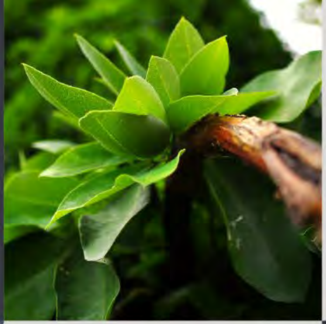
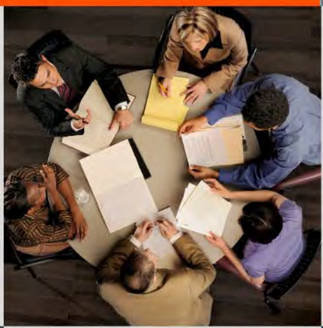
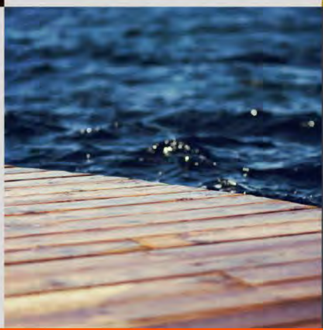






TOWN PLANNING REPORT

Planning Scheme Amendment - Rezoning Application

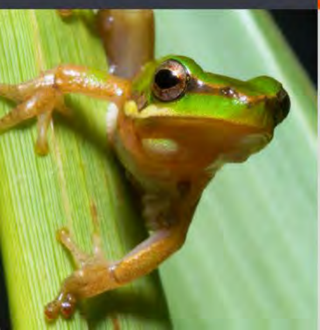
5, 20, 25 and 30 Ormond Street, Bannockburn

Prepared for Inglis, Collins, Kennedy & Hinchcliffe

By Planit Consulting Pty Ltd

November 2022

Job No. J7482



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Client	Inglis, Collins, Kennedy & Hinchcliffe
Client Project Manager	Chris Marshall
Authors	Chris Marshall
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1.0 Introduction

Planit Consulting has been engaged by landowners Inglis, Collins, Kennedy & Hinchcliffe to prepare a planning scheme amendment application to rezone their land at Bannockburn to the General Residential 1 Zone. The ownership details are as follows:

- 5 Ormond Street, Owner Inglis
- 20 Ormond Street, Owner Collins
- 25 Ormond Street, Owner Kennedy
- 30 Ormond Street, Owner Hinchcliffe

The application also seeks to introduce a Schedule to the Development Plan Overlay over the land proposed to be rezoned. The subject site is located to the west of central Bannockburn and is identified in the Bannockburn Urban Design Framework Plan for future residential development.

1.1 Application Details

Table 1- Basic Information

Basic Information	
Applicant	Inglis, Collins, Kennedy & Hinchcliffe
Application	Planning Scheme Amendment - Rezoning Application
Address	5, 20, 25 and 30 Ormond Street, Bannockburn
Property Description	Farming land
Total Site Area	16.93 hectares
Proposed Zone	General Residential Zone
Proposed Overlay	Schedule to the Development Plan Overlay
Planning Scheme	Golden Plains Shire

This planning report has been prepared consistent with the overarching State and Local Strategic Planning Policies and specific statutory planning provisions of the Golden Plains Planning Scheme relevant to the rezoning of this land. The planning report also includes a number of technical reports and plans (attached to this report) that demonstrate the subject land's suitability and capability for rezoning to the General Residential zone and should be read in conjunction with these technical reports as attached.

2.0 Subject Site and Context

2.1 Subject Site

Site Description	
Location	The subject site is located on Ormond Street and Harvey Road, Bannockburn as highlighted above.
Lot Description	The subject site is made up of four (4) individual titles known formally as follows: 5 Ormond Street, Bannockburn Vol 09523 Fol 914, Allotment 12 Section 22B 20 Ormond Street, Bannockburn Vol 09381 Fol 088, Allotment 11 Section 22B 25 Ormond Street, Bannockburn Vol 09338 Fol 821, Allotment 10 Section 22B 30 Ormond Street, Bannockburn Vol 09358 Fol 645, Lot 1 on TP174543 The land is irregular in shape with an overall area of approximately 16.93 hectares. As advised the land is made up of four individual allotments which essentially resemble developed rural residential lots with a mix of dwelling types and outbuildings contained on each lot. Each lot has its own individual access to either Ormond Street or Harvey Road.
Site Attributes	Overall, the subject site is described as substantially cleared land with mostly planted vegetation along lot boundaries and surrounding the existing dwellings on each allotment and grape vines on 5 Ormond Road. The vegetation cover is sparse, and the land is degraded in appearance. The site is devoid of significant environmental values except for Bruce's Creek which is a steeply incised waterway located along the eastern boundary of the subject site and bisects the north-eastern boundary of 25 Ormond Street Bannockburn. There are also a small

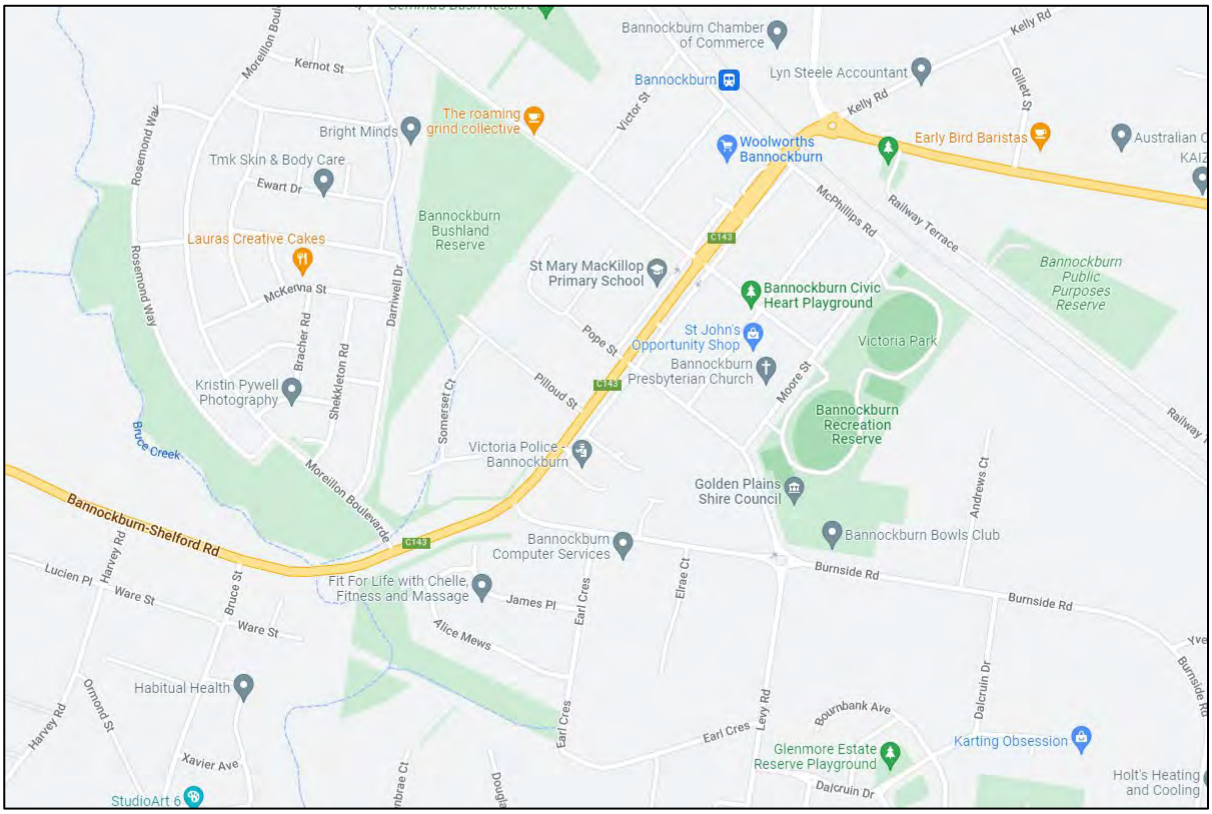
Site Description	
	number of patches of native vegetation on site however overall, the land is considered substantially degraded. The lots are fenced with post and wire fencing.
Access Point	Each allotment has a formal vehicle crossover access to either Ormond Street or Harvey Road.
Current Zone	Farming Zone
Utilities and services	The subject site is connected to electricity, water, and telecommunications. The subject site benefits from access to a range of nearby services and facilities within Bannockburn.

2.2 Site Surrounds

The surrounding land immediately to the north and northeast is developed as conventional residential housing lots. The surrounding land to the east, west and south is described as small lot farming land which has a mix of lot sizes and uses and are developed with houses, outbuildings and in some cases glass houses. As advised Bruce's Creek is located to the east of the subject land and bisects land at 25 Ormond Road.

2.3 Broader Context

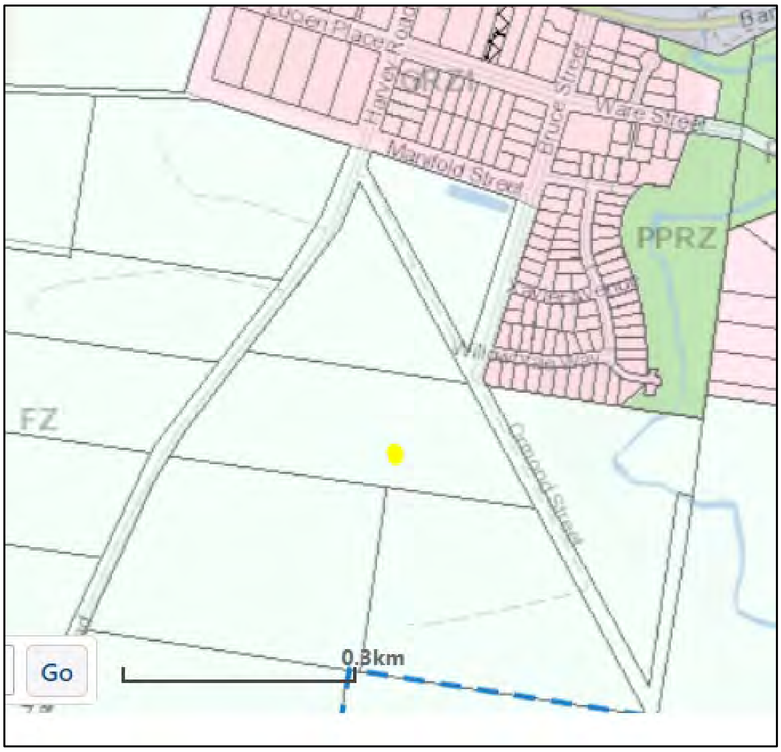
The subject site is located in close proximity to all the town services of Bannockburn including approximately 1km to central Bannockburn where commercial and community services including the Mary Mackillop Primary School are located. The Shire Offices, Day Care Centre and Recreation Reserve are located to the east of the land. Public transport in the form of buses and trains are available from Bannockburn to Geelong.



Surrounding Locality Plan

2.4 Surrounding Zones and Overlays

The subject site and surrounding land to the east, west and south are included within the Farming Zone. The land to the north is included within the General Residential Zone. Land at 25 Ormond Road is affected by the Environmental Significance Overlay (Schedule 2) and Land Subject to Inundation Overlay.



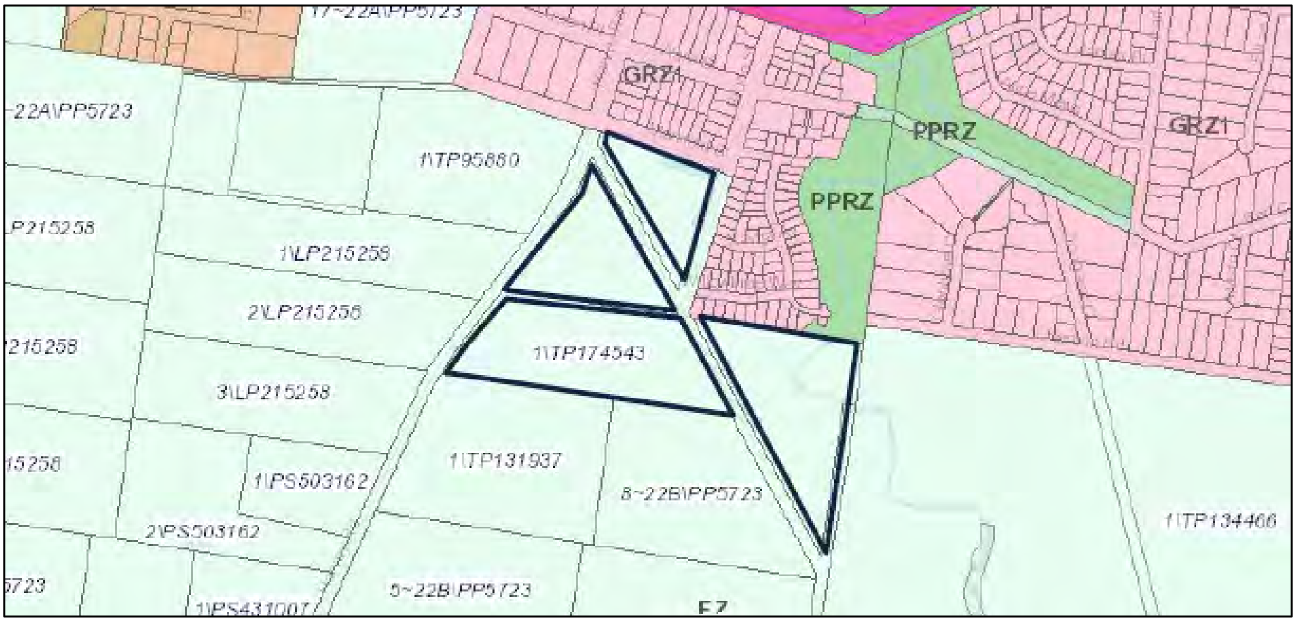
Zone Map

Ormond Street and Harvey Road are the main access roads to the site. Harvey Road is a sealed road with grassed verges. Ormond Street contains a gravel surface with grassed swales. Both these roads are local roads managed by the Golden Plains Shire.

3.0 Current Zone

3.1 Farming Zone

Pursuant to the Golden Plains Planning Scheme the subject site is located within the Farming Zone.



The purpose of the Farming Zone is to:

- Implement the Municipal Planning Strategy and the Planning Policy Framework.
- Provide for the use of land for agriculture.
- Encourage the retention of productive agricultural land.
- Ensure that non-agricultural uses, including dwellings, do not adversely affect the use of land for agriculture.
- Encourage the retention of employment and population to support rural communities.
- Encourage use and development of land based on comprehensive and sustainable land management practices and infrastructure provision.
- Provide for the use and development of land for the specific purposes identified in a schedule to this zone.

Comment: The land is currently within the Farming Zone and contains existing dwellings on each lot. Each lot is sparsely vegetated and degraded in appearance. The land is made up of four (4) small allotments each with limited to no capacity to be managed and used for productive agricultural purposes. Therefore, the future rezoning of this land will not have a detrimental impact on the farming productivity of the Shire as the land is essentially small unproductive land and not managed for any commercial agricultural enterprise. In addition, the proposed rezoning of this land to the General Residential 1 Zone accords with the strategic planning direction of Bannockburn as referenced further in this report.

4.0 Current Overlays

4.1 Land Subject to Inundation Overlay – Clause 44.04

Pursuant to the Golden Plains Planning Scheme the land at 25 Ormond Street is partly included within the Land Subject to Inundation Overlay and Environmental Significance Overlay (Schedule 2) as shown below. No other overlays effect the subject land.

The purpose of the Clause 44.04, Land Subject to Inundation Overlay is:

- To implement the Municipal Planning Strategy and the Planning Policy Framework.
- To identify land in a flood storage or flood fringe area affected by the 1 in 100 year flood or any other area determined by the floodplain management authority.
- To ensure that development maintains the free passage and temporary storage of floodwaters, minimises flood damage, is compatible with the flood hazard and local drainage conditions and will not cause any significant rise in flood level or flow velocity.
- To reflect any declaration under Division 4 of Part 10 of the Water Act, 1989 where a declaration has been made.
- To protect water quality in accordance with the provisions of relevant State Environment Protection.
- Policies, particulary in accordance with Clauses 33 and 35 of the State Environment Protection Policy (Waters of Victoria).
- To ensure that development maintains or improves river and wetland health, waterway protection and flood plain heath.

Decision guidelines - Clause 44.04-8

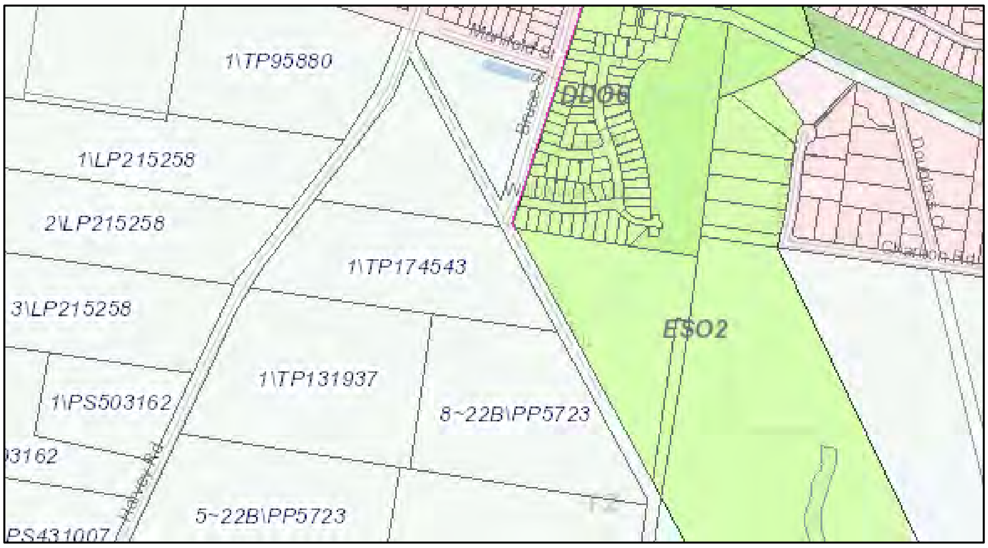
Before deciding on an application, in addition to the decision guidelines in Clause 65, the responsible authority must consider, as appropriate:

- The Municipal Planning Strategy and the Planning Policy Framework.
- Any local floodplain development plan.
- Any comments from the relevant floodplain management authority.
- The existing use and development of the land.
- Whether the proposed use or development could be located on flood-free land or land with a lesser flood hazard outside this overlay.
- The susceptibility of the development to flooding and flood damage.
- The potential flood risk to life, health and safety associated with the development. Flood risk factors to consider include:
    - The frequency, duration, extent, depth and velocity of flooding of the site and accessway.

Comment: Land at 25 Ormond Street is the only lot within the subject site affected by this overlay which appears to be located exclusively over Bruces Creek environs. A planning permit is required under this overlay for the subdivision of the land however the future subdivision will require setbacks from the instream environs of Bruce's Creeks and therefore is unlikely to impact on the creek.

4.2 Environmental Significance Overlay – Clause 42.01

Pursuant to the Golden Plains Planning Scheme the subject site is included within the Environmental Significance Overlay.



The purpose of the Clause 42.01, Environmental Significance Overlay is:

- To implement the Municipal Planning Strategy and the Planning Policy Framework.
- To identify areas where the development of land may be affected by environmental constraints.
- To ensure that development is compatible with identified environmental values.

Under the provisions of Clause 42.01-2 a permit is required to:

- Construct a building or construct or carry out works. This does not apply if a schedule to this overlay specifically states that a permit is not required.
- Construct a fence if specified in a schedule to this overlay.
- Construct bicycle pathways and trails.
- Subdivide land. This does not apply if a schedule to this overlay specifically states that a permit is not required.
- Remove, destroy or lop any vegetation, including dead vegetation. This does not apply:
    - If a schedule to this overlay specifically states that a permit is not required.
    - If the table to Clause 42.01-3 specifically states that a permit is not required.

Application requirements – Clause 42.01-4

An application must be accompanied by any information specified in a schedule to this overlay.

Decision guidelines – Clause 42.01-5

Before deciding on an application, in addition to the decision guidelines in Clause 65, the responsible authority must consider, as appropriate:

- The Municipal Planning Strategy and Planning Policy Framework.
- The statement of environmental significance and the environmental objective contained in a schedule to this overlay.
- The need to remove, destroy or lop vegetation to create a defendable space to reduce the risk of bushfire to life and property.
- Any other matters specified in a schedule to this overlay.

Comment: This overlay only effects land at 25 Ormond Street. A planning permit is required under this overlay for the subdivision of the land. The Flora and Fauna assessment attached to this application has assessed that this land does not harbour native vegetation.

Regional Strategic Planning Context

Strategic Planning Context

The following strategic plans and policies provide the broader strategic planning context and direction for urban development in Bannockburn which is relevant to this application.

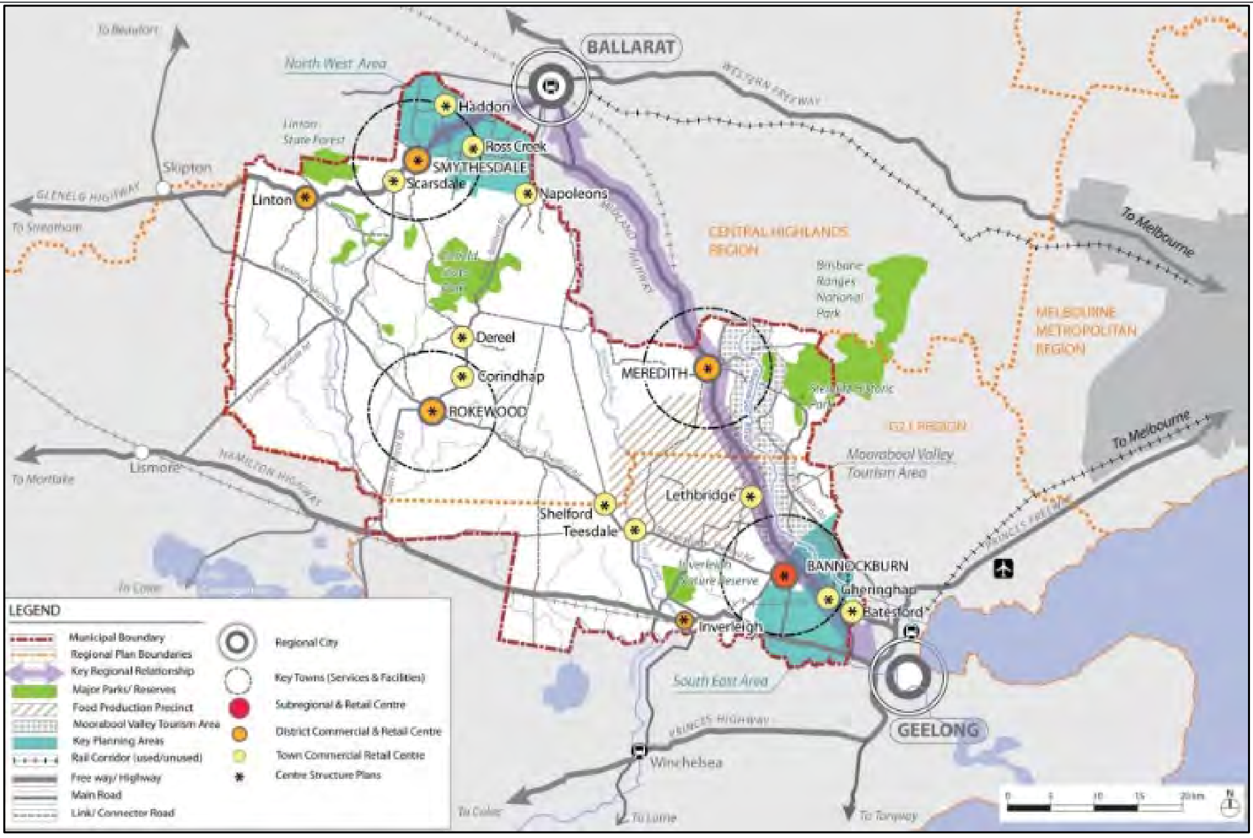
G21 Regional Growth Plan

The G21 Regional Growth Plan identifies Bannockburn as a District Town where additional housing growth is encouraged to facilitate a population increase. Bannockburn is a growth town where the majority of new residents and jobs are proposed to be located. The planned growth of Bannockburn is comprised of residential greenfield development, known major infill opportunities and employment precincts. Infrastructure development, such as water and sewerage, community services and public transport, will be required as the identified areas are developed.

Appendix B below of the G21 Regional Growth Plan provides a more localised focus on the planning and infrastructure directions required to enable Bannockburn to fulfil its capacity to accommodate future growth consistent with and in support of the Growth Plan and its principles.

APPENDIX B

BANNOCKBURN	
Residential growth	Take up of existing areas identified in Structure Plan Investigate infill opportunities around town centre or low density/rural living conversions Potential additional growth capacity at Lethbridge to supplement Bannockburn No new rural living beyond that already identified in strategic plans
Relationship with & future role of other settlements	Bannockburn is a subregional hub for the south-eastern portion of Golden Plains Shire with strong relationships with Geelong for services and employment Townships such as Lethbridge, Batesford, Shelford, Teesdale and Inverleigh provide rural living/lifestyle options with quality small town characteristics for the municipality and the Geelong region. Growth of these towns is to be limited to existing settlement boundaries with potential uptake of rural living land within sewered towns
Key current & future employment nodes/sectors	Bannockburn industrial estate (expansion as per UDF) Town centre expansion (Bannockburn Plaza) Agriculture, including intensive agriculture (poultry and pigs), viticulture Geelong and Melbourne
Key infrastructure projects	Reticulated natural gas roll out in Bannockburn Prep to year 12 school Water infrastructure for intensive agriculture activity node near Lethbridge Water supply and sewerage upgrade for Bannockburn, water supply upgrade for Inverleigh
Key project work	Strategic Planning priorities: • Completion of the Gheringhap Structure Plan • Review town Structure Plans over time consistent with the Growth Plan directions. Transport network and services investigation including: • Investigation of return of passenger rail services to Bannockburn/Lethbridge and road upgrades Geelong – Bannockburn (Rail Revival Study underway) • Bus services review within Bannockburn and to adjacent centres (including Geelong - Melbourne rail line) • Pedestrian and cycling networks • Road hierarchy planning Moorabool River restoration



Golden Plains Strategic Framework Plan

The Golden Plains Strategic Framework Plan (above) identifies Bannockburn as a Key Town containing services and facilities and a subregional and Retail Centre.

Golden Plains Planning Scheme

Clause 02.03- Strategic Directions

Bannockburn is the largest urban centre in Golden Plains Shire and a key regional centre within the Shire's network of townships across the south-east, serving residential, commercial and administrative functions. The sewering of the town, its rural ambience and proximity to Geelong have attributed to its strong growth in recent years. This growth, however, has also placed pressure on retaining the ambience that makes the town attractive.

Council seeks to support Bannockburn by:

- Accommodating all growth within Bannockburn's growth boundary, as identified in the Bannockburn Growth Plan (Victorian Planning Authority, May 2021).
- Protecting the natural and built environment including environmental assets, the Bruce's Creek environs, town character and rural ambience.
- Providing an integrated and environmentally responsive open space network throughout Bannockburn township.
- Locating and designing new development to be bushfire responsive.

Clause 11.03-6L -01 Bannockburn

Policy application

This policy applies to the land identified on the Bannockburn Framework Plan.

Settlement strategies

- Identify existing and future bushfire hazards and ensure buffers between vegetation and development are provided and managed to reduce bushfire risks and improve community resilience.
- Manage interim bushfire hazards during settlement expansion.
- Reinforce the Bannockburn Town Centre as the primary location for retail floorspace in Bannockburn.
- Provide a supplementary retail centre in the location supported by the Bannockburn Framework Plan.
- Develop Milton Street to provide a future road link across Bruce's Creek to serve future residential areas to the west of Bannockburn.
- Support medium density housing in locations close to retail and community facilities.
- Identify appropriate buffers to surrounding agriculture uses, transport corridors and utilities infrastructure and plan for compatible, non-sensitive uses within these buffers.

Land use and development strategies

Support a wide range of industry and business activities to meet the needs of a growing population and to provide increased employment opportunities.

- Support a diversity of uses within the Bannockburn Town Centre.
- Support the re-use of existing housing stock, particularly heritage buildings for professional/commercial uses in the Township Zone and Commercial 1 Zone to retain a sense of the existing town fabric.
- Support cafés and restaurants to include an outdoor seating area, particularly where it activates the use of open plaza areas.
- Deliver a second arterial road to support Bannockburn's growth and enable more efficient through-freight movements.
- Encourage the use of perimeter roads adjacent to bushfire hazards to provide a hard surface edge between vegetation and development.
- Locate land uses associated with vulnerable people including residential aged care facilities and education centres away from bushfire hazards, particularly the Bannockburn Flora and Fauna Reserve.
- Protect and enhance Aboriginal Cultural Heritage significance and promote Aboriginal history and culture when planning for new urban development.

Urban design strategies

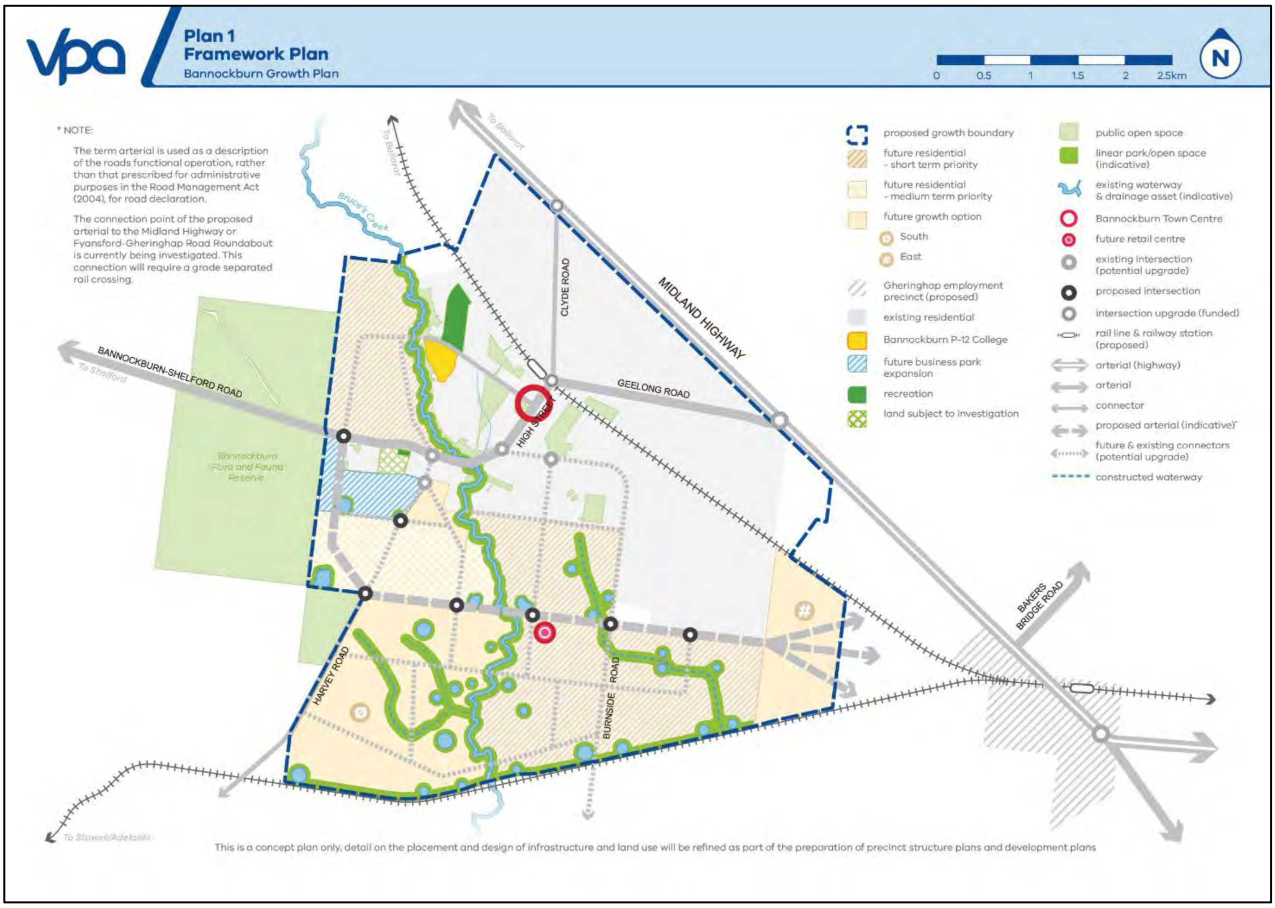
Maintain the village character of Bannockburn by:

- Protecting historic buildings, wide tree-lined avenues and low-scale streetscapes.
- Providing walking and cycling linkages to open space areas, community facilities and the town centre in new development and subdivision.
- Providing attractive and usable public spaces adjacent to or close to the town centre to encourage social activity.
- Design development to maintain view corridors to the Shire Hall.
- Locate car parking so it does not dominate road frontages and the streetscape.
- Encourage residential subdivision and development that respects Bannockburn's rural character.
- Support residential and other development at the rural interface where it provides a sympathetic transition to the adjoining rural landscape.
- Ensure the design and layout of development appropriately manages and responds to the settlement bushfire interface.
- Ensure development is designed to be capable of implementing vegetation management requirements to reduce bushfire risks on private and public land.
- Ensure the use of non-combustible design elements for the construction of walking, cycling and riding trails and flammable resistant building materials for public assets such as street furniture and artwork to reduce bushfire risk.

