Bannockburn South East Precinct Bridges Feasibility Assessment

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Bruce Creek Options Assessment
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B01	Final	18/12/2024	VPA	Final report for VPA
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Executive summary

The Victorian Planning Authority (VPA) engaged Jacobs Group (Australia) Pty Ltd (Jacobs) to undertake an investigation into VPA's three proposed bridge crossings over Bruce Creek in the Bannockburn South-East Precinct Structure Plan (PSP) area in December 2022. VPA provided Jacobs with indicative bridge and road locations to guide the options assessment and the following were the key outcomes from the investigation:

- Northern Region (BR-01) is suitable for a straight road alignment and the structure could consist of either a low or high level crossing.
- Central Region (BR-02) was not previously considered to be a feasible location for a crossing due to the following identified constraints during December 2022:
    - An eagle's nest (subsequently removed as a constraint in 2024 due to advice that the eagle is not a protected species) being located approximately 50m north of the proposed bridge crossing location.
    - A Heritage Inventory site located 215m south from the proposed bridge crossing location
    - Excluding these identified constraints, location BR-02 would otherwise be suitable for a three span concrete plank bridge structure with minor approach earthworks due to the conducive landscape for the bridge to ramp down to the required level.
- Southern Region (BR-03) was not previously considered to be a feasible location for a crossing due to the following identified constraints during December 2022:
    - An eagle's nest being located 150m north-west of the proposed bridge crossing location.
    - Growling grass frogs being recorded 80m to the south of the proposed bridge crossing location.
    - Excluding these identified constraints, this location would otherwise be suitable with its gentle gradient for a two span concrete plank bridge with minor earthworks on the approaches.

Following the identification of constraints associated with the locations of BR-02 and BR-03 above, Jacobs sought guidance from VPA in relation to what appropriate offsets could be adopted for the purposes of the options assessment. Based on the offsets nominated by VPA in 2022, Jacobs determined that locations BR-02 and BR-03 are not feasible.

At the completion of the draft options assessment Jacobs and VPA discussed and refined the extent of offset required in particular:

- The no-go zone (originally assumed to be 200m) for eagle's nests. VPA spoke with DEECA who noted that the eagles were not a protected species however, it would be best to provide a buffer space if the nests were inhabited but this is not a requirement.
- No-go zone (originally 100m) as to not impact the Heritage Inventory site was retained.
- The Growling Grass frog habitat will be impacted regardless of the location of the bridge as the habitat extends 200m either side of Bruce Creek. There will need to be a process undertaken in accordance with the Environment Protection and Biodiversity Conservation Act 1999 to assess the level of impact and seek the appropriate approvals.
- Extents of the Historic Planting site adjacent the rail corridor

After the options assessment, VPA and Jacobs discussed the potential location of the bridge to progress into concept design and costing. Due to the topography, a location 200m south of the powerline structures (location BR-04) was deemed most suitable for bridge construction. However, when considering other impacts such as (vegetation removal, impacts to native fauna, etc.), BR-01 is the preferred option.

Jacobs was then tasked with developing a bridge concept design to assist with basic costing of the crossing. Through this process, VPA decided to implement the works in two stages, an interim dual carriageway bridge and an ultimate two bridge arrangement supporting each carriageway. VPA and Jacobs discussed the location of the bridge and agreed that location BR-01 is preferred due to the impacts to biodiversity, cultural heritage, implications to urban design and impacts on the road alignments on the east and west of the creek.

Jacobs developed a high-level super T girder bridge design supported on portal structures for the crossing due to the simplicity of construction and the solution being generally adopted for similar road solutions. Jacobs indicated the primary structural elements sizing for costing of the bridge.

To further refine the design and cost estimation, Jacobs recommends that VPA:

- Consults a construction company to understand the challenges of building the bridge and whether adopting a longer spanning structure would reduce cost given the specific site constraints. The current design assumes a bridge using standard components which is suitable from a technical perspective and readily able to be constructed.
- Undertaking geotechnical investigations to refine substructure design.
- Confirms the requirements for relocation of moderate / high value retention value trees.

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Acronyms and abbreviations

VPA	Victorian Planning Authority
CBD	Central Business District
SE	South-East
DDA	Disability Discrimination Act
DEECA	Department of Energy, Environment and Climate Action

1. Background

Bannockburn is a township southwest of Melbourne approximately 88km from the Central Business District (CBD) with a large creek running through the centre of the township. Bannockburn has been flagged for development by the Victorian Planning Authority (VPA) in partnership with Golden Shire Council as a part of the sustainable growth plan to the year 2050. The population of Bannockburn is expected to increase from approximately 6,500 to 13,000 by 2036, and will require housing expansion to achieve this demand. The Bannockburn growth plan details precincts being developed in the north-west and south-east in the short term and long term development opportunities in the south to south-west. To accommodate these developments, new roads and supportive infrastructure will be required to limit traffic congestion.

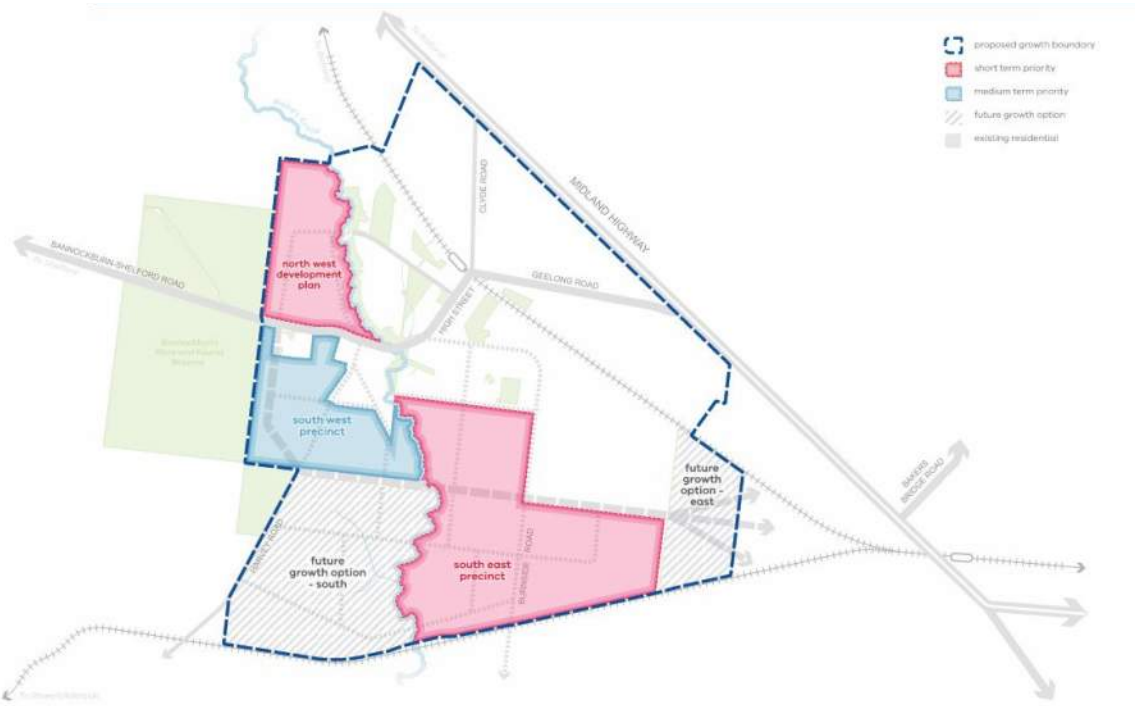


Figure 1-1: Bannockburn Growth Plan Concept Plan. Referenced from Bannockburn Growth Plan (May 2021) accessed from https://vpa-web.s3.amazonaws.com/wp-content/uploads/2021/09/Bannockburn-Growth-Plan-May-2021-Approval-Gazetted.pdf

As part of the original development strategy, the VPA requested Jacobs to investigate three potential bridge crossings over Bruce Creek in southern Bannockburn. Jacobs was requested to undertake a feasibility assessment of bridging methodologies to inform the VPA on the cost of each location. These bridges were given identifiers in the following table. Each option intended to limit impacts to protected ecology, sites of heritage significant and arboriculture.

Table 1-1: Preliminary Option Bridge Details (December 2022)

Bridge ID	Road Name	Road Description
BR-01	Un-named future road	Arterial Road
BR-02	Un-named future local road	Local Connector Boulevard
BR-03	Un-named future local road	Local Connector Boulevard

The potential bridge locations and site constraints documented in December 2022 are shown in Figure 1-2 and the locations are based on information provided by the VPA to Jacobs on 14 July 2022.

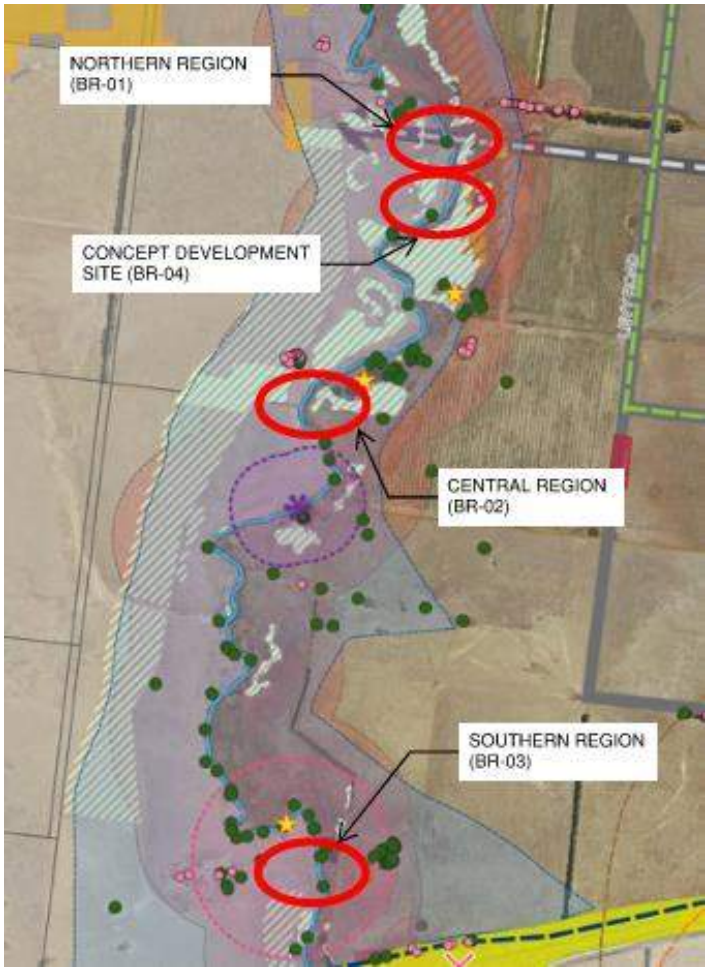


Figure 1-2: Location of proposed bridge sites provided by the VPA. Constraints shown as per advice received March 2025. Refer to Appendix A for April 2025 constraint map.

Following discussions held between Jacobs and VPA during August 2024, the potential bridge locations identified in December 2022 were deemed unsuitable. A workshop was held to investigate a fourth location between BR-01 and BR-02 to understand if there is a more suitable location for the crossing (BR-04). VPA suggested a high-level structure (similar to option BR-01 December 2022) would be most suitable for this location and Jacobs were directed to progress with a concept for the crossing. In addition, VPA provided further guidance on constraints had been used to inform the December 2022 bridge locations. The updated guidance included:

- Eagles Nest
    - Previous offset of 200m from the recorded eagles nest can be significantly reduced. The Department of Energy Environment and Climate Action (DEECA) informed VPA that there is no policy position on protecting the nests as the eagles are not deemed endangered in Victoria. If the nests are active during construction, an open area should be provided between the nest to not disturb their habitat.
- Growling Grass Frog (GGF)
    - The bridge will impact GGF habitat as they have been recorded along Bruce Creek. The habitat extends 200m either side of the creek. Any bridge to assist with Bannockburn's development will impact the habitat. This will require an assessment of impact undertaken through the Environment Protection and Biodiversity Conservation Act 1998 and associated approvals for construction.
- Significant Value Tree / Tree Sites

- Any trees impacted during construction will need to be removed and relocated. This will require permits if they are local vegetation and offsets / relocation will be discussed at a later stage of design when the permits are applied for.

