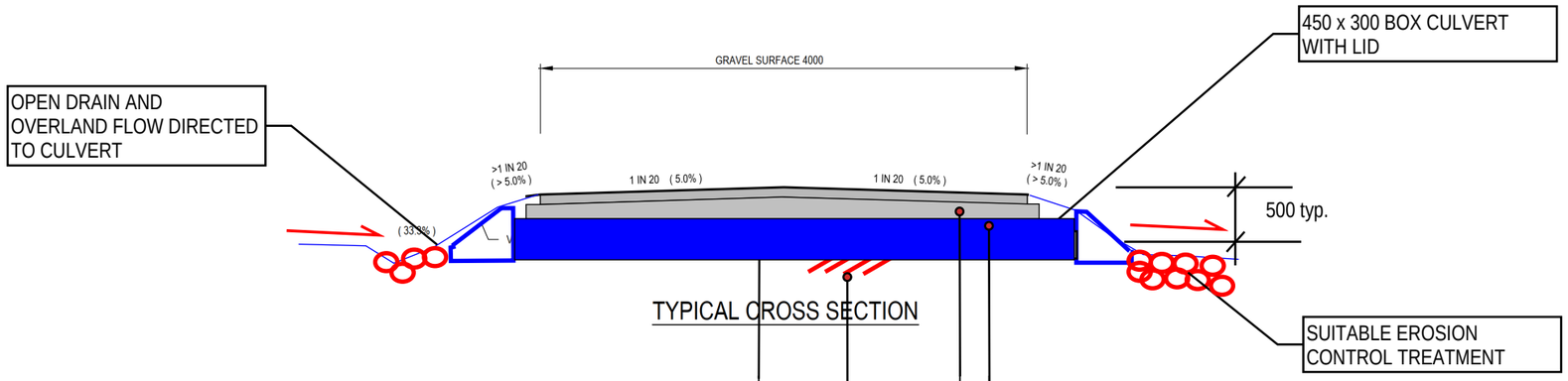

FIGURE 3: TYPICAL LOW FORMATION DRAINAGE DETAIL

REFER TO LANDSCAPE ARCHITECT'S DRAWINGS FOR LOCATIONS.