Open space strategies

- Provide open space areas in new developments that incorporate pedestrian, bicycle or riding trail paths to other open space areas such as the Bruce's Creek Corridor.
- Create flora and fauna corridors within open space reserves that incorporate locally indigenous vegetation, where there are identified biodiversity values.
- Create open space and drainage assets that perform both recreational and environmental functions.
- Create a linear open space network connecting Bannockburn's growth areas with the Bruce's Creek corridor.
- Facilitate a vegetation belt at the Bannockburn growth boundary for future use as a walking, cycling and riding trail.
- Ensure vegetation within the Bannockburn Flora and Fauna Reserve, Bruce's Creek, constructed waterway corridors and other local environmental assets are managed to mitigate bushfire risk.

Bannockburn Framework Plan



Comment: Bannockburn is the largest urban centre of the Golden Plains Shire where additional urban growth is encouraged. The subject land is identified in the Bannockburn Growth Plan as future residential – medium term priority and therefore its rezoning and future development as residential land is entirely consistent with the strategic planning direction of the Bannockburn Growth Plan.

Clause 11.03-6L Bannockburn – applies to the land identified in the Bannockburn Urban Design Framework Overall Principles Plan. The subject land is located within this plan identified for "consolidated residential" which accords with this rezoning and development plan application.

***Comment**: This policy essentially sets the strategic development direction for Bannockburn in accordance with the above Framework Plan and also sets out a number of local strategies regarding land development, urban design and open space outcomes.*

Further strategic analysis in response to the State and Local Planning Policy Frameworks is provided in this report in support of this application.

5.0 Application

The application seeks approval for a planning scheme amendment to rezone the subject site from the Farming Zone to the General Residential 1 Zone.

The details of the Amendment include:

- Rezoning the land at 5, 20, 25 & 30 Ormond Street, Bannockburn (16.93 hectares) from the Farming Zone to the General Residential 1 Zone.
- The introduction of Schedule to the Development Plan Overlay over the land.

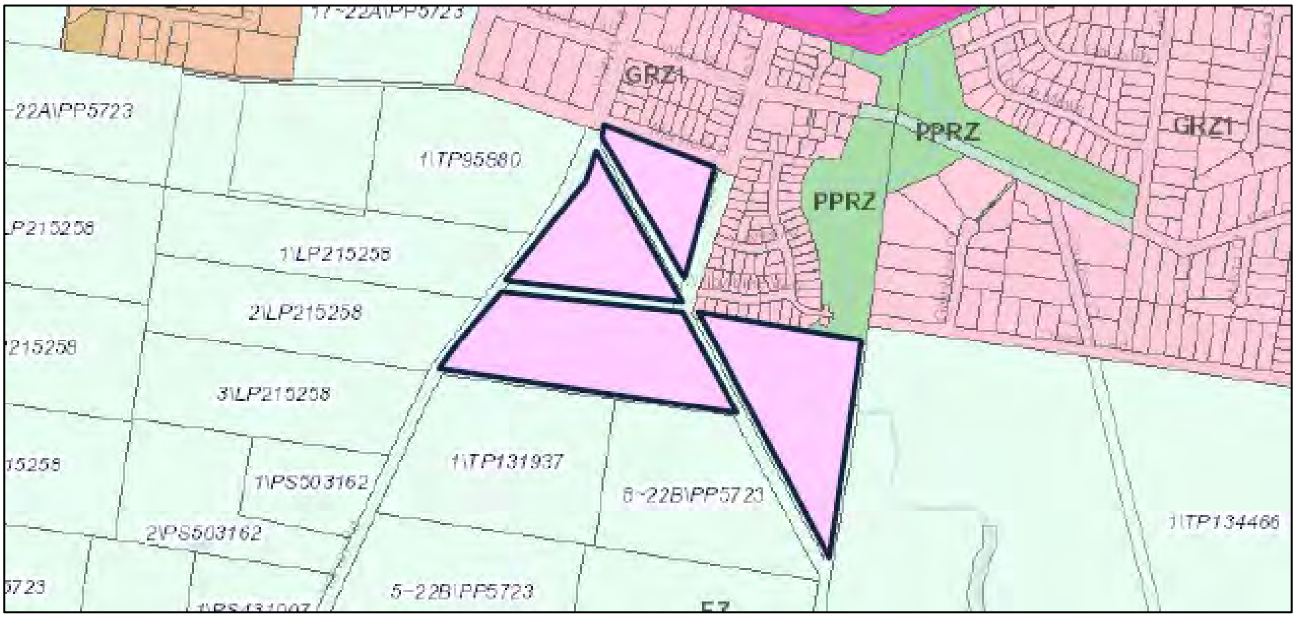
This application also seeks the following changes to the Golden Plains Planning Scheme:

- Amend Map 28 and 29 zones to show land at 5, 20, 25 & 30 Ormond Street, Bannockburn as General Residential 1 Zone.
- Introduce a new Schedule to Map 28 and 29 DPO on the subject land.

6.0 Proposed Planning Controls

6.1 Proposed Zone

This planning scheme amendment seeks approval to rezone the subject land from the Farming Zone to the General Residential 1 Zone as illustrated below.



The purpose Clause 32.08 the General Residential 1 Zone is:

- To implement the Municipal Planning Strategy and the Planning Policy Framework.
- To encourage development that respects the neighbourhood character of the area.
- To encourage a diversity of housing types and housing growth particularly in locations offering good access to services and transport.
- To allow educational, recreational, religious, community and a limited range of other non-residential uses to serve local community needs in appropriate locations.

Comment: The introduction of the General Residential Zone on the subject land is considered appropriate given the strategic planning direction for Bannockburn to facilitate additional urban growth and also the surrounding developed residential areas are also in this zone and have been developed in response to the provisions of this zone. The introduction of this zone will therefore provide integration opportunities and the development of a consistent neighbourhood character consistent with the surrounding residential development in accordance with the purpose of this zone.

Clause 32.08-3 Subdivision
A permit is required to subdivide land.

An application to subdivide land that would create a vacant lot less than 400 square metres capable of development for a dwelling or residential building, must ensure that each vacant lot created less than 400 square metres contains at least 25 percent as garden area. This does not apply to a lot created by an application to subdivide land where that lot is created in accordance with:

- An approved precinct structure plan or an equivalent strategic plan;
- An incorporated plan or approved development plan; or
- A permit for development.

An application to subdivide land, other than an application to subdivide land into lots each containing an existing dwelling or car parking space, must meet the requirements of Clause 56 and:

- Must meet all of the objectives included in the clauses specified in the following table.
- Should meet all of the standards included in the clauses specified in the following table.

Class of subdivision	Objectives and standards to be met
60 or more lots	All except Clause 56.03-5.
16 – 59 lots	All except Clauses 56.03-1 to 56.03-3, 56.03-5, 56.06-1 and 56.06-3.
3 – 15 lots	All except Clauses 56.02-1, 56.03-1 to 56.03-4, 56.05-2, 56.06-1, 56.06-3 and 56.06-6.
2 lots	Clauses 56.03-5, 56.04-2, 56.04-3, 56.04-5, 56.06-8 to 56.09-2.

Clause 32.08-11 Application requirements

An application must be accompanied by the following information, as appropriate:

- For a residential development of four storeys or less, the neighbourhood and site description and design response as required in Clause 54 and Clause 55.
- For an apartment development of five or more storeys, an urban context report and design response as required in Clause 58.01.
- For an application for subdivision, a site and context description and design response as required in Clause 56.
- Plans drawn to scale and dimensioned which show:
    - Site shape, size, dimensions and orientation.
    - The siting and use of existing and proposed buildings.

  - Adjacent buildings and uses.
  - The building form and scale.
  - Setbacks to property boundaries.
- The likely effects, if any, on adjoining land, including noise levels, traffic, the hours of delivery and despatch of good and materials, hours of operation and light spill, solar access and glare.
- Any other application requirements specified in a schedule to this zone.

If in the opinion of the responsible authority an application requirement is not relevant to the evaluation of an application, the responsible authority may waive or reduce the requirement.

Clause 32.08-13 Decision guidelines

Before deciding on an application, in addition to the decision guidelines in Clause 65, the responsible authority must consider, as appropriate:

General

- The Municipal Planning Strategy and the Planning Policy Framework.
- The purpose of this zone.
- The objectives set out in a schedule to this zone.
- Any other decision guidelines specified in a schedule to this zone.
- The impact of overshadowing on existing rooftop solar energy systems on dwellings on adjoining lots in a General Residential Zone, Mixed Use Zone, Neighbourhood Residential Zone, Residential Growth Zone or Township Zone.

Subdivision

- The pattern of subdivision and its effect on the spacing of buildings.
- For subdivision of land for residential development, the objectives and standards of Clause 56.

Dwellings and residential buildings

- For the construction and extension of one dwelling on a lot, the objectives, standards and decision guidelines of Clause 54.
- For the construction and extension of two or more dwellings on a lot, dwellings on common property and residential buildings, the objectives, standards and decision guidelines of Clause 55. This does not apply to an apartment development of five or more storeys, excluding a basement.
- For the construction and extension of an apartment development of five or more storeys, excluding a basement, the objectives, standards and decisions guidelines of Clause 58.

Comment: A response to the Decision Guidelines of the General Residential Zone is not required at rezoning. However, these guidelines reinforce the requirement to respect the established neighbourhood character and meet the subdivision standards of Clause 56 which will ensure integration and assimilation with the adjoining residential development. Therefore, the introduction of this zone is considered appropriate in this instance.

7.0 Proposed Overlays

7.1 Development Plan Overlay

The planning scheme amendment also seeks approval for the introduction of a Schedule to the Clause 43.04 Development Plan Overly to be applied to the subject land. The purpose of this overlay is:

- To implement the Municipal Planning Strategy and the Planning Policy Framework.
- To identify areas which require the form and conditions of future use and development to be shown on a development plan before a permit can be granted to use or develop the land.
- To exempt an application from notice and review if a development plan has been prepared to the satisfaction of the responsible authority.

Clause 43.04-4 Preparation of the development plan requires the following:

- The development plan may consist of plans or other documents and may, with the agreement of the responsible authority, be prepared and implemented in stages.
- A development plan that provides for residential subdivision in the Neighbourhood Residential Zone.

The development plan must describe:

- The land to which the plan applies.
- The proposed use and development of each part of the land.
- Any other requirements specified for the plan in a schedule to this overlay.
- The development plan may be amended to the satisfaction of the responsible authority.

Comment: The introduction of a Schedule to the Development Plan Overlay on the subject land is considered appropriate in this instance as it will include requirements that will ensure that the future subdivision of the land results in an orderly well planned estate having regard to the requirements of the Planning Scheme and those of the Golden Plains Shire and statutory referrals. Some of the requirements of the Development Plan for the site includes in summary:

- ***An Urban Design Masterplan***
- ***The integration of Bushfire mitigation measures as required.***
- ***An Integrated Stormwater Management Plan***
- ***A Road Network and Traffic Management Plan.***
- ***A Development Sequencing Plan.***
- ***A Landscape Masterplan.***

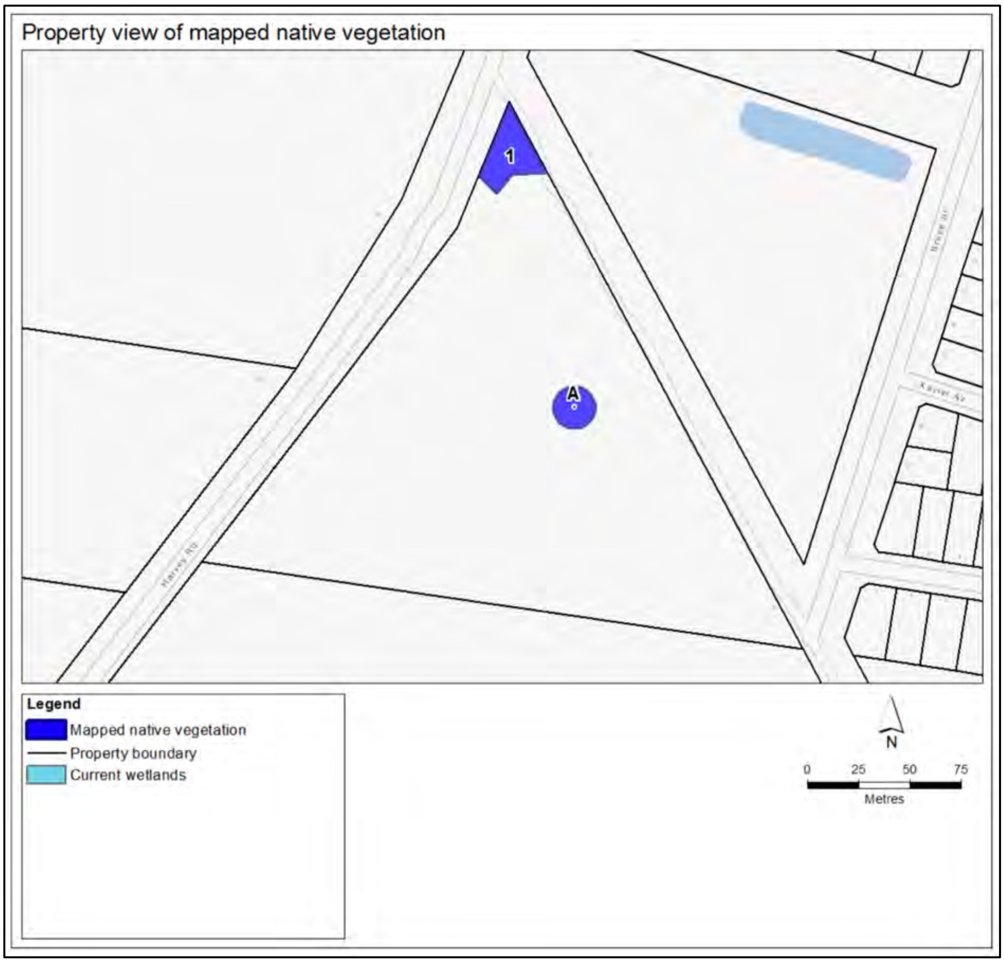
8.0 Particular & General Provisions

8.1 Native Vegetation

Under the provisions of Clause 52.17-1, a permit is required to remove, destroy or lop native vegetation, including dead native vegetation. This does not apply:

- If the table to Clause 52.17-7 specifically states that a permit is not required.
- If a native vegetation precinct plan corresponding to the land is incorporated into this scheme and listed in the schedule to Clause 52.16.
- To the removal, destruction or lopping of native vegetation specified in the schedule to this clause.

***Comment**: The application is supported by a Vegetation Assessment and Native Vegetation Removal Report by Mark Trengove Ecological Services, which indicates that the land is severely degraded and contains a small area of native vegetation and the removal will not likely have any significant implications and can be off-set.*



Location of native vegetation form

8.2 Public Open Space Contributions and Subdivision

Under the provisions of Clause 53.01, a person who proposes to subdivide land must make a contribution to the council for public open space in an amount specified in the schedule to this clause (being a percentage of the land intended to be used for residential, industrial or commercial purposes, or a percentage of the site value of such land, or a combination of both). If no amount is specified, a contribution for public open space may still be required under Section 18 of the Subdivision Act 1988.

Comment: The application is for rezoning only and therefore this provision does not apply however an open space contribution in cash will be required as part of the future subdivision of the land.

8.3 Bushfire Planning

The purpose of Clause 53.02 is:

- To implement the Municipal Planning Strategy and the Planning Policy Framework.
- To ensure that the development of land prioritises the protection of human life and strengthens community resilience to bushfire.
- To ensure that the location, design and construction of development appropriately responds to the bushfire hazard.
- To ensure development is only permitted where the risk to life, property and community infrastructure from bushfire can be reduced to an acceptable level.
- To specify location, design and construction measures for a single dwelling that reduces the bushfire risk to life and property to an acceptable level.

These provisions apply to an application to subdivide land, construct a building or construct or carry out works under the provisions of the Bushfire Management Overlay.

Comment: Refer to the attached Bushfire Risk Assessment by South Coast Bushfire Consultants indicates that with some mitigation measures the subject site can meet the requirements of this clause. Note these mitigations measures have been incorporated in the attached Overall Development Plan.

8.4 Stormwater Management In Urban Development

The purpose of Clause 53.18 is to ensure that stormwater in urban development, including retention and reuse, is managed to mitigate the impacts of stormwater on the environment, property and public safety, and to provide cooling, local habitat and amenity benefits.

An application to subdivide land should meet the standards of Clauses 53.18-4 and 53.18-6 and must be accompanied by details of the proposed stormwater management system, including drainage works and retention, detention and discharges of stormwater to the drainage system.

Clause 53.18-4, stormwater management for subdivision, aims to:

- Minimise damage to properties and inconvenience to the public from stormwater.
- Ensure that the street operates adequately during major storm events and provides for public safety.
- Minimise increases in stormwater and protect the environmental values and physical characteristics of receiving waters from degradation by stormwater.
- Encourage stormwater management that maximises the retention and reuse of stormwater.
- Encourage stormwater management that contributes to cooling, local habitat improvements and provision of attractive and enjoyable spaces.

Standard W1 states that the stormwater management system should be:

- Designed and managed in accordance with the requirements and to the satisfaction of the relevant drainage authority.
- Designed and managed in accordance with the requirements and to the satisfaction of the water authority where reuse of stormwater is proposed.
- Designed to meet the current best practice performance objectives for stormwater quality as contained in the *Urban Stormwater - Best Practice Environmental Management Guidelines* (Victorian Stormwater Committee, 1999).
- Designed to ensure that flows downstream of the subdivision site are restricted to pre-development levels unless increased flows are approved by the relevant drainage authority and there are no detrimental downstream impacts.
- Designed to contribute to cooling, improving local habitat and providing attractive and enjoyable spaces.
- The stormwater management system should be integrated with the overall development plan including the street and public open space networks and landscape design.

For all storm events up to and including the 20% Average Exceedance Probability (AEP) standard:

- Stormwater flows should be contained within the drainage system to the requirements of the relevant authority.
- Ponding on roads should not occur for longer than 1 hour after the cessation of rainfall.
- For storm events greater than 20% AEP and up to and including 1% AEP standard:
- Provision must be made for the safe and effective passage of stormwater flows.
- All new lots should be free from inundation or to a lesser standard of flood protection where agreed by the relevant floodplain management authority.
- Ensure that streets, footpaths and cycle paths that are subject to flooding meet the safety criteria da Vave < 0.35 m2/s (where, da = average depth in metres and Vave = average velocity in metres per second).

The design of the local drainage network should:

- Ensure stormwater is retarded to a standard required by the responsible drainage authority.
- Ensure every lot is provided with drainage to a standard acceptable to the relevant drainage authority. Wherever possible, stormwater should be directed to the front of the lot and discharged into the street drainage system or legal point of discharge.
- Ensure that inlet and outlet structures take into account the effects of obstructions and debris build up. Any surcharge drainage pit should discharge into an overland flow in a safe and predetermined manner.
- Include water sensitive urban design features to manage stormwater in streets and public open space. Where such features are provided, an application must describe maintenance responsibilities, requirements and costs.
- Any flood mitigation works must be designed and constructed in accordance with the requirements of the relevant floodplain management authority.

Comment: The application is supported by the attached Site Stormwater Management Plan Strategy by Cardno/TGM which demonstrates that the land can be subdivided in the future and can be appropriately drained via the construction of a detention basin within the subject land.

Clause 53.18-6, site management, aims to protect drainage infrastructure and receiving waters from sedimentation and contamination and to protect the site and surrounding area from environmental degradation prior to and during construction of subdivision works.

Standard W3 states that an application should describe how the site will be managed prior to and during the construction period and may set out requirements for managing:

- Erosion and sediment.
- Stormwater.
- Litter, concrete and other construction wastes.
- Chemical contamination.

Comment: Approval for the subdivision of the subject land is yet to be obtained. As a result, site management during the construction phase is currently unknown as no contracts have been entered into at this early stage. However, it is anticipated that appropriate measures will be undertaken during construction works to ensure that the site and surrounding area, including erosion and sediment, stormwater, litter, concrete and other construction wastes and chemical contamination are appropriately managed during the construction stage as required by Clause 53.18-6 and can be dealt with via a permit condition.

9.0 Decision Guidelines

9.1 Clause 65.02 Approval of an Application to Subdivide Land

Before deciding on an application to subdivide land, the responsible authority must also consider, as appropriate:

- The suitability of the land for subdivision.
- The existing use and possible future development of the land and nearby land.
- The availability of subdivided land in the locality, and the need for the creation of further lots.
- The effect of development on the use or development of other land which has a common means of drainage.
- The subdivision pattern having regard to the physical characteristics of the land including existing vegetation.
- The density of the proposed development.
- The area and dimensions of each lot in the subdivision.
- The layout of roads having regard to their function and relationship to existing roads.
- The movement of pedestrians and vehicles throughout the subdivision and the ease of access to all lots.
- The provision and location of reserves for public open space and other community facilities.
- The staging of the subdivision.
- The design and siting of buildings having regard to safety and the risk of spread of fire.
- The provision of off-street parking.
- The provision and location of common property.
- The functions of any body corporate.
- The availability and provision of utility services, including water, sewerage, drainage, electricity and gas.
- If the land is not sewered and no provision has been made for the land to be sewered, the capacity of the land to treat and retain all sewage and sullage within the boundaries of each lot.
- Whether, in relation to subdivision plans, native vegetation can be protected through subdivision and siting of open space areas.
- The impact the development will have on the current and future development and operation of the transport system.
- This clause does not apply to a VicSmart application.

Comment: The application is for the rezoning of the subject land which if approved will be subdivided in the future. The subject land is considered to be appropriate to rezone and subdivided in this location as it is located within an existing residential context which is in short distance to the services of Bannockburn. The land can be appropriately drained and can be connected to all utility services which is supported in the attached reports. The proposed pattern of subdivision can be designed to integrate with the irregular lot shape and surrounding road network as indicated in the attached Overall Development Plan.

10.0 Planning Policy Framework

10.1 State Planning Policy Framework

Planning and Environment Act 1987

Pursuant to Section 12(1) of the Planning and Environment Act 1987, it is a duty of planning authorities to implement the following objectives of Planning Victoria as set out in Section 4(1) of the Planning and Environment Act 1987:

- to provide for the fair, orderly, economic and sustainable use, and development of land.
- to provide for the protection of natural and man-made resources and the maintenance of ecological processes and genetic diversity.
- to secure a pleasant, efficient and safe working, living and recreational environment for all Victorians and visitors to Victoria.
- to conserve and enhance those buildings, areas or other places which are of scientific, aesthetic, architectural or historical interest, or otherwise of special cultural value.
- to protect public utilities and other assets and enable the orderly provision and coordination of public utilities and other facilities for the benefit of the community.
- to facilitate development in accordance with the objectives set out in paragraphs (a), (b), (c), (d) and
- to balance the present and future interest of all Victorians.

Comment: The application is considered to accord with the Planning and Environment Act 1987 as it will facilitate the rezoning and future subdivision of the subject land to achieve an orderly planning outcome consistent with the surrounding residential use and the strategic planning direction of Bannockburn.

Planning Policy Framework

Clause 02.02 –(Vision): The amendment supports council's vision to sustainably manage land use within the shire by directing residential development to be contained within the Bannockburn Growth Boundary.

Clause 02.03-1 – (Settlement): The amendment supports the shires desire to direct residential development within township boundaries and encouraging development that reinforces town character.

Clause 11.01-1S (Settlement): The amendment supports the objective of promoting the sustainable growth and development of Victoria through a network of settlements, by facilitating urban growth in Bannockburn, as identified in the G21 Regional Growth Plan.

Clause 11.01-1R (Settlement – Geelong G21): The amendment supports the role of Bannockburn as a district town where residential development is expected.

Clause 11.01-1L (Settlement) The amendment facilitates the rezoning of the subject land within Bannockburn, accounting for sustainable land supply, growth capacity and infrastructure provision.

Clause 11.03-6L – (Bannockburn) The amendment is consistent with the strategic direction of growth in Bannockburn by developing infill opportunities.

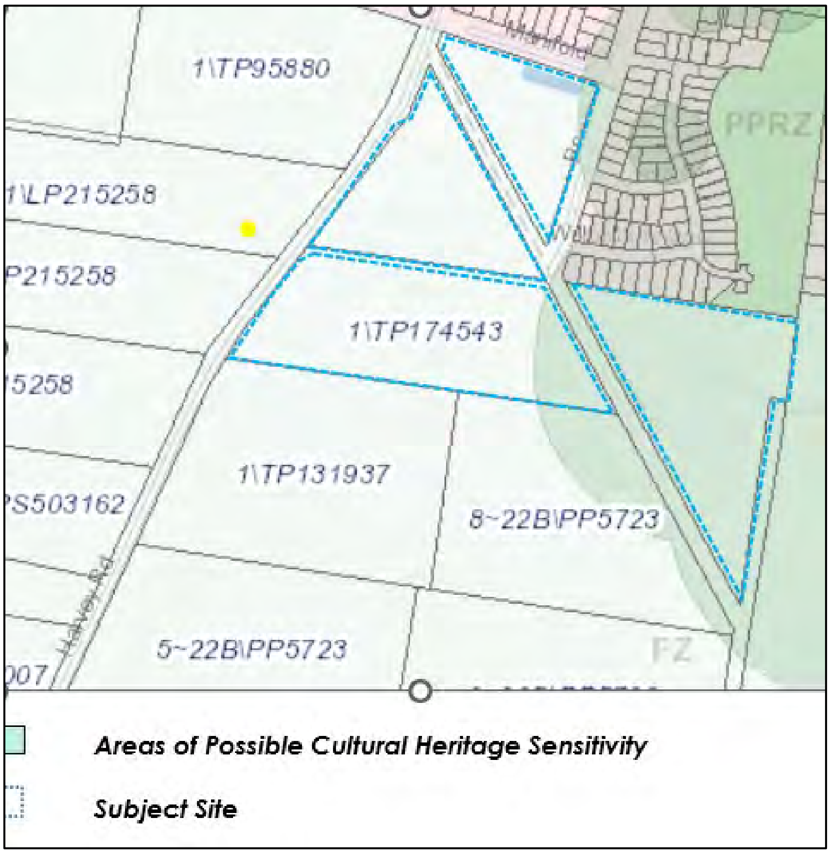
Clause 12.01-2S (Native vegetation management): The amendment supports the objective of ensuring no loss to biodiversity as a result of the rezoning of the subject land as native vegetation proposed for removal ca be appropriately off-set.

Clause 12.03-1S – (River Corridors, Waterways, Lakes and Wetlands) – The amendment supports this policy by seeking to protect the Bruce's Creek environs which is proposed to be addressed in the Schedule to the Development Plan Overlay.

Clause 13.03-1S –(Floodplain Management) – The amendment supports this policy as Bruce's Creek will be set aside and not detrimentally impacted by the future subdivision of the subject land.

Clause 13.04-1S (Contaminated and potentially contaminated land): The amendment supports the objective as the land is not considered to be potentially contaminated as indicated in the attached Environmental Assessment by ESA Group.

Clause 15.03-2S (Aboriginal cultural heritage): The amendment is supported by an attached approved Cultural Heritage Management Plan and includes salvage and contingency conditions to manage artefacts should they be discovered during the subdivision of the subject land.



Clause 18 – (Transport) Clause 18.01-1S (Land use and transport planning): The amendment supports the creation of a safe and sustainable transport system by integrating land use with the existing surrounding road network. The amendment is also supported by the attached Traffic Engineering Report by TRAFFIX.

11.0 Conclusion

The rezoning of the subject land to the General Residential 1 Zone is entirely consistent with the State and Local Planning Policy in relation to the promotion of residential development in Bannockburn which is a District town where most of the residential development is planned in the Golden Plains Shire. The introduction of this zone in this context will also ensure the reinforcement of the existing surrounding neighbourhood character.

The introduction of a Schedule to the Development Plan Overlay, is an appropriate planning tool to guide the development of the land prior to subdivision.

The application is also supported by a number of technical reports and plans that demonstrate the lands appropriateness to be rezoned and subdivided to facilitate future residential growth.

For the reasons outlined in this report, it is considered that the rezoning of the subject land is entirely appropriate and should therefore be supported.

……………………………………………………………

Chris Marshall
Planning Manager

BUSHFIRE RISK ASSESSMENT - RESPONSE TO CLAUSE 13.02-1S – 5, 20, 25 AND 30 ORMOND ST, BANNOCKBURN

REF: 2021-280

12 May 2022

South Coast Bushfire Consultants

South Coast Bushfire Consultants

Principal Consultant – Kylie Steel

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Qualifications / Accreditations:

- Accredited Bushfire Consultant (BPAD level 2) with the Fire Protection Association Australia (FPA) (2014)
- Preparing and assessing an application under the Bushfire Management Overlay – Planet (Department of Planning and Community Development) (2013)
- Postgraduate Certificate in Bushfire Planning and Management – The University of Melbourne (2013)
- Postgraduate Certificate in Business – The University of Notre Dame, Broome (2002)
- Bachelor of Science, Honours – The University of Melbourne (1998)
- Native Vegetation Planning Permit Applications – Planet (Department of Planning and Community Development) Training Seminar (2013)

Version Control

	Name	Date Completed	Comments
Report Version	Kylie Steel	02/12/21 12/05/22	Version 1 Version 2
Field Assessment	Kylie Steel	02/12/21	
Report	Kylie Steel	02/12/21	
Mapping	Kylie Steel	02/12/21	

Disclaimer

This report has been made with careful consideration and with the best information available to South Coast Bushfire Consultants at the time of writing. Before relying on information in this report, users should evaluate the accuracy, completeness and relevance of the information provided for their purposes. South Coast Bushfire Consultants do not guarantee that it is without flaw or omission of any kind and therefore disclaim all liability for any error, loss or other consequence that may arise from you relying on any information in this report.

Requirements detailed in this document do not guarantee survival of the buildings or the occupants. The client is strongly encouraged to develop and practice a bushfire survival plan.

Information and assistance including a template for a Bushfire Survival Plan is provided as part of the 'Fire Ready Kit' available through the CFA website at http://www.cfa.vic.gov.au or through your local CFA Regional office.

Conditions of Use

Contents

DEFINITIONS, ABBREVIATIONS AND ACRONYMS

AS 3959-2018	Australian Standard AS 3959 -2018 Construction of buildings in bushfire-prone areas
CFA	Country Fire Authority
Clause	A clause is a provision in the planning scheme
Clause 44.06	Bushfire Management Overlay
Clause 53.02	Planning for Bushfire
Clause 13.02	Environmental Risk – Bushfire
DELWP	Department of Environment, Land, Water and Planning
BAL	Bushfire Attack Level
BPA	Bushfire Prone Area
BMO	Bushfire Management Overlay
BMS	Bushfire Management Statement
Method 1	refers to methodology in AS 3959-2018 for determining a BAL with a number of predetermined inputs
Method 2	refers to methodology in AS 3959-2018 for determining a site specific BAL
Pathway 1	refers to an application pathway in Clause 53.02 of the planning scheme
Pathway 2	refers to an application pathway in Clause 53.02 of the planning scheme
Planning Practice Note	a guide for using various sections of the planning scheme prepared by DELWP
RA	Responsible Authority
SCBC	South Coast Bushfire Consultants
Total Fire Ban Day	is declared by CFA on days when fires are likely to spread rapidly and could be difficult to control

Bushfire Risk Assessment - Response to Clause 13.02-1S – 5, 20, 25 and 30 Ormond St, Bannockburn

1. EXECUTIVE SUMMARY

This report has been prepared to accompany a planning permit application at 5, 20, 25 and 30 Ormond St, Bannockburn (referred to as 'the site' in this report). The proposal seeks to re-zone and subdivide the site for residential lots.