1.1 Preliminary Option Northern Site (BR-01) (December 2022)

The northern site proposed in December 2022 is approximately 60m south of the existing powerlines at the southern end of Levy Road shown in Figure 1-3. The riverbank in the northern region is extremely steep, however roughly 250m south of the powerlines, the banks have a far gentler slop which is more conducive for a road approach. However, there was an eagles nest situated 400m south of the proposed road which restricted how far south the road could be located at the time of the assessment.

Figure 1-3: Northern Site approximately 60m from powerlines facing north-west.

The site has the been flagged as having artefact scatter and a couple of historically significant trees as highlighted in Figure 1-2. The VPA Biodiversity Assessment highlighted that the northern site has plains grassy woodland and creekline grassy woodland within the immediate vicinity. In December 2022,there were no location specific reported nationally or state significant fauna or flora reported, however they do have the potential to occur. Along Levy Road there is a significant number of moderate value trees and at the southern end of the road there is a significant amount of historic and indigenous vegetation that may restrict construction access.

There were no historical or culturally sensitive locations impacted or detailed near the northern site in the Bannockburn South East PSP Historical Heritage Assessment.

After consultation with the appropriate stakeholder, the VPA advised Jacobs that building under the powerlines would not be possible and construction works should be kept to 60m away if practical. Although the proposed bridge site was located outside this region, the close proximity to the easement would likely cause construction activities to encroach within the restricted area.

1.2 Preliminary Option Central Site (BR-02) (December 2022)

The central site proposed in December 2022 is approximately 550m south-west of the northern site and has several key constraints in the immediate vicinity. There are several critical / high retention trees on the eastern bank and a large group of moderate value trees on the western bank. These trees are in the northern area of the site with the southern constrained by a high retention value tree on the eastern bank and a historical site on the west.

Figure 1-4: Slightly north of the central site facing south-west

In addition to the historical place on the western side, approximately 200m further south there is a historical inventory site. In the Bannockburn Historical Heritage Assessment, it is recommended that a 100m works no-go zone is established to protect them from inadvertent harm during any future development works. This extremely limits the available space for a bridge to be constructed.

1.3 Preliminary Option Southern Site (BR-03) (December 2022)

The southern bridge site proposed in December 2022 is approximately 250-300m north of the rail crossing over Bruce Creek and has a large amount of vegetation constraining the alignment of a new local road. On the eastern side there is a significant number of high retention trees and a historical heritage site. The western side has several high retention and some moderate retention value trees which could be avoided by shifting the alignment further south. However, shifting the alignment further south causes the alignment to impact recorded growling grass frogs and a historic planting site.

Both sides of Bruce Creek are quite gentle in gradient and conducive for road construction. Depending on the flood levels within this region, several piers and earthworks to raise the road level may be required to bridge across the creek.

Figure 1-5: Southern site facing north

In addition to the ecology constraints there is a heritage building situated close to Burnside Road and an area potentially containing late-nineteenth century handmade bricks situated slightly north of the rail reserve. These impose further limitations on how far south a potential road alignment can be shifted.

1.4 Concept Development Site (BR-04) (December 2024)

At the presentation of the preliminary options assessment, VPA indicated that a single road bridge location be progressed to costing. This should be a high-level structure to limit impacts to Bruce Creek reserve, the growling grass frogs habitat and limit impacts to the existing landscape. This area will conflict with the artefact scatter on the eastern side of the creek and needs to be considered and observed during construction.

The proposed bridge location (BR-04) is approximately 200m south of the powerline easement in the location where the topography is more conducive for construction (milder topographic slopes) and limit the quantity of earthworks required to construct the bridges substructure. The topography on the eastern side of Bruce creek is steeper than the western which may require some interim earthworks to help facilitate the construction of the bridge. On the eastern side there will likely be an impact to a critical / high value retention tree due to the location of the twin bridges shown in Figure 1-6. In the interim stage where only one bridge is constructed, this tree may not be impacted.

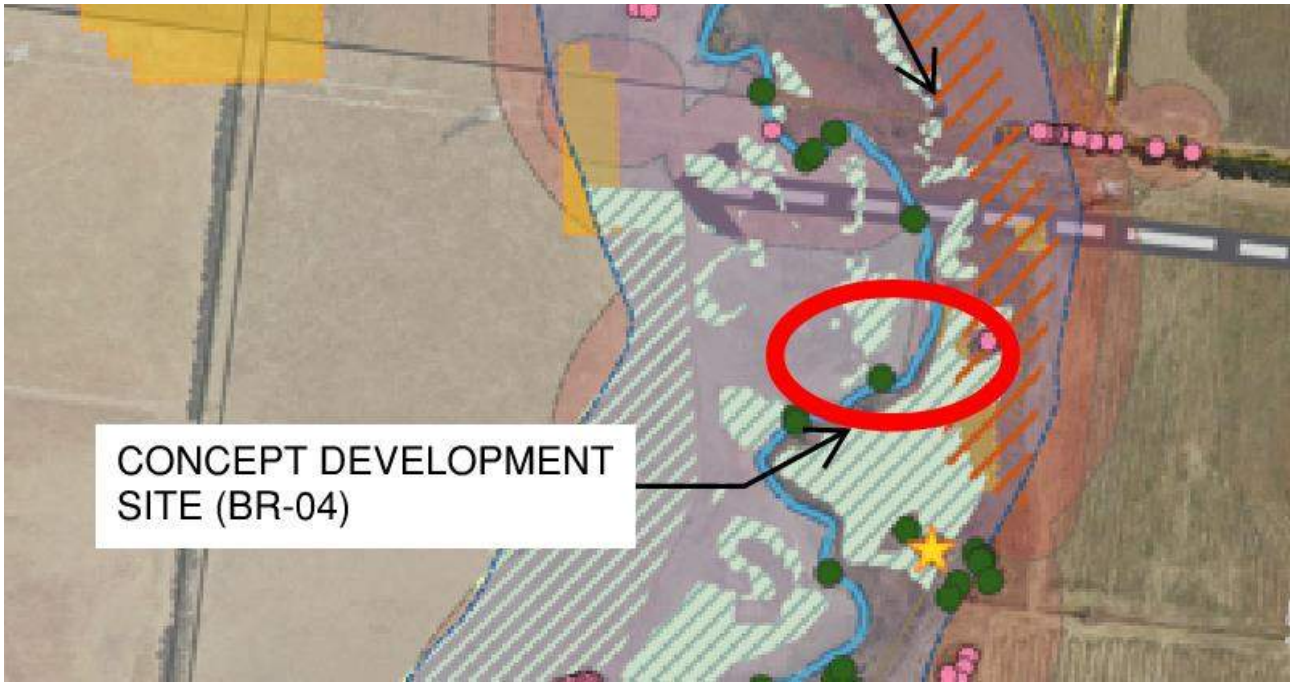


Figure 1-6 Concept development site constraint mapping excerpt. Refer to Appendix A for full constraint map.

As the creek is on a high skew to the proposed road alignment in this region, it is probable that the pier locations will need to be skewed and longer than a typical perpendicular portal structure. There is an opportunity to shift the alignment further south where the creek is less skewed to the road alignment, however this will cause the alignment to impact a larger number of valued trees at the final stage of the project.

2. Site Investigation

On the 17th of November 2022, Jacobs conducted a site visit to Bannockburn to investigate the creek region and better understand each bridge location and the overall topography of the creek. During this visit Jacobs also viewed the existing Bannockburn to Shelford Road bridge (over Bruce Creek) to appreciate water flow and subsequent pier spacings for the proposed structures.

2.1 Existing Bannockburn-Shelford Road Bridge

The existing 3 span Bannockburn-Shelford Road bridge has a large diameter utility pipe being supported off the substructure. The superstructure consists of concrete u-slabs with steel traffic barriers while the substructure consists of 800mm thick bluestone piers. The bridges total length is 19.64m with 3.2m vertical clearance over the underpass footpath. The footpath travelling parallel with the roadway is supported by a 2.1m wide x 300mm tall concrete culvert across Bruce Creek.

Figure 2-1: Bannockburn-Shelford Road Bridge facing north

It is evident that the creek overtops the culvert shown in Figure 2-2. Due to the lack of available flood information, Jacobs proposes that the cross-sectional flow area for the downstream structures should match the existing road bridge.

Figure 2-2: Bannockburn-Shelford Road footpath culvert and surrounding vegetation

2.2 Preliminary Option Northern Site (BR-01)

From the VPA provided information, BR-01 is proposed to be approximately 75m from the powerlines running parallel with the wires. The high-level information provided indicates the road alignment to be straight for simplicity and traverse the creek avoiding the historical heritage site and high retention tree.

The northern site's topography in the proposed location is quite steep on the eastern side and gentle on the western. Constructing a bridge and approach would be quite challenging due to the amount of earthworks or height of bridge piers required to support the road across the creek.

Figure 2-3: Northern proposed bridge site (60m from powerlines) facing north-west

Jacobs noted that there was a ridge line approximately 250m south of the powerlines which naturally ramped down at a gentle gradient which would be conducive for a road design. The road alignment could then be altered to curve to this natural slope and cut across the river in a north-westerly direction to utilise the gentle gradient on the western side of the creek assuming the eagles nest exclusion zone can be reduced.

Figure 2-4: Northern Site facing south viewing natural ridge 250m from powerlines

While moving in a southern direction between the northern and central site an eagle's nest was discovered approximately 400m from the powerlines. Advice provided by VPA in 2022, indicated that any works should remain at least 200m away from the nest as to not impact the nest and eagle's habitat. This initially constrained how far the road alignment can be shifted in a southerly direction and limited utilising the natural ridge line. This requirement was discussed between VPA and DEECA and the exclusion zone was removed due to the eagles not being endangered however, if the nest is inhabited a buffer should be provided to not disturb them.

Figure 2-5: Eagles nest located between northern and central site approximately 400m from powerlines

2.3 Preliminary Option Central Site (BR-02)

BR-02 from the information provided by the VPA is approximately 630m south of the powerlines running parallel with the northern proposed road. The high-level information provided indicates the road alignment would be straight for simplicity and traverse the creek avoiding the historical heritage site and high retention tree, however the alignment intersects a river red gum (recruit) which would need to be relocated.

The central sites topography in the proposed location is quite gentle on both sides which is suitable for road construction. Constructing a bridge in this location would be quite challenging due to the amount of constraints in this region and the flat section at the top of the creeks bank depending on flood levels.

Figure 2-6: View of central site from approximately 30m south looking north

Approximately 55m further north of the proposed road's location another eagle's nest was identified. Similarly with the northern location, the advice given in 2022 was to provide a 200m avoidance zone which restricted the possibility of moving the road alignment further north. This constraint was discussed and removed during 2024.

Moving further south of the proposed BR-02 location encroaches on the heritage inventory site. Advice given in Bruce Creek (west) Access Corridor Historical Heritage Assessment (September 2022) advised that a 100m works no-go zone should be established in order to protect them from inadvertent harm during any future development works.

These constraints are shown in Figure 2-7 to show the lack of available space for BR-02 to be constructed given the advised parameters. The purple represents no-go zone as to not impact the heritage inventory site and the star symbol represents the location of the eagle's nest.