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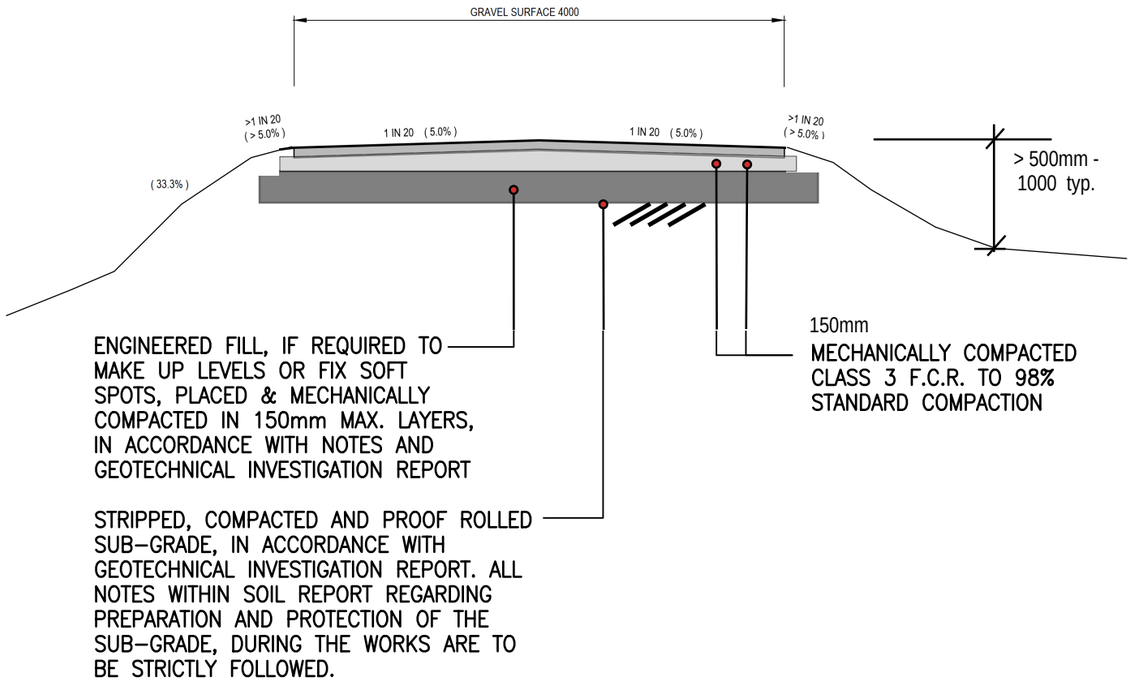
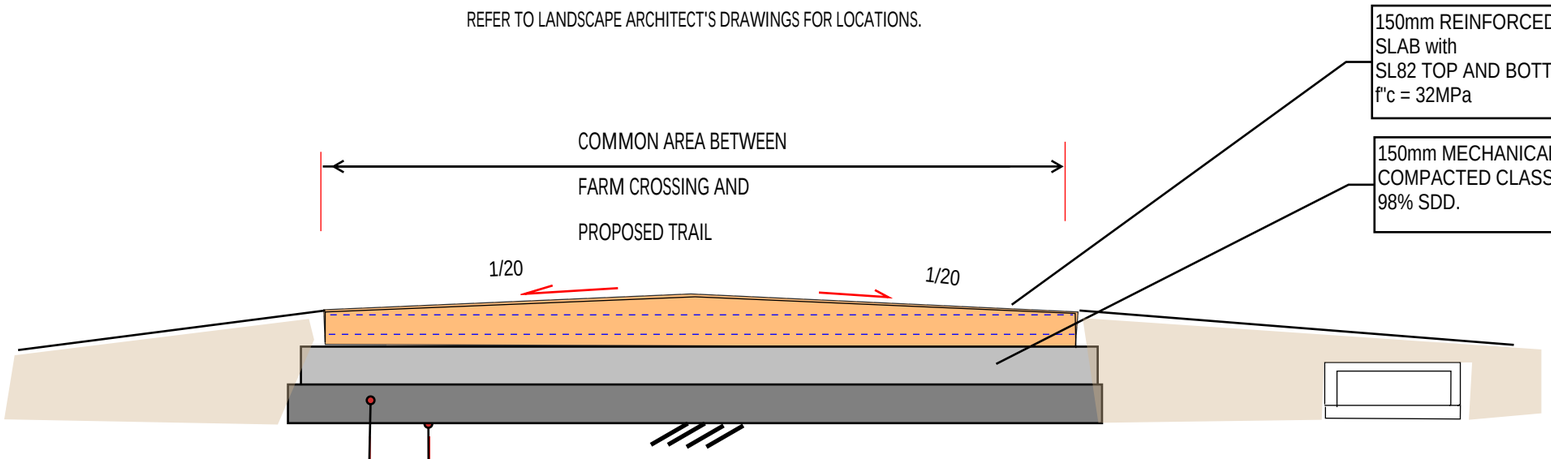


FIGURE 4: TYPICAL HIGH FORMATION DETAIL

REFER TO LANDSCAPE ARCHITECT'S DRAWINGS FOR LOCATIONS.



TYPICAL STOCK CROSSING CONCRETE PAVEMENT DETAIL

REFER TO LANDSCAPE ARCHITECT'S DRAWINGS FOR LOCATIONS.