The site is within a Bushfire Prone Area (BPA) of the state and as such all development needs to demonstrate that it meets the objective of *Clause 13.02-1S Bushfire Planning*. The objective of *Clause 13.02-1S* is 'to strengthen the resilience of settlements and communities to bushfire through risk-based planning that prioritises the protection of human life'.

The proposed development is not within the Bushfire Management Overlay (BMO).

The site within the township boundary of

The development site is surrounded by grassland hazards to the west and south. These hazards can be mitigated through ensuring appropriate setback through subdivision design.

East of the development is Bruce Creek that supports small narrow areas of unmanaged vegetation.

Clause 13.02-1S requires a subdivision (settlement development) to enable setbacks to ensure future residential development is not exposed to radiant heat loads greater than 12.5kW/m^2. This is achieved through the management of defendable space, perimeter roads and staging the subdivision.

A BAL-Low can be achieved where development has a 50m setback from grassland hazards. A BAL-Low can be achieved within internal areas of the subdivision.

A staged development of the site at proposed development can mitigate the bushfire hazards and provide adequate separation from the surrounding hazards, meeting the life safety objectives detailed in Clause 13.02-1S with appropriate subdivision design.

2. SUMMARY

The following details the proposed development, the assessment methodology and the proposed bushfire mitigation measures.

Application	To rezone and subdivide land at 5, 20, 25 and 30 Ormond St, Bannockburn for a residential subdivision.
Construction Standard	The National Construction Code (NCC) requires all dwellings within the Bushfire Prone Area (BPA) to be constructed in accordance with AS 3959-2018.
Bushfire Landscape Risk	The broader landscape shows the dominant hazard in the surrounding landscape is grassland vegetation.
Assumptions	In undertaking the assessment, the following assumptions have been made: 1. It is assumed that all vegetation within the street scape and open space areas will be managed to a low threat condition in accordance with AS 3959-2018 (see appendix 11.1). 2. The *Bannockburn Urban Design Framework Overall Principles Plan* shows a perimeter access road to the south of the development, and it shows the surrounding land to the south and east as 'Future Low Density Residential Development'. For the purposes of this assessment it is determined that this development will occur at some time in the future. 3. A distance of 39m of defendable space is proposed to the west along Bruce Creek. This defendable space distance will reduce the radiant heat exposure to a BAL of 12.5 based on the creek line vegetation remaining as a scrub fuel load.
Staging	1. It is proposed that that development will occur in stages. The land within 50m of the southern boundary and eastern boundary (abutting the farmland) must not be developed until the grassland is adequately mitigated. This could be achieved by undertaking the one of the following options: A. Future development includes a perimeter road to the township to the south and the east. In the interim the land to the south and east must manage the 50m buffer to a low threat condition. B. A steel fence with steel uprights and supports is installed along the southern and eastern perimeters of the subdivision to mitigate the grassland hazards. This will be appropriate where the development in the growth areas to the south and east area being undertaken.
Perimeter Roads	1. There are perimeter roads to the north and west that provide access and egress. 2. There is a road reserve to the east between the proposed development and the farmland to the east. It is proposed that this road reserve would be developed as a road or managed to a low threat condition.

	3. A perimeter road to the south has not been proposed as part of this subdivision. The land to the south is included in the South West Growth Precinct and it is likely this land will be developed in the future and a formalized township boundary road will be part of this development. In the interim a number of grassfire mitigation measures are proposed that include staging, management of buffers and a steel perimeter fence to the south and east.
Bushfire Site Assessment (Bushfire Attack Level) BAL	The development can meet setbacks for a BAL of 12.5 in accordance with AS 3959-2021. The setbacks require the following: 1. The western interface has the separation of Harvey Road. Development will need to ensure a 19m setback from the grassland hazards. The setback can include Harvey Road. 2. North of the site is the high-density residential area and setbacks are not required. 3. The section to the east of the site adjoining Bruce Creek requires a 39m setback around the creek interface. 4. A section to the east adjoining the road reserve and grassland must manage defendable space or a distance of 22m. The road reserve would be managed as part of this development and it has a width of 20m. A dwelling setback of 2m will then achieve the 22m setback. 5. South of the site is farmland that supports grassland. A setback of 19m is required within the property boundary to achieve a BAL of 12.5. Based on a precautionary measure and to be compliant with Clause 13.02-1S it is proposed that the subdivision is undertaken in stages and no development will occur within 50m of the southern boundary until such time as a perimeter road is established in future development to the south (as per the Bannockburn Growth Plan May 2021).
Protection of Human Life	The site can meet the objectives of Clause 13.02-1S relating to the protection of human life. Ensuring no development is exposed to radiant heat loads greater than 12.5kW/m^2 and that central areas within the subdivision ensure areas considered a BAL of Low. The proposed development is adjoining the existing residential areas of Bannockburn.
Vegetation Management within the site	It is recommended that all landscaping within the site is managed as 'low threat vegetation' in accordance with AS 3959-2018 (see Appendix 11.1 for definition).
Access	In accordance with the CFA recommendations the following access requirements can be met: • Roads must be constructed to a standard so that they are accessible in all weather conditions and capable of accommodating a vehicle of 15 tonnes for the trafficable road width. • The average grade must be no more than 1 in 7 (14.4%) (8.1 degrees) with a maximum of no more than 1 in 5 (20%) (11.3 degrees) for no more than 50 meters. Dips must have no more than a 1 in 8 (12%) (7.1 degree) entry and exit angle.

	• Curves must have a minimum inner radius of 10 metres. Have a minimum trafficable width of 3.5 metres and be clear of encroachments for at least 0.5 metres on each side and 4 metres above the access way. • Roads more than 60m in length from the nearest intersection must have a turning circle with a minimum radius of 8m (including roll-over kerbs if they are provided) T or Y heads of dimensions specified by CFA may be used as alternatives.
Hydrant	In accordance with the CFA the site must have Hydrants installed within the site that meet the following requirements: • Above or below ground operable hydrants must be provided. The maximum distance between these hydrants and the rear of all building envelopes (or in the absence of building envelopes, the rear of the lots) must be 90 metres and the hydrants must be no more than 120 metres apart. These distances must be measured around lot boundaries. • The hydrants must be identified with marker posts and road reflectors as applicable to the satisfaction of the Country Fire Authority.

3. SCOPE OF THE REPORT

This assessment has been prepared to demonstrate that the proposed development has regard for the surrounding bushfire hazards. The associated legislative requirements affecting the site have been identified and address.

The report considers how the proposed subdivision can demonstrate compliance with the objectives of Clause 13.02-1S.

4. METHODOLOGY

The methodology used to prepare a holistic approach to assessing and mitigation the bushfire risk to the development includes the following:

- Legislative Controls Affecting the Development
- Bushfire Hazard Landscape Assessment
- Bushfire Hazard Site Assessment
- A Bushfire Attack Level (BAL) Assessment
- Vegetation Management within the site
- Response to Clause 13.02-1S

5. LEGISLATIVE CONTROLS AFFECTING THE DEVELOPMENT

The site is affected by planning, building and legislative controls.

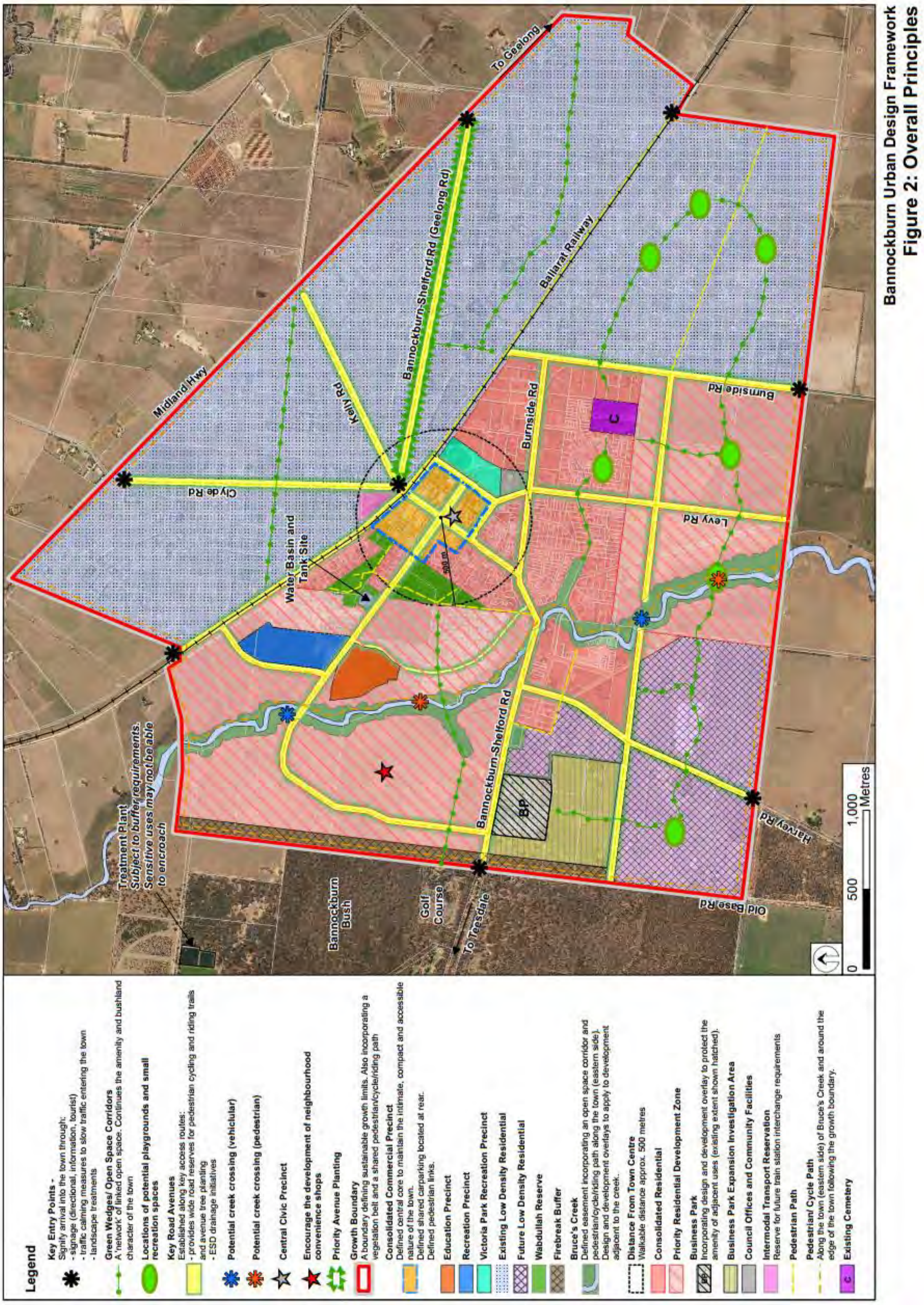
5.1 Planning controls

Table 1 – Planning Clauses affecting the site

Clause Number	Name	Detail
State Planning Policy Framework		
13.02-1S	***Bushfire planning***	*Objective - To strengthen the resilience of settlements and communities to bushfire through risk-based planning that prioritises the protection of human life.* *This policy must be applied to all planning and decision making relating to land which is:* • *Within a designated bushfire prone area;* • *Subject to a Bushfire Management Overlay; or* • *Proposed to be used or developed in a way that may create a bushfire hazard.* *The subject site is within a designated Bushfire Prone Area and therefore the policy applies.*
Planning Zone:		
	Farming Zone	To implement the Municipal Planning Strategy and the Planning Policy Framework. To provide for the use of land for agriculture. To encourage the retention of productive agricultural land. To ensure that non-agricultural uses, including dwellings, do not adversely affect the use of land for agriculture. To encourage the retention of employment and population to support rural communities. To encourage use and development of land based on comprehensive and sustainable land management practices and infrastructure provision.
Planning Overlays:		
Applies only to 25 Ormond St, Bannockburn	***Environmental Significance Overlay – Schedule 2***	To implement the Municipal Planning Strategy and the Planning Policy Framework. To identify areas where the development of land may be affected by environmental constraints. To ensure that development is compatible with identified environmental values.
Applies only to 25 Ormond St, Bannockburn	***Land Subject to Inundation Overlay***	To implement the Municipal Planning Strategy and the Planning Policy Framework. To identify flood prone land in a riverine or coastal area affected by the 1 in 100 (1 per cent Annual Exceedance

		Probability) year flood or any other area determined by the floodplain management authority. To ensure that development maintains the free passage and temporary storage of floodwaters, minimises flood damage, responds to the flood hazard and local drainage conditions and will not cause any significant rise in flood level or flow velocity. To minimise the potential flood risk to life, health and safety associated with development. To reflect a declaration under Division 4 of Part 10 of the Water Act, 1989. To protect water quality and waterways as natural resources by managing urban stormwater, protecting water supply catchment areas, and managing saline discharges to minimise the risks to the environmental quality of water and groundwater. To ensure that development maintains or improves river, marine, coastal and wetland health, waterway protection and floodplain health.
Local Planning Policy Framework – Golden Plains Shire Council Planning Scheme		
11.03-6L	Bannockburn Strategy	*Settlement Strategies:* • *Avoid out of sequence residential subdivision and development.* • *Maintain a fire buffer area at the urban growth boundary of Bannockburn.* • *Avoid commercial development that is separated from the defined town centre.* • *Develop Milton Street to provide a future road link across Bruce's Creek to serve future residential areas to the west of Bannockburn.* • *Support medium density housing within a general 500 metre radius of the Bannockburn Town Centre.*

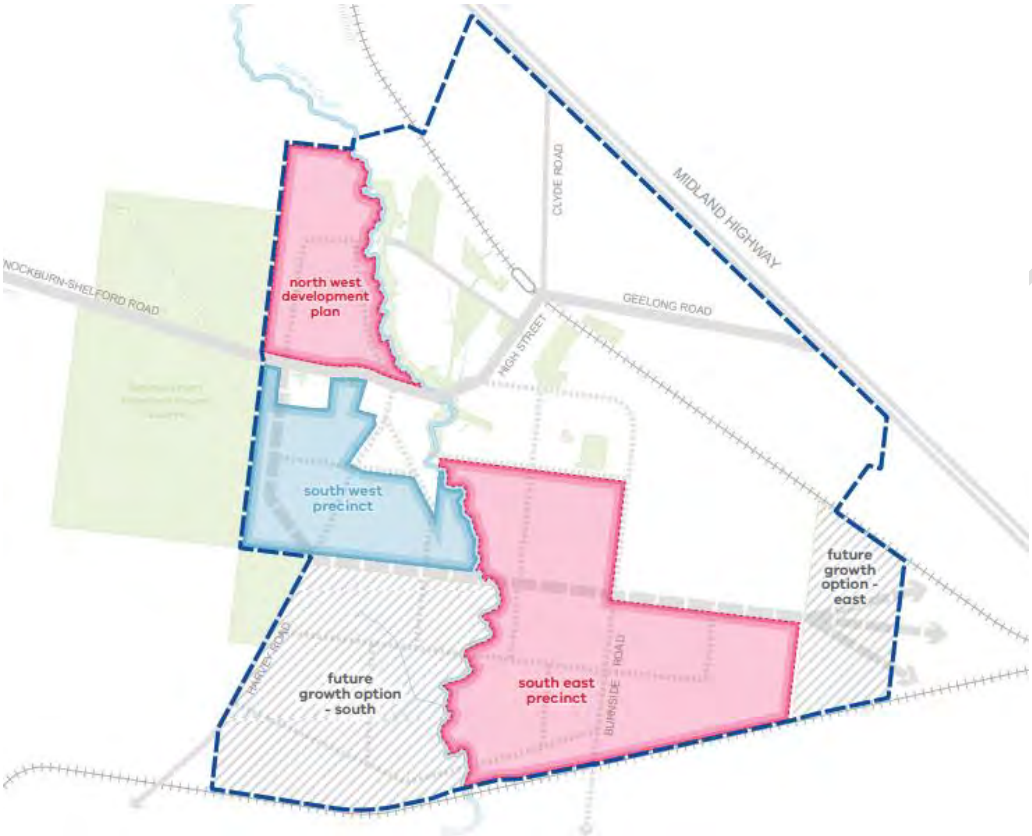
Bannockburn Urban Design Framework Overall Principles Plan



Bannockburn Growth Plan – May 2021

The Bannockburn Growth Plan (May 2021) was prepared by the Victorian Planning Authority in partnership with Golden Plains Shire Council to guide the sustainable development of Bannockburn to the year 2050.

The proosed development is within the proposed growth boundary and adjoined by the south west precinct (shown in blue) and the south east precinct (shown in pink).



5.2 Building Controls

All building work must comply with the Building Act 1993, Building Regulations 2006 and the National Construction Code (the NCC) unless specifically exempted.

The development site is within the Bushfire Prone Area of the state and as such construction is required to address bushfire risk.

The NCC is a performance-based document and it sets out the minimum criteria which defines how buildings must perform to meet the objectives and functional statements. The NCC calls upon the *Australian Standard AS 3959–2018 Construction of Buildings in Bushfire Prone Areas* for Class1, 2 and 3 buildings and associated Class 10a (e.g. deck) building works.

Section 3.7.4 of the BCA – Acceptable Construction, Part 3.7.4 Bushfire Prone Areas calls upon AS 3959-2018, if all the criteria in Method 1 or 2 of this document are met a building is deemed to satisfy the requirements of the VCC.

The Standard AS 3959-2018 specifies the requirements for the construction of buildings in bushfire prone areas in order to improve their resistance to bushfire attack from burning embers, radiant heat, flame contact and combinations of the three attack forms.

6. BUSHFIRE HAZARD IDENTIFICATION AND ASSESSMENT

The landscape assessment is important to consider as it defines the context of site assessment. The Bushfire Hazard Landscape Assessment has identified risks in the surrounding landscape and has considered the assessment of bushfire hazards on the basis of:

- Landscape conditions – meaning conditions in the landscape up to 75 kilometers from a site;
- Local conditions – meaning conditions in the area within approximately 1km of a site;
- Neighbourhood conditions – meaning conditions in the area within 400m of a site; and
- The site for the development.

6.1 Vegetation in the Surrounding Landscape

The development site is located to the southwest of the of the existing township area of Bannockburn. The site will be bordered by residential development to the north and in some areas to the east.

West and south of the site are areas of open grassland used for a variety of farming practices. The grasslands extend for significant distances.

East of the site is the Bruce Creek which supports a narrow band of shrubs and some scattered trees.

The township of Bannockburn is surrounded by grassland to all aspects and a grassland fire is the only form of landscape bushfire that would impact the township.

The Bannockburn Nature Reserve is located to the west of the existing township and is over 1km from the proposed development.

Long fire runs through grassland are unlikely due to the extent of the surrounding residential and agricultural development.

6.2 Mitigating Features within the surrounding landscape

There are a number of features within the surrounding landscape that would aid in the suppression of a landscape grassfire, including:

1. The Midland Highway to the east.
2. Residential development to the north.
3. Intensive Agriculture to the south.
4. Low density residential properties to the west.

6.3 Potential Fire Behavior

Bushfire behavior is influenced by three key factors; climate, topography and fuel availability. The landscape surrounding the site is dominated by grassland fuel loads and the topography of the landscape is undulating.

Table 3 – Bushfire attack mechanisms and appropriate inputs for models.

	Standard Assessment Inputs and Considerations	**Risk Based Assessment Inputs and Considerations**
Consideration of all bushfire mechanisms:	The AS 3959-2018 methodology assumes that distance to classification determines the radiant heat exposure and associated BAL. The BAL determines the construction standard. The higher the BAL the greater a developments resilience to bushfire. AS 3959-2018 does not have any regard for convective heat or bushfire induced winds.	Consider and assess each bushfire attack mechanism independently considering the unique specifics of the site. The bushfire attack mechanisms to be assessed include: • Radiant Heat Exposure • Convective Heat Exposure • Ember Attack • Bushfire Induced Winds.
Analysis of the bushfire model inputs:	**Forest Fire Danger Index (FFDI)** The FFDI is used nationally as a measure for fire weather. It uses the drought factor (seasonal dryness), relative humidity, temperature and wind speed to establish the fire weather severity. The BMO and AS 3959-2018 assumes an FFDI of 100.	The assessment has assumed an FFDI of 100 as it is the state based assumption.
	Flame Temperature The BMO and AS 3959-2018 assumes a flame temperature of 1090K.	Use the state-based assumption.
	Fuel Loads In AS 3959-2018 assumes fuel loads within grasslands.	The assumed fuel loads within AS 3959-2018 for grassland are deemed appropriate.

Table 4 – Bushfire Attack Mechanisms

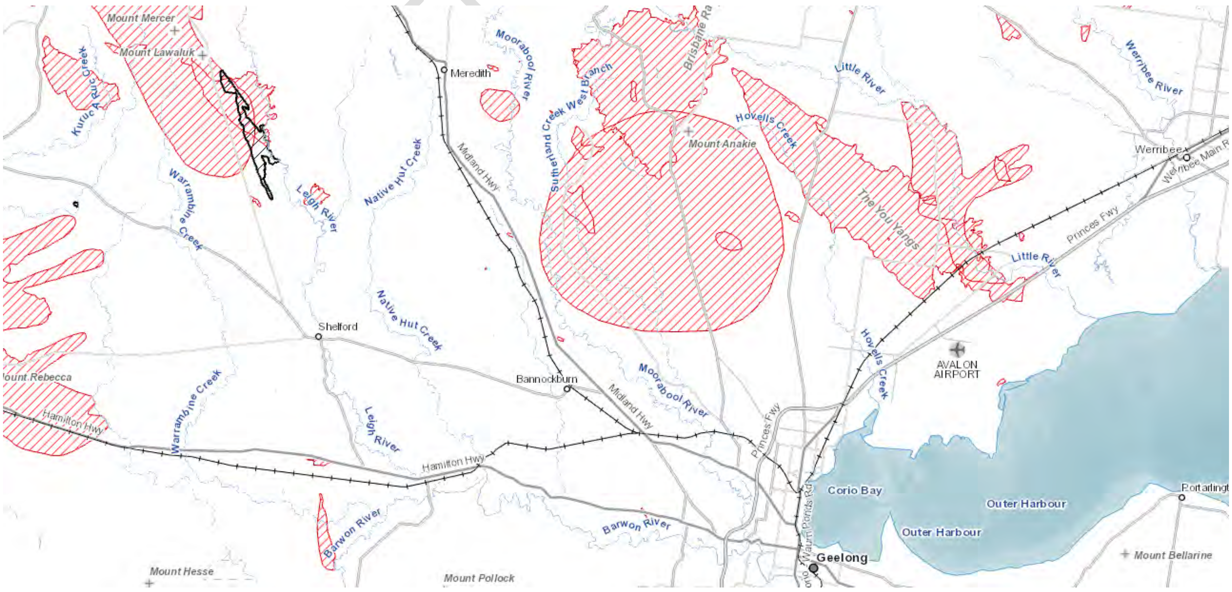
Attack Mechanism	Sites Risk and Response
Radiant Heat Exposure	Low exposure to radiant heat as the site is able to meet a BAL of Low and BAL of 12. due to the low threat vegetation within the surrounding landscape. All construction will be in accordance with a BAL of 12.5 to mitigate the impacts of low radiant heat exposures.
Convective Heat Exposure	The site will not be affected by convective heat as the topography surrounding the site is largely flat.
Ember Attack	Ember attack will be limited due to the lack of eucalypt species within the surrounding landscape.
Bushfire Induced Winds	Bushfire induced winds are not expected to be extreme in this location due to the benign topography of the surrounding landscape.

6.4 Bushfire History of the Area

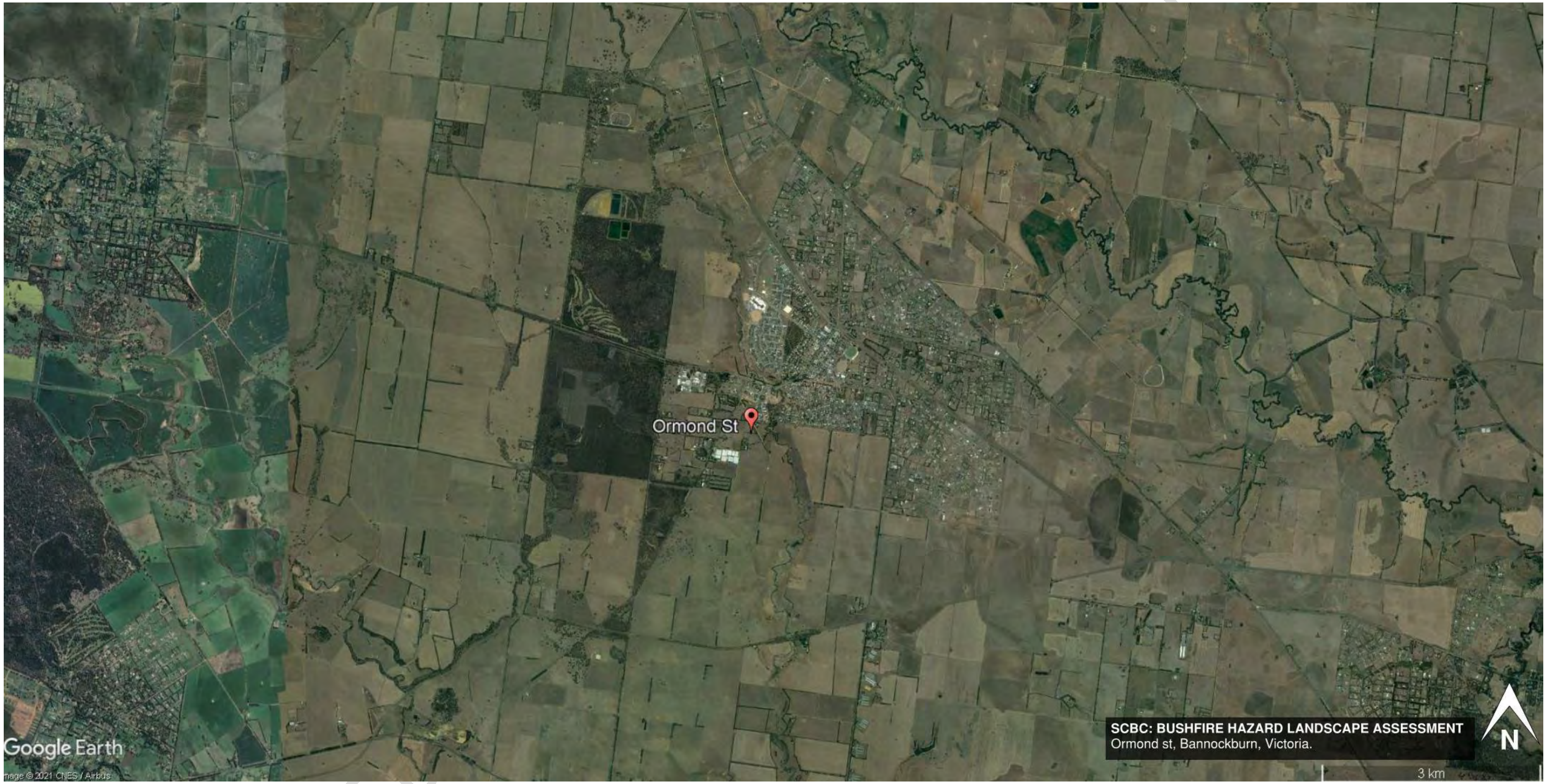
The map below (Map 3) sourced from NatureKit shows bushfires within the surrounding landscape since 1970. This map shows a historical fire in the surrounding landscape.

The map shows historical grassfires around Lara and the You Yangs. The map also shows a number of historical fires to the west.

6.4.1 Map 1 – Bushfire History of the surrounding area



6.5 Map 2 – Bushfire Hazard Landscape Assessment



The broader landscape shows the dominant hazard in the surrounding landscape is grassland vegetation. The Bannockburn nature reserve and golf course is located approximately 1km to the west of the proposed development.

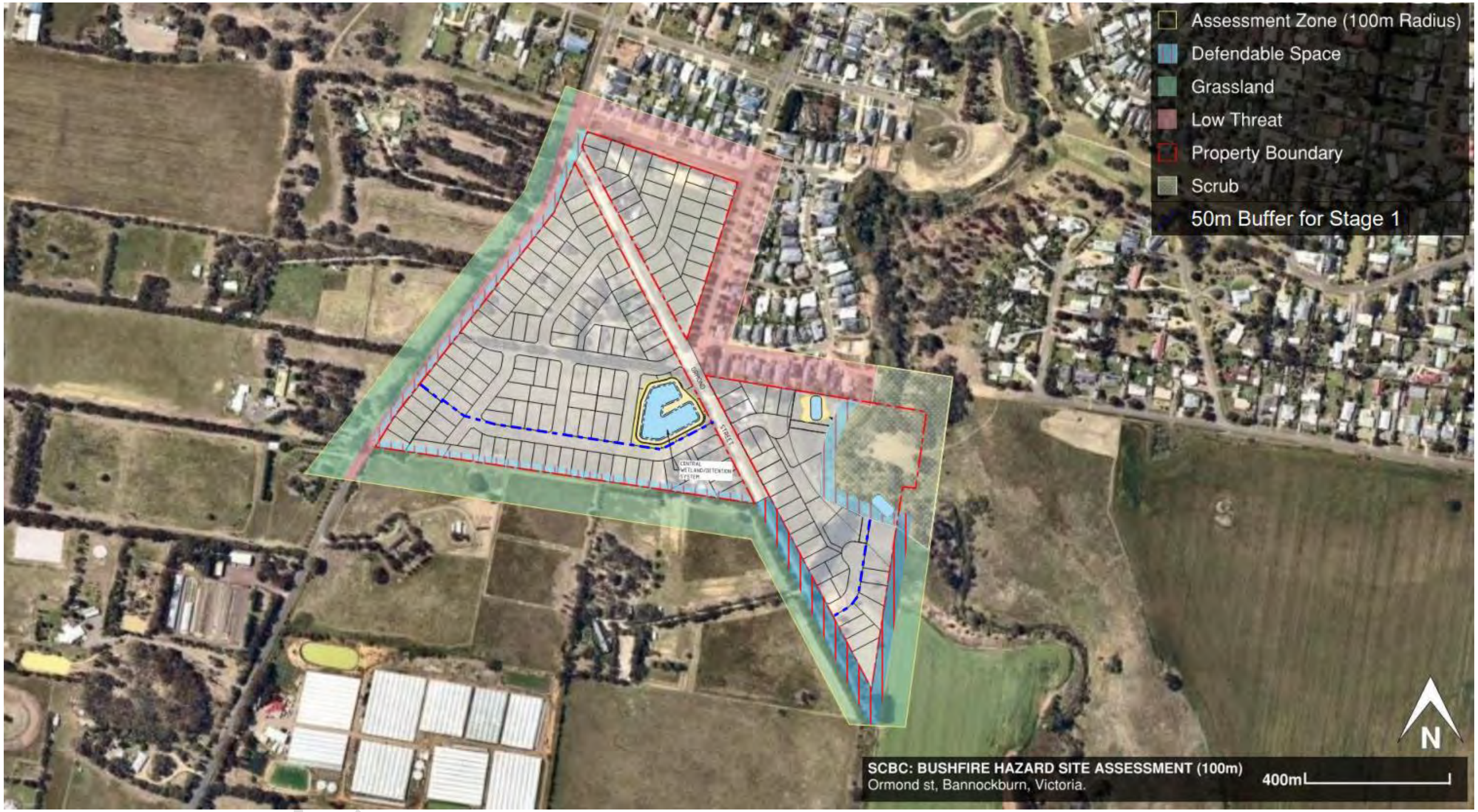
6.6 Map 3 - Bushfire Hazard Site Assessment – 1km Assessment Zone

The 1km assessment zone shows the extent of development in the surrounding landscape. The proposed development site is surrounded by grassland hazards, low density residential development to the south and west and high density residential development to the north and north east.