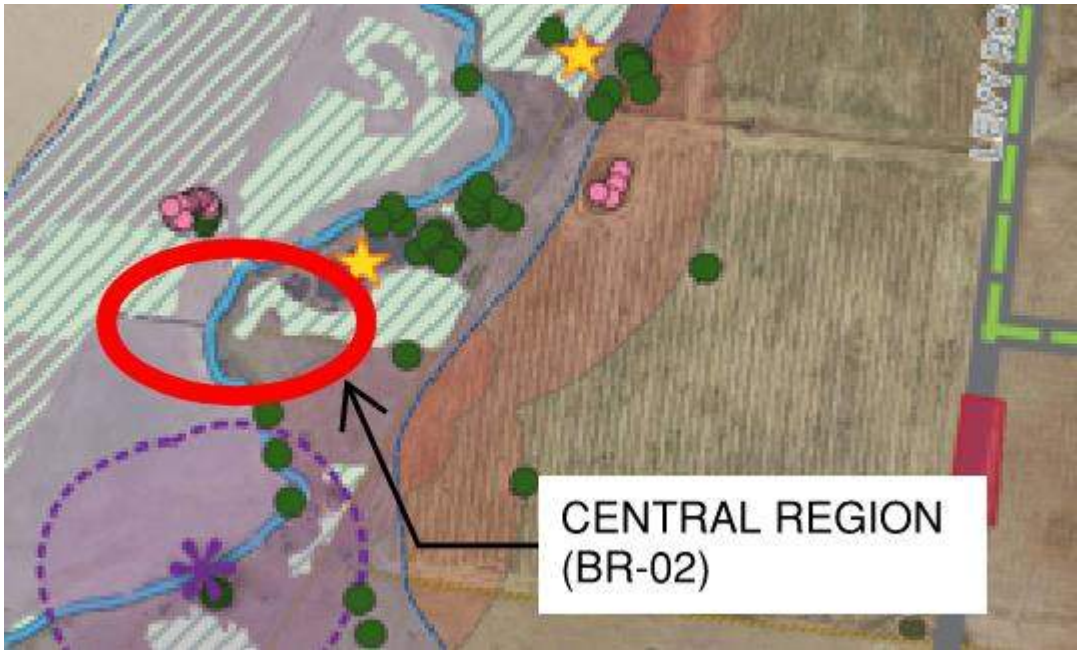


Figure 2-7: Central site constraint mapping excerpt. Constraints shown as per advice received March 2025. Refer to Appendix for updated April 2025 constraint map.

2.4 Preliminary Option Southern Site (BR-03)

From the information provided by the VPA, BR-03 is proposed to be approximately 200m north of the indigenous vegetation railway corridor with the road running almost parallel with the tracks. The high-level information provided indicated the road alignment would be straight for simplicity and traverse the creek avoiding the recorded growling grass frog habitat and historical heritage site. The proposed alignment impacts several high retention value trees on the eastern side but avoids the valued trees on the western side.

Figure 2-8: View of Southern Site looking south.

The southern sites topography in the proposed location is quite gentle on both sides which is suitable for road construction. Constructing a bridge in this location might be challenging due to the flatness of the area around at the top of the creek bank which may require several bridge spans depending on flood levels.

Figure 2-9: Panoramic view of the southern site looking north

Shifting the road alignment further north causes the alignment to encroach on the proximity offset to an eagle's nest along with impacting a greater number of high and moderate retention value trees. Along with these issues, the gradient of the land increases as you go further north as shown in Figure 2-9 which may be a benefit depending on the flood level to limit the extents of earthworks for the approaches and causing afflux.

Moving towards the rail corridor encroaches on the area with recorded growling grass frogs, encroaching into this habitat will require targeted surveys for these species and may lead to a referral to the Commonwealth Environment Minister.

2.5 Concept Development Site (BR-04)

The proposed bridge location (BR-04) is approximately 200m south of the powerline support structures and has milder topography to the preliminary option site BR-01. Consistent with the preliminary options, the road alignment was assumed to remain straight across the creek and with minimal cut or fill on the approaches the structure.

A ridge line exists near BR-04 which naturally ramps down at a relatively gentle gradient which is conducive for a road design and may reduce the total length and height of the structure required. VPA and Jacobs discussed this opportunity of using a curved road alignment but it was agreed to continue with the assumption of a straight road using a high-level structure. If the cost of a high level bridge is deemed excessive, the road alignment could then be altered to include curves to follow this natural slope and cut across the river in a north-westerly direction to utilise the gentle gradient on either side of the creek.

VPA and Jacobs undertook a review and workshopped the proposed BR-04 location and concluded that although this site is more favourable from a bridge design standpoint, the implications to biodiversity, cultural heritage, urban design and the connecting road alignments cause the location to be less favourable than BR-01.

3. Preliminary Bridge Structure (December 2022)

The VPA advised Jacobs to not consider options that impacted constraints and thus Jacobs considers the central (BR-02) and southern (BR-03) region as unsuitable.

The road structures will consist of a traffic lane in each direction with a median strip in the middle and shared use paths running along either side of the road as shown in Figure 3-1. For this assessment Jacobs assumed that the shared use path would not be Disability Discrimination Act (DDA) compliant and be required on both sides of the road, however typically a shared user path would only be required on one side. Road barrier containment level would be subject to heavy vehicle traffic volumes and the speed of the road among other factors. At this stage it will most likely require medium containment barriers on the arterial roads.

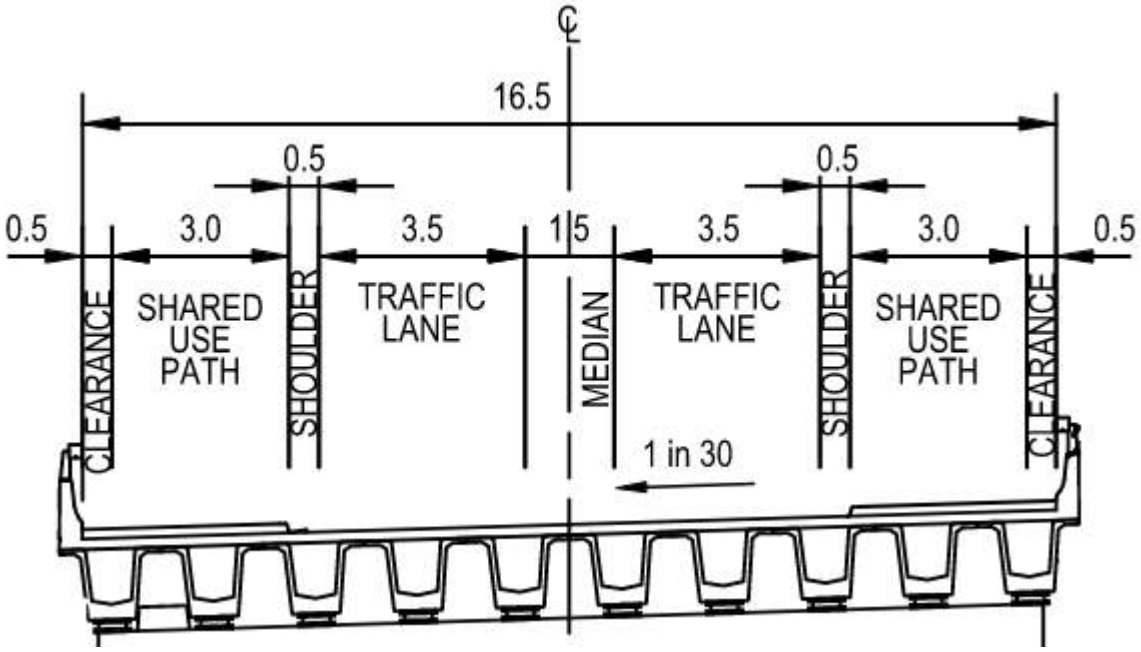


Figure 3-1: Road Cross section depicting lane widths and structural extents

3.1 Northern Region BR-01 Preliminary Option (December 2022)

The bridge is positioned on the edge of the 60m exclusion zone to the powerlines. The bridge will conflict with the artefact scatter zone which may impact the design and construction.

Considering the constraints in the northern region, Jacobs proposed two options for bridge crossings:

- Option 1 – Low Level Structure
- Option 2 – High Level Structure

3.1.1 Option 1 – Low Level Structure

To limit the length of structure, Jacobs proposed a cutting option to excavate the road down to a suitable height to bridge across Bruce Creek. The outer bank is approximately 20m above the creeks outer bank level and using AustRoads Guidelines 2021 Part 3, the gradient of the road should be 5% to have minimal impact on road users whilst maximising road gradient to limit the cutting amount. The span across the creek will consist of 700mm deep concrete planks with an 80mm thick concrete deck spanning 18m supported by piled abutments. Concrete planks were adopted due to their reduced structural depth limiting the height of the road whilst achieving the 600mm freeboard requirement.

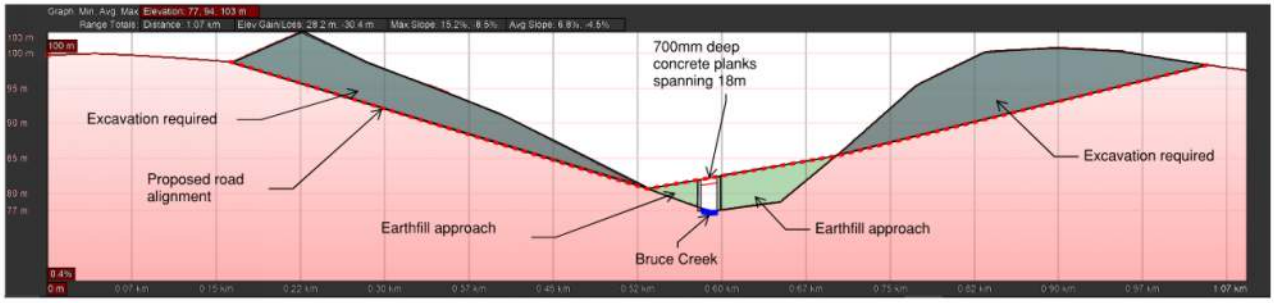


Figure 3-2: Proposed Low Level Structure road alignment elevation

The approaches to the structure will consist of earthfill ramps supported with 1:2 batter slopes up to a maximum height of 5m. Typically embankments are kept to a height of around 3m but due to the cutting on the western approach and subject to further soil testing, it may be possible for the fill to be reused for the approach embankments. The batters for the cuttings will be consistent with the approach embankment with 1:2 batter and the extents are shown in the following figure.

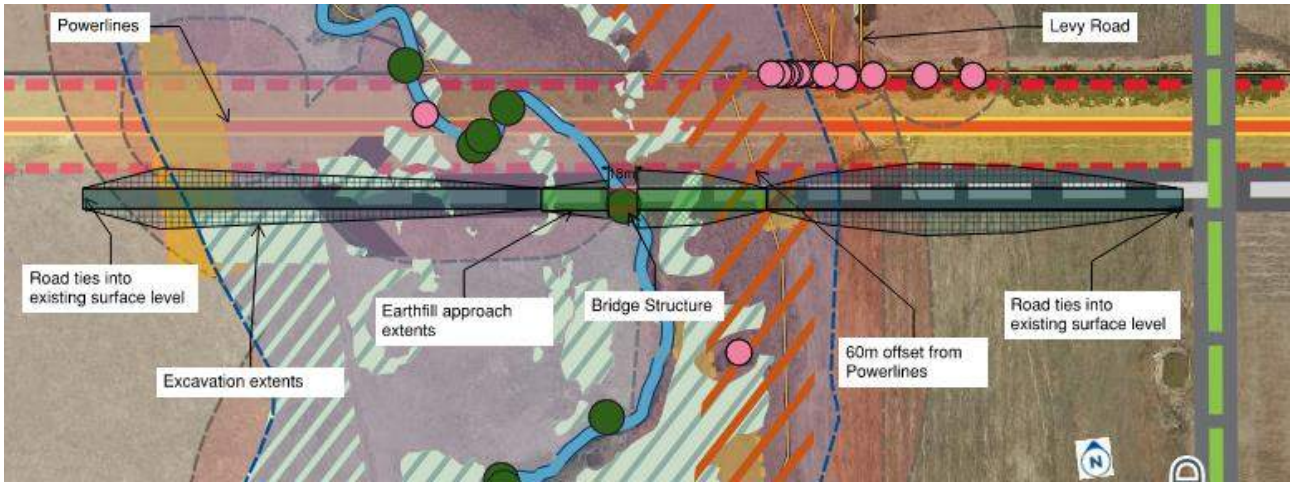


Figure 3-3: Option 1 – Low Level Structure showing extents of earthworks required

Due to the long extents of earthworks required to ramp the road down on the eastern side, there may be minor impacts to the historic planting. As the batters will be quite small in this region (approximately less than 1.5m) these trees should be able to be maintained. Further road alignment development may be able to limit the overall extents of the batters and negate the impact to the historic plantings.