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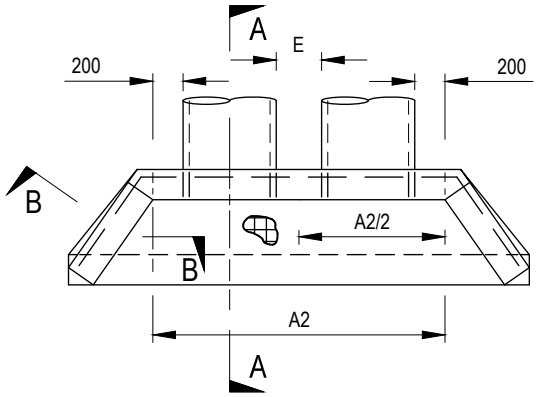
DIMENSIONS

TYPE 1 *SLOPE AT 1.5:1				TYPE 2 *SLOPE AT 2:1				TYPE 3 *SLOPE AT 3:1			
B	C	D	F	B	C	D	F	B	C	D	F
138	1037	197	240	138	1129	262	320	275	1312	393	480
221	1286	315	385	294	1433	420	513	441	1727	630	769
307	1547	438	535	409	1752	584	713	613	2161	876	1069
394	1804	563	687	525	2066	750	916	788	2591	1125	1373

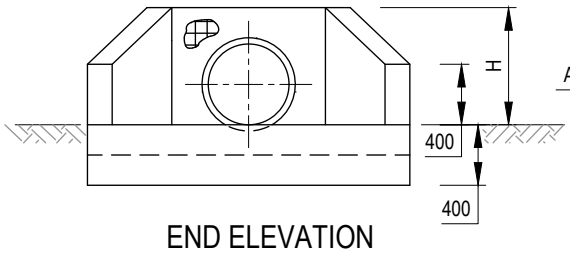
* THEORETICAL SLOPE OF WINGWALL MEASURED AT RIGHT ANGLES TO THE ROADWAY.
** A2=A+E+EXTERNAL DIAMETER OF PIPE
# APPROXIMATE ONLY

NOM PIPE DIA	EXTERNAL PIPE DIA#	A**	E	H
300	362	762	300	531
375	445	845	300	610
450	534	934	300	692
525	616	1016	300	775

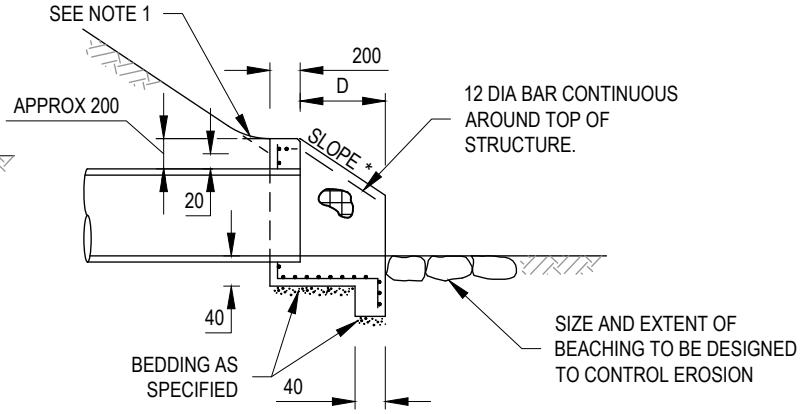
FOR LARGER PIPE DIAMETERS REFER TO VICROADS SD1931 REV B



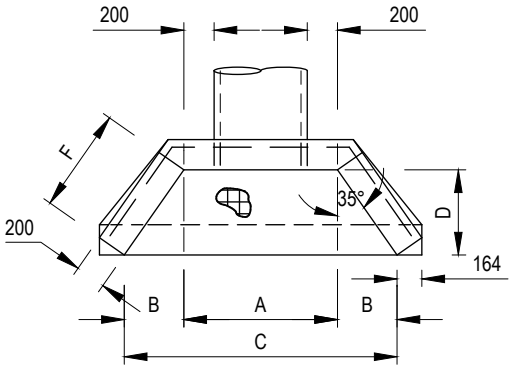
PLAN



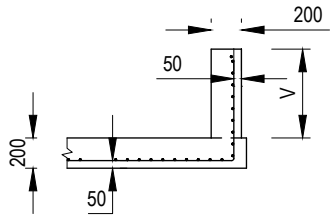
END ELEVATION



SECTION A-A



PLAN



SECTION B-B

V = VARIABLE HEIGHT OF THE WINGWALL

NOTES:

1. BECAUSE THE RELATION OF THE BATTER TO THE TOP OF THE ENDWALL IS ESSENTIAL FOR THE SAFETY OF THE MOTORIST THE DETAILS AS SHOWN IN SECTION A-A MUST BE ADHERED TO DURING CONSTRUCTION.
2. REINFORCEMENT, F82 UNLESS OTHERWISE SPECIFIED, SHALL BE CONTINUOUS AROUND CORNERS AND LOCATED AS SHOWN ON SECTIONS A-A AND B-B. CLEAR COVER 50 MIN. LAPS: FABRICS 300 MIN, BARS 25 X BAR DIAMETER MIN.
3. DISTRIBUTION BARS 12 DIA AT 200 CENTRES.
4. CONCRETE STRENGTH SHALL BE 32MPa. (MIN) AT 28 DAYS.STANDARD STRENGTH GRADE OR HIGHER COMPLYING WITH THE REQUIREMENTS OF AS 1379. EXPOSURE CLASSIFICATION UP TO AND INCLUDING B1.
5. EXPOSED EDGES SHALL HAVE 20 x 20 CHAMFERS.
6. COMPACTION PRESSURE BEHIND WALLS NOT TO EXCEED 15 kPa. (1.5 TONNE VIBRATORY ROLLER OR 300 kg VIBRATING PLATE WITHIN 0.5m OF WALL).
7. ENDWALLS SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE RELEVANT PROVISIONS OF AS 3600.

ALL MEASUREMENTS IN MILLIMETRES

REINFORCED CONCRETE WINGWALL (IN-SITU)

LAST UPDATED 26/02/2020

Infrastructure Design Manual Standard Drawings

SD 497

Local Government Infrastructure Design Association

A copy of the Infrastructure Design Manual can be viewed on the Design Manual website www.designmanual.com.au

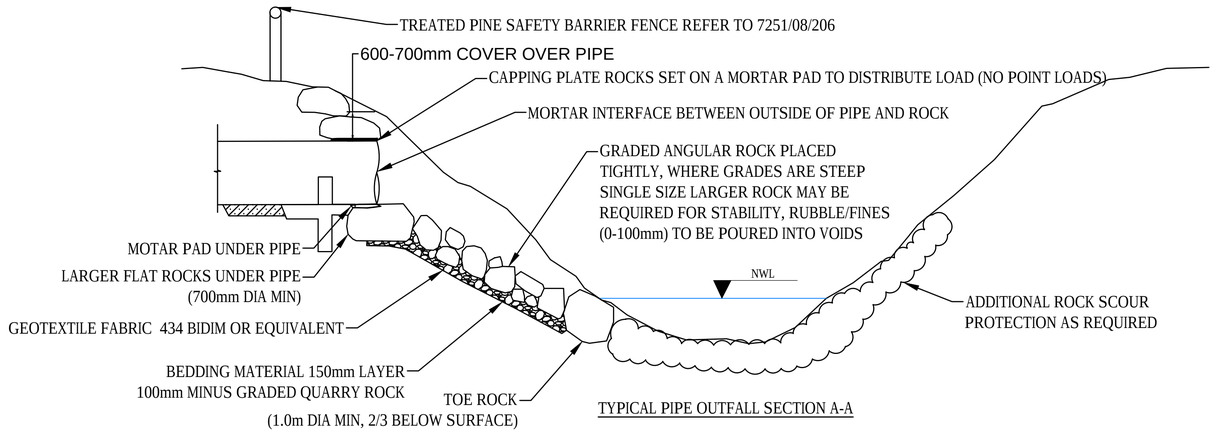
NOT TO SCALE

NOTE:

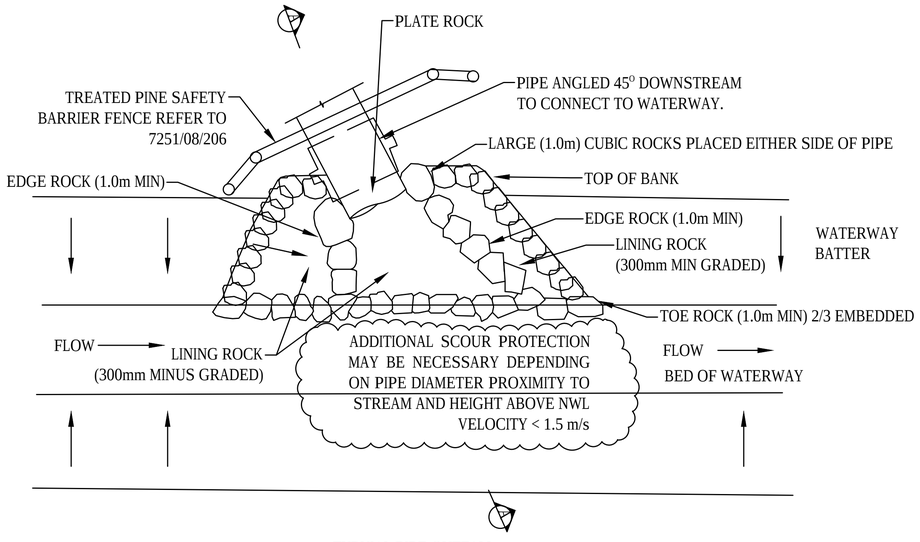
- PIPE OUTLET MUST NOT 'DAYLIGHT'. STOP PIPE AT MINIMUM COVER OF 600-700MM. OUTFALL MAY BE INSET AS SHOWN IN TOP DRAWING
- CUT OFF WALLS. BOTTOM MINIMUM 500MM INTO IN SITU. SIDE MINIMUM 1M INTO IN SITU
- FOR LARGER OUTFALL PIPES CONSTRUCT CONCRETE END WALLS (PARTICULARLY OUTFALLS LARGER THAN 1200MM DIA).
- EITHER GRADED ROCK WORK OR PLACED ROCK WORK DEPENDING ON THE GRADE AND WHETHER BELOW OR ABOVE NWL
- ENERGY DISSIPATION CAN BE ENHANCED WITH SHALLOW PLANTED INLET POOLS/SUMPS
- 1.5 M/SEC MAX. OUTLET VELOCITY ;
- OUTLET PIPE TO BE SET BACK INTO THE FINISHED BATTER SLOPE, POINTING A MAX. OF 45 DEGREES DOWNSTREAM;
- ROCKS ABUTTING THE PIPE TO HAVE A MORTAR PAD BETWEEN THE ROCK AND THE OUTSIDE EDGE OF THE PIPE (NO POINT LOADINGS);
- ROCKWORK PROTECTION REQUIRED FOR THE BED AND BANKS, FROM THE END OF PIPE TO THE LOW FLOW WATER LEVEL. ROCK PROTECTION REQUIRED FOR THE FULL EROSION PROJECTION OF THE OPPOSITE BANK AND BED AS REQUIRED FOR THE WATER FLOW PROFILE WHEN THE OUTLET IS FLOWING FULL ;
- ROCKS WITHIN THE BASE TO BE PLACED ON A FCR BEDDING TO ENSURE THE STORMWATER DISCHARGE IS FLOWING OVER AND AROUND THE ROCKS DOWN INTO THE CREEK, AND NOT UNDERNEATH. THE REMAINING EXPOSED DIMENSION OF THE ROCKWORK IS TO BE A MINIMUM OF 150mm;
- DISTURBED AREAS OF EXISTING BANK RESULTING FROM THESE WORKS ARE TO BE STABILISED WITH REVEGETATION.
- THE OUTLET MUST BE INTEGRATED INTO THE BANK AND SURROUNDING LANDSCAPE TO MAXIMISE AESTHETICS AND MINIMISE IMPACTS
- TOE AND EDGE ROCKS AE TO ADEQUATELY KEYED INTO THE BED OF THE CREEK.
- ALL VOIDS SHALL BE FILLED WITH A 0-100mm FCR MIX.
- APPROPRIATE SILT/DEBRIS CONTROL MEASURES MUST BE INSTALLED.