6.7 Map 4 – Bushfire Hazard Site Assessment – 400m Assessment Zone

The 400m assessment zone shows the established development to the north, east and west.

6.8 Map 5 – Bushfire Attack Level (BAL) Assessment – 100m Assessment Zone



The 100m assessment zone shows the proposed development and the hazards within 100m of the perimeter of the site that dictate the BAL assessment.

7. BUSHFIRE HAZARD SITE ASSESSMENT

The Bushfire Hazard Site Assessment includes a plan that describes the bushfire hazard within 150 meters of proposed development. The description of the hazard is prepared in accordance with AS 3959-2018 Construction of buildings in bushfire prone areas (Standards Australia) excluding paragraph (a) of section 2.2.3.2 (Vegetation Exclusions).

7.1 Site Details

Address:	2, 20, 25 and 30 Ormond Road, Bannockburn
Parcel	The property has 4 Parcels: 1. Allotment 12 Sec. 22B Township of South Bannockburn. 2. Allotment 11 Sec. 22B Township of South Bannockburn. 3. Allotment 10 Sec. 22B Township of South Bannockburn. 4. Lot 1 TP174543
Municipality:	Golden Plains
BMO Schedule:	N/A
Melways Reference:	Melway 488 A9

7.2 Vegetation

The vegetation within the 100 metre assessment area was classified according to method 1 in AS 3959-2018 for the purposes of this assessment.

The method 1 assessment in AS 3959-2018 uses a generalised description of vegetation based on the AUSLIG (Australian Natural Resources Atlas: No.7 Native Vegetation) classification system. According to this method, vegetation can be classified into seven categories. Each category indicates a particular type of fire behavior and these categories or classifications are then used to determine bushfire intensity.

Table 6 – Vegetation Assessment

Vegetation Classification	Vegetation Type (AS 3959-2018 Description)	Site Description
Grassland	***Open Woodland/Low Open Woodland/Open Shrubland/Low Open Shrubland/Hummock Grassland/Closed Tussock Grassland/Tussock Grassland/Open Tussock/Sparse Open Tussock/Dense Sown Pasture/Sown Pasture/Open Herbfield/Spare Open Herbfield:*** *All forms (expect tussock, moorlands), including situations with shrubs and trees, if the overstorey foliage cover is less than 10%. Includes pasture and cropland.*	The surrounding landscape is dominated by grazed grasslands. The grasslands have a mixed use including grazing and cropping.

		Figure 1 –Grassland along Bruce Creek. 
Scrub	***<u>Closed Scrub:</u>*** *Found in wet areas and / or areas affected by poor soil fertility or shallow soils; >30% foliage cover. Dry heaths occur in rocky areas. Shrubs >2m high. Typical of coastal wetlands and tall heaths up to 6m in height. May be dominated by Banksia, Melaleuca or Leptospermum with heights of up to 6m.* ***<u>Open Scrub</u>****: Shrubs greater than 2m high; 10%-30% foliage cover with a mixed species composition.*	The vegetation within the 100m assessment area to the west along Bruce Creek is classified as scrub. There are trees located further to the north and south, however, this area of Bruce Creek is dominated by grassland and scrub. The creek line is a narrow band of vegetation that meanders along the creek line.

		Figure 2 – Scrub along Bruce Creek. 

7.3 Topography

Topography of the land surrounding a site is particularly important as the topography influences the rate of spread and intensity of a fire. Fire burns faster uphill, as the slope increases so does the speed of the fire and its intensity. As a general rule for every increase 10° up a slope, the fire will double its speed and conversely down a slope. Fires tend to move more slowly as the slope decreases.

The topography of the surrounding landscape is largely flat with small depressions into dams and a deep depression along Bruce Creek as can be seen in Figure 1 and 2.

Grassland fires are predominantly influenced by wind speed and the cured (dryness) nature of the grassland rather than topography.

Map 6 – Topography of the site.

7.4 Bushfire Attack Level (BAL) for the proposed developments

The bushfire attack level (BAL) is a means of measuring the severity of a building's potential exposure to ember attack, radiant heat and direct flame contact, using increments of radiant heat expressed in kilowatts per meter squared, and the basis for establishing the requirements for construction to improve protection of building elements from attack by bushfire.

The BAL for this site has been calculated to assess the radiant heat exposure to the site. The BAL inputs include a 'Forest Fire Danger Index' (FFDI) of 100 and a Flame Temperature of 1090K.

The minimum construction standard in a Bushfire Prone Area is a BAL of 12.5 from AS 3959-2018.

The BAL assessment assumes that vegetation within the site will be managed to a low threat condition in accordance with AS 3959-2018. The definition of low threat vegetation is detailed in Appendix 1 of this document.

Table 7 – BAL for the development.

Orientation	Highest threat vegetation	Slope under classifiable vegetation	Distance to the unmanaged bushfire hazard.	Bushfire Attack Level (BAL)
North	Low-Threat	Flat	>100m	BAL - Low
East	Scrub	Downslope 10-15°	39m	BAL - 12.5
East	Grassland	Downslope 0-5°	22m	BAL - 12.5
South	Grassland	Flat	19m	BAL - 12.5
West	Grassland	Flat	19m	BAL - 12.5

8. BUSHFIRE MANAGEMENT PLAN

Bushfire Management Plan – 5, 20, 25 & 30 Ormond Road, Bannockburn (Prepared By SCBC – 12/05/22)

Access Requirements

- Roads must be constructed to a standard so that they are accessible in all weather conditions and capable of accommodating a vehicle of 15 tonnes for the trafficable road width.
- The average grade must be no more than 1 in 7 (14.4%) (8.1 degrees) with a maximum of no more than 1 in 5 (20%) (11.3 degrees) for no more than 50 meters. Dips must have no more than a 1 in 8 (12%) (7.1 degree) entry and exit angle.
- Curves must have a minimum inner radius of 10 metres. Have a minimum trafficable width of 3.5 metres and be clear of encroachments for at least 0.5 metres on each side and 4 metres above the access way.
- Roads more than 60m in length from the nearest intersection must have a turning circle with a minimum radius of 8m (including roll-over kerbs if they are provided) T or Y heads of dimensions specified by CFA may be used as alternatives.

Construction Standards

All future construction works will comply with a **BAL 12.5** compliant with AS 3959-2018.

Defendable space will be managed for the following distances:

North – Property Boundary
East – 39m (around the Bruce Creek)
East – 22m (to the farmland and existing road reserve)
South – 19m
West – 19m (can include Harvey Street and Ormond Road in the defendable space).

Vegetation Management requirements within the street scape and the open space areas of the subdivision include:

- Grass must be short cropped and maintained during the declared fire danger period.
- All leaves and vegetation debris must be removed at regular intervals during the declared fire danger period.
- Within 10 metres of a building, flammable objects must not be located close to the vulnerable parts of the building.
- Plants greater than 10 centimetres in height must not be placed within 3 metres of a window or glass feature of the building.
- Shrubs must not be located under the canopy of trees.
- Individual and clumps of shrubs must not exceed 5 square metres in area and must be separated by at least 5 metres.
- Trees must not overhang or touch any elements of the building.
- The canopy of trees must be separated by at least 5 metres.
- There must be a clearance of at least 2 metres between the lowest tree branches and ground level.

Hydrant Requirements

Above or below ground operable hydrants must be provided. The maximum distance between these hydrants and the rear of all building envelopes (or in the absence of building envelopes, the rear of the lots) must be 90 metres and the hydrants must be no more than 120 metres apart. These distances must be measured around lot boundaries.

The hydrants must be identified with marker posts and road reflectors as applicable to the satisfaction of the Country Fire Authority.

9. RESPONSE TO CLAUSE 13.02 – BUSHFIRE PLANNING

9.1 Policy Application

Clause 13.02 must be applied to all planning and decision making under the Planning and Environment Act 1987 relating to land that is:

- *Within a designated bushfire prone area,*
- *Subject to a Bushfire Management Overlay, or*
- *Proposed to be used or developed in a way that may create a bushfire hazard.*

9.2 Objective

To strengthen the resilience of settlements and communities to bushfire through risk-based planning that prioritises the protection of human life.

9.3 Strategies: Protection of human life

Give priority to the protection of human life by:

Strategy	Consideration
Prioritising the protection of human life over all other policy considerations.	There are no conflicting policy considerations identified during the assessment of this development. The site is not in a landscape at a high risk from bushfire and the site can provide areas exposed to low levels of radiant heat.
Directing population growth and development to low risk locations and ensuring the availability of, and safe access to, areas where human life can be better protected from the effects of bushfire.	The development site is identified in the Bannockburn Urban Design Framework as being a location for 'Consolidated Residential Development' and for 'Priority Residential Development Zone'. The proposed development can adequately mitigate the surrounding hazards to protect human life. Central areas of the subdivision will be exposed to a BAL Low.
Reducing the vulnerability of communities to bushfire through the consideration of bushfire risk in decision making at all stages of the planning process.	The bushfire risk of the proposed site is being considered at the permit stage. The development of this site will reduce the grassland hazards western interface of the existing township. The site is on the edge of a number of future growth zones including the north west development plan, the south west precinct and the south east precinct.

9.4 Strategies: Bushfire Hazard Identification and Assessment

Identify bushfire hazard and undertake appropriate risk assessment by:

Strategy	Consideration
Applying the best available science to identify vegetation, topographic and climatic conditions that create a bushfire hazard	The best available science has been applied to this application.
Considering the best available information about bushfire hazard including the map of designated bushfire prone areas prepared under the Building Act 1993 or regulations made under that Act	The site is within the Bushfire Prone Area of the state.
Applying the Bushfire Management Overlay in planning schemes to areas where the extent of vegetation can create an extreme bushfire hazard	The BMO is not applied to the site.
Considering and assessing the bushfire hazard on the basis of: • ***Landscape conditions – meaning conditions in the landscape within 20 km (and potentially up to 75km) of a site.*** • ***Local conditions – meaning conditions in the area within approximately 1km of a site.*** • ***Neighbourhood conditions – meaning conditions in the area within 400m of a site.*** • ***The site for the development.***	Section 5, 6 and 7 of this report address the landscape, local and neighborhood conditions.
Consulting with emergency management agencies and the relevant fire authority early in the process to receive their recommendations and implement appropriate bushfire protection measures.	Emergency services have provided an Response to Version 1 of this report. This Version (2) provides some enhanced mitigation measures to the area's of concern raised by the CFA. Emergency services would have been consulted in the development of the *Bannockburn Urban Design Framework Overall Principles Plan.*
Ensuring that strategic planning documents, planning scheme amendments, planning permit applications and development plan approvals properly assess bushfire risk and include	The application includes appropriate bushfire protection measures, including: staging of the subdivision to mitigate the grassland impacts from the south and east, proposed perimeter fencing as n interim mitigation measure whilst the growth areas to

appropriate bushfire protection measures.	the south and east are under development, vegetation management within the subdivision in the public open space areas and road reserves, access and egress for emergency services and hydrant requirements.
Not approving development where a landowner or proponent has not satisfactorily demonstrated that the relevant policies have been addressed, performance measures satisfied or bushfire protection measures can be adequately implemented.	The site is surrounded by grassland vegetation and the hazards can be appropriately managed. The bushfire risk to the site will be addressed through vegetation management.

9.5 Strategies: Settlement Planning

Plan to strengthen the resilience of settlements and communities and prioritise protection of human life by:

Strategy	Consideration
Directing population growth and development to low risk locations, being those locations assessed as having a radiant heat flux of less than 12.5 kilowatts/square metre under AS 3959-2018 Construction of Buildings in Bushfire-prone Areas (Standards Australia, 2018).	The development will not be exposed to radiant heat levels that exceed 12.5kW/m^2 as demonstrated in the BAL assessment in section of this report. A number of mitigation measures associated with staging and perimeter steel fences are proposed as an interim solution whilst the abutting growth areas are being developed.
Ensuring the availability of, and safe access to, areas assessed as a BAL-LOW rating under AS 3959-2018 Construction of Buildings in Bushfire-prone Areas (Standards Australia, 2009) where human life can be better protected from the effects of bushfire.	The central areas of the site greater than 50m from the grassland hazards and 100m from all other hazards are exposed to a BAL Low in accordance with AS 3959-2018.
Ensuring the bushfire risk to existing and future residents, property and community infrastructure will not increase as a result of future land use and development.	The proposed development will not increase the risk to future residence, property, or community infrastructure.
Achieving no net increase in risk to existing and future residents, property and community infrastructure, through the implementation of bushfire protection Measures and where possible reducing bushfire risk overall.	There is a net decrease in risk associated with this development as the management of the grassland within the property will further protect the properties that border the proposed development.
Assessing and addressing the bushfire hazard posed to the settlement and the	The bushfire hazards have been assessed in sections 6 and 7 of this report.

likely bushfire behavior it will produce at a landscape, settlement, local, neighbourhood and site scale, including the potential for neighbourhood-scale destruction.	The hazards to the proposed site have been addressed through, staging of the development, potential steel fencing to the south and east, management of vegetation within the site, construction requirements and setback distances associated with AS 3959-2018.
Assessing alternative low risk locations for settlement growth on a regional, municipal, settlement, local and neighbourhood basis.	The site is identified in the Bannockburn Urban Design Framework as a site for future residential development and thus an alternative low risk location for settlement growth is not considered.
Not approving any strategic planning document, local planning policy, or planning scheme amendment that will result in the introduction or intensification of development in an area that has, or will on completion have, more than a BAL 12.5 rating under AS 3959-2018 Construction of Buildings in Bushfire-prone Areas (Standards Australia, 2018).	The buildings within the site will not be exposed to radiant heat loads greater than $12.5 kW/m^2$.

9.6 Strategies: Areas of biodiversity conservation value

Strategy	Consideration
Ensure settlement growth and development approvals can implement bushfire protection measures without unacceptable biodiversity impacts by discouraging settlement growth and development in bushfire affected areas that are important areas of biodiversity.	The biodiversity impacts have not been considered as part of this report.

9.7 Use and development control in a Bushfire Prone Area

In a bushfire prone area designated in accordance with regulations made under the Building Act 1993, bushfire risk should be considered when assessing planning applications for the following uses and development:

- *Subdivisions of more than 10 lots.*
- *Accommodation.*
- *Child care centre.*
- *Education centre.*
- *Emergency services facility.*
- *Hospital.*
- *Indoor recreation facility.*

- *Major sports and recreation facility.*
- *Place of assembly.*

Any application for development that will result in people congregating in large numbers. When assessing a planning permit application for the above uses and development:

Strategy	Consideration
Consider the risk of bushfire to people, property and community infrastructure.	The bushfire risk to people and property has been addressed as part of this application.
Require the implementation of appropriate bushfire protection measures to address the identified bushfire risk.	The proposal includes appropriate bushfire protection from the surrounding hazards.
Ensure new development can implement bushfire protection measures without unacceptable biodiversity impacts.	The biodiversity impacts have not been considered as part of this report.

9.8 Policy Guidelines

Consider as relevant:

- *Any applicable approved state, regional and municipal fire prevention plan.*

9.9 Policy Documents

Consider as relevant:

- *AS 3959-2018 Construction of Buildings in Bushfire-prone Areas (Standards Australia, 2018).*
- *Building in bushfire-prone areas – CSIRO and Standards Australia (SAA HB36-1993, 1993)*
- *An bushfire prone area map prepared under the Building Act 1993 or regulations made under the Act.*

10.REFERENCES

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11. APPENDICES

11.1 Appendix 1 – The definition of 'Low Threat Vegetation'.

There are two different definitions of 'Low Threat' vegetation. One is detailed within the planning scheme (Clause 53.02 Bushfire Planning) and another in AS 3959-2018.

Within the body of this report the existing fuel is assessed in accordance with AS 3959-2018 and the recommended low threat vegetation management within the road reserves and public open space within the subdivision is managed in accordance with the definition from Clause 53.02 for defendable space.

Low threat vegetation – AS 3959-2018

The definition in AS 3959-2018 includes the following:

(a) Multiple areas of vegetation less than 0.25ha in area and not within 20m of the site, or each other of other areas of vegetation being classified vegetation.
(b) Strips of vegetation less than 20m in width (measured perpendicular to the evaluation exposed to the strip of vegetation) regardless of length and not within 20m of the site or each other, or other areas of vegetation being classified.
(c) Non-vegetated areas, including waterways, roads, footpaths, buildings and rocky outcrops.

Vegetation regarded as low threat due to factors such flammability, moisture content or fuel load. This includes grassland managed in a minimal fuel condition, mangroves and other saline wetlands, maintained lawns, golf courses (such as playing areas and fairways), maintained public reserves and parklands, sporting fields, vineyards, orchards, market gardens (and other non-curing crops), cultivated gardens, commercial nurseries, nature strips and windbreaks.

Low threat vegetation (Defendable Space) – Clause 53.02

The definition of 'Low Threat' vegetation is detailed in Clause 53.02 for sites within the Bushfire Management Overlay (BMO). Clause 53.02 refers to areas of low fuel loads around buildings as areas of Defendable Space. The vegetation management criteria of defendable space include the following:

- Grass must be short cropped and maintained during the declared fire danger period.
- All leaves and vegetation debris must be removed at regular intervals during the declared fire danger period.
- Within 10 metres of a building, flammable objects must not be located close to the vulnerable parts of the building.
- Plants greater than 10 centimetres in height must not be placed within 3 metres of a window or glass feature of the building.
- Shrubs must not be located under the canopy of trees.
- Individual and clumps of shrubs must not exceed 5 square metres in area and must be separated by at least 5 metres.
- Trees must not overhang or touch any elements of the building.
- The canopy of trees must be separated by at least 5 metres.
- There must be a clearance of at least 2 metres between the lowest tree branches and ground level.

TGM

Engineering | Surveying | Planning

5, 20, 25 & 30 ORMOND STREET BANNOCKBURN

INFRASTRUCTURE SERVICING ASSESSMENT

REPORT V01

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Level 1, 27-31 Myers Street
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Phone: (03) 5202 4600

Reference: 17170-02
September 2020

Client: Ormond Street Landowners Group

Project: 5, 20, 25 & 30 Ormond Street Bannockburn

Document: Infrastructure Servicing Assessment (ISA)

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Client Project Manager	L. Prossor
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J:\17170 (30 Ormond Street, Bannockburn)\02-CE (ISA)\17170-02 2020.09.01 Infrastructure Servicing Assessment (Ormond Street Bannockburn)Draft.docx

1. INTRODUCTION

This Infrastructure Servicing Assessment has been prepared at the request of David Collins.

The subject site is currently zoned as Farming (FZ) and is within the Golden Plains Growth zone.

Existing Conditions / Location

Numbers 5, 20 & 30 are located along Harvey Road and Ormond Street and Number 25 has access from Ormond street.

Figure 1: 5, 20, 25, 30 Ormond Street Bannockburn – *Locality Plan*

Any proposed development of 5, 20, 25 & 30 Ormond Road Bannockburn must be undertaken in accordance with the Golden Plains Shire Planning Scheme.

2. DEVELOPMENT PLAN

A concept Development Plan has been undertaken for 5, 20, 25, 30 Ormond Street Bannockburn, refer Figure 2 below.

The development plan shows the potential number of lots for each property Storm water management is subject to a separate report.

Council or service authorities have not approved the Development Plan layout hence the layout and lot yield will be likely to change based on input and comments from key stakeholders, but any changes are not expected to affect the servicing of the land.

Figure 2: 5, 20, 25, 30 Ormond Street Bannockburn - Development Plan

3. ACCESS

Direct access to the site is from Ormond Street, Bruce Street and Harvey Road. The addition of roads built within the proposed development site, will provide six extra access points from Ormond Road and one extra access road on Harvey Road which will provide access to all Lots.

4. DRAINAGE

The proposed development will result in an increase in impervious surfaces resulting in an increase in stormwater runoff volumes and pollutants.

Clause 56.07-04 of the Victoria Planning Provisions details the requirement for Residential sub-divisions to achieve the objectives of the State Environment Protection Policy (SEPP) as set out by the Urban Stormwater best practice environmental management guidelines (BPEMG) for stormwater quality.

As part of the proposed rezoning, a Site Stormwater Management Plan (SSMP) has been Prepared by TGM / CardnoTGM to assess the impact and proposed mitigation measures to achieve best practise requirements.

The SSMP shows that stormwater pollutants can be mitigated to meet 'best-practice' objectives with the adoption of a combination of one wetland and two raingardens.

5. SEWER

The proposed development land is located in South Bannockburn area. Barwon Water have stated that Golden Plains Shire have previously advised the proposed land zoning in this area as outlined in Figure 3:

- Land west of Ormond Street will be future residential land (filled red area)
- Land east of Ormond Street has been identified as priority future residential zone (highlighted in pink).

Barwon Water's Sewerage Planning team have previously indicated that a reticulated sewer can drain to the north to the existing sewer pump station located at the eastern end of Archie Lane. The proposed gravity sewer alignment is shown as a dotted red line.

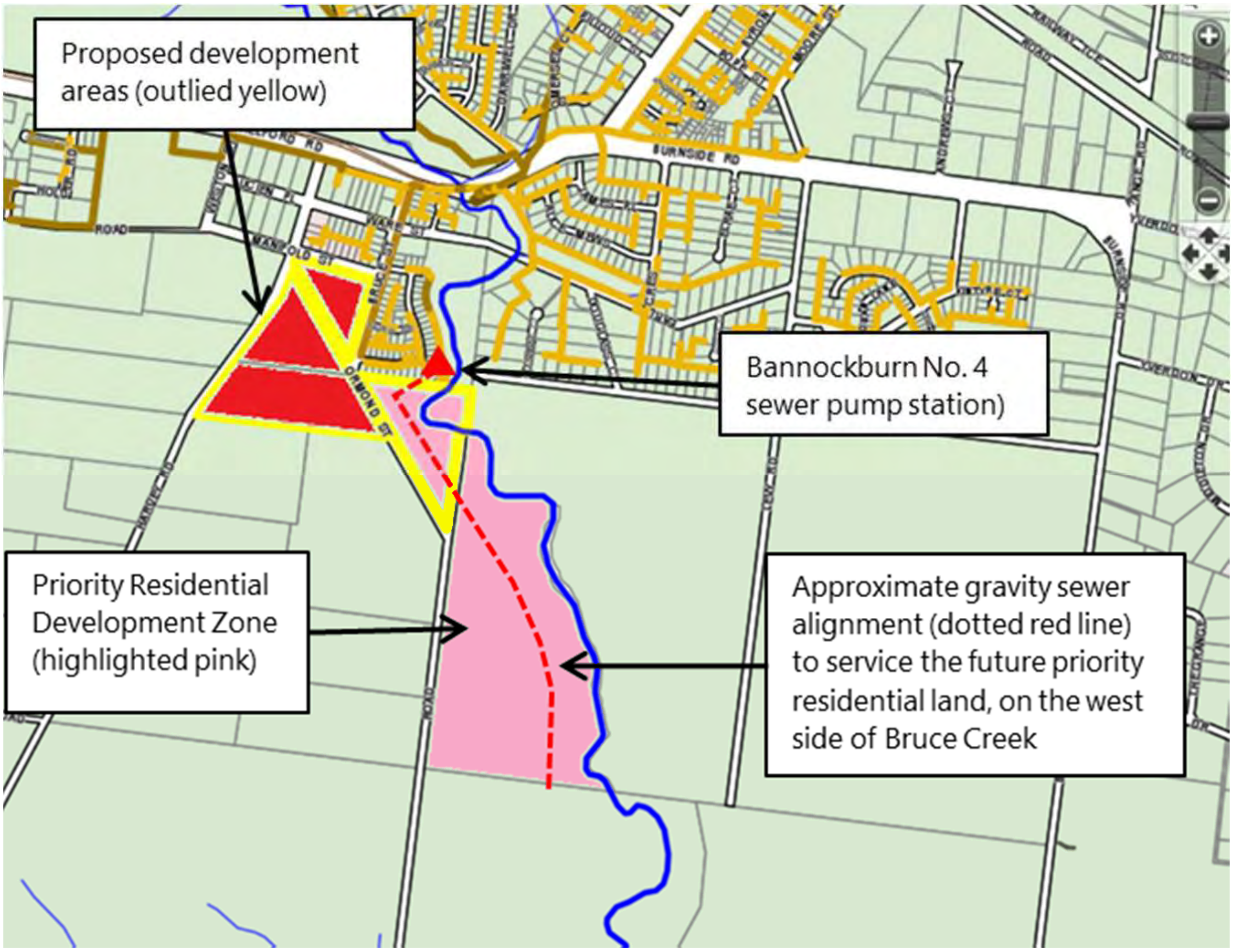

Figure 3: Development location within Bannockburn South

The existing Bannockburn sewer system is located towards the north east of the proposed development areas. There are 3 development areas that require a sewer service.

AREA 1: can be serviced by the existing DN300 gravity sewer within Bruce Street

AREA 2: the northern section can discharge into Area 1. The southern section can discharge into Area 3.

AREA 3: is located on land that is steep and naturally drains toward the east and Bruce Creek. The development can be accommodated by the Bannockburn No.4 Sewer Pump Station (red triangle). This pump station is deep and can accommodate Area 2.

Future sewers within Area 3

The future gravity sewers within Area 3 will need to have the appropriate depth to ensure it can service the future priority residential land to the south, as shown in figure 4.

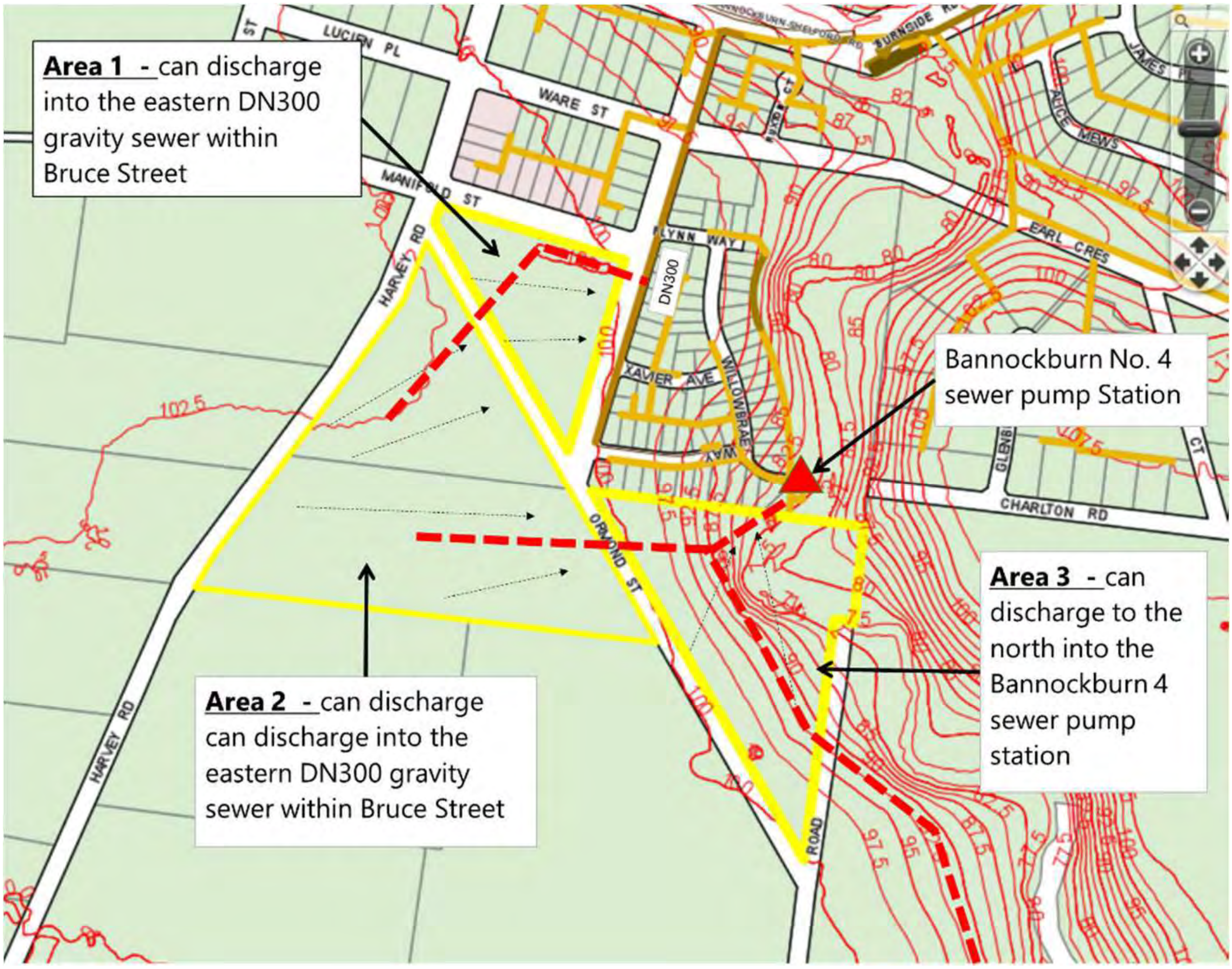

Figure 4: Proposed sewer strategy development at 5, 20, 25 and 30 Ormond St Bannockburn (Source: Barwon Water.)

6. WATER

This development will connect to the Bannockburn pressure zone which is a boosted water supply system with a full supply level of 167m AHD.

All dead end water mains will require a loop on the end of the water main. A DN300 shared water main will need to be constructed by the developer along Bruce street and south on Ormond Street. This come under shared assets and will be refunded by Barwon Water on take over.

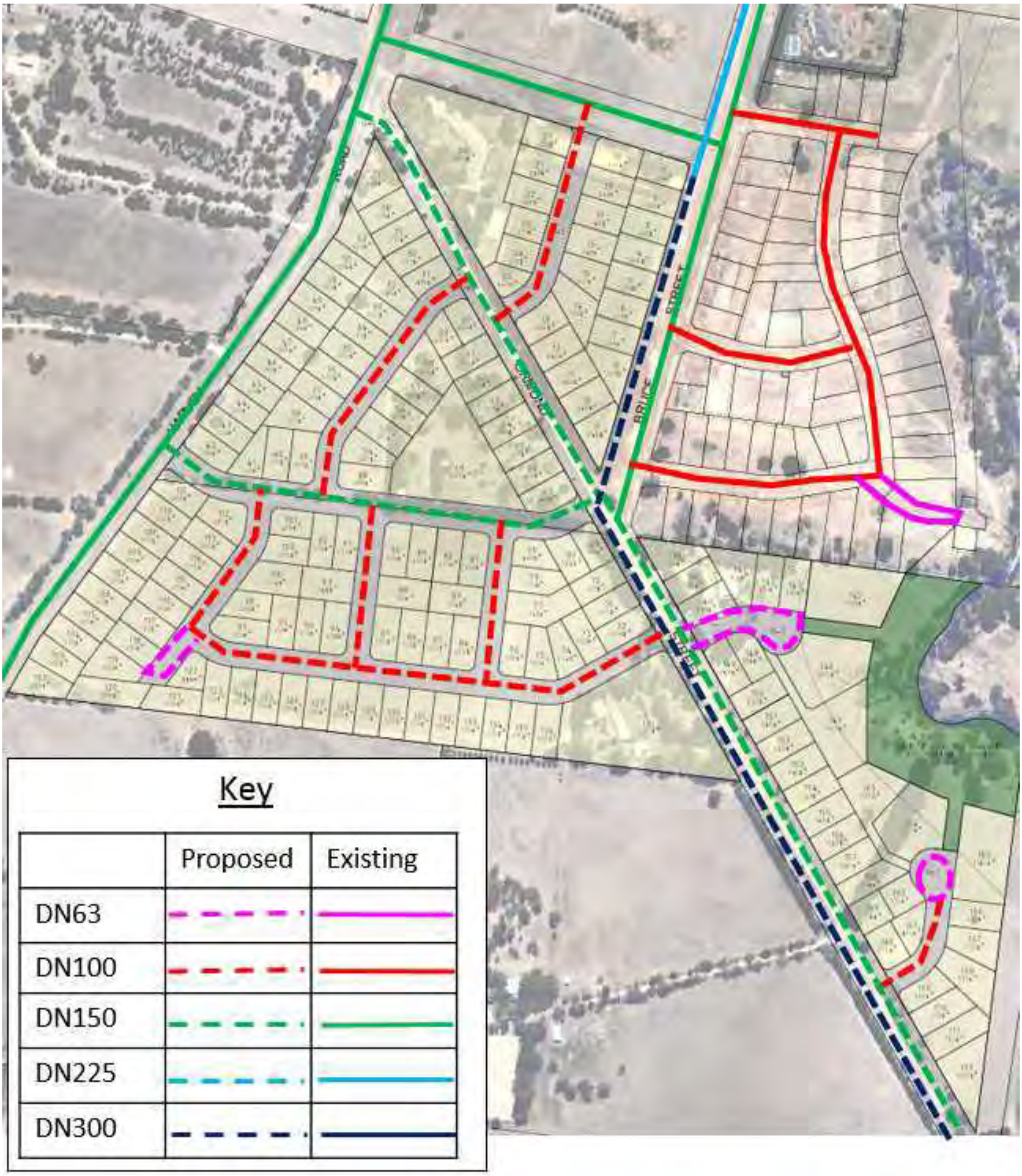

Figure 5: 5, 20, 25 and 30 Ormond Street Bannockburn-Water mains layout. *(Source: Barwon Water)*

RECYCLED WATER

There is no recycled water infrastructure in this part of Barwon Water's network, therefore no recycled water reticulation is required to be provided.