3.1.2 Option 2 – High Level Structure

Jacobs assessed an option to minimise the cutting required around the riverbank which resulted in a high level and long bridge structure. For long bridges with minimal pier constraints, it is best to take a modular approach and use concrete girders. As the bridge will be approximately 330m long, it will consist of 11 spans of 30m achieved using 1500mm deep concrete girders with 200mm concrete deck supported on piled foundations. Additional options may include reducing the number of spans and piers by incorporating a longer spanning beam (i.e. 2000mm deep trough for a 40m span) pending further discussions with the VPA.

Figure 3-4: High Level Structure road alignment elevation

The maximum pier height for the proposed alignment is approximately 17m tall and will consist of a 2.5m centralised column with a reinforced concrete crosshead. The approaches to the structure will consist of earthfill ramps supported with 1:2 batter slopes up to a maximum height of 5.5m. Similarly with option 1, the excavated fill can be reused to for the earthfill approaches.

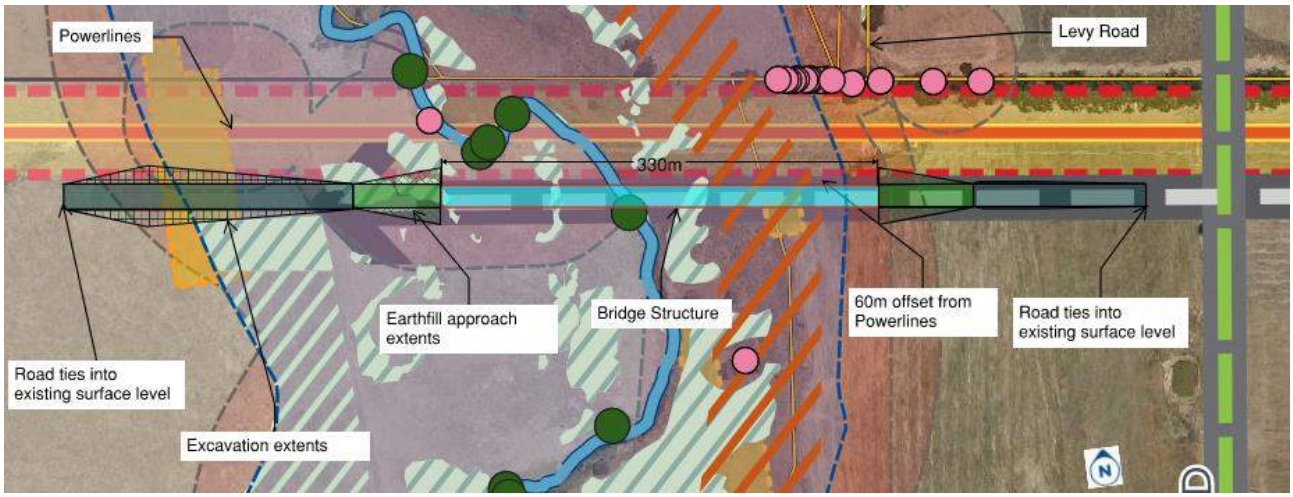


Figure 3-5: Option 2 – High Level Structure plan showing earthworks extents

4. Concept Bridge Structure (February 2025)

4.1 Concept Design Location (BR-01)

VPA engaged a transport consultant to review the number of lanes required for the bridge crossing. Based on the advice of the transport consultant, VPA proposed the bridge to be built in two stages (interim & ultimate) to assist with funding of the project. The initial stage is to consist of a single dual carriageway bridge and the ultimate consisting of an additional bridge allowing a carriageway on each bridge. Jacobs and VPA discussed and agreed on the proposed location of the concept design bridge. This location will impact a critical / high value retention tree as shown in Figure 1-6.

The interim road structures will consist of a traffic lane in each direction and a shared use path running along the southern side of the road as shown in Figure 4-1 and documented in the Appendix B Design Drawings.

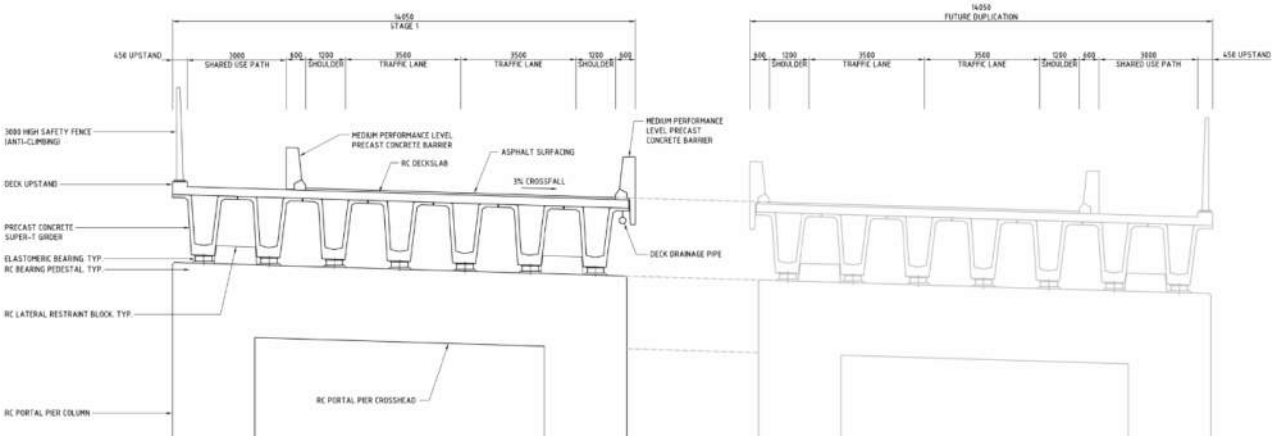


Figure 4-1: Concept Bridge cross section showing interim and ultimate configurations

The bridges will require traffic barriers between the roadway and the shared use path to comply with AustRoads Guide to Road Design Part 6. For this assessment Jacobs assumed that the shared use path would not be Disability Discrimination Act (DDA) compliant. Road barrier containment level would be subject to heavy vehicle traffic volumes and the speed of the road among other factors. At this stage it will most likely require medium containment barriers on the bridge.

The ultimate stage would consist of duplicating the existing structure in the region adjacent and would include an additional SUP.

Jacobs considered several different structural forms when assessing the valley crossing which included concrete super T girders, concrete box girders, steel box girders and a cable stayed structure. Jacobs notes that steel box girders and cable stayed structures can have longer spans, reducing the number of piers, in comparison to concrete options. However, steel bridges present a significant maintenance and ongoing cost implication which commonly outweighs the savings due to the reduction in number of piers. Based on this, Jacobs progressed with a concrete superstructure option.

Jacobs notes that concrete box girders can efficiently span up to approximately 60m, however transportation and erection of long spanning beams can be troublesome. Due to the topography and limited existing access to the site, long spanning concrete box structures were avoided but present an opportunity at a future design stage. Jacobs progressed the concept design based on a typical 1800mm deep super T girder which is readily available and commonly used in road projects across Victoria due to their ease of construction.

4.2 Information To Assist With Costing

Jacobs has discussed with VPA providing details to assist with high level costing of the bridge structure primarily relating to the sizing of primary structural elements. Jacobs notes that the concept design sizes listed below are included to assist with cost estimation and element sizes have been detailed based on past projects and are subject to change pending further design development. Pile lengths have not been provided due to no geotechnical investigation being undertaken and no geotechnical advise provided.

4.2.1 Superstructure

The bridges superstructure will consist of 2000mm wide x 1800mm deep concrete super T girders spanning nominally 32m supported on elastomeric bearings. The girders will be topped with a 200mm thick concrete deck and minimum 80mm road surfacing. The bridge will have two medium performance barriers at either side of the roadway and a 3m high safety fence adjacent the shared use path. The bridge will likely require lighting which has been omitted at this stage of design, however will need to be costed for.

4.2.2 Substructure

The bridges substructure will comprise of large portal pier structures ,2250mm wide x 2250mm deep, reinforced concrete cross head, two 2500mm square columns and two 4500mm x 2000mm deep square pile caps supported on 4x1050mm diameter piles.

The bridge abutments will consist of a 1800mm wide x 1500mm deep sill beam supported on 8x900 diameter piles.

4.2.3 Bridge Cost Estimate

In accordance with the agreement between Jacobs and VPA, a cost estimate for the construction of Bannockburn Bridge option BR01 was completed. The construction cost for the interim 2 lane, 323m long bridge spanning approximately 15m above the creek, is estimated to be circa $55 million based on the information provided in Section 4.2. Refer to Appendix C for a breakdown of the cost and the assumptions made.

5. Further Design Development

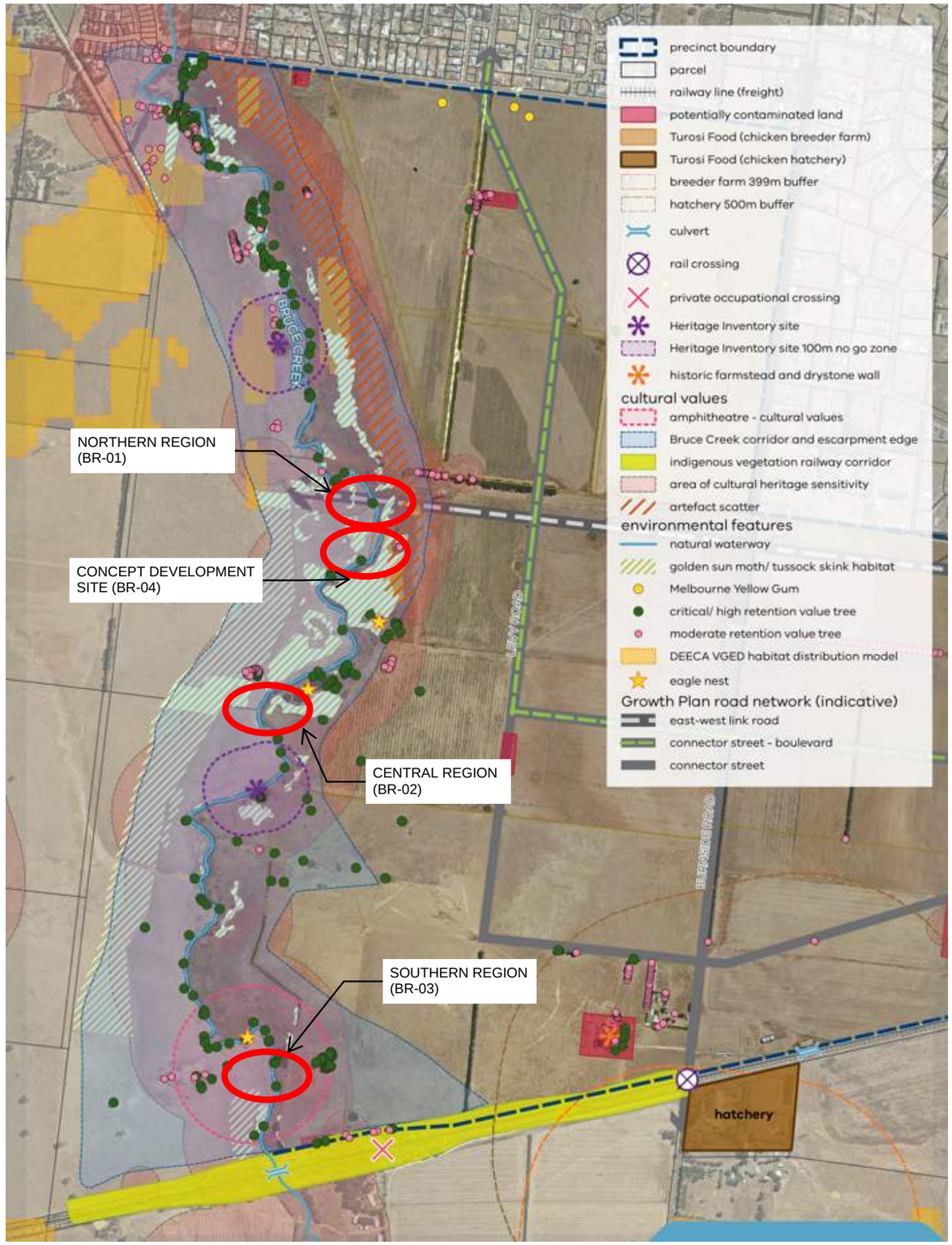
Jacobs suggests the VPA to undertake the following to further refine the cost and design of the bridge structure:

- Confirm / design the proposed road alignment
- Consult a construction company to understand the practicality of a long spanning structure to limit number of piers
- Geotechnical investigations to refine substructure design
- Confirm requirements for relocation of moderate / high value retention value trees
- Undertake survey to correctly map the extents and levels of the creek and banks

Appendix A. Bridge Sketches

Refer to the attached sketches:

- BNB-STR-SKT-001 – BANNOCKBURN SOUTH-EAST – CONSTRAINTS PLAN
- BNB-STR-SKT-002 – BANNOCKBURN SOUTH-EAST – OPTION 1 – LOW LEVEL STRUCTURE
- BNB-STR-SKT-003 – BANNOCKBURN SOUTH-EAST – OPTION 2 – HIGH LEVEL STRUCTURE



NOTES:
1. CONSTRAINTS SHOWN AS PER INFORMATION PROVIDED BY VPA MARCH 2025

ISSUED FOR FINAL DOCUMENTATION

NOT FOR CONSTRUCTION

REV	DATE	DRAWN	REVD	APPD	REVISION	DRAWING NUMBER	REFERENCE DRAWING TITLE
2	17/04/2025	MP	--		ISSUED FOR FINAL DOCUMENTATION		
1	18/12/2024	MP	--		ISSUED FOR CONCEPT DEVELOPMENT - FINAL		
0	8/12/2022	MP	AS		DRAFT FOR COMMENT		

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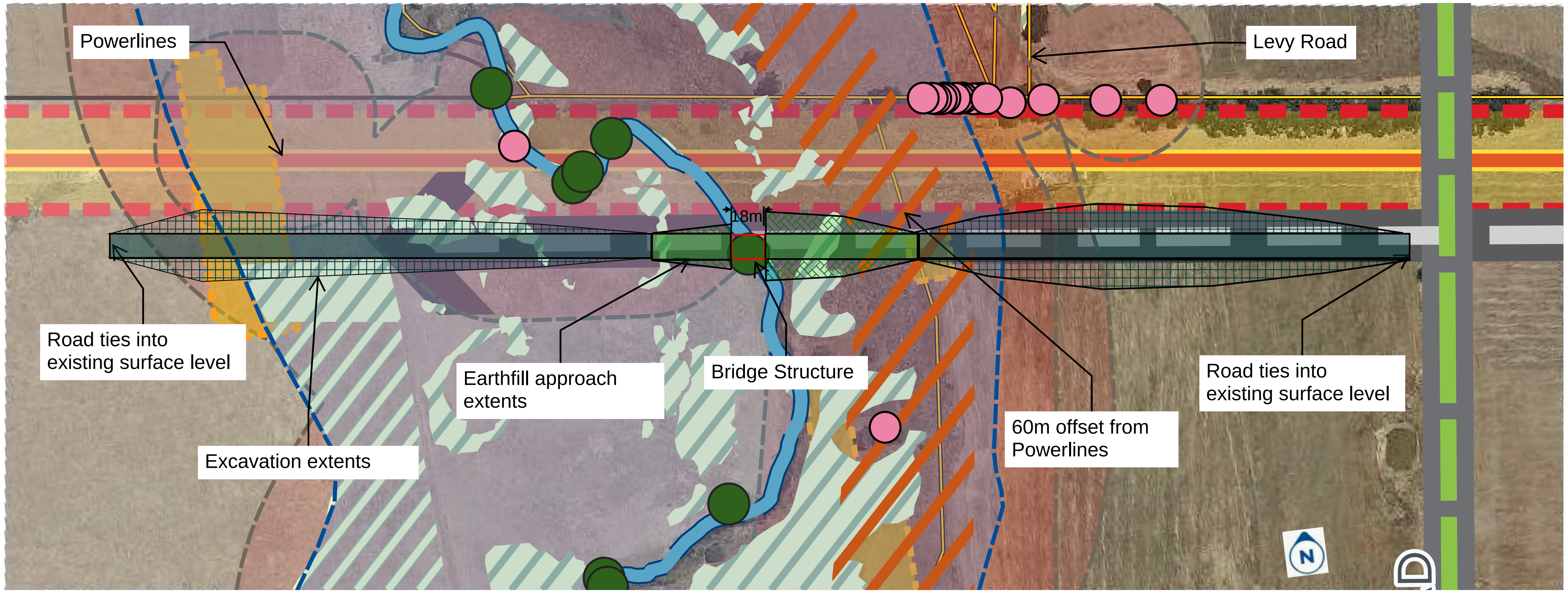
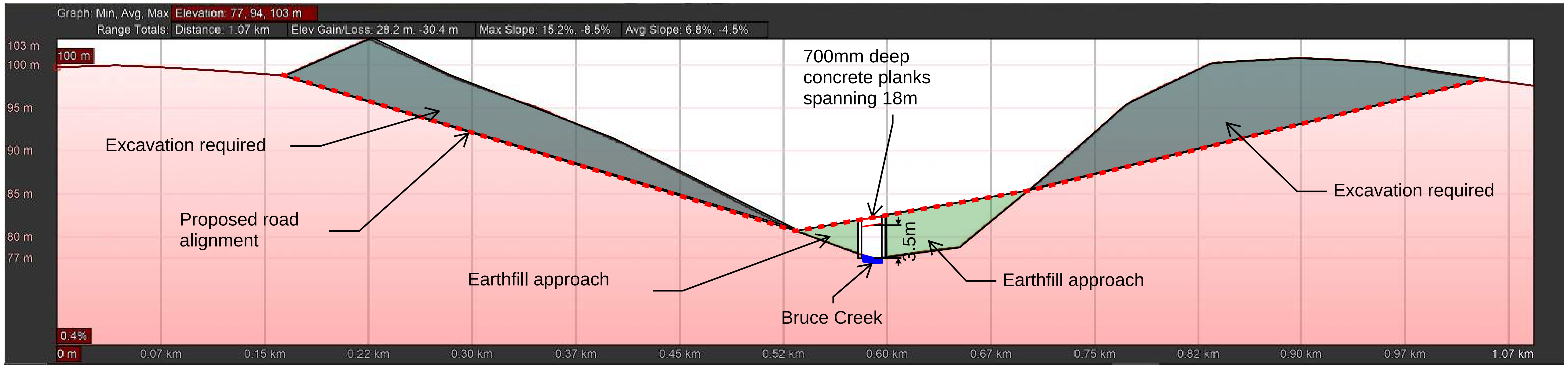
CLIENT: VICTORIAN PLANNING AUTHORITY
PROJECT: BANNOCKBURN SOUTH-EAST BRIDGE FEASIBILITY ASSESSMENT
DRAWN: MP | DRAWING CHECK: AS | REVIEWED: | APPROVED:
DESIGNED: MP | DESIGN REVIEW: AS | DATE: | DATE:

TITLE: BANNOCKBURN SOUTH-EAST - CONSTRAINTS PLAN
SCALE: NTS | DRAWING No: BNB-STR-SKT-001 | REV: 2





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0	8/12/2022	MP	AS		DRAFT FOR COMMENT		

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CLIENT: VICTORIAN PLANNING AUTHORITY

PROJECT: BANNOCKBURN SOUTH-EAST BRIDGE FEASIBILITY ASSESSMENT

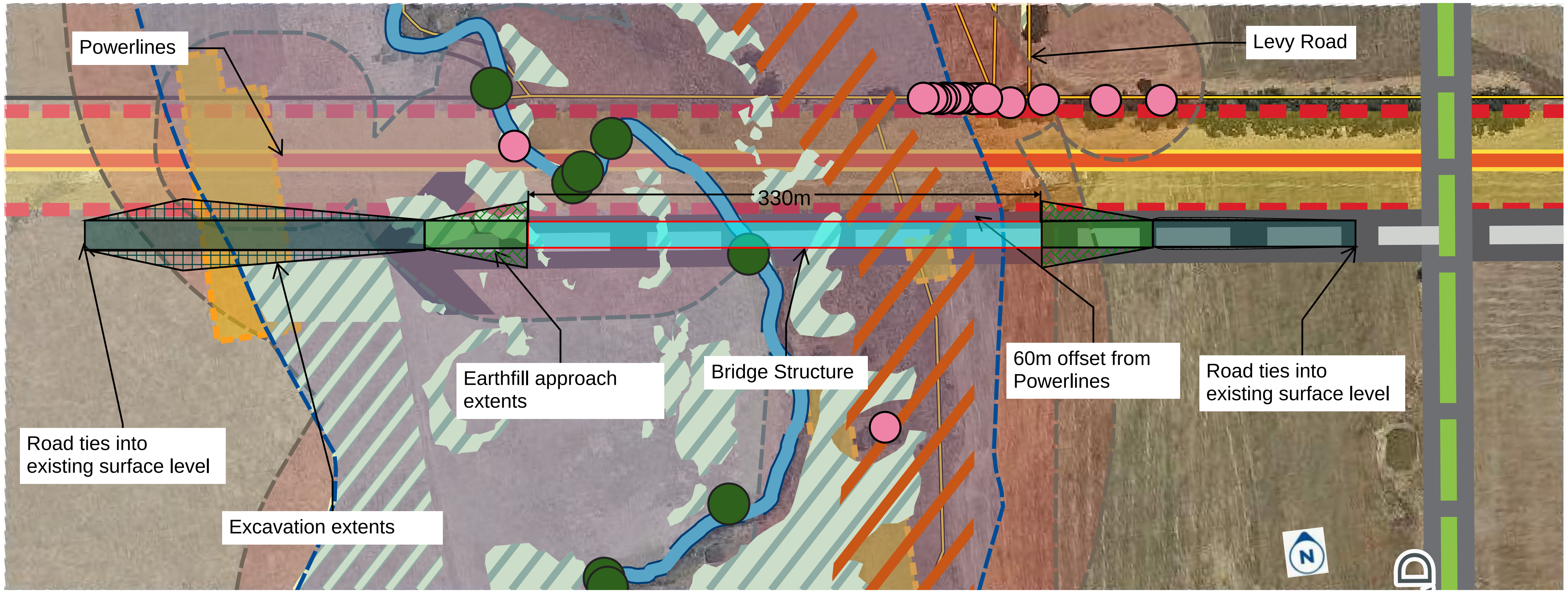
DRAWN	DRAWING CHECK	REVIEWED	APPROVED
MP	AS		
DESIGNED MP	DESIGN REVIEW AS	DATE	DATE

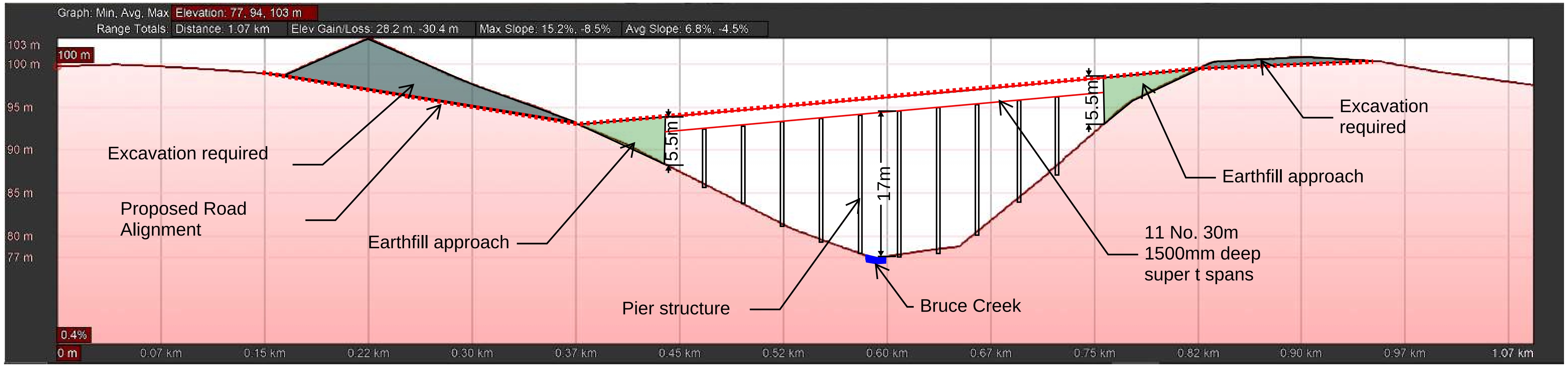
TITLE: BANNOCKBURN SOUTH-EAST - OPTION 1 - LOW LEVEL STRUCTURE

SCALE: NTS

DRAWING No: BNB-STR-SKT-002

REV: 2





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0	8/12/2022	MP	AS		DRAFT FOR COMMENT		