PROCEDURE

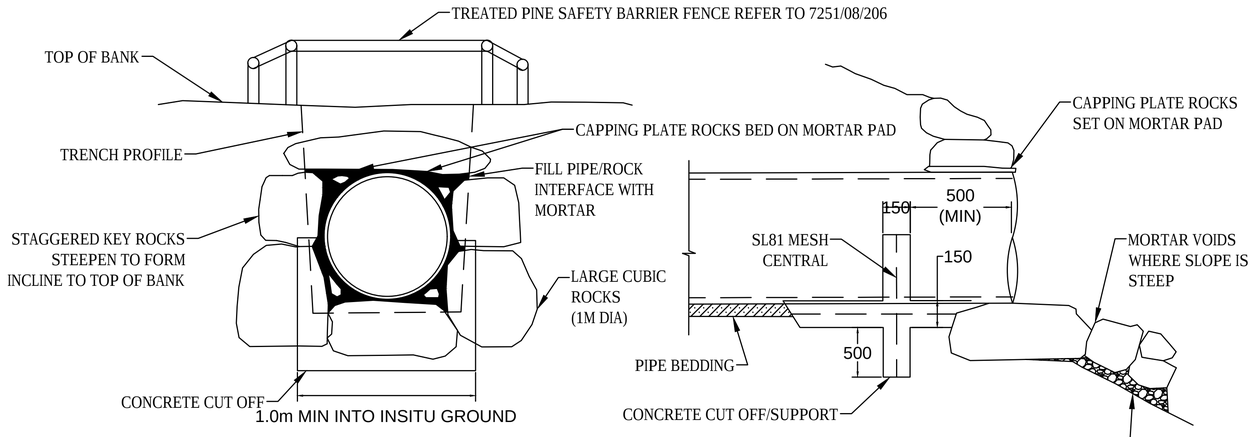
- EXCAVATE/BOX OUT TO ENABLE TOE AND MATERIAL.
- INFILL THE CHUTE WITH A 0-100mm FCR MIX. THE CONTRACTOR SHALL USE METHODS FOR HANDLING AND PLACEMENT OF ROCK THAT WILL AVOID SEGREGATION OF ROCK SIZE FRACTIONS.
- ROCK SHALL BE CAREFULLY PLACED INTO POSITION. ROCK SHALL NOT BE DUMPED DIRECTLY.
- IT IS IMPERATIVE THAT ROCK USED TO FORM THE ROCK CHUTE IS WELL GRADED WITH MINIMAL VOIDS TO PRODUCE A BLANKET OF INTERLOCKING ROCK.



TYPICAL PIPE OUTFALL SECTION A-A



TYPICAL PIPE OUTFALL



PIPE END DETAILS

REV	DESCRIPTION	COMPANY	PROJECT OR WO NUMBER	DRAWN	ENG. CHECK	PR. MAN. APP'D	DATE
B	WATERWAY DESIGN MANUAL	ALLUVIUM		JB			21/08/19
A	NOTATION AMENDMENTS	MW		MK			17/12/18