7. ELECTRICITY

The subject property can be supplied from Manifold Street. Two Triple Switch Kiosks will be required to service the whole development

Figure 6: 5,20,25 & 30 Ormond Street Bannockburn – *Electricity network*

8. GAS

The subject site has existing gas mains fronting the site within Manifold Street and Bruce Street. Ausnet Services have advised that these services have sufficient capacity to service the proposed development and will be required to be extended through the development as it occurs.

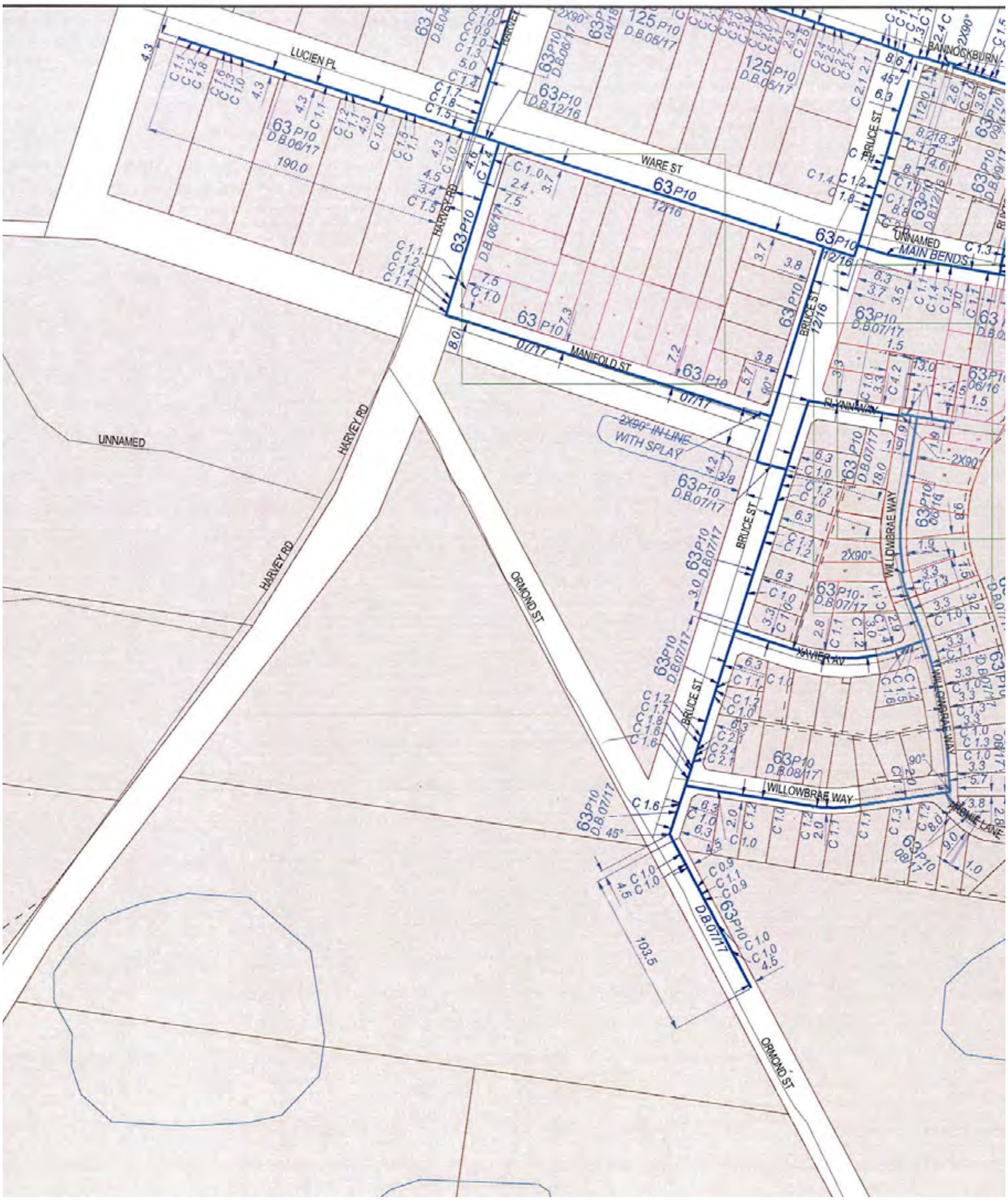

Figure 7: 5,20,25 & 30 Ormond Street Bannockburn – *Gas network*

9. TELECOMUNICATIONS

NBN have advised they are able to supply telecommunications to the development site.

Further discussion will be required with the individual telecommunication service providers to understand any potential or further network costs.

10. CONCLUSION

The report indicates that development can proceed at 5, 20, 25 and 30 Ormond Street Bannockburn as all required services can be provided to the site.

APPENDIX A – DEVELOPMENT PLAN

APPENDIX B – BARWON WATER SERVICING ADVICE

Barwon Water

Preliminary Servicing Advice

To: Coral Launer
From: Yves Nininahazwe
Date: 17 September 2018
Subject: Water & Sewer Servicing Advice: 5, 20, 25 & 30 Ormond Street, Bannockburn

Dear Coral,

We have reviewed the water servicing advice for the development at 5, 20, 25 & 30 Ormond Street, Bannockburn, and we have the following comments.

Water Servicing Advice

The development will connect to the Bannockburn pressure zone, which is a boosted water supply system with a full supply level of 167 m AHD.

A water mains layout is shown in Attachment 1. All dead end water mains will require a 'loop' on the end of the water main. There will be a DN300 shared water main in Bruce Street and heading south on Ormond Street. The shared assets will be constructed by the developer and paid for by Barwon Water.

Barwon Water

Attachment 1: Water Mains Layout

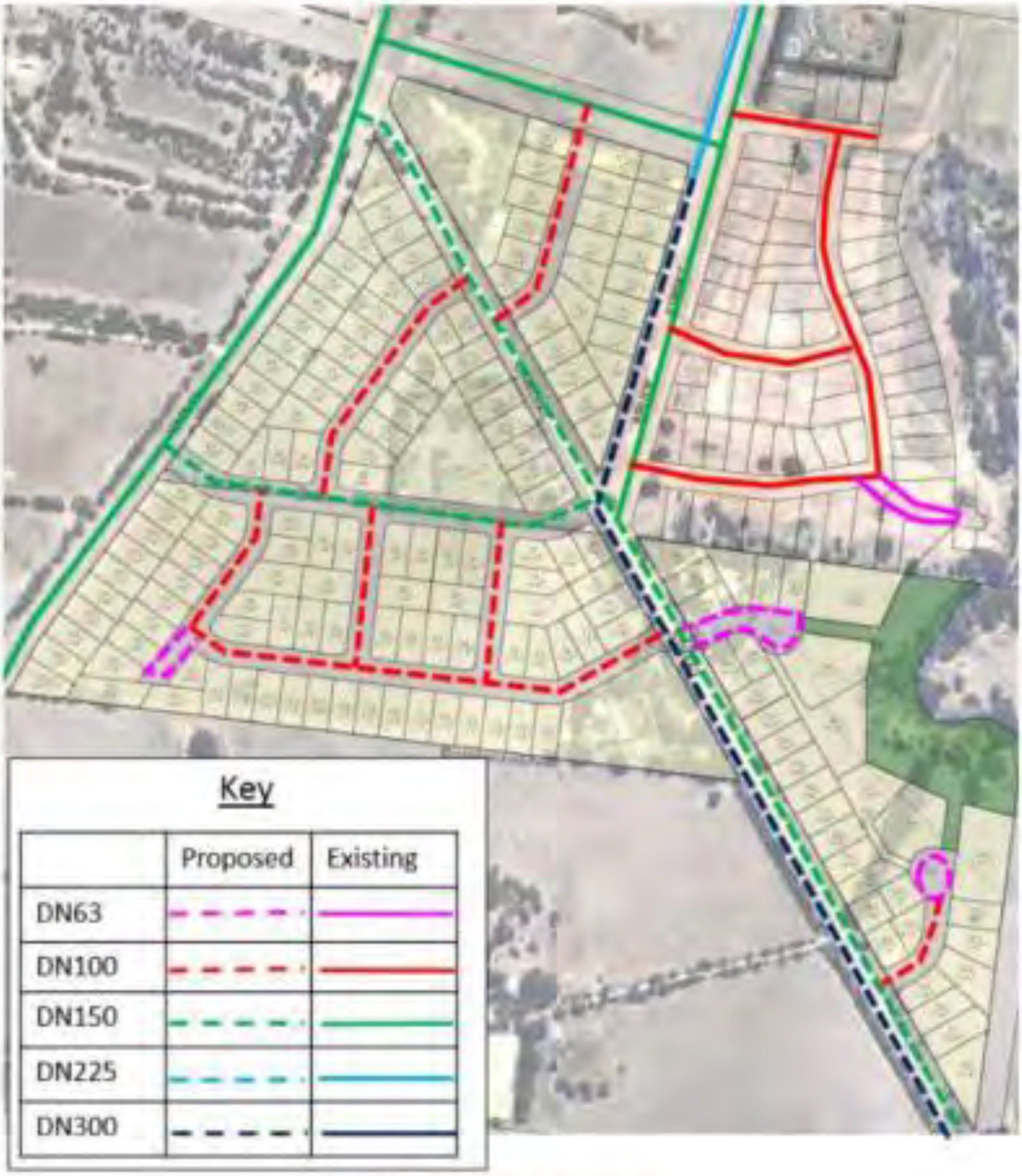

Figure 1: Water Mains Layout

Barwon Water

Sewer Servicing Advice

The proposed development land is located in South Bannockburn area, as shown in Plan1 below (proposed development land is outlined yellow). The Golden Plains Shire previously have indicted the proposed land zoning in this area:

- Land west of Ormond Street will be future residential land (filled red area in Plan 1)
- Land east of Ormond Street has been identified as priority future residential zone (highlighted pink in Plan 1). Sewerage Planning have previously indicated that a reticulated sewer can drain to the north, the proposed gravity sewer alignment is shown as a dotted red line in Plan 1 below.

Plan 1 Development location within Bannockburn South

The existing Bannockburn sewer system is located towards the north east of the proposed development areas. There are 3 development areas that require a sewer service. The areas are summarized below:

- **Area 1** can be served by the existing DN300 gravity sewer within Bruce Street.
- **Area 2** – The northern section can discharge into Area 1. The southern section can discharge into Area 3.
- **Area 3** is located on land that is steep that naturally drains towards to the east towards Bruce Creek. The development can be accommodated by the Bannockburn No. 4 Sewer Pump Station (red triangle ion Plan 2). This pumps station is deep and can accommodate Area 2.

BarwonWater

Plan 2 Proposed sewer strategy development at 20, 25 and 30 Ormond Road, Bannockburn

Future Sewers within Area 3

The future gravity sewers within Area 3 will need to have the appropriate depth to ensure it can service the future priority residential developer land to the south, as shown in Plan 1 above.

Should you have further questions about this letter, please contact the officer listed above.

Kind Regards,

Chris Molloy
Project Team Leader
Enterprise Project Delivery

ORMOND ST, BANNOCKBURN

SITE STORMWATER MANAGEMENT PLAN

TGM GROUP PTY. LTD.
Level 1, 27-31 Myers Street
Geelong, Victoria 3220
Phone: (03) 5202 4600

Reference: 17170-03
November 2021

Client: Land Owners at 5, 20, 25 and 30 Ormond St, Bannockburn
Project: Ormond St, Bannockburn
Document: Site Stormwater Management Plan

Document Status

Version	Document type	Prepared by	Reviewed by	Date Issued
V00	Site Stormwater Management Plan	YL	MC	19 Feb 2019
V01	Site Stormwater Management Plan	AP	MC	5 Mar 2019
V02	Site Stormwater Management Plan	TD	LP	18 December 2020
V03	Site Stormwater Management Plan	MO	LP	21 October 2021
V04	Site Stormwater Management Plan	MO	LP	15 November 2021

Project Details

Project Name	Ormond St, Bannockburn, Site Stormwater Management Plan
Client	David Collins
Client Project Manager	Chris Marshall
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TGM Reference	17170-03

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Document Location

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Executive Summary

TGM Group Pty Ltd has been engaged by Land Owners at 5, 20, 25 and 30 Ormond St, Bannockburn to develop a Site Stormwater Management Plan (SSMP) to support a planning scheme amendment application of the land at Ormond Street, Bannockburn.

The subject land currently comprises four (4) small rural holdings of approximately 17 hectares, located to the south west of the Township of Bannockburn.

The proposed development will result in an increase in impervious surfaces resulting in an increase in stormwater runoff volumes and pollutants.

Clause 56.07-04 of the Victoria Planning Provisions details the requirement for Residential sub-divisions to achieve the objectives of the State Environment Protection Policy (SEPP) as set out by the Urban Stormwater best practice environmental management guidelines (BPEMG) for stormwater quality.

The study shows that stormwater pollutants can be mitigated to meet 'best-practice' objectives with the adoption of a combination of a central wetland and two raingardens. The resulting stormwater contaminant removal efficiency can be seen in Table A.

Table A: Stormwater quality treatment efficiency

Criteria	Reduction (%)	Objective (%)
Total Suspended Solids (kg/yr)	80	80
Total Phosphorus (kg/yr)	62.1	45
Total Nitrogen (kg/yr)	45.8	45
Gross Pollutants (kg/yr)	100	70

Stormwater quantity is able to be mitigated to predeveloped flow rates with the adoption of a combination of a central detention basin (located above the wetland storage level) and isolated detention basins for the small catchments (Catchments S3 & S4) not able to be directed to the centrally located detention system. The resulting flows present at the sites legal point of discharge can be seen in Table B and Table C

Table B: Stormwater Discharge – Eastern Outlet

AEP	Existing Conditions		Developed Conditions	
	Critical Event Duration	Critical Peak Discharge (m^3/s)	Critical Event Duration	Critical Peak Discharge (m^3/s)
1%	1hour	0.940	20min	0.785
10%	45min	0.326	10min	0.311
20%	1.5hour	0.247	10min	0.250

Table C: Stormwater Discharge – Western Outlet

AEP	Existing Conditions		Developed Conditions	
	Critical Event Duration	Critical Peak Discharge (m^3/s)	Critical Event Duration	Critical Peak Discharge (m^3/s)
1%	3hour	0.120	20min	0.062
10%	4.5hour	0.047	25min	0.037
20%	4.5hour	0.032	10min	0.029

We note that the exact outflows achieved will be confirmed at the detailed design stage of the project.

Contents

List of Tables

List of Figures

1 Introduction

TGM Group Pty Ltd has been engaged to develop a Site Stormwater Management Plan (SSMP) to support a Rezoning Application of land at 5, 20, 25, and 30 Ormond Street, Bannockburn, herein known as 'the site'.

The following report details the adopted analytical process and design outcomes for this study. A stormwater quality and a hydrological model were developed to predict the efficiency of the proposed treatment system in the reduction of contaminants and pollutants and to ensure that the site discharge can be maintained to predeveloped rates

The following report discusses the ability of the proposed development to discharge stormwater flows directly to Bruce Creek.

2 Stormwater Objectives

The objective of the following SSMP is to mitigate adverse impacts on stormwater discharges resulting from the development of the site. The SSMP will focus on stormwater discharge quality and quantity and the provision of mitigation facilities that will be designed to meet the conditions and requirements for stormwater management.

The objectives of the Site Stormwater Management Plan (SSMP) are detailed below.

2.1 Site Stormwater Objectives

The site stormwater objectives are:

1. Best Practice reductions for Water Quality
   - 80% reduction in Suspended solids (SS)
   - 45% reduction in total nitrogen (TN)
   - 45% reduction in total phosphorus (TP)
   - 70% reduction in gross pollutants (GP)
2. Stormwater conveyance
   - Conveyance of flows up to and including the 1% AEP flows to the LPOD.
3. Stormwater Quantity
   - Ensuring no increase in stormwater rates discharging from the LPOD for events up to and including the 1% AEP flows.

The following stormwater management plan will provide details on the proposed stormwater treatment facilities and associated structures physical requirements for the mitigation of runoff from the development to ensure stormwater discharge targets are achieved for the entire site.

3 Study Area

3.1 Existing Site

The site constitutes four (4) small rural holdings with a combined area of approximately 17 hectares. The site is located south west of the Township of Bannockburn.

The site is identified in the Bannockburn Urban Design Framework Plan as land set aside for 'Consolidated Residential' as adopted by the Golden Plains Shire. Therefore, strategic planning support has been be established to validate a Planning Scheme Amendment application to rezone this land for residential development in the short term.

The site is located on the west bank of Bruce Creek. Specifically, part of 25 Ormond St is subject to inundation caused by Bruce Creek flooding, as shown in Figure 3.2.

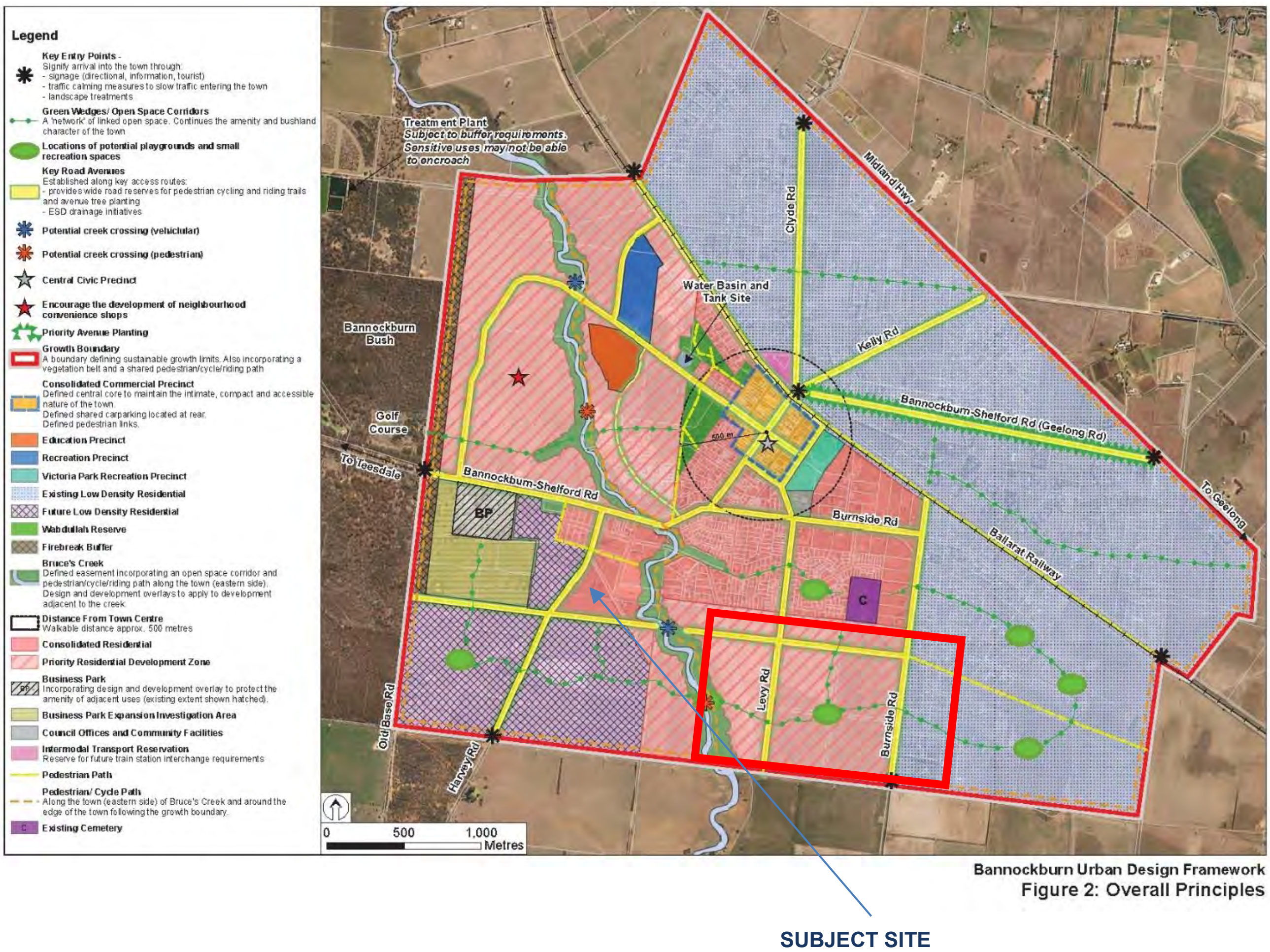


Figure 3.1: Bannockburn urban design framework, land use and activities

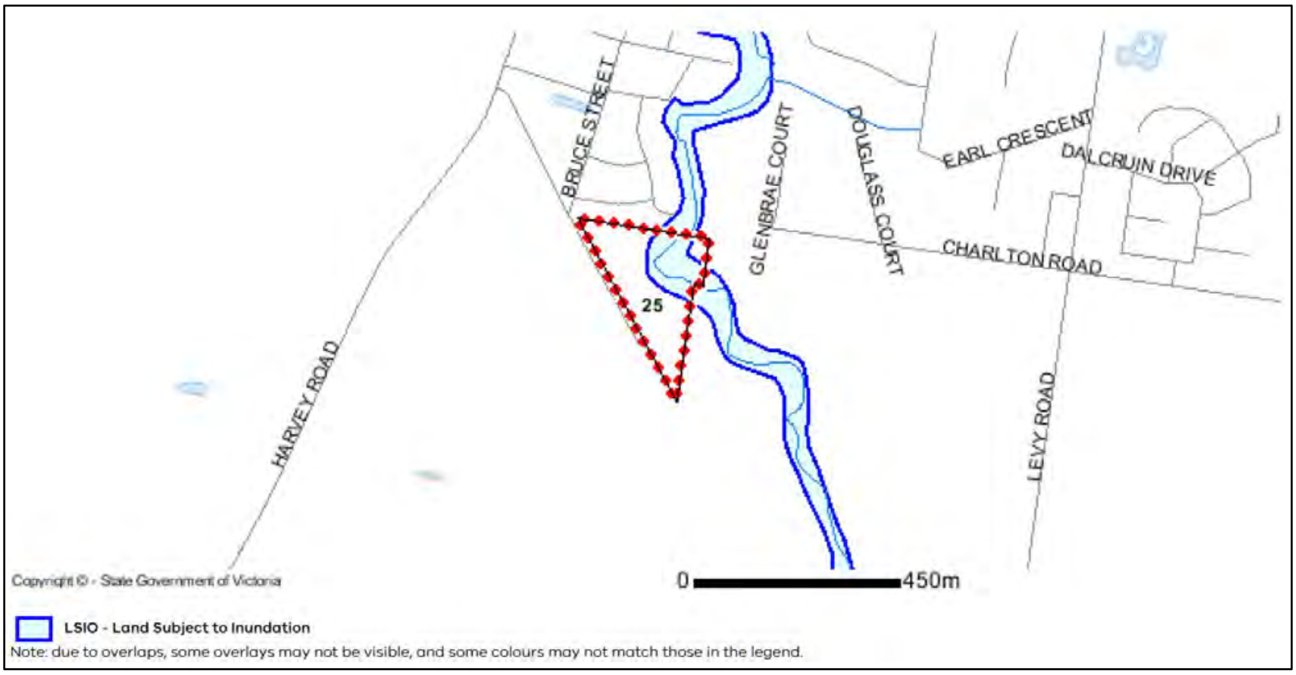


Figure 3.2: Land Subject to Inundation area[1]

The northern, western and central portion of the proposed development site exhibits flat slopes with no distinct topographical features. The central and eastern sections flow eastwards toward Bruce Creek with the eastern portion of the site, located on the western bank of Bruce Creek dropping steeply down towards the creek. The south western portion of the site generally quite flat although ultimately discharges west and into Harvey Street. The existing site and existing contours can be seen in Figure 3.3 below

[1] Planning Maps Online, http://services.land.vic.gov.au/landchannel/jsp/map/PlanningMapsIntro.jsp. Accessed on 7 Feb 2019.

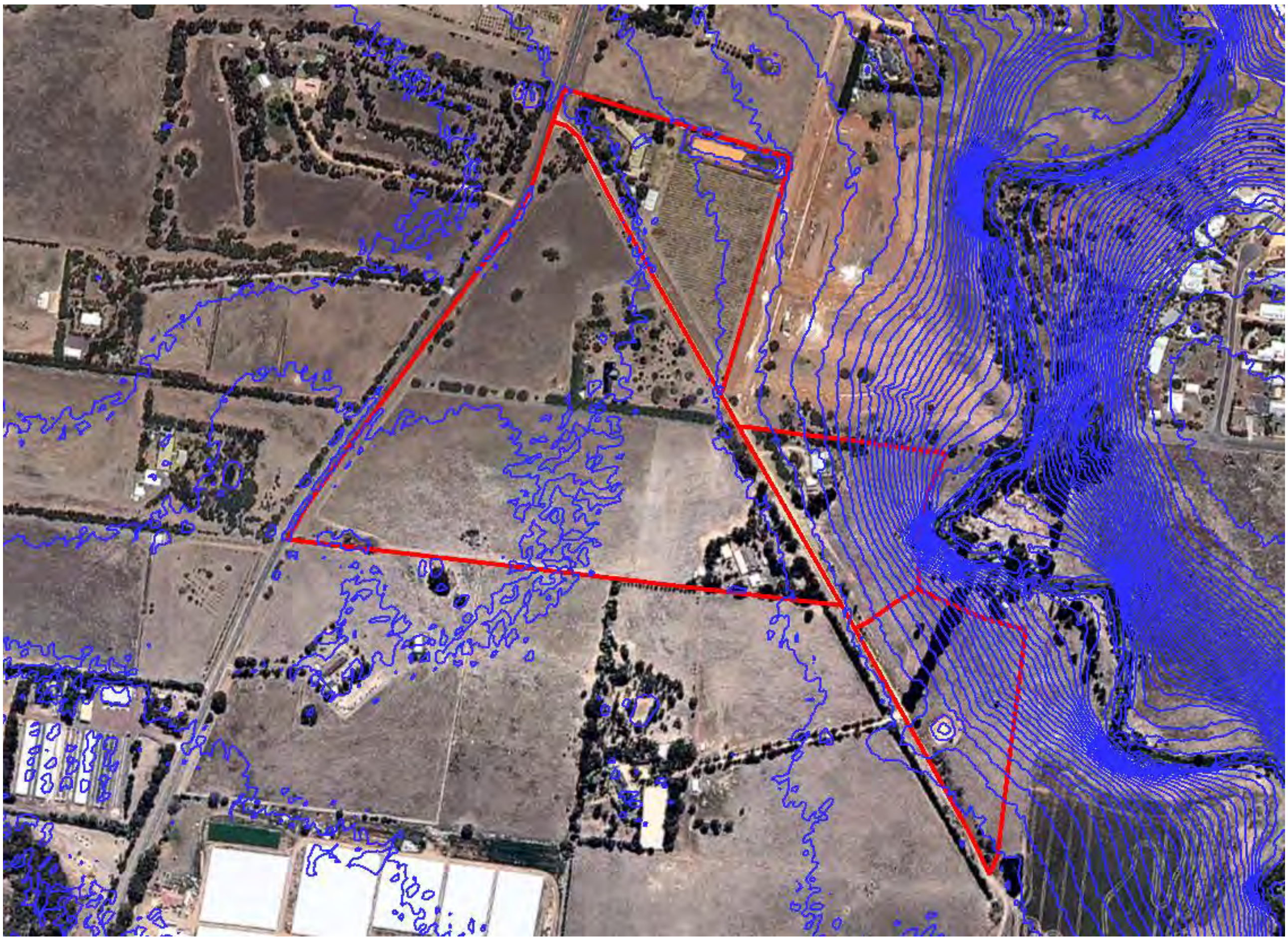


Figure 3.3: Existing Contours

3.2 Developed Site

The proposed development of the site will include construction of a General Residential (GRZ1) sub-division, as well as associated road network and reserve area.

The preliminary plan of sub-division, shown in Figure 3.4, proposes construction of approximately 170 lots. The proposed lots range in size from 431 m² to 2,168 m². There are three (3) super lots (3,990 m² – 6,137 m²) delineated around the existing residences to be retained.

The majority of lots are within the 590 m² to 1,000 m² range. Therefore, a fraction impervious of 70% was adopted for new lots. The larger lots around existing residences adopted a modelled fraction impervious based on actual area.

Fraction impervious was calculated based on Melbourne Water MUSIC Guideline[2], the initial plan (Figure 3.4), and the aerial imagery (nearmap[3]).

The proposed development results in a change of fraction impervious of the site from 4.7% under existing conditions to 58.6% under developed conditions.

Due to the layout of the site and the proximity to Bruce Creek a single end of line treatment system will not be practical. The below proposal analyses an integrated strategy including a centrally located wetland/detention facility servicing the majority of the development with additional rainwater tanks being provided on allotments that cannot drain directly to the centrally located system. It is proposed that the lots containing rainwater tanks will be subject to a restriction on title such as a section 173 agreement as indicated by catchments S2B, S3 & S4 as shown in Figure 3.4 and Section 6

Two bioretention systems are also proposed adjacent the Bruce Creek outfall to ensure flows that cannot be directed to the centrally located wetland system can undergo stormwater quality treatment ensuring best practice guidelines are met and maintained.

[2] Melbourne Water (2018). MUSIC Guidelines – Input parameters and modelling approaches for MUSIC users in Melbourne Water's service area 2018.

[3] Nearmap. https://www.nearmap.com.au/. Accessed on 9 May 2018.

LAND BUDGET	
SITE AREA	16.14ha
OPEN SPACE	0.95ha
NET DEVELOPABLE AREA	15.19ha
No. OF LOTS	191
LOT DENSITY	12.6 LOTS/ha

Figure 3.4: Plan of Prosposed Sub Division (TGM Group 2021)

3.3 Site Topography and Stormwater Conveyance

3.3.1 Topographical data

The Digital Elevation Model (DEM) used in this study was generated using LIDAR data from the *2003-04 National Action Plan for Salinity and Water Quality Corangamite LiDAR* dataset flown between 19 July 2003 and 10 August 2003.

The LIDAR data has a resolution of 0.6 m with a horizontal accuracy of ± 1.5 m and a vertical accuracy of ± 50 cm. The DEM was rendered using ESRI ArcGIS at a sampling resolution of 5 metres.

The DEM generated for the analysis is shown in Figure 3.5.

3.3.2 Bruce Creek

Bruce Creek is situated immediately east of the site. The Creek alignment dissects the north-east corner of 25 Ormond Street.

Bruce Creek originates approximately 16 km north of the site and has an upper catchment area in the vicinity of 30 to 40 km². Critical flooding within Bruce Creek is driven by longer duration rainfall events and from runoff generated within the upper catchment area.

The majority of the site is at an elevation greater than 100 m AHD before grading down to Bruce Creek.

The Bruce Creek alignment invert is at an elevation of approximately 70 m AHD through 25 Ormond Street.

Bruce Creek ultimately receives all stormwater runoff from the site.