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CLIENT VICTORIAN PLANNING AUTHORITY

PROJECT BANNOCKBURN SOUTH-EAST BRIDGE FEASIBILITY ASSESSMENT

DRAWN MP | DRAWING CHECK AS | REVIEWED | APPROVED

DESIGNED MP | DESIGN REVIEW AS | DATE | DATE

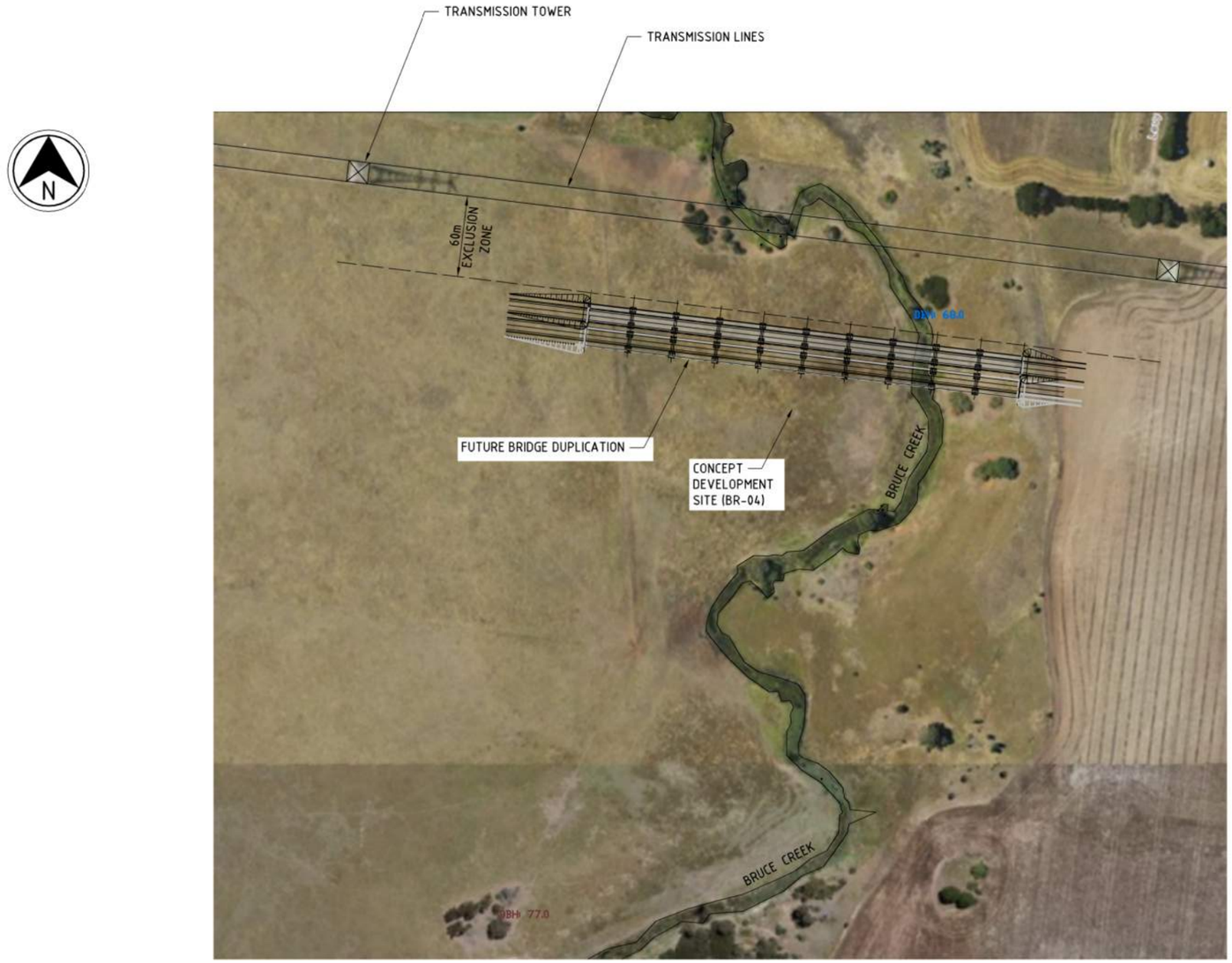
TITLE BANNOCKBURN SOUTH-EAST - OPTION 2 - HIGH LEVEL STRUCTURE

SCALE NTS | DRAWING No BNB-STR-SKT-003 | REV 2

Appendix B. Bridge Concept Drawings

Refer to the attached Bridge Concept Drawings:

- IA288900 – JCB-SBR-0005 – BANNOCKBURN CONCEPT DESIGN – ROAD BRIDGE – LOCALITY PLAN
- IA288900 – JCB-SBR-0010 – BANNOCKBURN CONCEPT DESIGN – ROAD BRIDGE – PLAN
- IA288900 – JCB-SBR-0015 – BANNOCKBURN CONCEPT DESIGN – ROAD BRIDGE – ELEVATION
- IA288900 – JCB-SBR-0020 – BANNOCKBURN CONCEPT DESIGN – ROAD BRIDGE – TYPICAL CROSS SECTION



LOCALITY PLAN
SCALE 1:2000

NOTES:

1. BRIDGE HAS BEEN DESIGNED TO A 5% DETAILED DESIGN STAGE.
2. VPA HAS PROVIDED LIDAR AND CONSTRAINT INFORMATION WHICH MAY NOT BE REPRESENTATIVE OF CURRENT CONDITIONS. BRIDGE DESIGN MAY REQUIRE ADJUSTMENT TO SUIT SITE CONSTRAINTS.
3. NO GEOTECHNICAL INFORMATION WAS PROVIDED. HIGH LEVEL ASSUMPTIONS HAVE BEEN USED TO INFORM THE DESIGN.
4. ROAD DESIGN HAS NOT OCCURRED AT THIS STAGE. THE BRIDGE LOCATION AND TYPE OF BRIDGE MAY NEED TO BE ALTERED TO SUIT ROAD CONFIGURATION.
5. FLOOD MODELLING HAS NOT BEEN UNDERTAKEN. PIERS MAY REQUIRE SHIFTING OR SKEWING TO ACCOMMODATE RIVER FLOWS.
6. PIER ORIENTATION MAY NEED TO BE ALTERED TO BETTER SUIT EXISTING TOPOGRAPHY AND LIMIT EXCAVATION.

SCALE 1:2000 (A1) 0 40 80 120 160 200m (40 20)

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CONCEPT DESIGN

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SCALES AT A1

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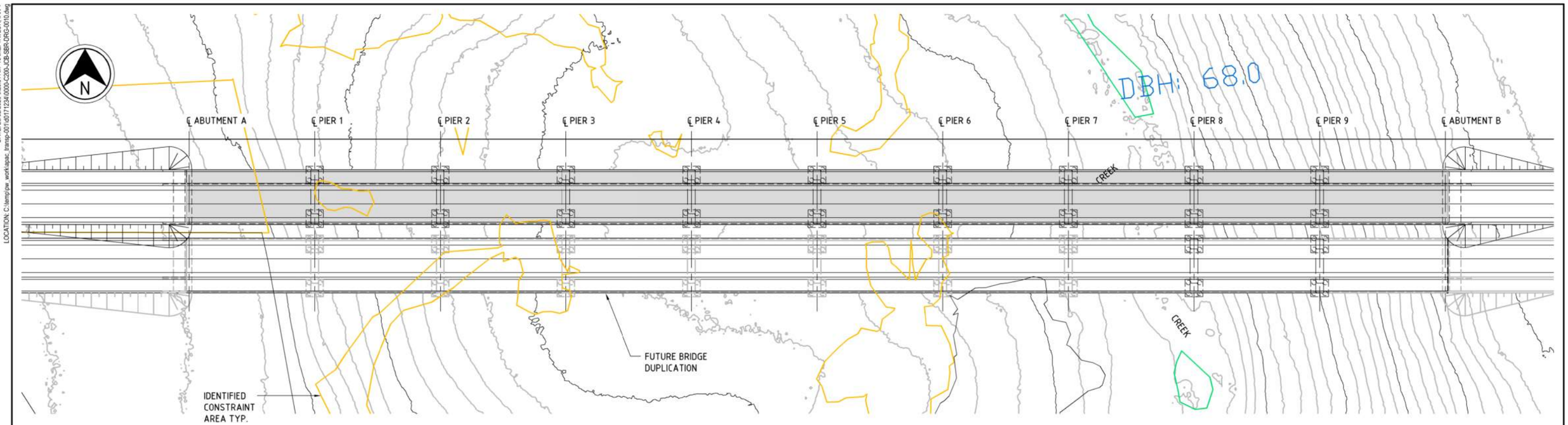
CLIENT: VICTORIAN PLANNING AUTHORITY			
PROJECT: BANNOCKBURN SOUTH EAST DEVELOPMENT PLAN			
DRAWN: I.TAYLOR	DRAWING CHECK:	REVIEWED: A.SONNENBERG	APPROVED:
DESIGNED: M.PINSON	DESIGN REVIEW:	DATE	DATE

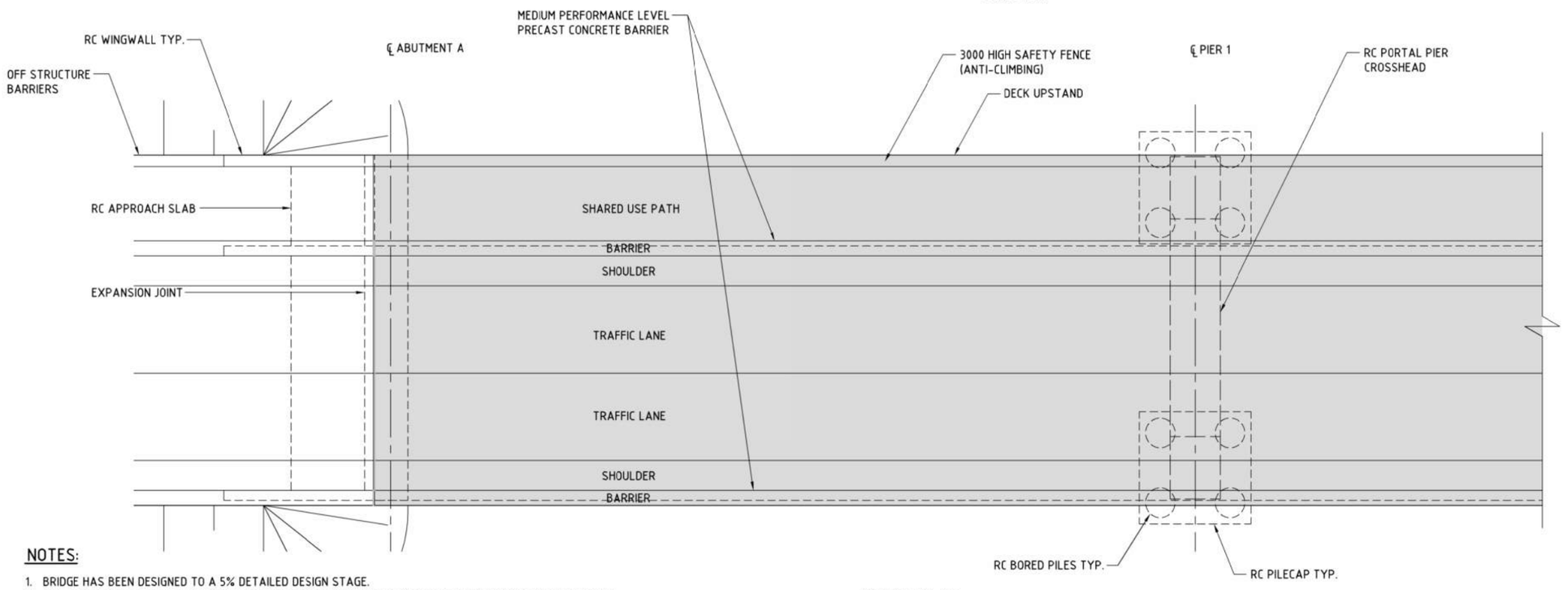
TITLE: TRANSPORT CONCEPT DESIGN
ROAD BRIDGE
LOCALITY PLAN

SCALE: AS SHOWN | DRAWING No: IA288900-JCB-SBR-0005 | REV: C

A1



PLAN
SCALE 1:500



DETAIL PLAN
SCALE 1:100

SCALE 1:100 (A1) 0 2000 4000 6000 8000 10000mm

SCALE 1:500 (A1) 0 10 20 30 40 50m

NOTES:

1. BRIDGE HAS BEEN DESIGNED TO A 5% DETAILED DESIGN STAGE.
2. VPA HAS PROVIDED LIDAR AND CONSTRAINT INFORMATION WHICH MAY NOT BE REPRESENTATIVE OF CURRENT CONDITIONS. BRIDGE DESIGN MAY REQUIRE ADJUSTMENT TO SUIT SITE CONSTRAINTS.
3. NO GEOTECHNICAL INFORMATION WAS PROVIDED. HIGH LEVEL ASSUMPTIONS HAVE BEEN USED TO INFORM THE DESIGN.
4. ROAD DESIGN HAS NOT OCCURRED AT THIS STAGE. THE BRIDGE LOCATION AND TYPE OF BRIDGE MAY NEED TO BE ALTERED TO SUIT ROAD CONFIGURATION.
5. FLOOD MODELLING HAS NOT BEEN UNDERTAKEN. PIERS MAY REQUIRE SHIFTING OR SKEWING TO ACCOMMODATE RIVER FLOWS.
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DRAFT CONCEPT DESIGN

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C	18/12/2024		CONCEPT DESIGN ISSUE
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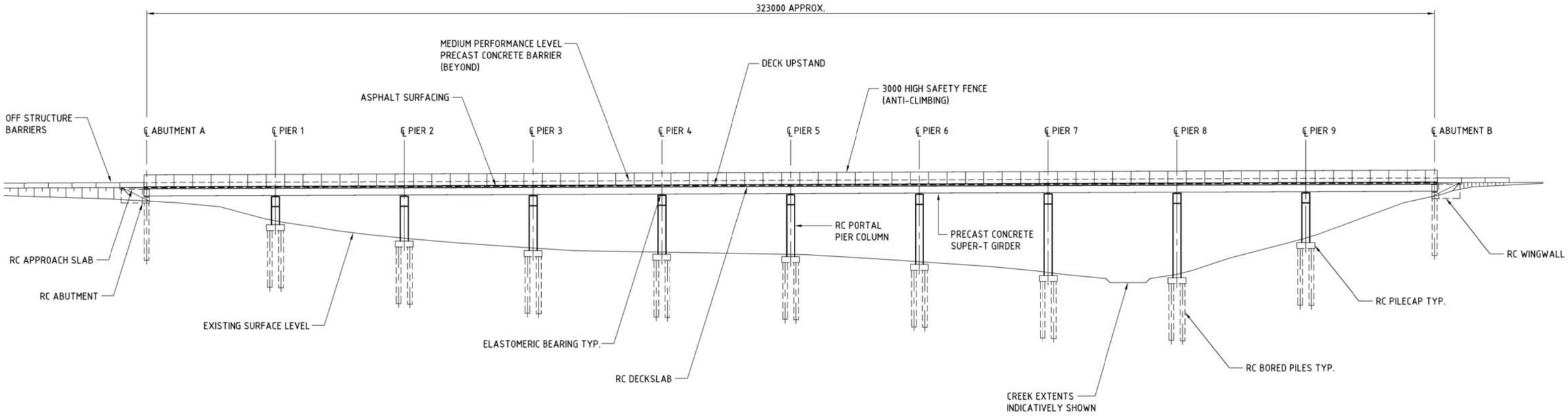
CLIENT: VICTORIAN PLANNING AUTHORITY
PROJECT: BANNOCKBURN SOUTH EAST DEVELOPMENT PLAN

DRAWN	DRAWING CHECK	REVIEWED	APPROVED
I.TAYLOR		A.SONNENBERG	
DESIGNED	DESIGN REVIEW	DATE	DATE
M.PINSON			

TITLE: TRANSPORT CONCEPT DESIGN
ROAD BRIDGE
PLANS

SCALE	DRAWING No.	REV
AS SHOWN	IA288900-JCB-SBR-0010	E

A1



TYPICAL ELEVATION
SCALE 1:500

NOTES:

1. REFER DRAWING SBR-0010 FOR GENERAL NOTES.
2. EXISTING GROUND PROFILE INDICATIVELY SHOWN BASED ON THE SURVEY INFORMATION PROVIDED BY VPA.
3. CREEK LOCATION INDICATELY SHOWN DUE TO SKEW OF WATERWAY.

SCALE 1:500 (A1) 0 10 20 30 40 50m (10 8 6 4 2)

NOT FOR CONSTRUCTION

DRAFT CONCEPT DESIGN

REV	DATE	APP'D	REVISION
E	17/04/2025		ISSUED FOR FINAL DOCUMENTATION
D	28/02/2025		CONCEPT DESIGN ISSUE
C	18/12/2024		CONCEPT DESIGN ISSUE
B	18/10/2024		DRAFT CONCEPT DESIGN ISSUE
A	8/10/2024		DRAFT CONCEPT DESIGN ISSUE

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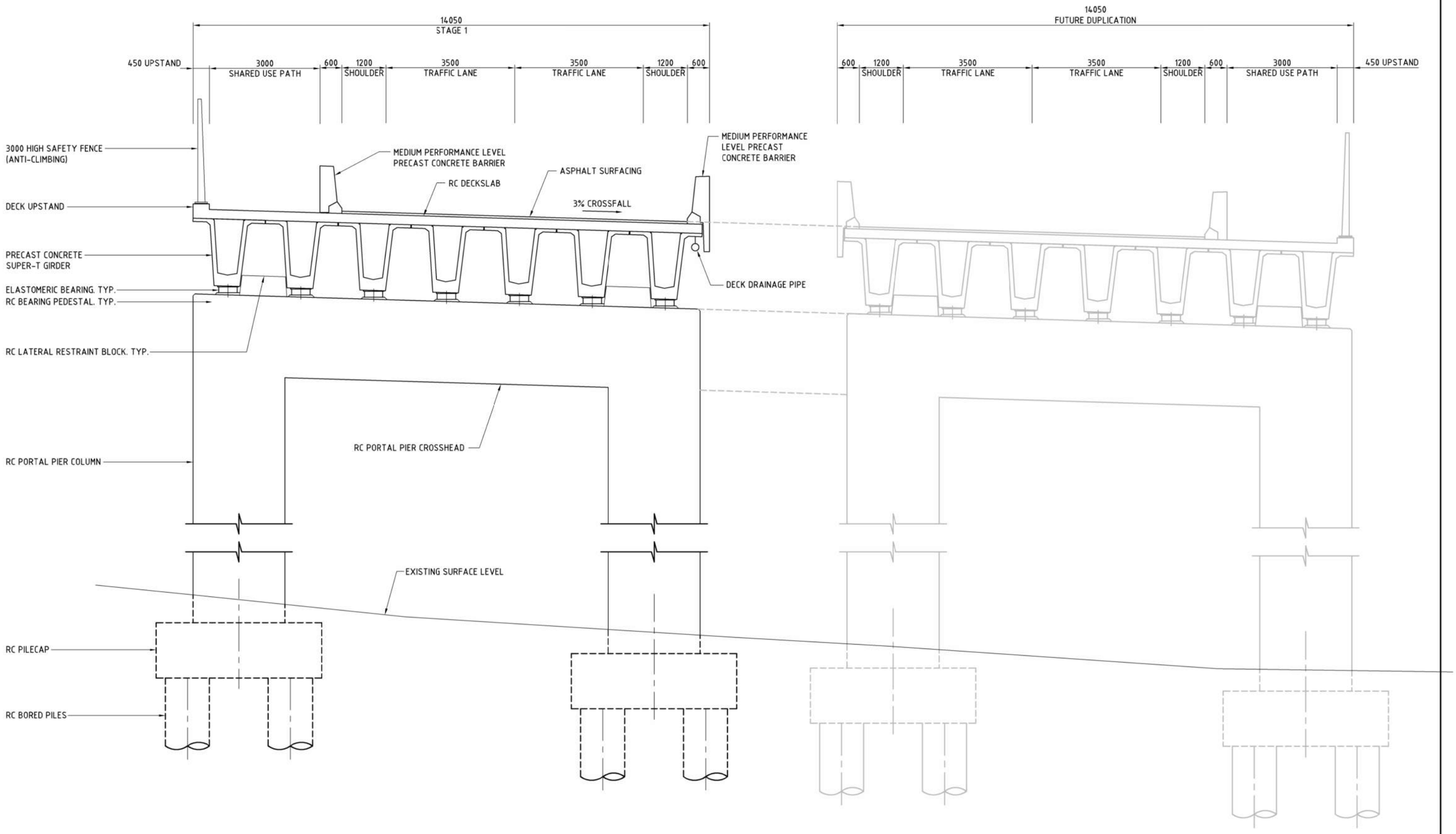
CLIENT: VICTORIAN PLANNING AUTHORITY
PROJECT: BANNOCKBURN SOUTH EAST DEVELOPMENT PLAN

DRAWN	DRAWING CHECK	REVIEWED	APPROVED
I.TAYLOR		A.SONNENBERG	
DESIGNED	DESIGN REVIEW	DATE	DATE
M.PINSON			

TITLE: TRANSPORT CONCEPT DESIGN
ROAD BRIDGE
TYPICAL ELEVATION

SCALE: AS SHOWN | DRAWING No: IA288900-JCB-SBR-0015 | REV: E

A1



TYPICAL SECTION AT PIER
SCALE 1:50

NOTES:

1. REFER DRAWING SBR-0010 FOR GENERAL NOTES.
2. TYPICAL BRIDGE CROSS SECTION HAS BEEN SHOWN. GROUND PROFILE AT EACH PIER VARIES.

SCALE 1:50 (A1) 0 1000 2000 3000 4000 5000mm

NOT FOR CONSTRUCTION
DRAFT CONCEPT DESIGN

REV	DATE	APP'D	REVISION
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C	18/12/2024		CONCEPT DESIGN ISSUE
B	18/10/2024		DRAFT CONCEPT DESIGN ISSUE
A	8/10/2024		DRAFT CONCEPT DESIGN ISSUE

SCALES AT A1

Victorian Planning Authority

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CLIENT: VICTORIAN PLANNING AUTHORITY
PROJECT: BANNOCKBURN SOUTH EAST DEVELOPMENT PLAN

DRAWN	DRAWING CHECK	REVIEWED	APPROVED
I.TAYLOR		A.SONNENBERG	
DESIGNED	DESIGN REVIEW	DATE	DATE
M.PINSON			

TITLE: TRANSPORT CONCEPT DESIGN
ROAD BRIDGE
TYPICAL CROSS SECTION

SCALE: AS SHOWN | DRAWING No: IA288900-JCB-SBR-0020 | REV: E

A1

Appendix C. Bridge Costing

Refer to the attached information for costing of bridge Bannockburn Bridge BR01.