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Melbourne Water

DRAFTER	DESIGNER	DESIGN MANAGER APPROVAL	PROJECT MANAGER APPROVAL
DRAFTING CHECK	ENGINEERING REVIEW		

TITLE

PIPE OUTFALL DRAWING

PROJECT DATUM

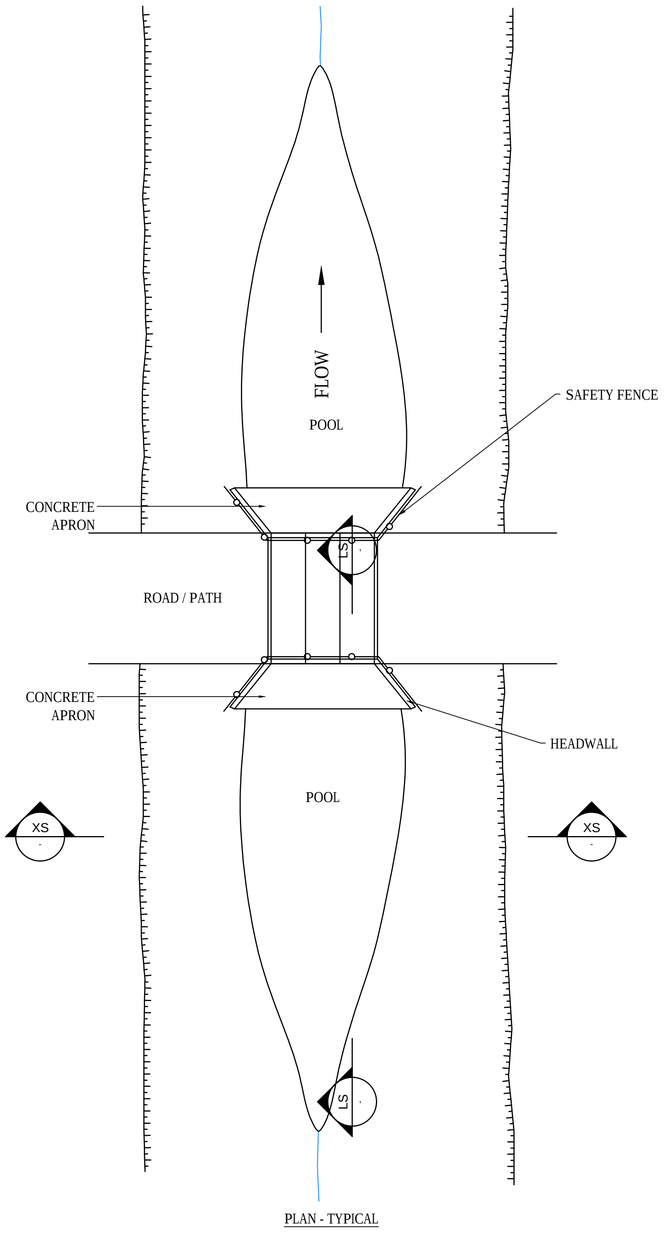
SCALE NOT TO SCALE

Original Size A1

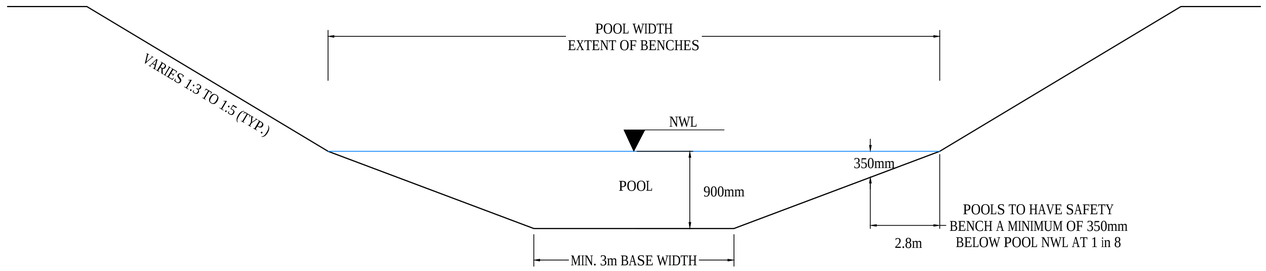
MELBOURNE WATER CORPORATION

CODE	MWC DRAWING NUMBER	REV
C	7251/08/103	B

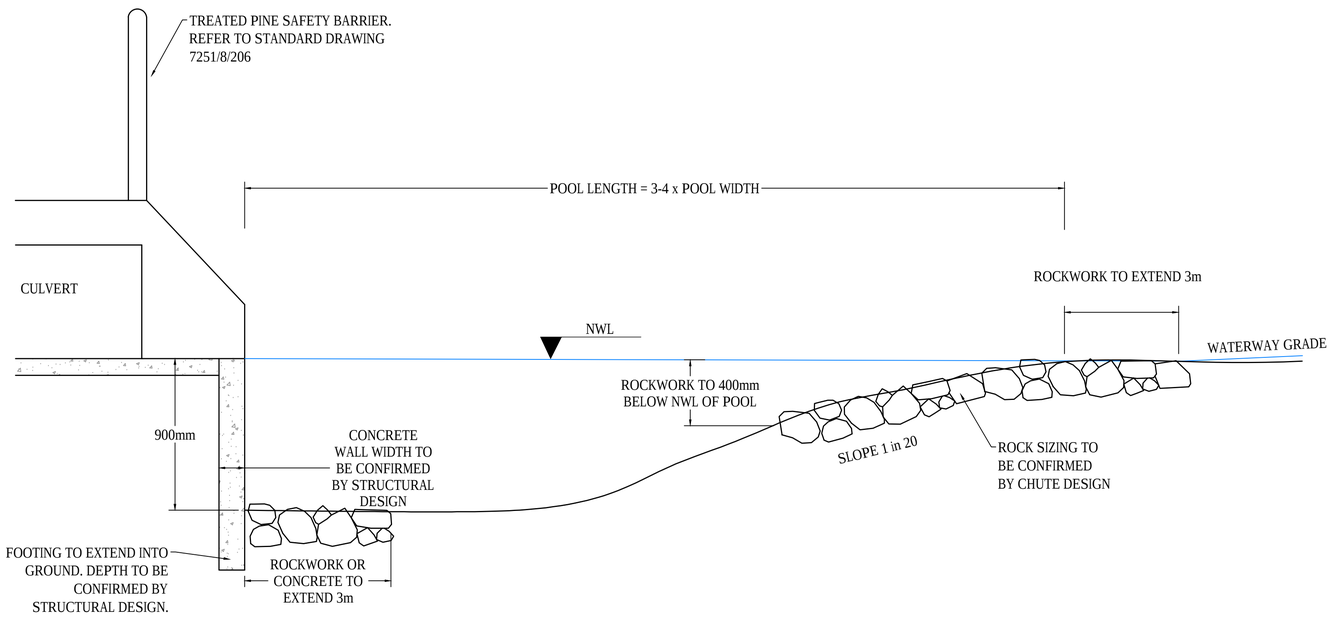
CODE	MWC DRAWING NUMBER	REV
C	7251/08/120	A



PLAN - TYPICAL



CROSS SECTION



LONGITUDINAL SECTION

NOTE:
- REFER TO MELBOURNE WATER CULVERT DRAWING FOR CULVERT DETAILS STANDARD DRAWING 7251/08/421
- THE 900mm DEPTH IS FROM 'DRY' CULVERT CELLS INVERT, SO VEGETATION WON'T GROW

REV	DESCRIPTION	COMPANY	PROJECT OR WO NUMBER	DRAWN	ENG. CHECK	PR. MAN. APP'D	DATE
A	WATERWAY DESIGN MANUAL	ALLUVIUM		JB			21/08/19

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DRAFTER	DESIGNER	DESIGN MANAGER APPROVAL	PROJECT MANAGER APPROVAL
DRAFTING CHECK	ENGINEERING REVIEW		

TITLE CULVERT TRANSITION

PROJECT DATUM

SCALE NOT TO SCALE

Original Size A1

MELBOURNE WATER CORPORATION

CODE	MWC DRAWING NUMBER	REV
C	7251/08/120	A