3.3.3 Stormwater Conveyance

The site straddles a minor ridgeline creating two (2) site discharge direction, east and west. Ultimately, all stormwater runoff from the site enters Bruce Creek. The east catchment discharges to Bruce Creek directly, whereas, the smaller west catchment discharges through neighbouring properties and into the existing Harvey Street table drains before entering Bruce Creek approximately 3 km south of the site.

The difference in elevation between the east and west catchment is approximately 0.5 metres. It is expected that the developed surface levels will generally be graded out to allow conveyance of the majority of stormwater flows to Bruce Creek within the east catchment. A small amount of allotments along the Harvey Street frontage are proposed to continue directing flows west to maintain flow to downstream water uses. The exact arrangement will be confirmed through civil functional design at a later stage.

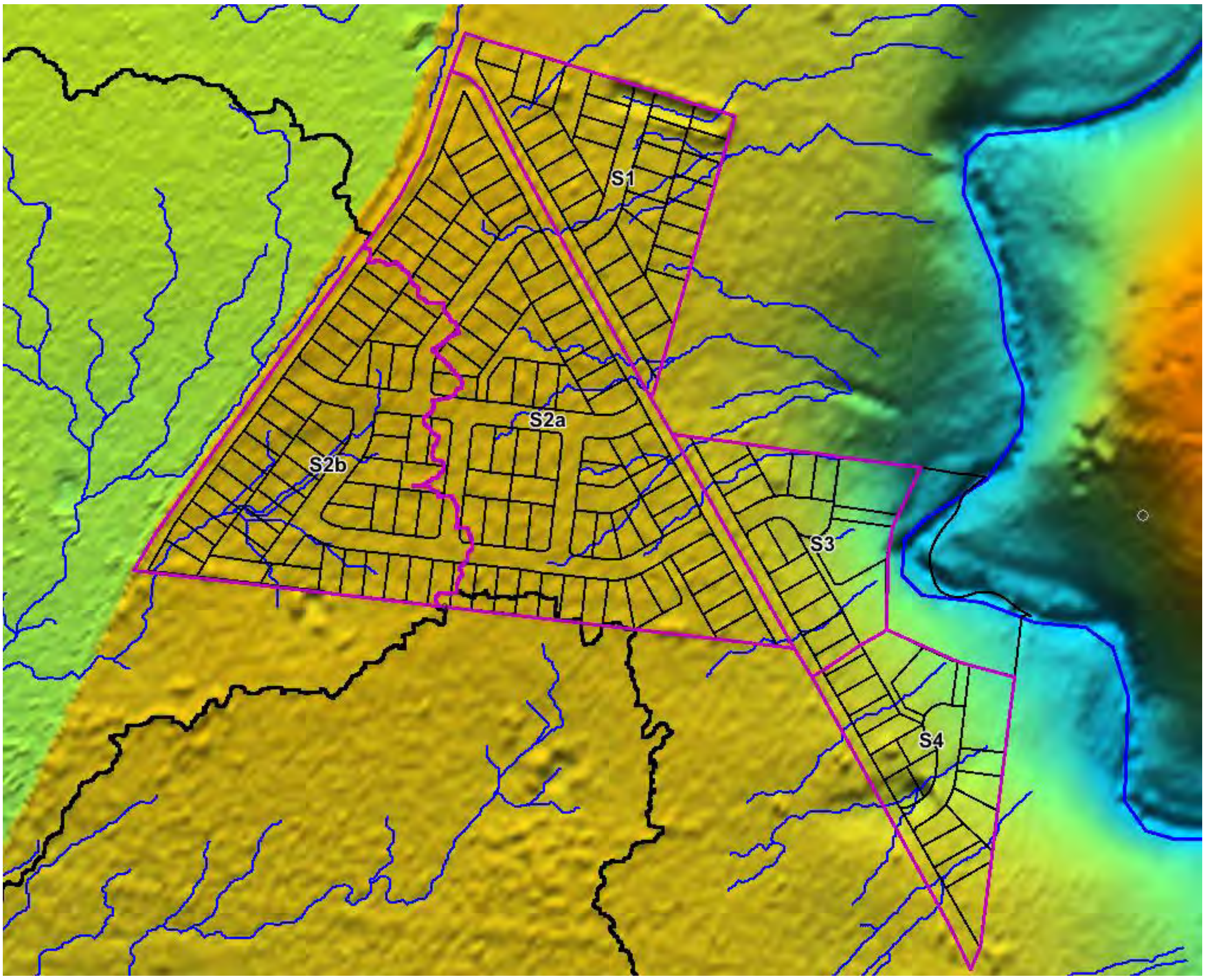


Figure 3.5: DEM and Stormwater flow path

4 Hydraulics and Hydrology

To ensure flows are maintained to predeveloped flowrates a hydrological analysis was simulated with XP-STORM by applying the rainfall and runoff, Laurenson routing and one-dimensional (1D) hydraulic channel techniques based on Australian Rainfall & Runoff 2019 (ARR2019) Methodology. XP-STORM provides features to allow interface with the ARR Data Hub and Bureau of Meteorology (BOM) to obtain IFD and rainfall data to generate temporal patterns for a range of event probabilities.

A distributed hydrological model of the study catchment was used to compute the stormwater hydrographs to determine the discharge infrastructure sizing and distributed detention basin sizing for input into 12D to further determine land area requirements.

4.1 Design Catchment Delineation

Determination of design catchments was devised by undertaking a conceptual design which indicated the proposed developed flow paths within the site. Developed catchments can be seen in Figure 4-1.

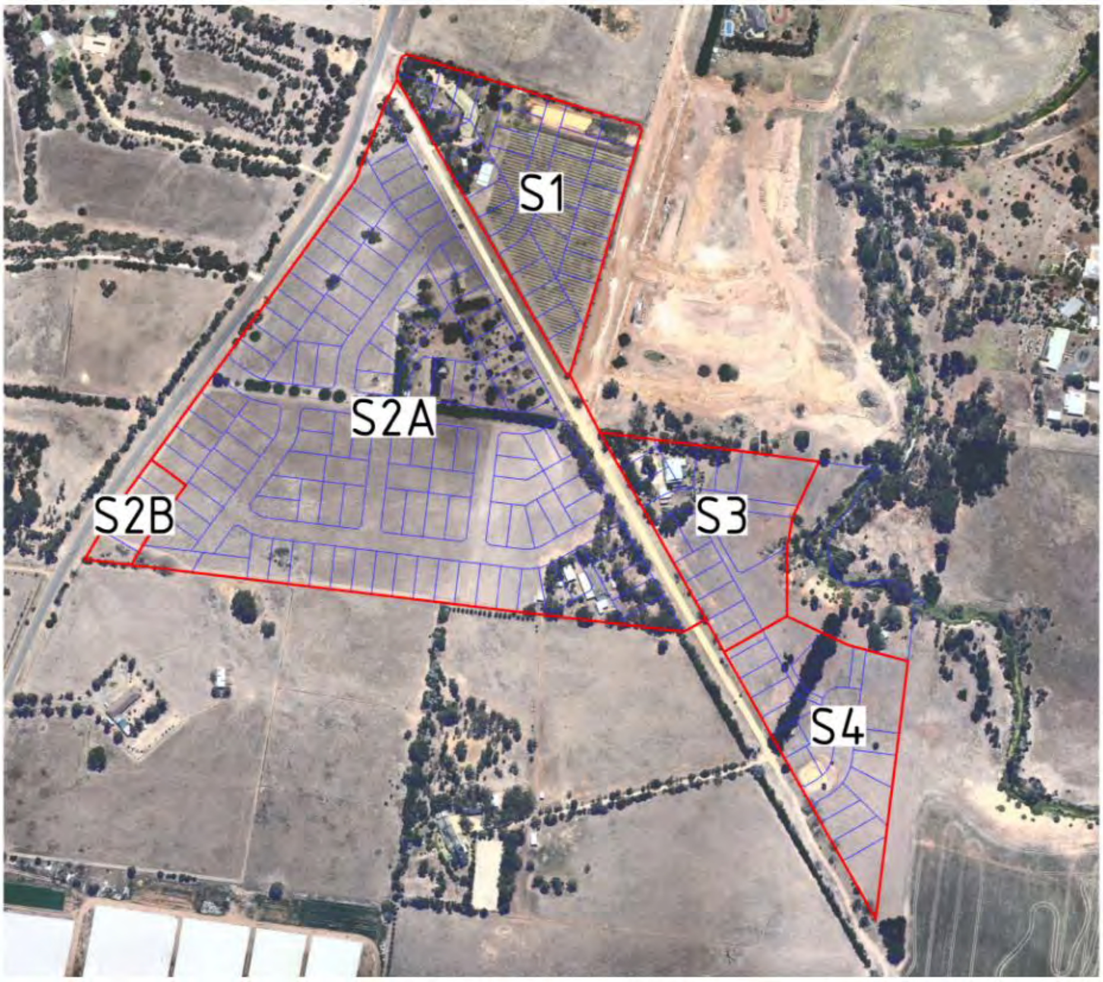


Figure 4-1 Overall Design Catchments

4.2 Model Parameters

4.2.1 Permeability and Fraction Impervious

A fraction impervious percentage was assigned to the catchments to reflect the excepted permeability based on planning context and actual land use.

To assign fraction impervious values for the developed conditions, lot sizes indicated within the Overall Development Plan (ODP) were related to the relevant impervious fractions noted in Melbourne Water[4].

Table 4-1 Fraction Impervious

Land Use	Impervious Surface (%)
Agricultural	0.0
Existing Buildings	1
Rural Road Reserve	0.2
Small Residential Lots (Under 1000m2)	0.7
Large Residential Lots (Typically 2000m2)	0.3

Details of the existing conditions input values are shown in Table 4-2 below.

Table 4-2 Existing Catchment Parameters

Catchment	Area (ha)	Fraction Impervious	Impervious Area (ha)	Slope (%)
S1	2.684	0.098	0.29	0.520
S2A	6.356	0.047	0.3	0.630
S2B	4.083	0	0	0.200
S3	1.886	0.084	0.158	0.105
S4	2.058	0.950	0.46	0.390

Details of the proposed conditions input values are shown in Table 4-3 below.

[4] Melbourne Water (2018). MUSIC Guidelines – Input parameters and modelling approaches for MUSIC users in Melbourne Water's service area 2018.

Table 4-3 Design Catchment Parameters

Catchment	Area (ha)	Fraction Impervious	Impervious Area (ha)	Slope (%)
S1	2.684	0.55	1.193	0.62
S2A	10.038	0.625	6.278	0.40
S2B	0.401	0.7	0.281	0.19
S3	1.886	0.468	0.883	10.53
S4	2.058	0.518	1.066	6.57

Rainwater tanks are proposed to control peak discharge from the development site catchments where flows could not be directed to the central treatment facility. Catchments S2B, S3 and S4 were further delineated to take into consideration the portion of the roof area that would be intercepted by the rainwater tank and the area that would not. It was assumed that 70% of the roof area of each allotment would be directed to the rainwater tanks. Rainwater tanks of 2kL (2m3) and 5kL (5m3) were provided for the conventional lots (Area under 1000m2) and the larger lots (above 1000m2) respectively. An average roof area of 300m2 and 600m2 has been used for the small and large lots respectively.

The catchment delineation for the rainwater tank assessment can be seen below in Table 4-4 below.

Table 4-4 Design Catchment Parameters

Catchment	Area (ha)	Lots per Catchments	Fraction Impervious	Impervious Area (ha)	Pervious Area (ha)
S2B – Roof	0.106	5	1	0.106	0
S2B - Balance	0.296	0	0.7	0.157	0.139
S3 – Roof (Small Lots)	0.274	13	1	0.274	0
S3 – Roof (Large Lots)	0.127	3	1	0.127	0
S3 - Balance	1.505	0	0.43*	0.648	0.857
S4 – Roof (Small Lots)	0.317	15	1	0.317	0
S4– Roof (Large Lots)	0.127	3	1	0.127	0
S4 - Balance	1.591	0	0.45*	0.729	0.862

*Weighted average of large and small lot impervious areas

4.2.2 Loss Parameters

XP-STORM was run as an Initial Loss (IL) and Continuing Loss (CL) model using parameters provided from the ARR Data Hub[5].

The hydrologic losses adopted in this study are summarised in Table 4-5 below.

Table 4-5 Adopted Hydrological Loss Parameters

Surface	Storm Initial Loss (mm)	Pre-Burst Depth (mm)	Adopted Losses	
			Burst Initial Loss (mm)	Continuing Loss (mm/hr)
Pervious	13.00	1.50	11.50	2.3
Impervious	0		0	0

4.2.3 Manning's Roughness Coefficients

In the hydrological model, all sub-areas are also characterised by Manning's 'n' coefficients, which describe the hydraulic roughness properties of the soil surfaces.

The Manning's coefficients adopted in this study are summarised in Table 4-6.

Table 4-6 Manning's Coefficients 'n' Adopted in the Hydrological Model.

Surface	Manning's Coefficients 'n'
Pervious	0.038
Impervious	0.018

The Manning's coefficients for the pervious surface have been further analysed through the sensitivity analysis process (Section 5.2.4)

4.2.4 ARR2016 Regional Flood Frequency (RFFE) Model

The ARR2016 RFFE model[6,7] available online at http://arr.ga.gov.au, was used to provide peak flow estimates for the study catchments.

The RFFE model provide peak flood estimates for rural catchments, therefore, the lumped model of the larger catchments S1 and S2 were initially considered to be undeveloped (pre-development) to allow comparison.

---

[5] ARR Data Hub, http://data.arr-software.org/ .
[6] Rahman. A, et al (2013). New Regional Flood Frequency Estimation (RFFE) Method for the whole of Australia: Overview of progress. Paper. Flood plain conference 2013.
[7] Rahman. A, Haddad. K, Kuczera. G and Weinmann. E, 2016, Peak Flow Estimation, Chapter 3 Book 3 in Australian Rainfall and Runoff – A Guide to Flood Estimation, Commonwealth of Australia.

4.2.5 Storm Burst Pattern Ensemble

The XP-STORM model applied ensemble rainfall patterns, storm burst loss factors and runoff estimation techniques from ARR2016[8] to the study catchment area to generate runoff hydrographs and predict the volume of stormwater generated.

As detailed in ARR2016[9] the majority of hydrograph estimation methods used for flood estimation require a temporal pattern that describes how rainfall falls over time as a design input.

The importance of temporal patterners has increased as the practice of flood estimation has evolved from peak flow estimation to full hydrology estimation.

An ensemble of 140 storms was analysed within the XP-STORM model for each storm event probability. For the sensitivity analysis process, the study catchment was set up as a rural catchment with no impervious surfaces.

Using the burst initial loss and continuing loss identified in Table 5-4, and known catchment characteristics, i.e. area, slope, overland flow path profiles, etc. the model was run using all 140 storm burst patterns for each AEP.

ARR2016 states that the temporal pattern that represents the worst (or best) case should not be used by itself for design. Testing has demonstrated that on most catchments large number of events in the ensemble patterns are clusters around the mean and median[10]. Based on this guidance the design has adopted the temporal pattern producing the median peak flow rate at the catchment outlet.

4.2.6 Results Summary

Based on the sensitivity analysis, the Manning's 'n' was refined. The comparison between the peak discharges generated with the XP-STORM model and the estimated RFFE model for the catchment is summarised in Table 4-7 and shown in Figure 4-2.

The hydrological parameters defined by the catchment characteristics, were capable of generating discharges within an acceptable range of the predicted RFFE discharge targets for all event probabilities.

[8] Ball. J, Babister. M, Nathan. R, Weeks. W, Weinmann. E, Retallick. M, Testoni. I, (Editors), 2016, Australian Rainfall and Runoff: A Guide to Flood Estimation, Commonwealth of Australia.
[9] Babister. M, Retallicj. M, Loveridge. M, Testoni. I and Podger. S, 2016, Temporal Patterns. Chapter 5 Book 2 in Australian Rainfall and Runoff- A Guide to Flood Estimation, Commonwealth of Australia.
[10] Babister. M, Retallicj. M, Loveridge. M, Testoni. I and Podger. S, 2016, Temporal Patterns. Chapter 5 Book 2 in Australian Rainfall and Runoff- A Guide to Flood Estimation, Commonwealth of Australia.

Table 4-7 Manning's 'n' and Peak Discharges

Event AEP (%)	Area (ha)	Manning's 'n' Adopted	RFFE Discharge (m^3/s)	XP STORM Discharge (m^3/s)
50	13.1	0.035	0.07	0.05
20			0.13	0.12
10			0.18	0.17
5			0.24	0.24
2			0.33	0.36
1			0.41	0.45

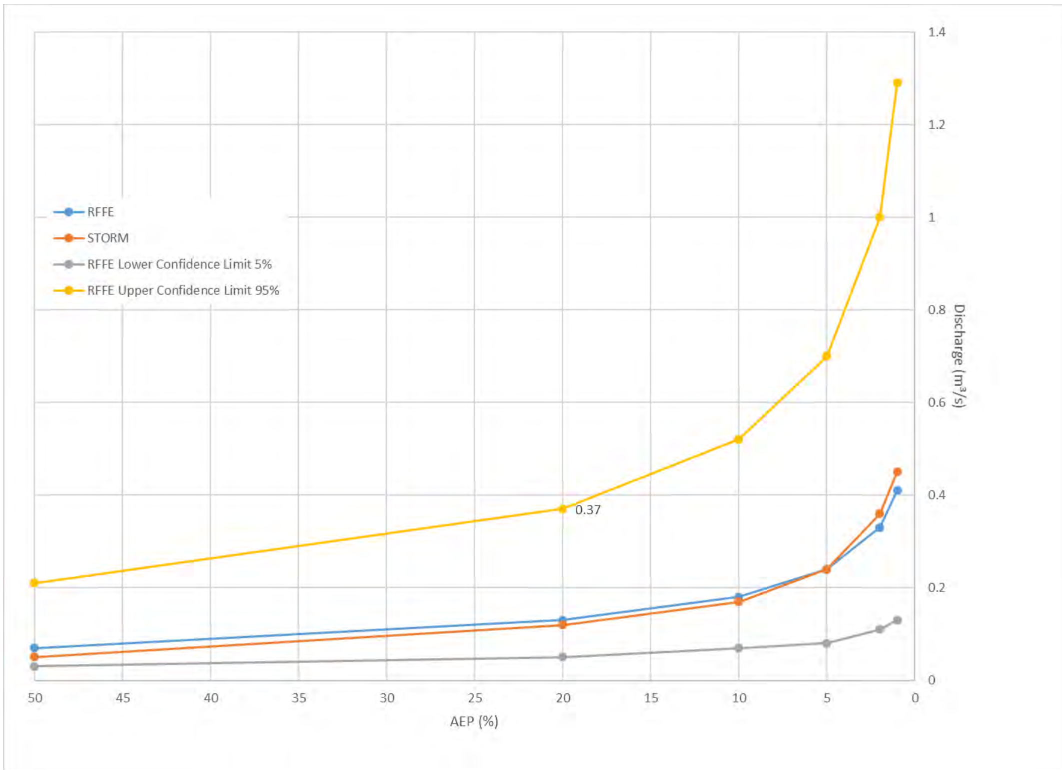


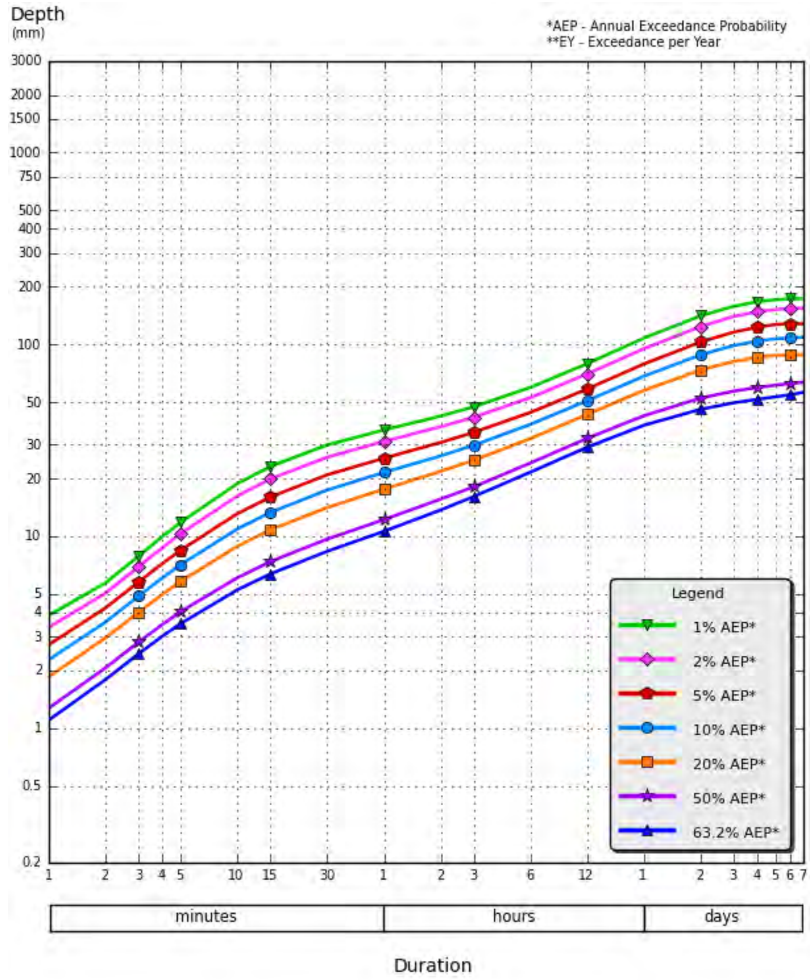
Figure 4-2 Estimated Peak Discharge – XP-STORM vs RFFE

4.3 Temporal Pattern Selection

For this study, the Bureau of Meteorology's 2016 IFD data and ARR2016 temporal patterns were used to produce an ensemble of storm burst patterns which were analysed for a whole catchment response.

4.3.1 Intensity Frequency Duration (IFD) Data

The 2016 rainfall intensity frequency duration (IFD) climatic data used in the hydrological model was extracted from the Bureau of Meteorology (BOM) website11. The IFD curves are shown in **Error! Reference s ource not found.**.



Note:
The 50% AEP IFD **does not** correspond to the 2 year Average Recurrence Interval (ARI) IFD. Rather it corresponds to the 1.44 ARI.
* The 20% AEP IFD **does not** correspond to the 5 year Average Recurrence Interval (ARI) IFD. Rather it corresponds to the 4.48 ARI.

11 Bureau of Meteorology, http://www.bom.gov.ua/water/designRainfalls/.

Figure 4-3 2016 IFD Curves – Bureau of Meteorology 2019

4.3.2 Critical Storm Burst Pattern Selection

For this analysis, 10 storm burst temporal patterns were extracted for events up to 24-hour duration, for each AEP event. By analysing the hydrological response to the ensemble temporal patterns, one critical pattern was selected for each of the 16 durations. The fixed temporal patterns over the entire study for design flood estimation were implemented and the spatial variation was not considered. The analysed events and durations are shown in Table 4-8.

Table 4-8 Analysed Rainfall Patterns, Durations and Events.

Number of Storm Burst Patterns in Ensemble (per event duration)	Storm Durations Analysed (minutes)		Event Probability Range Analysed (AEP)	
			(%)	(1 in x)
10	10	120	1	100
	15	180	10	10
	20	270	20	5
	25	360		
	30	540		
	45	720		
	60	1080		
	90	1440		

The median value of the peak discharges generated for 10 temporal patterns under pre-developed conditions has been calculated. The critical temporal pattern was selected by identifying the temporal pattern characterised by the peak discharge closest to the median for each duration up to of the 6-hour durations. The procedure has been then repeated for each of event probability.

4.4 Hydrological Model Simulations

Sensitivity analysis models applied 100% pervious surfaces within the catchments. Impervious surfaces and urban characteristics were subsequently integrated into the temporal pattern selection and existing/developed conditions hydrological models.

The modelling work was conducted through the study area for the 1%, 10% and 20% AEP. Adopted Storm temporal Burst Patterns for the subject site can be seen in Table 4-9.

Table 4-9 Adopted Storm Burst Patterns.

Duration	Temporal Pattern No.		
	1% AEP	10% AEP	20% AEP
10min	3	3	2
15min	4	3	4
20min	6	4	6
25min	1	3	6
30min	5	1	3
45min	4	9	5
1hour	3	5	2
1.5hour	6	7	4
2hour	5	3	3
3hour	7	5	3
4.5hour	8	7	5
6hour	8	6	1
9hour	7	2	3
12hour	4	1	2
18hour	3	2	3
24hour	4	2	2

5 Modelling Results

The results of the stormwater hydrology and water quality analysis are shown in this section. Design has been undertaken to meet stormwater quality and quantity 'best practice' standards and to calculate the requirements of site detention basins, rainwater tanks and constructed wetlands within the developed catchment.

5.1 Existing Site Discharge

The permissible site discharge (PSD) from the LPOD for each even probability was determined using the local hydrological model under existing conditions. The runoff hydrograph for the 1% AEP for the eastern and western catchments is shown in Figure 5-1 and Figure 5-2 respectively. The critical peak discharges for the 1%, 10% and 20% AEPs for the eastern and western catchments have been tabulated in Table 5-1 and Table 5-2 respectively.

Table 5-1 Validated Peak Discharges – Eastern Combined Catchment

AEP	Critical Event Duration	Critical Peak Discharge (m^3/s)
1%	1hour	0.940
10%	45min	0.326
20%	1.5hour	0.247

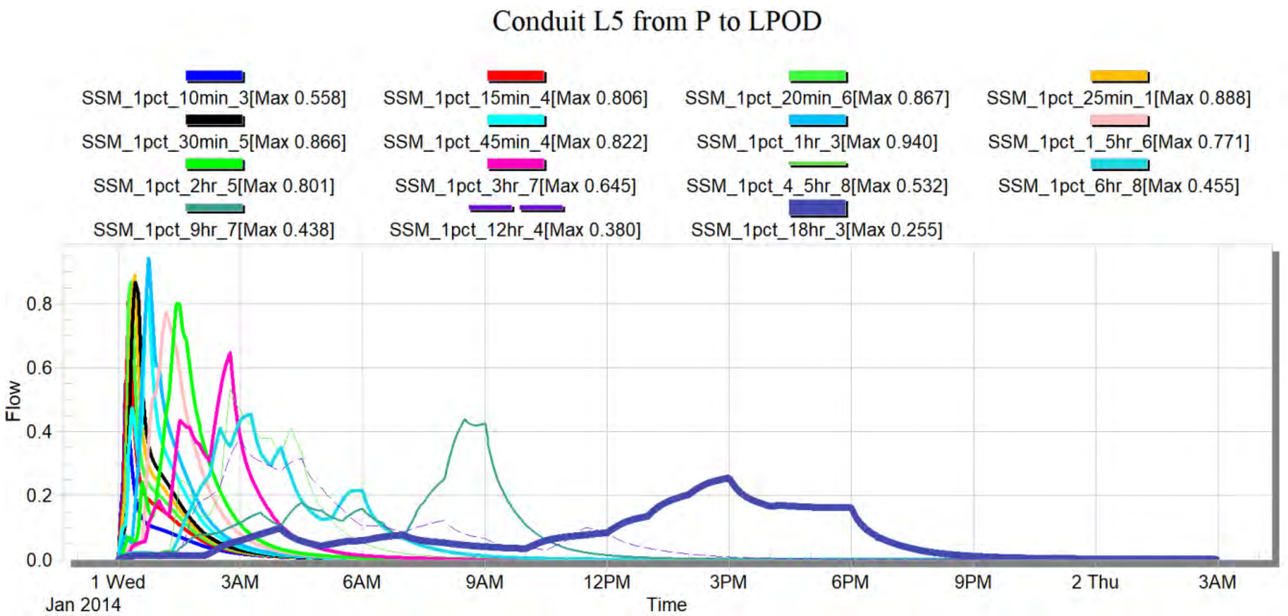


Figure 5-1 1% AEP Hydrographs – Eastern Outlet

Table 5-2 Validated Peak Discharges – Western Catchment (S2B)

AEP	Critical Event Duration	Critical Peak Discharge (m^3/s)
1%	3hour	0.120
10%	4.5hour	0.047
20%	4.5hour	0.032

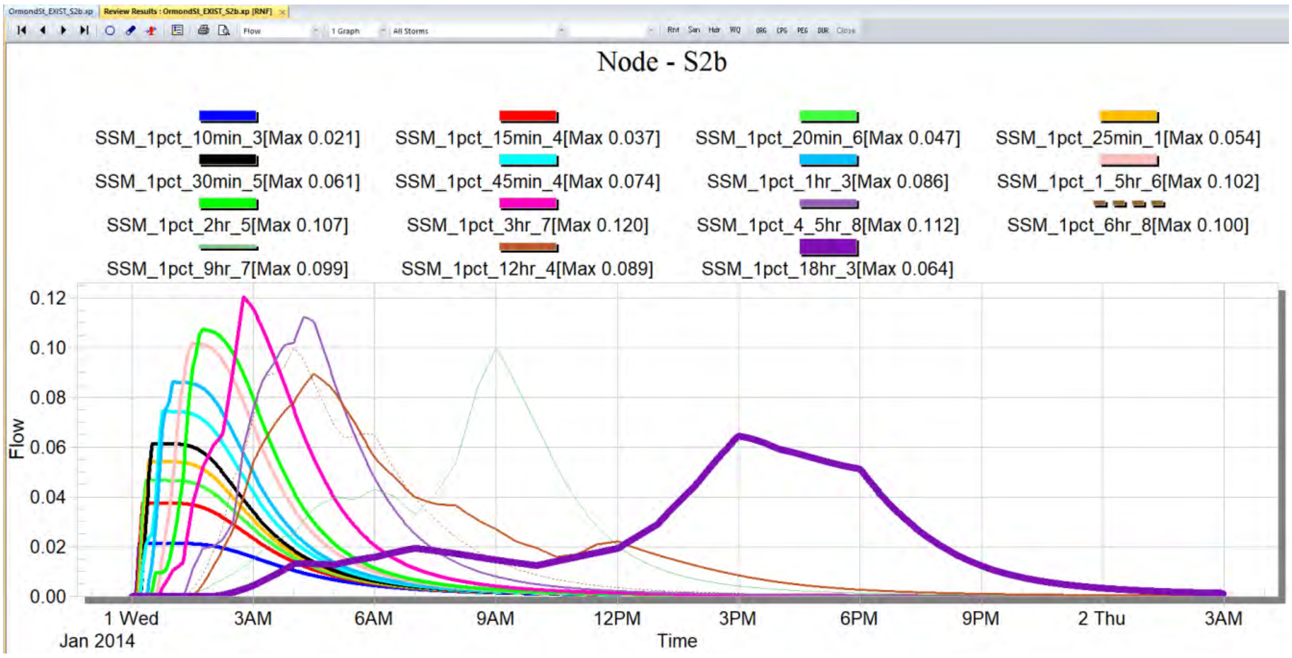


Figure 5-2 1% AEP Hydrographs – Western Outlet (S2B)

5.2 Developed Site Characteristics.

The characteristics of the major catchments guided the design process and the measures proposed to be implemented to ensure site discharges meet best practice guidelines.

Catchments S1 and S2A will be directed to a centrally located treatment facility, whereas catchment S2B will make use exclusively of rainwater tanks to control peak flows from the site. Catchment S3 and S4 will control the peak outflows via the use of rainwater tanks in addition to small bioretention systems (inclusive of sediment forebay and gross pollutant trap) to ensure best practice targets are achieved.

The opportunity to direct all catchment flows to the centrally located system was investigated however due to existing hydrological and topographic conditions a dispersed approach need to be adopted. The above proposal was simulated with XP-STORM and the resulting stormwater hydrographs were then evaluated to ensure compliance.