Project: VPA - Bannockburn Bridge
Class 4/5 Estimate (AACE)

Date:	17/04/2025
Project name:	VPA - Bannockburn Bridge
Project no:	IA288900
Attention:	-
Company:	Victorian Planning Authority
Prepared by:	Simon Baum
Reviewed by:	Stuart Jackson
Document No:	IA288900-EST-001
Revision no:	B
Copies to:	VPA - Bannockburn Bridge

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Australia
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Document history and status

Revision	Date	Description	Author	Checked	Reviewed	Approved
A	25/02/2025	Draft for Client Comments	SB	SB/SJ	SB/SJ/MP	MP/AS
B	17/04/2025	Issued For Final Documentation	SB	SB/SJ	SB/SJ/MP	MP/AS

Distribution of copies

Revision	Date	Description	Issued to	Comments
A	25/02/2025	Draft for Client Comments	VPA	
B	17/04/2025	Issued For Final Documentation	VPA	

1. Limitations

The sole purpose of the estimates in this report is to provide a project cost estimate for the **Bannockburn Bridge Option** in accordance with the scope of services set out in the contract between Jacobs and **VPA**. The scope of services, as described in this report, was developed with the Client.

In preparing this report, Jacobs has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by the Client and/or from other sources. Except as otherwise stated in the report, Jacobs has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our estimated values and conclusions as expressed in this report may change.

The passage of time, the manifestation of latent conditions or impacts of future events may require further examination of the project and subsequent data analysis, and re-evaluation of the data, findings, observations and conclusions expressed in this report. Jacobs has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

This report should be read in full and no excerpts are to be taken as representative of the findings. No responsibility is accepted by Jacobs for use of any part of this report in any other context.

This report is strictly indicative only and includes indicative estimated quantities, rates, values, etc. for various items. The report does not provide a guarantee that the indicative prices, quantities, or rates (individual or groups) will be required/obtained or that the break-down provided will match those submitted by Contractors / Sub-contractors, etc.

The Client acknowledges and accepts that the estimate is based on current cost estimates and that the Consultant has no control over cost fluctuations in labour or materials to be ultimately used in the project.

This report has been prepared on behalf of, and for the exclusive use of, **VPA**, and is subject to, and issued in accordance with, the provisions of the contract between Jacobs and the Client. Jacobs accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report by any third party.

2. Estimate Accuracy

Jacobs classifies cost plans and estimates, based on the amount and quality of information available at the time the estimate is developed. The amount of time available and effort expended to prepare the estimate has a significant bearing on the expected accuracy range.

As such, the level of accuracy, in this case, is based on a **Class 4** Estimate due to the Project Scope being in the order of **<10%** design thus leading to an Expected Estimate range in the region of **-20%, +40%** as shown in Table 1.

Table 1: The Expected Accuracy Ranges stated in the Cost Estimate Classification Matrix

	Primary Characteristics	Secondary Characteristic		
ESTIMATE CLASS	**LEVEL OF PROJECT DEFINITION** Expressed as % of complete definition	**END USAGE** Typical purpose of the estimate	**METHODOLOGY** Typical estimating method	**EXPECTED ACCURACY RANGE** Typical variation in low and high ranges [a]
Class 5 (Order of Magnitude)	***0% to 2%***	Concept Screening	Capacity Factored, Parametric Models, Judgment, or Analogy	**L: -20% to -50%** **H: +30% to +100%**
Class 4 (Preliminary)	***1% to 15%***	Study or Feasibility	Equipment Factored or Parametric Models	**L: -15% to -30%** **H: +20% to +50%**
Class 3 (Early Budget)	***10% to 40%***	Budget, Authorization, or Control	Semi-Detailed Unit Costs with Assembly Level Line Items	**L: -10% to -20%** **H: +10% to +30%**
Class 2 (Budget/Control)	***30% to 70%***	Control or Bid / Tender	Detailed Unit Cost with Forced Detailed Take-off	**L: -5% to -15%** **H: +5% to +20%**
Class 1 (Definitive/Construction)	***50% to 100%***	Check Estimate or Bid/Tender	Detailed Unit Cost with Detailed Take-Off	**L: -3% to -10%** **H: +3% to +15%**

The availability of applicable reference cost data affects the range markedly. The +/- value represents the typical percentage variation of actual costs from the cost estimate after the application of contingency for the given scope.

3. Basis of Estimate

The project comprises the following work scope;
- New Bridge Works, 323m long, as per design drawings (Single Bridge, Stage 1)
- Associated Works, etc.

We have included for contractor's preliminaries, and on site construction management, and profit. Costs are deemed c urrent as at Feb 2025. Current construction cost data has been utilised for the estimate development.

Indirect Project Costs: refer to estimate summary.

Contingencies: refer to estimate summary

Victorian Planning Authority
VPA - Bannockburn Bridge

Jacobs

February 2024
Prepared by Simon Baum
Reviewed by Stuart Jackson

Descriptions		Qty	Unit	Rate	Total	Total
Key Notes						
Background & Introduction Notes						
Refer to Project Drawings.						
Estimate						
Option - 323M Bridge						
Site Establishment						610,000
Allowance for general site establishment, temp fencing, etc		1	Set	250,000	250,000	
Services identifications		-	Day	3,500	-	
Services proving		-	Day	3,500	-	
Access Tracks						
- 750m x 6m						
- difficult terrain		800.0	LM	450	360,000	
Bridge Works		4,522	m2	6,309		28,527,666
Key Measurement						
Abutments		2	No			
Piers		9	No			
Bridge Deck	290m x 14m	4,522	m2			
Bridge Length		323	LM			
Piles to Piers		72	Piles			
Piles to Abutments	2 x 8	16	Piles			
Volume Per Pile	1200 Dia, 20m nominal depth	22.6	m3 each, without waste			
Pile Caps		18.0	Pile Caps			
Volume per Pile Cap, approx.	4.5 x 4.5 x 1.5, each	30.4	m3 each, without waste			
Formwork at each Pile Cap		27.0	m2 each			
Pier Leg Heights (excluding Pier Head Depth)	Pier 1	4	LM			
	Pier 2	10	LM			
	Pier 3	11	LM			
	Pier 4	13	LM			
	Pier 5	13	LM			
	Pier 6	16	LM			
	Pier 7	18	LM			
	Pier 8	19	LM			
	Pier 9	10	LM			
	Total	114	LM			
	Average	12.7	LM			
Super Tee Beams, 1800 deep	323m, 10 spans	32.30	LM each			
Super Tee Beams, count	7 Beams per Span, 9 Spans	70.0	Beams			
Piles		88.0	Each	45,245		
		1,990.8	m3 Rate Onl	2,000		
Excavation to Piles		1,990.8	m3	450	895,847	
Concrete to Piles		1,990.8	m3	700	1,393,540	
Reo Cages to Piles - 200kg/m3		398.2	m3	3,800	1,512,986	
Disposals		1,990.8	m3	90	179,169	
Pile Caps						
Excavation for Pile Caps		820	m3	90	73,811	
Disposals		547	m3	50	27,338	
Backfilling at Pile Caps		273	m3	90	24,604	
Concrete to Pile Caps		547	m3	600	328,050	
Reo to Pile Caps, 150kg/m3		82	Tons	3,800	311,648	
Formwork to Pile Caps		486	m2	200	97,200	
Piers						
Concrete to Piers - Legs Only	2.5 wide, 2.0m deep	1,140	m3	750	855,000	
Reo to Pier Legs, 200kg/m3		228	Tons	3,900	889,200	
Formwork to Pier Legs		2,052	m2	500	1,026,000	
Concrete to Pier Heads		1,109	m3	750	831,600	
Reo to Pier Heads		222	Tons	3,900	864,864	
Formwork to Pier Heads, sides and soffits		1,619	m2	600	971,520	
Lateral Restraint Blocks, 2 per Pier		18	Sets	5,000	90,000	
Abutments						
Piles to Abutments	8 each x 2 abutments	16	Piles	Included		
Concrete to Abutments		112	m3	700	78,400	
Reo to abutments		22	Tons	3,800	85,120	
Formworks		140	m2	450	63,000	
Super Tee Deck						
Supply Super Tee Beams, 1800 Deep						
- 1.7 tons/m or ~55t each						
- based on $2900/m, $4200/m3, say	Super Tee Beam Pricing is					
- Cross Section ~0.7m2	current, and checked with					
- Volume ~32.2 x 0.7 = 22.5m3	Jacobs Estimating Teams, and					
- https://www.nationalprecast.com.au/wp-	current supply prices (Late					
content/uploads/2015/10/Products-Super-Tees.pdf	2024)	70	Each	93,670	6,556,900	
Placement of Super Tee Beams	80 days, $50k/day	70	Each	65,000	4,550,000	
Bridge Bearings		140	Each	3,750	525,000	
Stitching of SuperTees		70	Each	5,000	350,000	
Bridge Deck						
Formwork to Super Tees						
- 323m x 1m x 7 beams		2,261	m2	275	621,775	
Concrete to Deck Slab, 250 thick		1,131	m3	650	734,825	
Reo to Deck Slab		226	Ton	3,700	836,570	
Formwork to edges		646	LM	350	226,100	
Bridge Barrier, including edge drop section	6m each end longer than bridge	335	LM	1,900	636,500	
Bridge Barrier, on Bridge Deck	6m each end longer than bridge	335	LM	1,200	402,000	
Bridge Barrier Throw Screen, 3000mm high	6m each end longer than bridge	335	LM	3,000	1,005,000	
Bridge Sundries						

Victorian Planning Authority
VPA - Bannockburn Bridge

Jacobs

February 2024
Prepared by Simon Baum
Reviewed by Stuart Jackson

Descriptions		Qty	Unit	Rate	Total	Total
Light Poles	Every 50m	6	No	25,000	150,000	
Power Connection		1	Set	100,000	100,000	
Drainage Lines		350	LM	450	157,500	
Service Route	Allowance	350	LM	450	157,500	
Approach Slabs						
Allowance for approach slabs	2 each x 3m x 14m	84	m2	400	33,600	
Abutment Civils						
Site scrapes		2,100	m2	15	31,500	
Engineered Filling						
-		2,800	m3	180	504,000	
Road Works						
-	2 x 14m x 50m	1,400	m2	250	350,000	
Spare						-
- Not required						
Commissioning						-
Commissioning Allowance						
- not applicable						
Contractor's Overhead Costs and Profit						**13,111,950**
Contractor's Project Management and Site Supervision including						
- temporary works design - management plans - safety, quality , environment, comms - Site meetings with Superintendent	Keep high, for small project. Specialised work, slightly remote	30%	of	29,137,666	8,741,300	
Contractor's Overheads and Profit		10%	of	29,137,666	2,913,767	
Environmental Monitoring Costs - Air, Noise, Water, etc.			Item		-	
- usually not required						
Engineering Design						
- Contractor's Detailed Design		5%	of	29,137,666	1,456,883	
TOTAL Constructed Cost (excl. GST)		4,522	m2	9,343	**42,249,616**	**42,249,616**
Indirect Project Costs						**6,969,939**
Consultant Design Fees						
Geotechnical Investigations		1	Item		**75,000**	
Engineering Design						
- including detailed design		8%	of	42,249,616	**3,379,969**	
					-	
Client Project Management and Communications					-	
Client Project Management and Communications		8%	of	42,249,616	**3,379,969**	
					-	
Due Diligence and Site Investigations		NONE				
CHMP Due Diligence			Item		**15,000**	
Statutory Planning Due Diligence			Item		**10,000**	
Flora and Fauna Due Diligence			Item		**10,000**	
CHMP field investigations and formal CHMP standard			Item		**25,000**	
Flora & Fauna field investigation and report -standard			Item		**25,000**	
Planning permit report addressing triggers			Item		**20,000**	
Land Acquisition including rezoning and legal costs					No Allowance	
Easement Acquisition including Legal costs		-	Item		No Allowance	
Approvals/permit applications by Client/consultant						
Roads			Item		**10,000**	
Rail Track			Item		-	
Drainage			Item		**20,000**	
Gas/Power transmission			Item		-	
Other Costs						

TOTAL ESTIMATED COST (EXCL GST)				**49,219,555**
Contingency Allowance	**25.0%**			**12,304,889**
TOTAL INCLUDING CONTINGENCY ALLOWANCE			Excl GST	**61,524,444**
Potential P10 Cost		Deterministic	Optimistic	44,300,000
Potential P50 Cost		Deterministic	Most Likely	55,370,000
Potential P90 Cost		Deterministic	Pessimistic	61,520,000