5.2.1 Centralised Detention Storage

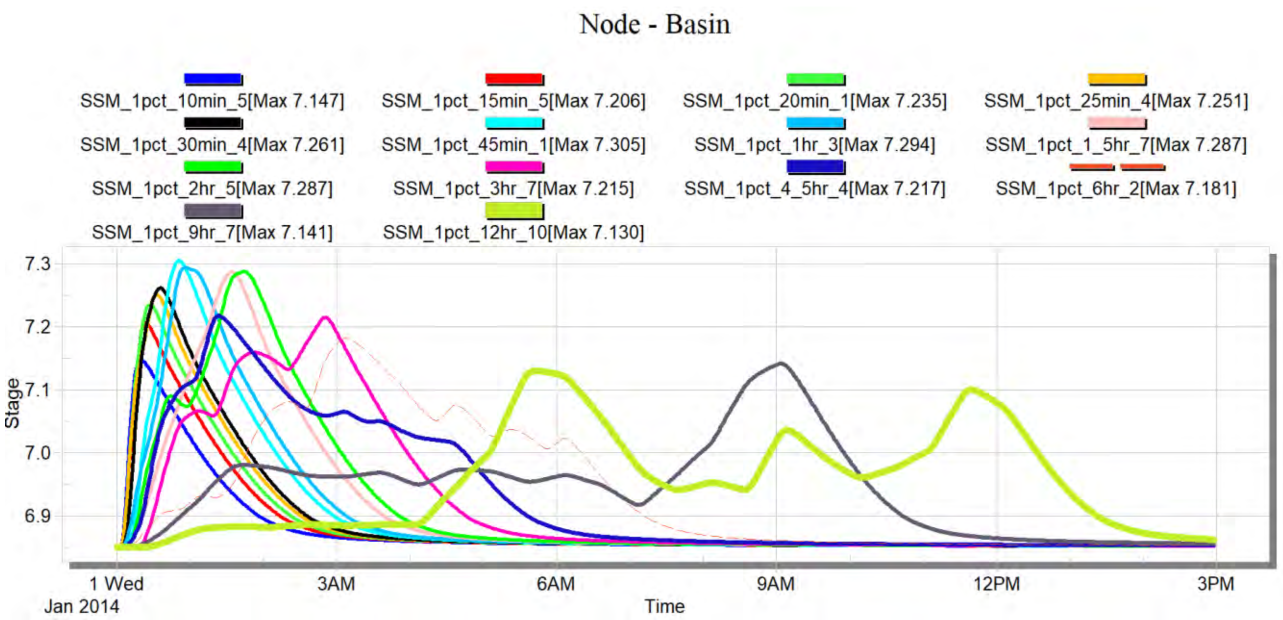
Due to the topography of the subject site, where practical, the proposed development site is directed to the centrally located stormwater treatment facility. The facility consists of a Sedimentation Basin and Wetland system and above these quality treatment measures will be a detention system designed to mitigate flows. The facility is proposed to discharge to an underground drainage network that will subsequently connect into the Bruce Creek drainage outfall. It should be noted that the achieved detention basin peak flow rates are below the locale catchment PSD due to the inability to direct the entire development site to the system.

The peak discharges from the centrally located basin are summarised in Table 5-3

Table 5-3 Developed Peak Discharge – Detention Basin Outflows

AEP	Critical Event Duration	Critical Peak Discharge (m^3/s)
1%	3 hours	0.547
10%	9 hours	0.204
20%	9 hours	0.144

Figure 5-3 Developed 1% AEP Hydrograph



Key parameters of the Detention basin retarding flows are shown in Table 5-4 below.

Table 5-4 Stormwater Treatment Basin Details Summary

	1%AEP	10% AEP	20%AEP
Peak Outflow (m^3/s)	0.547	0.204	0.144
Critical Duration (min)	180	540	540
Top Water Level	100.775	100.686	100.666
Basin Volume (m^3) (Top Water Level to Top Extended Detention	3203	2766	2667
Orifice IL (m AHD)	-	100.6	100.05
Outlet Configuration (modelled)	-	900mm x 1200mm Grated Pit	100mm x 100mm Side Orifice in Outlet Pit

5.2.2 Rainwater Tanks

As previously discussed, due to site topography preventing total site flows being directed to the centrally located detention system, rainwater tanks were investigated for the purpose of detention of stormwater flows prior to discharge into the downstream drainage network.

It was assumed that 70% of the roof area of each allotment would be directed to the rainwater tanks. Rainwater tanks of 2kL (2m3) and 5kL (5m3) were provided for the conventional lots (Area under 1000m2) and the larger lots (above 1000m2) respectively. An average roof area of 300m2 and 600m2 has been used for the small and large lots respectively.

Flows not intercepted by the rainwater tanks were modelled as discharging directly to the site outfall.

Key parameters of the rainwater tanks shown in Table 5-5 below

Table 5-5 Stormwater Treatment Basin Details Summary

Catchment	Lots per Catchments	Tank Size (Per Lot)	Outlet (Low flow)	Outlet (High Flow)	Outflow Per Cluster (20% AEP)	Outflow Per Cluster (1% AEP)
S2B	5	2kL	$0.002m^2$ @ Invert	$0.07m^2$ @ Obvert	0.008 m^3/s	0.018 m^3/s
S3 (Small Lots)	13	2kL	$0.0025m^2$ @ Invert	$0.071m^2$ @ Obvert	0.012 m^3/s	0.066 m^3/s
S3 (Large Lots)	3	5kL	$0.003m^2$ @ Invert	$0.018m^2$ @ Obvert	0.01 m^3/s	0.026 m^3/s
S4	15	2kL	$0.0025m^2$	$0.071m^2$	0.013 m^3/s	0.076 m^3/s

(Small Lots)			@ Invert	@ Obvert		
S4 (Large Lots)	3	5kL	0.003m^2 @ Invert	0.018m^2 @ Obvert	0.029 m^3/s	0.01 m^3/s

Rainwater Tanks were initially investigated, however following discussions with Council this option was not considered feasible.

5.2.3 S3 & S4 Catchment Detention Storage

As an alternative to Rainwater tanks, detention basins were investigated for the purpose of detaining stormwater flows prior to discharging into Bruce Creek.

Due to the topography of the site, both Catchment S3 and Catchment S4 will require a separate detention basin. The detention facilities consist of Bioretention systems for quality treatment measures combined with a detention system designed to mitigate flows.

For Catchment S3, further consideration will be required at detailed design to ensure that the detention facility remains outside the LSIO overlay. It is considered that this will be achieved with retaining walls greater than 1.5m. The water treatment and detention facility will also absorb on a lot, which is shown in Figure 6-2.

Similarly of Catchment 4, the detention and treatment facility will be located within the proposed drainage reserve, however based on current concepts it is not expected to impede on the LSIO overlay.

Key parameters for the Detention basins are shown in Table 5-6 below.

Table 5-6 Stormwater Treatment Basin Details Summary

Catchment	Basin Volume (m^3)	Average Depth (m)
S3	210	0.5
S4	230	0.5

Exact sizing of stormwater detention noted throughout will be optimised through the detailed design phase. Inlet and outlet configurations will also be confirmed through the detailed design phase

5.2.4 Overall Site Discharge

Flows from the development site will discharge into the surrounding catchment at two locations. The western site will discharge into Harvey Street whilst the eastern areas will be conveyed to a single location for controlled discharge to Bruce Creek. The below Table 5-7 and Table 5-8 summarises proposed discharges at the legal point of discharge for the eastern and western catchments respectively.

Table 5-7 Eastern Developed Peak Discharge – Bruce Creek

AEP	Existing Conditions		Developed Conditions	
	Critical Event Duration	Critical Peak Discharge (m^3/s)	Critical Event Duration	Critical Peak Discharge (m^3/s)
1%	1hour	0.940	20min	0.785
10%	45min	0.326	10min	0.311
20%	1.5hour	0.247	10min	0.250

Table 5-8 Western Developed Peak Discharge – Henry Street

AEP	Existing Conditions		Developed Conditions	
	Critical Event Duration	Critical Peak Discharge (m^3/s)	Critical Event Duration	Critical Peak Discharge (m^3/s)
1%	3hour	0.120	20min	0.062
10%	4.5hour	0.047	25min	0.037
20%	4.5hour	0.032	10min	0.029

Exact sizing of treatment measures noted throughout will be optimised through the detailed design phase.

5.3 Stormwater Quality Modelling

The ability of the development to meet stormwater quality 'best practice' standards and the performance of the treatment system was continuously simulated using MUSIC. The MUSIC model utilised rainfall data from the Geelong North site from 1971 to 1980 using a 6-minute timestep which was sourced from COGG data.

An overall view of the MUSIC model is provided below in Figure 5-4.

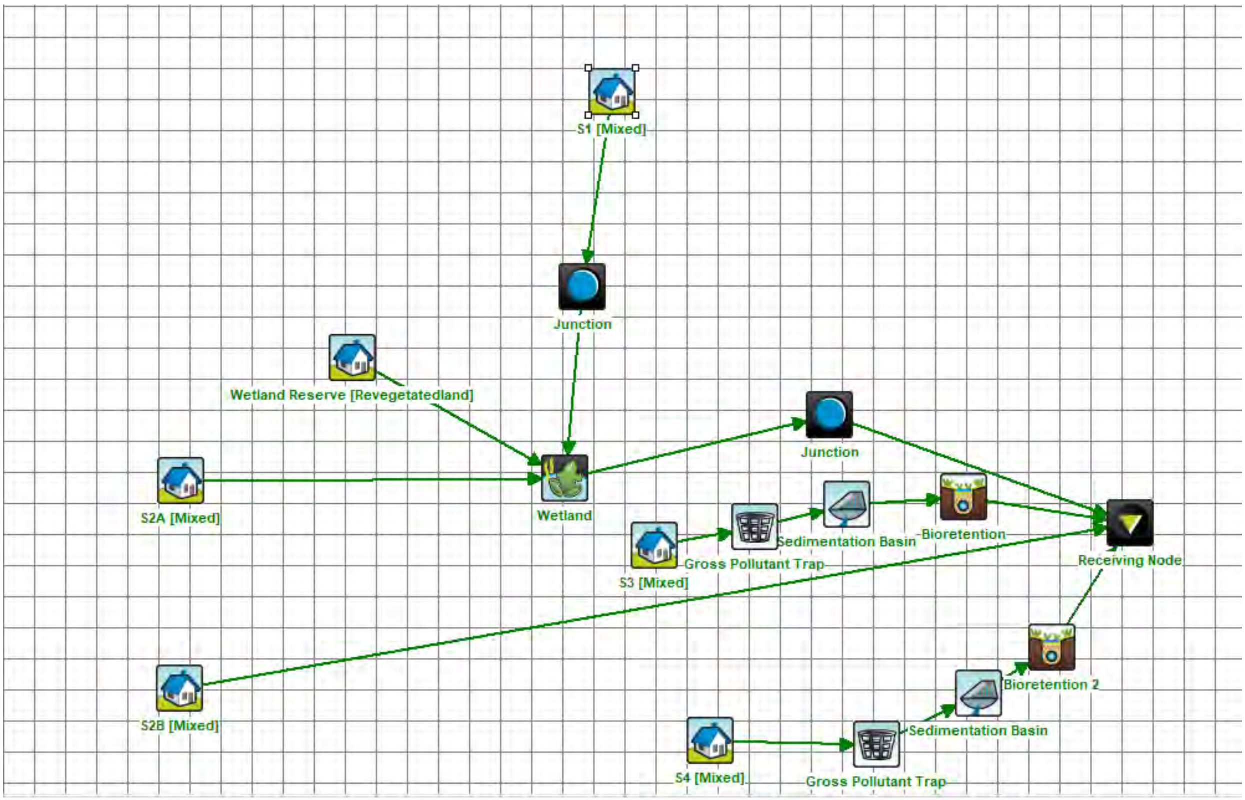


Figure 5-4 Overall MUSIC Model Network

The water quality treatment infrastructure consists of a conventional wetland/sedimentation basin centrally located to treat the majority of flows generated within the development site. Where site topography does not allow for flows to be directed to the centrally located system, additional treatment is provided via two bioretention systems at the boundary of catchments S3 and S4 developed area. The bioretention systems are proposed to be complimented by a Gross Pollutant Trap and sediment forebay to protect the filter media form the build-up of sediment.

In should be noted that no phosphorus or nitrogen removal has been factored into this modelling and that the sediment removal efficiency adopted within this model was the lowest of the values provided in published papers by SPEL[12], Rocla[13], Humes[14] and Urban Asset Solutions[15] of 49% removal of suspended solids.

The rainwater tanks previously discussed in section 5.2.2 have not been considered in the water quality portion of the assessment.

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[12] SPEL Vortceptor Hydrodynamic GPT 'Technical Data Sheet'
[13] Rocla CDS Unit Technical Summary
[14] Humes HumeGard GPT Technical Manual
[15] EcoSol Gross Pollutant Trap Technical Specifications

5.3.2 Lot Based Inputs

The characteristics of the catchment modelled in MUSIC are detailed in Table 5-9. These characteristics have been compiled using City of Greater Geelong Design Notes No.3.

Table 5-9 MUSIC Simulations – Lot/Road Properties.

Catchment Characteristics	
Zoning/Surface Type	Mixed
Impervious Area Properties	
Rainfall Threshold (mm/day)	1.00
Pervious Area Properties	
Soil Storage Capacity (mm)	120
Initial Storage (% of Capacity)	25
Field Capacity (mm)	50
Infiltration Capacity Coefficient -a	200
Infiltration Capacity Coefficient – b	1
Groundwater Properties	
Initial Depth (mm)	10
Daily Recharge Rate (%)	25
Daily Baseflow Rate (%)	5
Daily Deep Seepage Rate (%)	0

5.3.3 Treatment Inputs

The characteristics of the end of line treatment measures modelled in MUSIC are detailed in Table 5-10, Table 5-11 and Table 5-12. The figures displayed below do not include additional land area requirements such as land taken up by internal and external batters, access tracks, offsets to building etc, which may form a large percentage of the overall footprint depending on the final location of the systems.

Table 5-10 Central Sedimentation Basin / Wetland – MUSIC Inputs

Inlet Properties	
Low Flow By-pass (m^3/s)	0.0
High Flow By-pass (m^3/s)	100.0
Inlet Pond (m^3)	460
Storage Properties	
Surface Area (m^2)	2200
Extended Detention Depth (m)	0.35
Permanent Pool Volume (m^3)	500
Initial Volume (m^3)	500
Exfiltration Rate (mm/hr)	0
Evaporative Loss as % of PET	125
Outlet Properties	
Equivalent Pipe Diameter (mm)	47
Overflow Weir Width (m)	10
Notional Detention Time (hrs)	70.2

Table 5-11 S3 and S4 End of line Sedimentation Basin – MUSIC Inputs

Inlet Properties		
	S3	S4
Low Flow By-pass (m^3/s)	0.0	0.0
High Flow By-pass (m^3/s)	0.200	0.200
Storage Properties		
Surface Area (m^2)	40	40
Extended Detention Depth (m)	0.20	0.20
Permanent Pool Volume (m^3)	2	2
Initial Volume (m^3)	2	2

Exfiltration Rate (mm/hr)	0	0
Evaporative Loss as % of PET	75	75
Outlet Properties		
Equivalent Pipe Diameter (mm)	100	100
Overflow Weir Width (m)	2	2
Notional Detention Time (hrs)	0.213	0.213

Table 5-12 S3 and S4 Bioretention Basin – MUSIC Inputs

Inlet Properties		
	S3	S4
Low Flow By-pass (m^3/s)	0.0	0.0
High Flow By-pass (m^3/s)	0.200	0.200
Storage Properties		
Extended Detention Depth (m)	0.30	0.30
Surface Area (m^2)	28	28
Filter and Media Properties		
Filter Area (m^2)	2	2
Unlined Filter Media Perimeter (m)	24	24
Filter Depth (m)	0.5	0.5

5.3.4 End of Lines Efficiencies

The efficiencies of the treatment train described above is as follows;

Table 5-13 Stormwater Quality Treatment Efficiencies

Criteria	Reduction (%)	
	Results	Target
Total Suspended Solids (kg/yr)	80.0	80
Total Phosphorus (kg/yr)	65.7	45
Total Nitrogen (kg/yr)	46.4	45
Gross Pollutants (kg/yr)	100	70

Efficiencies and exact sizing of treatment measures noted throughout have the ability to be optimised throughout the detailed design phase.

6 Functional Design Outcomes and Limitations

To ensure the site can facilitate the treatment measures proposed above a conceptual design was undertaken to ensure flows could be directed to the proposed treatment facility, discharged to the relevant legal point of discharge and that expected infrastructure could be accommodated within the proposed site layout.

Site investigations confirmed the steep grades within the eastern portion of the development site indicated by the lidar survey used throughout this investigation. Due to the steep grades that exist earthworks batters have been shown to account for a large amount of land area however at max batter slopes of 1V:4H are still able to be integrated into the existing surface.

As per Council's comment, the detention facilities for Catchments S3 & S4 are required to be outside the LSIO overlay. Under these limitations, for Catchment S3, the basin will be located within the proposed developable lot. The current lot layout will need to be reconfigured. For Catchment S4, the detention facility will be located within the drainage reserve. Retaining walls up to 1m will be required, inclusive of further battering to facilitate the detention basin footprint. Exact location and sizing of the detention facilities will be optimised during the detailed design phase.

Determination of the treatment configuration, inclusive of a Gross Pollutant Trap and sediment forebay, for the most effective removal of suspended solids will be analysed during the detailed design phase.

The conceptual design of the major central treatment facility has allowed for the provision of a maintenance track around the perimeter of the facility, however it would be expected that this will be reduced during the detail design based on the adopted Melbourne Water guidelines and the provision of access from the surrounding road network. It was determined that the additional maintenance track and other detail provided at this concept stage will account for additional design stage requirements such as sediment drying areas, centre bunds and general changes to the site layout.

Table 6-1 and Table 6-2 below provides an indication of the required areas required to achieve the modelling outcomes provided within the SMP and is reflective of the footprints shown in Figure 6-2.

Table 6-1 Functional Details Summary – Central Wetland

	1%AEP
Area at Permeant Pool	2896m2
Area at Extended Detention	3500m2
Area at 1% AEP Level	4987m2
Area at 150mm Free Board (Above 1% AEP	5231m2
Area at extent of batter (including maintenance access tracks)	5600m2

Table 6-2 Functional Details Summary – Sediment Forebay and Bioretention System

	S3	S4
Area at Invert	70m2	70m2
Area at Extended Detention	100m2	40m2
Area including cut/fill batters	215m2	120m2

An overall development plan indicating the relative location and size of the various treatment infrastructure is shown in Figure 6-3. It should be noted that the exact location and size of the various infrastructure will be subject to detailed design. Lot layout to be corrected.

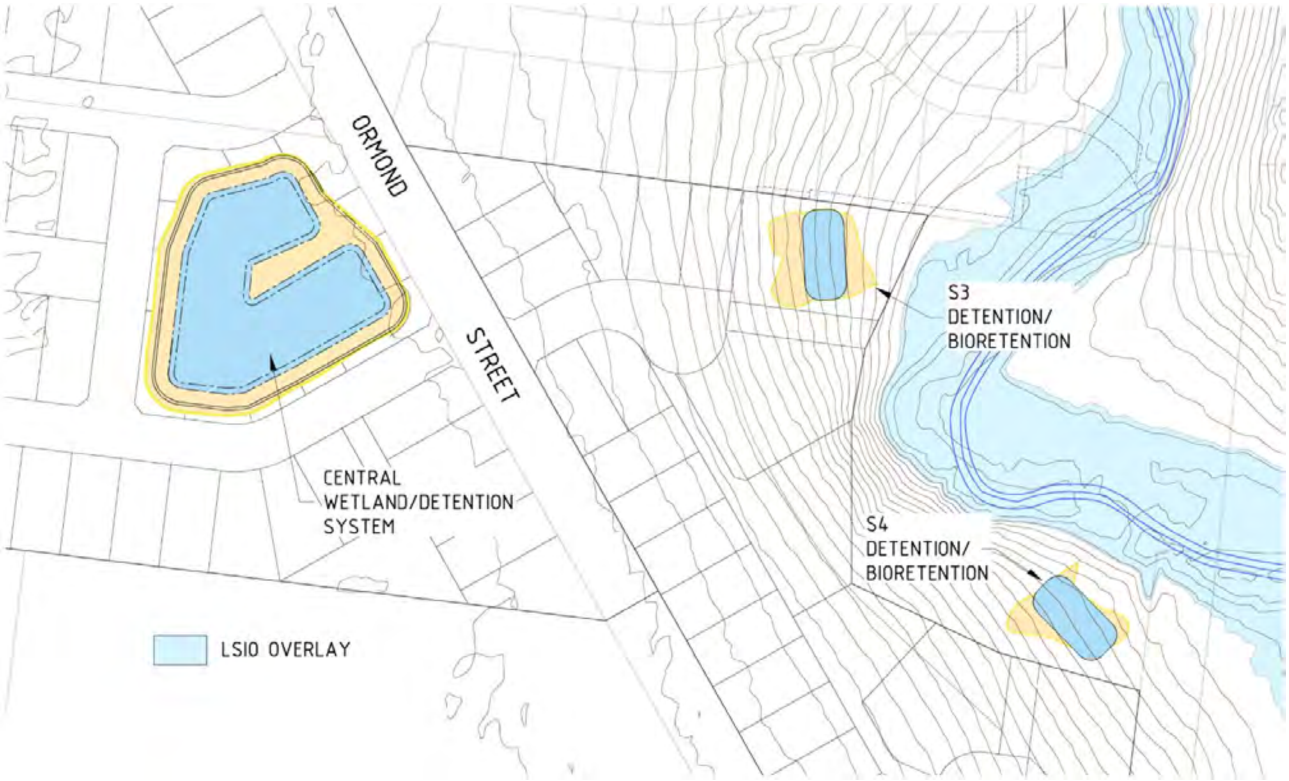

Figure 6-2 Conceptual Treatment Facility Layout

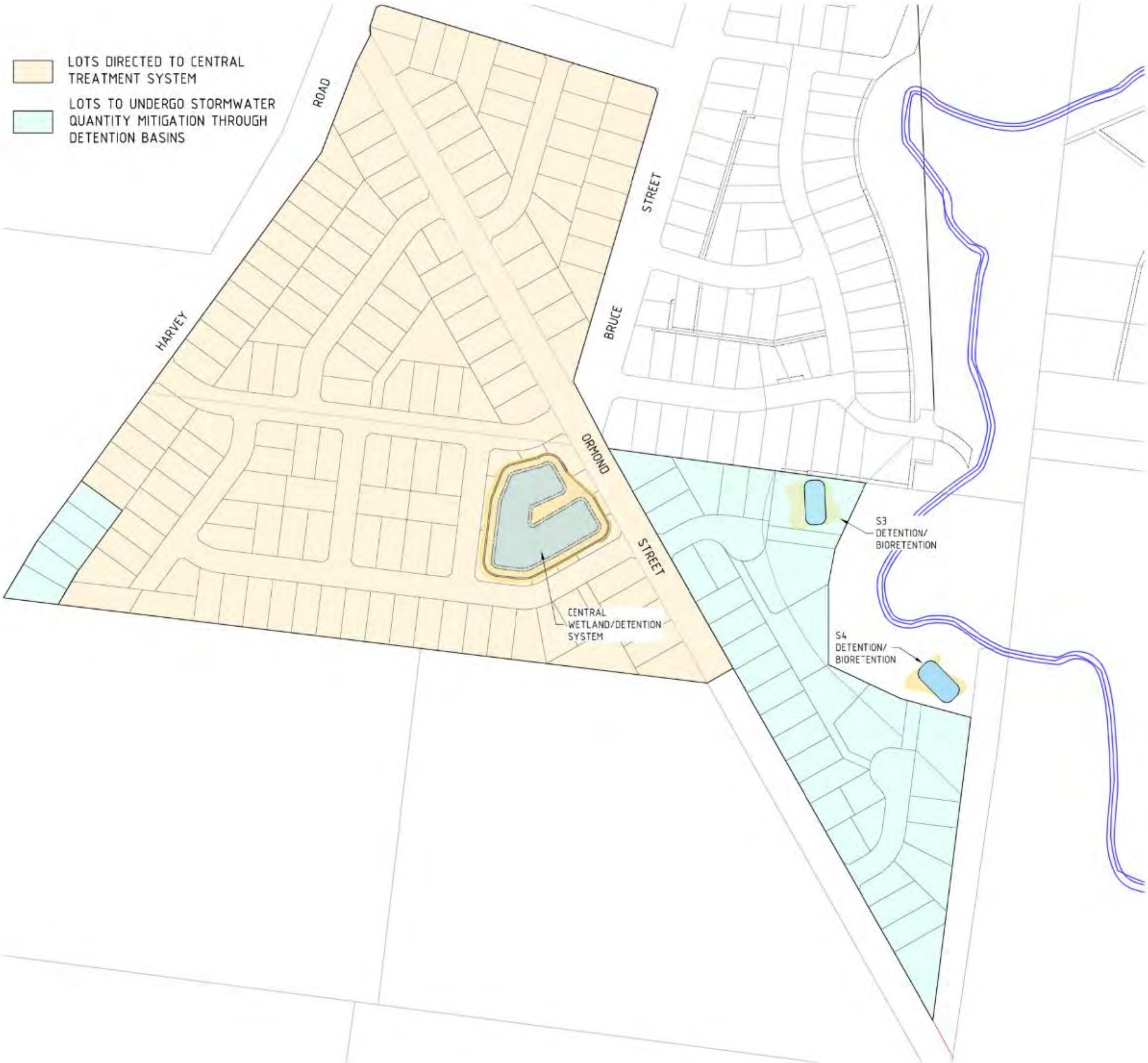

Figure 6-3 Overall Site Layout with treatment mechanisms

7 Conclusion

TGM recommends adoption of a wetland and raingarden treatment system to ensure the proposed development at 5, 20, 25, and 30 Ormond Street, Bannockburn meets best practice requirements for stormwater quality. Stormwater detention facilities are proposed to limit site discharge rates to predeveloped rates.

The stormwater generated from 5, 20, and 30 Ormond Street is suggested to be conveyed into and treated by a designed wetland and detention basin at the southeast corner of 30 Ormond Street, and then conveyed directly to Bruce Creek through a conventional drainage system.

Stormwater quality treatment resulting from flows generated within 25 Ormond Street is suggested to be treated by two separate raingardens before discharging into Bruce Creek. Raingarden footprints were restricted due to the steep topography. However, the wetland was increased to compensate for the restricted treatment capacity of the raingardens.

Initially, rainwater tanks were investigated to provide detention for 25 Ormond Street. However, after meetings with Council, this was considered not to be the desired approach. As an alternative design, stormwater discharge will be maintained to predeveloped rates up to the 1% AEP through the use of two separate detention basins.

A small number of allotments fronting Harvey Street will be maintained inclusive of rainwater tanks. This will ensure stock dams maintain flow however the provision of rainwater tanks will ensure flows do not exceed predeveloped rates.

Traffix Group

Traffic Engineering Report

Proposed Residential Subdivision

5, 20, 25 & 30 Ormond Street, Bannockburn

Prepared for
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November 2021

G30778R-01A

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A	First Issue	30/11/2021	D. Milder	J. Place

Table of Contents

1. Introduction

Traffix Group has been engaged by Barabara and Ian Hinchliffe to prepare a traffic engineering report for the proposed residential subdivision located at 5, 20, 25 & 30 Ormond Street in Bannockburn.

This report provides a traffic engineering assessment of the proposal with particular attention to traffic and access considerations.

In particular, this report addresses the criteria set out in the Infrastructure Design Manual (IDM[1]) for both a Traffic Impact Assessment Report (addressing external road network impacts) and a Traffic Management Assessment Report (addressing the internal road layout, road widths, functions, and connectivity).

1 *The Infrastructure Design Manual (IDM) is a joint initiative of Victorian rural and regional Council's working together to formulate and maintain a set of consistent requirements and standards for the design and development of infrastructure. The current version is Version 5.20 (March 2019) – www.designmanual.com.au. Benalla Rural City Council has adopted the manual.*

2. Existing Conditions

2.1. Subject Site

The subject site is located on the east side of Harvey Street and straddles both sides of Ormond Street in Bannockburn. It is bounded by Bruce Street and Bruces Creek, as shown in the locality plan presented at Figure 1.

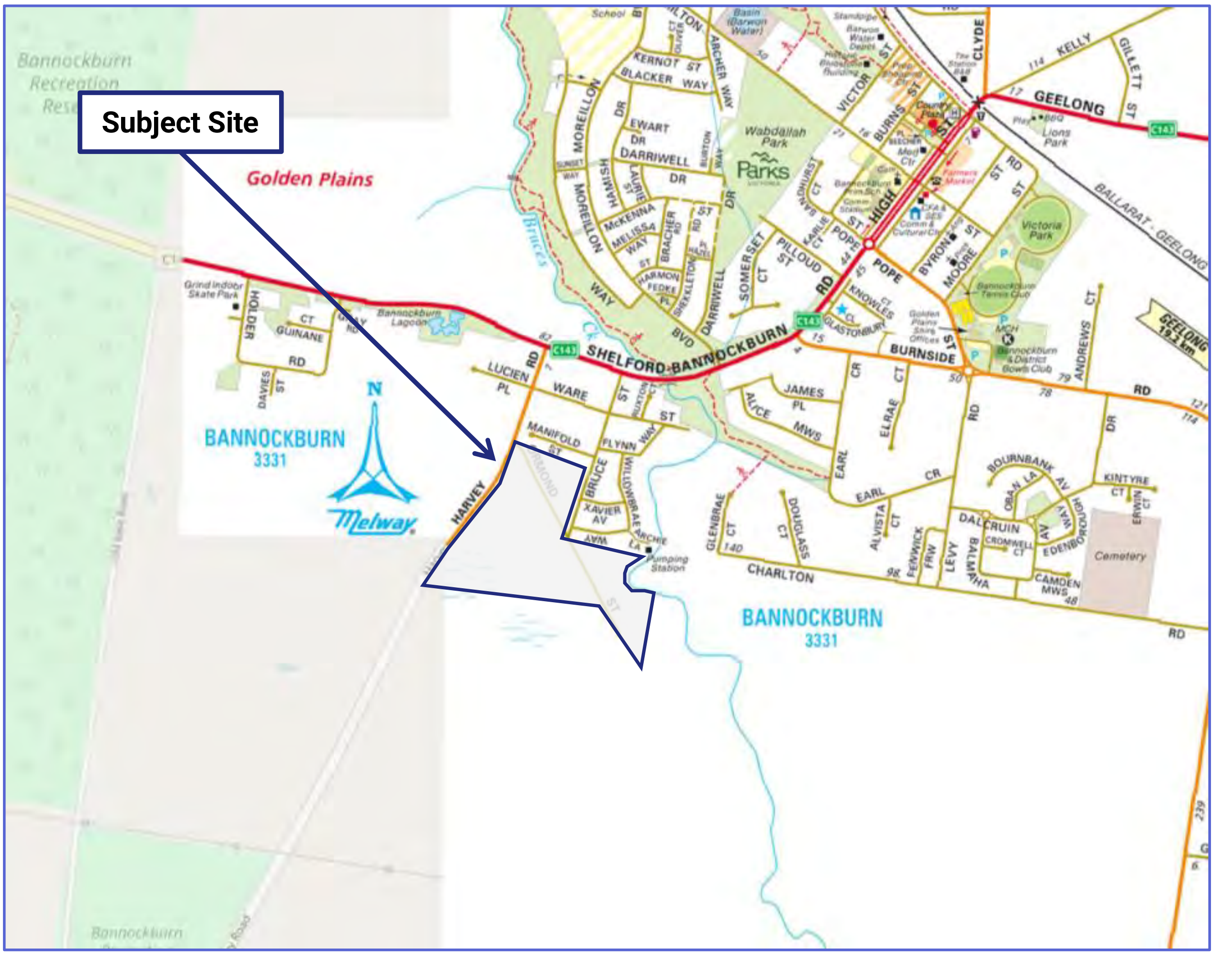

Figure 1: Locality Map

The subject site is irregular in shape with an area of 16.14 hectares and comprises 4 allotments, numbers 5, 20, 25 and 30 Ormond Street.

The site is located south of existing residential development, and has road frontages to Ormond Street, Bruce Street, and Harvey Road of approximately 820m, 230m and 430m respectively.

The site is currently used as farming land with four residential dwellings.

An aerial view of the site is shown in Figure 2 below.

Figure 2: Subject Site – Aerial View

2.2. Land Use

The site is predominantly located within the Farm Zone (FZ) under the Golden Plains Planning Scheme as presented in Figure 3 below.

The part of the site to the east of Ormond Street is also affected by an Environmental Significance Overlay – Schedule 2 (ESO2).

The whole site is within a designated bushfire prone area.

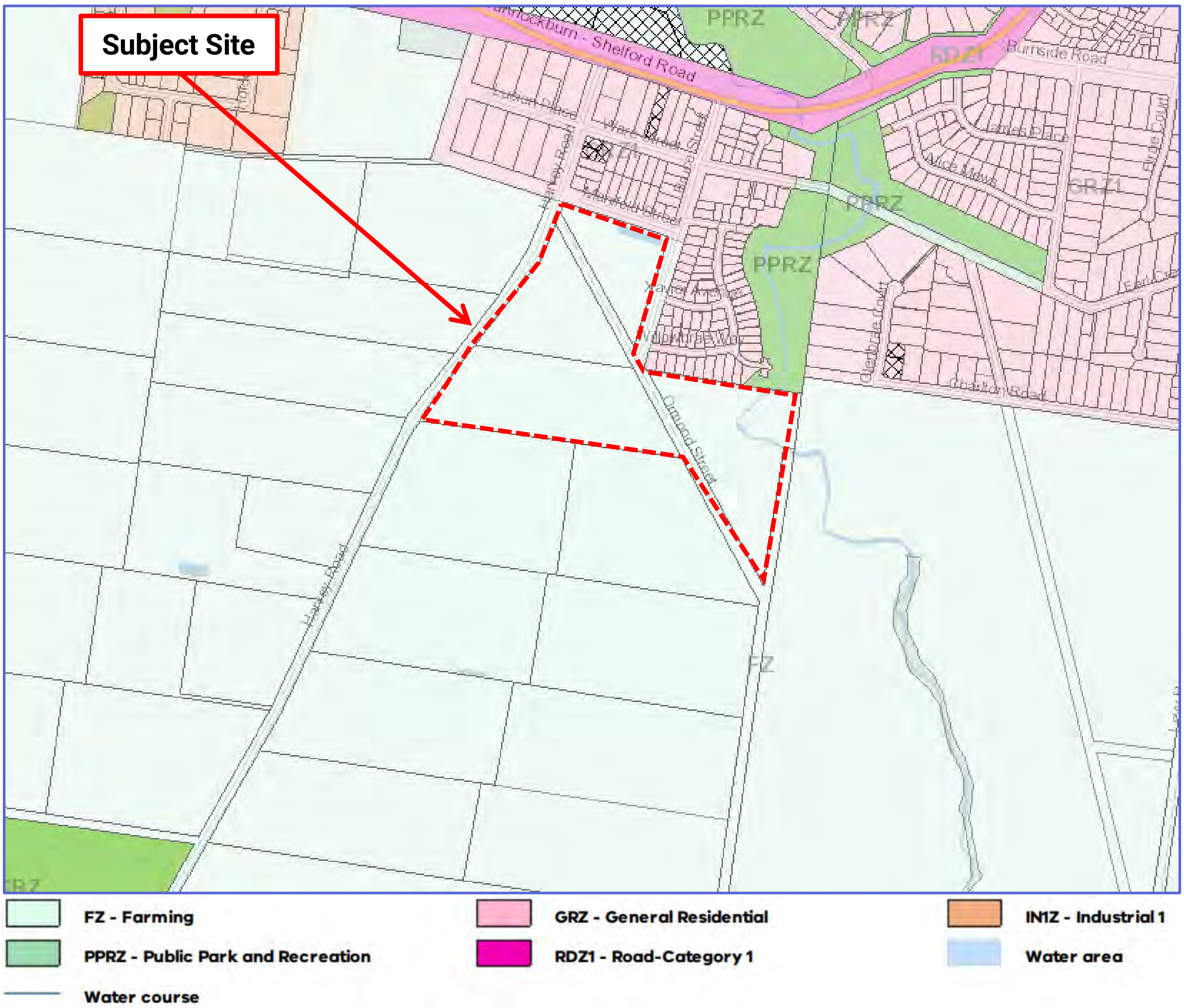

Figure 3: Land Use Zoning Map

Surrounding land uses include residential to the north, farm zoned land to the south, east, and west and a small pocket of industriayl zoned land to the northwest. A public park follows Bruce Creek from the Farming Zone towards the north.

2.3. Road Network

Ormond Street is a Council controlled unsealed access street that extends approximately 820m southeast from Harvey Road. The southern 200m (approx.) is unconstructed.

Ormond Street is constructed with a 4.5m wide unsealed carriageway which is suitable for a single lane of through traffic. Grass verges provide passing opportunities if required. The road reservation measures approximately 20m.

Figure 4: Ormond Street view Northwest

Figure 5: Ormond Street view Southeast

Bruce Street is a Council controlled access street that extends approximately 510m in a north-south direction between Bannockburn-Shelford Road to the north and Ormond Street to the south.

In the vicinity of the site, Bruce Street is constructed with a 6.1m wide carriageway which allows for a through traffic lane in each direction. Further to the north in the developed area, the carriageway is 7.3m wide which allows for kerbside parking on both sides and a through traffic lane.

The urban default speed limit of 50km/h applies.

Figure 6: Bruce Street view North

Figure 7: Bruce Street view North

Harvey Road is a Council controlled local access street that extends approximately 6.6km in a general north-south direction between Bannockburn-Shelford Road to the north and Hamilton Highway to the south.

In the vicinity of the site, Harvey Road is constructed with a 6.6m wide sealed carriageway which allows for a through traffic lane in both direction within a 20m road reservation.

A posted speed limit of 80km/h applies.

Figure 8: Harvey Road view North

Figure 9: Harvey Road view North

2.4. Existing Traffic Volumes

Traffix Group has sourced traffic volume data[2] for Harvey Road in the vicinity of its intersection with Ormond Street and at its intersection with Bannockburn-Shelford Road from 2018.

A summary of the information is presented below.

The AM and PM peak hours occurred at 8:15am – 9:15am and 4:45pm – 5:45pm respectively.

The recorded AM and PM peak hour turning movements are illustrated in Figure 10 below.

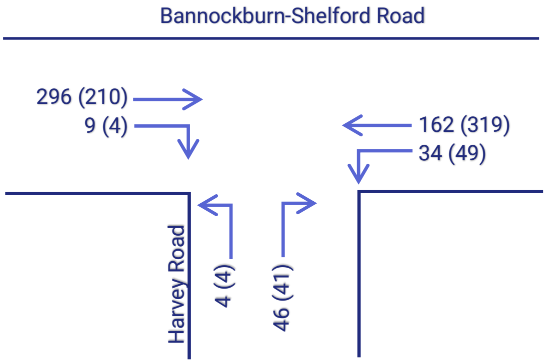

Figure 10: AM (PM) Peak Hour Turning Movements

Based on the available data, the two-way daily traffic volume for Harvey Road is 930 vehicles per day.

No information is available for Ormond Street or Bruce Street, however having regard to the existing dwellings which take access to each road and their function for local traffic only, we estimate the following:

- Ormond Street: 50vpd
- Bruce Street: 900vpd

Having regard to the locality of this site, we would not expect that there would have been any meaningful growth since the data was collected and thus, the data presented above is considered to be representative of current traffic volumes.

2 Bannockburn Transport Strategy prepared by Cardno 2019

3. Proposal

It is proposed to develop the site for the purposes of a residential subdivision comprising 172 lots ranging from 445m^2 to 6137m^2.

The subdivision also includes a drainage reserve at the eastern end of the site with an area of 9,513m^2.

Vehicular access is proposed to be provided to the site from Bruce Street and Ormond Street.

A copy of the proposed subdivision plan prepared by TGM Group Pty Ltd and dated November 2021 is attached at Appendix A.

4. Traffic Engineering Assessment

4.1. Traffic Generation

The RTA Guide to Traffic Generating Developments (2002) (RTA Guide) sets out traffic generation rates for a range of developments, based on survey data collected in New South Wales, and is generally regarded as a standard for metropolitan development characteristics.

The RTA Guide sets out the following rates for dwelling houses, based on surveys conducted where new subdivisions are being built:

Standard Dwellings:

- *Daily Vehicle Trips = 9 per dwelling*
- *Weekday Peak Hour Vehicle Trips = 0.85 per dwelling*

Clause 12.3.1 of the Infrastructure Design Manual (IDM) specifies that estimated traffic volumes for undeveloped areas should normally be based upon at least 10 vehicle movements per day (vpd) per lot.

For the purpose of undertaking a conservative assessment of the traffic impacts, a rate of 10 vpd per lot has been adopted, i.e. the upper end of the range for larger units and townhouses.

The anticipated daily and peak hour traffic generation is calculated in Table 2 below.

Table 1: Traffic Generation Summary

Type	No.	Daily Traffic Generation		Peak Hour Traffic Generation	
		Rate	Volume	Rate	Volume
Standard Lots	172	10/dwelling	1,720 vpd	0.85/dwelling	146 vph

Table 2 indicates that the proposed subdivision is anticipated to generate in the order of 1,720 vehicle trips per day with 146 vehicle trips occurring during the road network peak hours, based on full build-out of the subdivision.

4.2. Traffic Distribution

Having regard to the site's locality in relation to key traffic generators (schools, shops, employment, and freeway access), the following traffic distribution assumptions have been adopted:

- 80% out and 20% in during the AM road network peak hour,
- 30% out and 70% in during the PM road network peak hour,
- 25% south via Harvey Road
- 75% north
  - 30% via Harvey Road
  - 70% via Bruce Street
  - 5% to the west via Bannockburn-Shelford Road,
  - 95% to the east via Bannockburn-Shelford Road

Figure 11 below shows the anticipated AM and PM peak hour turning movements generated by the site based on the preceding assumptions.

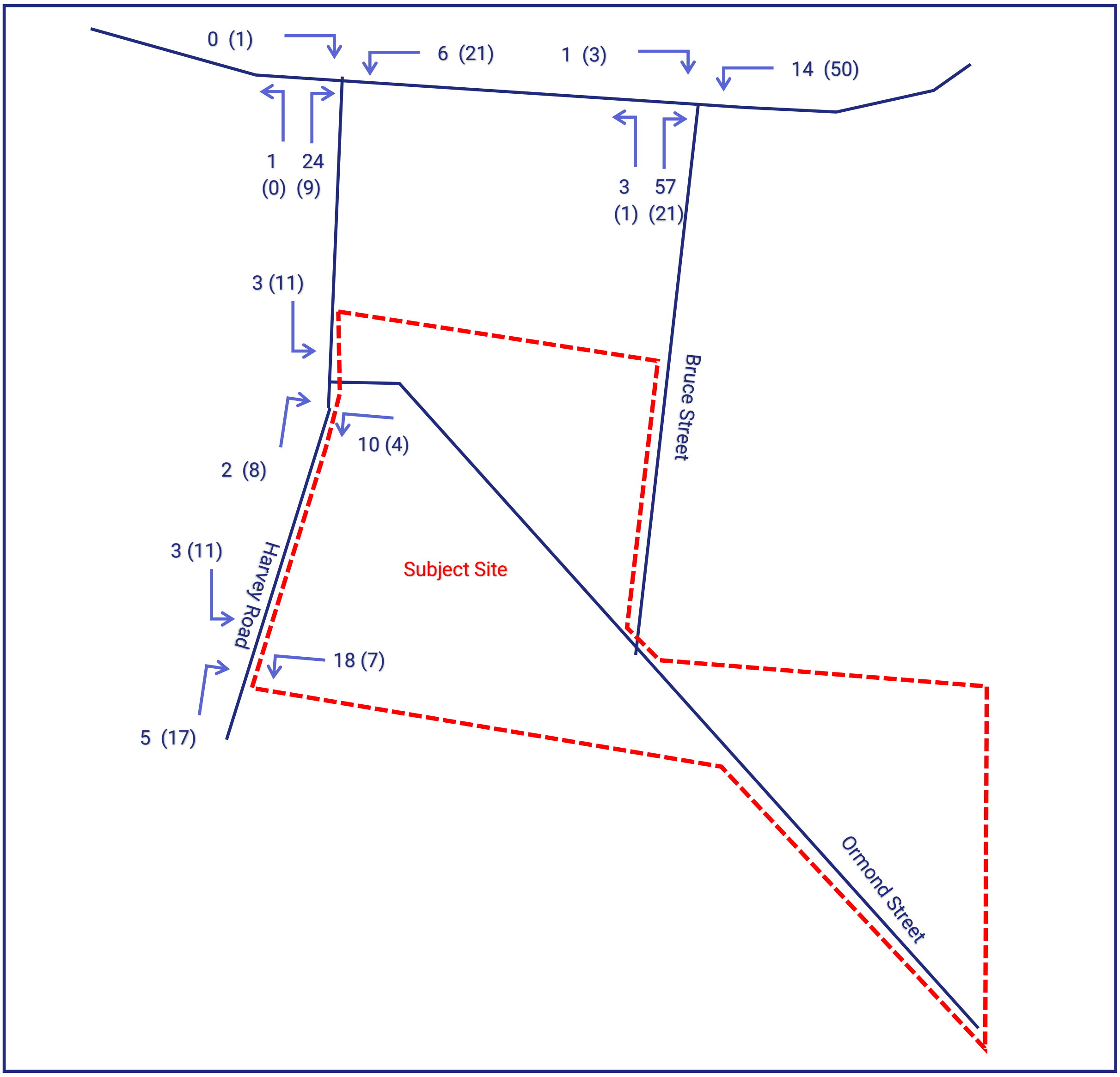

Figure 11: AM (PM) Peak Hour Site-Generated Traffic Movements

4.3. Traffic Impact

Having regard to the traffic distribution, it is evident that majority of movements at Bannockburn-Shelford Road are to/from the west (Bannockburn Town Centre). Bannockburn-Shelford Road is constructed with left-turn lanes at its intersections with both Harvey Road and Bruce Street and the additional traffic will be suitably accommodated.

Traffix Group has prepared SIDRA[3] assessments for both intersections under existing conditions and post development conditions.

For unsignalised intersections, degrees of saturation (DOS) of less than 0.8 are considered to be good operating conditions.

Tables 2 and 3 below summarises the SIDRA output for the AM and PM road network peak hours. Full SIDRA output is attached at Appendix B.

Table 2: SIDRA Output – Bannockburn-Shelford Road/Bruce Street

Approach	Degree of Saturation		Average Delay		95th Percentile Queue	
	Existing	Post Dev.	Existing	Post Dev.	Existing	Post Dev.
AM Peak						
Bruce Street (S)	0.148	0.275	10.9 sec	11.9 sec	3.9m	8.3m
Bannockburn-Shelford Road (E)	0.109	0.109	0.5 sec	5.8 sec	0.0m	0.0m
Bannockburn-Shelford Road (W)	0.152	0.153	0.0 sec	0.0 sec	0.1m	0.2m
PM Peak						
Bruce Street (S)	0.068	0.129	12.4 sec	13.2 sec	1.7m	3.2m
Bannockburn-Shelford Road (E)	0.205	0.205	0.8 sec	1.3 sec	0.0m	28.1m
Bannockburn-Shelford Road (W)	0.114	0.117	0.1 sec	0.3 sec	0.3m	0.6m

3 SIDRA is a computer software package used to analyse the capacity and function of intersections.

Table 3: SIDRA Output – Bannockburn-Shelford Road/Harvey Road

Approach	Degree of Saturation		Average Delay		95th Percentile Queue	
	Existing	Post Dev.	Existing	Post Dev.	Existing	Post Dev.
AM Peak						
Harvey Road (S)	0.093	0.122	12.2 sec	12.3 sec	2.5m	3.3m
Bannockburn-Shelford Road (E)	0.090	0.090	1.0 sec	1.1 sec	0.0m	0.0m
Bannockburn-Shelford Road (W)	0.173	0.173	0.2 sec	0.2sec	0.7m	0.7m
PM Peak						
Harvey Road (S)	0.094	0.116	13.2 sec	13.5 sec	2.4m	3.0m
Bannockburn-Shelford Road (E)	0.178	0.178	0.8 sec	1.0 sec	0.0m	0.0m
Bannockburn-Shelford Road (W)	0.122	0.123	0.2 sec	0.3 sec	0.4m	0.5m

Tables 2 and 3 indicate that the unsignalised intersections currently operate well within acceptable limits with minimal queues and delays and will continue to do so under post-development conditions.

4.4. Traffic Management and Mitigating Works

The road layout within the subdivision has been designed to minimise long straight stretches where possible. Bruce Street and Ormond Street are likely to equally share the access demands to the proposed lots.

The intersection of Ormond Street/Bruce Street and the internal road creates a cross-intersection which needs to be controlled. A suitable treatment for this intersection is a roundabout in accordance with Austroads Guide to Traffic Engineering Management Part 8: Local Area Traffic Management.

Having regard to the relatively few number of movements expected at each of the site's access points to Harvey Road, we do not believe that it is necessary to provide any formal turning treatments. However, the introduction of residential allotments taking access from Harvey Road provides sufficient justification to reduce the speed limit on Harvey Road to 60km/h between Bannockburn-Shelford Road and the site's southern boundary.

No additional traffic management treatments are necessary within, or to facilitate the subdivision. Figure 15 shows the proposed traffic management plan.

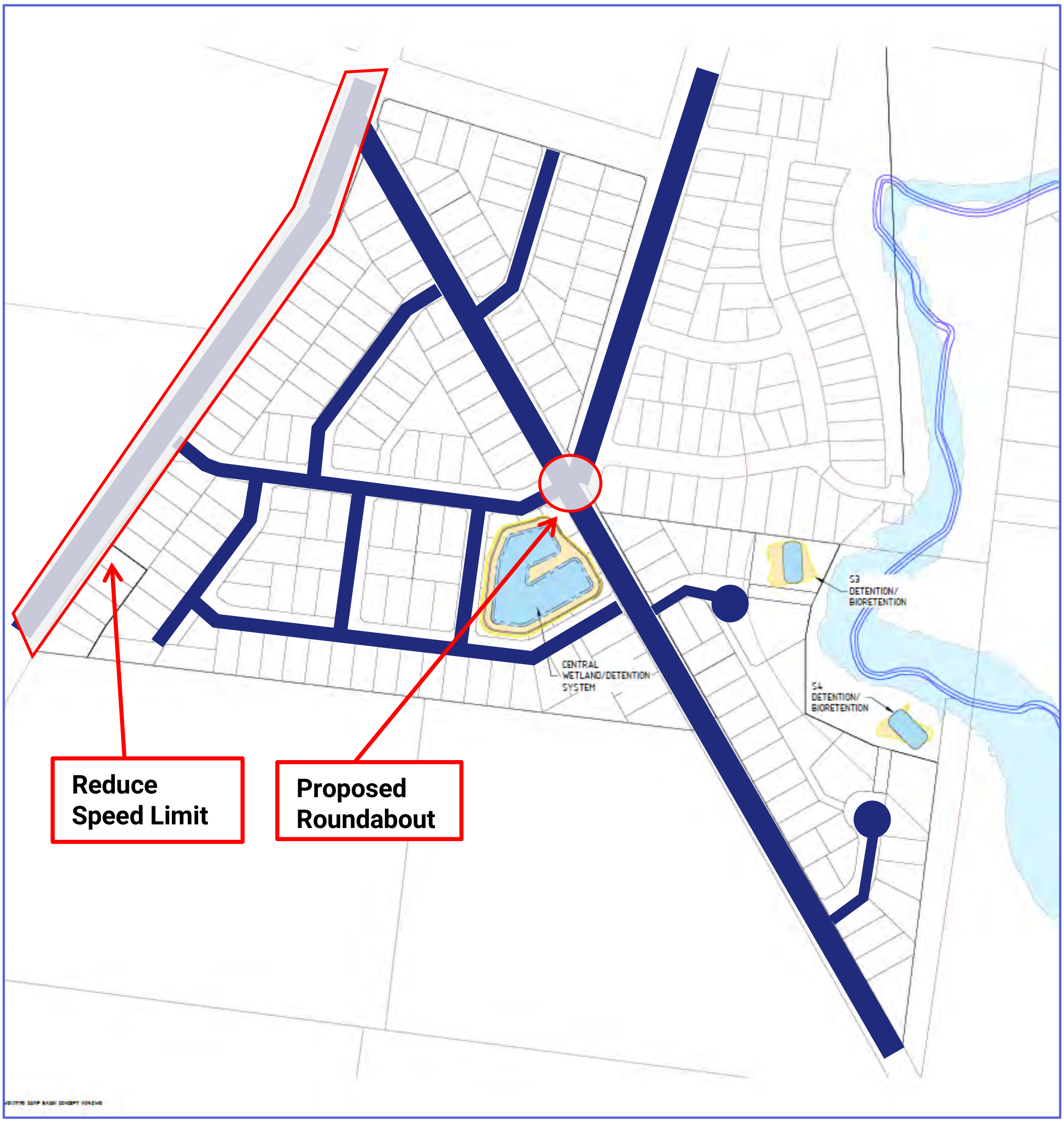

Figure 12: Traffic Management Plan

4.5. Cross-Sections and Road Hierarchy

Based on traffic generation rates detailed in Table 1 and taking into account the adopted traffic distribution assumptions, Table 4 below summarises the two-way daily traffic volumes on key roads.

Table 4: Daily Traffic Volumes

Road Name	Existing Traffic Volume	Site-Generated Traffic	Future Traffic Volume
Harvey Road	500 vpd*	410 vpd	910 vpd
Ormond Street	50 vpd*	365 vpd	415 vpd
Bruce Street	900 vpd*	880 vpd	1,700 vpd

Clause 12.3.2 of the Infrastructure Design Manual sets out the following indicative maximum traffic volumes for different street classifications:

- Access Place: 300vpd
- Access Street: 1,000 – 2,500vpd

It is significant to note that all of the new roads within the subdivision will be provided with a 16m cross-section consistent with an Access Street. The main east-west link will be provided with an 18m wide cross-section.

The existing roads (Ormond Street and Bruce Street) are to be constructed to Access Street Standard.

Under the provisions of the IDM:

- An Access Place is required to be constructed with a 6m carriageway within a 14m road reservation, with footpaths provided on both sides. Parking is permitted within the carriageway on one side only.
- An Access Street is required to be constructed with a 7.3m carriageway within a 16m reservation with footpaths provided on both sides. Parking is permitted within the carriageway on both sides.
- A Court Bowl is required to be constructed with a 10m radius pavement with a 28m reservation.

The IDM Access Street cross-section requirements are consistent with the Victorian Planning Authority (VPA) Guidelines, as shown in Figure 12 below.

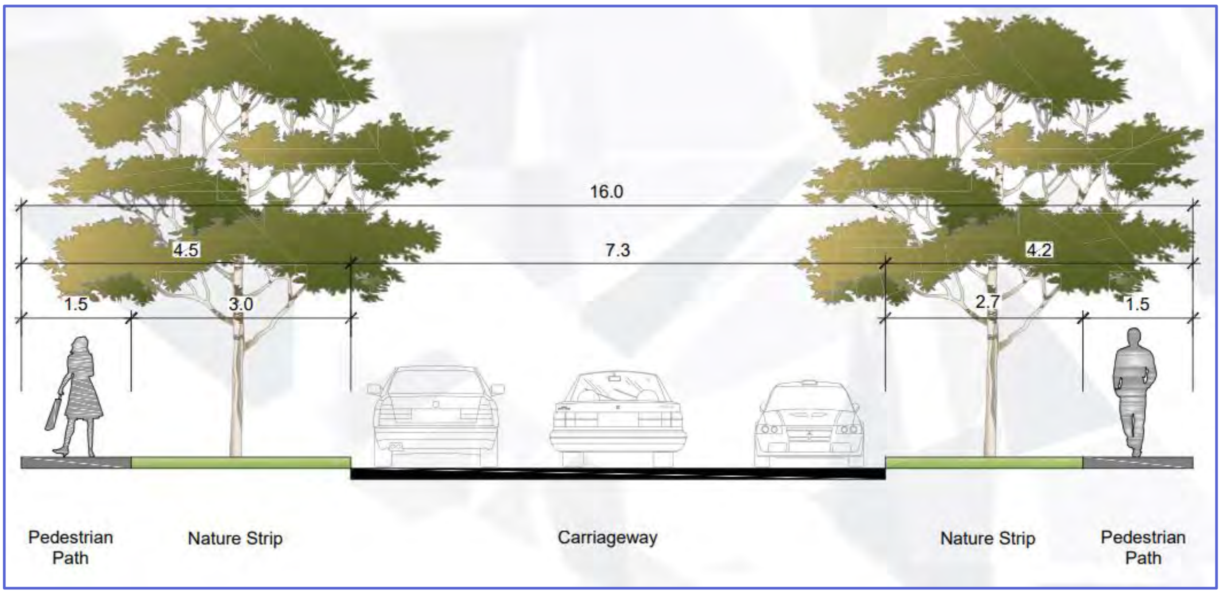

Figure 13: Access Street Cross-Section (VPA)

All of the proposed roads within the subdivision have a reservation of at least 16m. The court bowl has a 28m reservation.

The proposed road reservations meet or exceed the minimum requirements of Clause 56.06-8 of the Planning Scheme and the IDM.

Figure 14 below shows the proposed road hierarchy and road reservation widths within the subdivision.

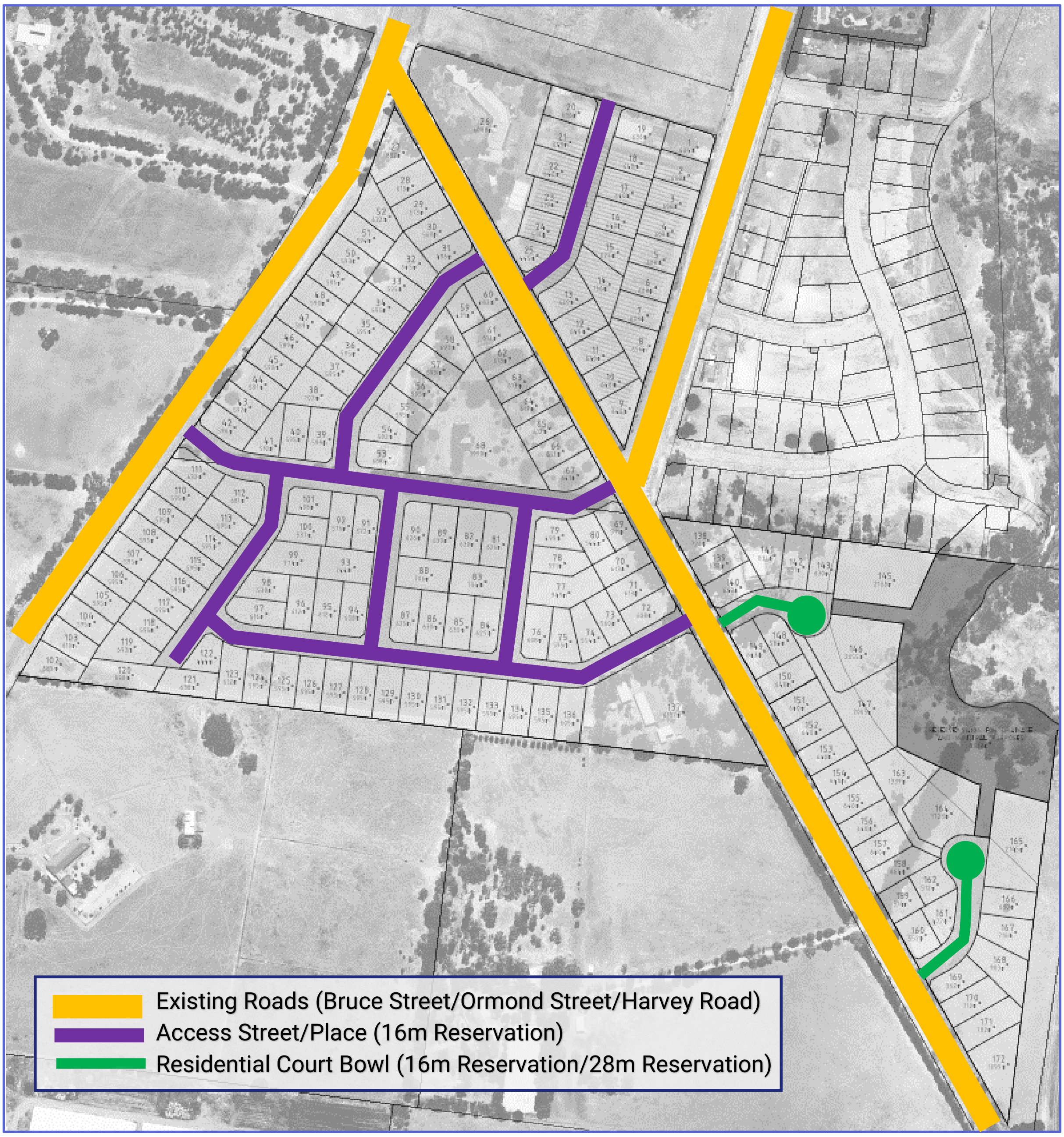

Figure 14: Road Hierarchy

4.6. Bicycle & Pedestrian Network

Footpaths will be provided on both sides of all residential streets within the subdivision.

All of the streets within the proposed subdivision will be low-volume local access streets, and separate formal bicycle path provision is therefore not required.

We are satisfied that the proposed pedestrian and cycle provision is in accordance with Clause 56.06-8 requirements and the IDM and will provide appropriate connectivity to the broader network.

4.7. Access for Service & Emergency Vehicles

The CFA 'Requirements for Water Supplies and Access for Subdivisions in Residential 1 and 2 and Township Zones' document (dated 9th October 2006) indicates the following in relation to access for fire trucks:

> *"The road width must allow room for safe passage of a fire truck with additional margins for human error and safe clearances. A 3.5 metre clearance is required horizontally and 4 metres vertically for access by a fire truck. A road at least 7.3 metres wide will allow for parking on both sides of the road and still enable access by a fire truck. A road 5.5 metres wide will allow parking on one side of the road only. Widths in between these may encourage parking on both sides of the road so that access by a fire truck is not possible."*

All of the proposed access streets (including the two short dead-end access places) are proposed to have a carriageway width of 7.3m, which is sufficient to allow parking to occur on both sides, whilst maintaining access by a fire truck.

In relation to dead-ends, the CFA Guidelines state that … *"constructed roads more than 60m in length from the nearest intersection must have a turning circle with a minimum radius of 8m (including roll-over kerbs if they are provided)"*.

Two short dead-end access places are proposed within the subdivision. Both are proposed to be provided with a formalised court-bowl turning treatment with a 28m diameter reservation. This accords with the IDM requirements, with Clause 12.3.2 of the IDM specifying a 10m radius pavement and a 28m reservation width and exceeds the CFA requirements.

Accordingly, we are satisfied that adequate provision is made for service and emergency vehicle access within the proposed subdivision.

CFA's Guidelines provide the following guidance on grades for emergency vehicle access:

- *The average grade must be no more than one in seven (14.4%) (8.1 degrees) with a maximum of no more than one in five (20%) (11.3 degrees) for no more than 50 metres. Dips must have no more than a one in eight (12%) (7.1 degree) entry and exit angle.*

The site is relatively flat and all grades within the proposed roadways will easily comply with these requirements.

5. Conclusions

Having undertaken a detailed traffic engineering assessment of the proposed residential subdivision at 5, 20, 25 & 30 Ormond Street, Bannockburn, we are of the opinion that:

a) the proposed residential subdivision provides appropriate connections to the surrounding road network,

b) the likely traffic volume on each of the streets will be consistent with (or less than) the volumes suggested within the IDM for each given street,

c) traffic generated by the proposed residential subdivision can easily be accommodated on the surrounding road network and intersections without any adverse impacts and no mitigating works are required,

d) the road reservations exceed the statutory Clause 56.06-8 requirements and meet or exceed the IDM requirements,

e) appropriate traffic management treatments will be provided at critical intersections,

f) adequate provision is made within the subdivision for pedestrians and cyclists in accordance with the Planning Scheme and IDM requirements,

g) the proposed road geometry will be sufficient for the passage of service and emergency vehicles, and

h) there are no traffic engineering reasons why a permit should not be granted for the proposed residential subdivision at 5, 20, 25 & 30 Ormond Street, Bannockburn.

Appendix A

Development Plan

OVERALL LAYOUT PLAN
ORMOND STREET
BANNOCKBURN, VIC 3331

N.T.S
NOVEMBER 2021

Cardno TGM

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J:\17170 (30 ORMOND STREET, BANNOCKBURN)\03-CE (SSMP)\DWG\17170 SSMP BASIN CONCEPT V04.DWG

Appendix B

SIDRA Output

MOVEMENT SUMMARY

Site: 101v [Bannockburn-Shelford Road/Bruce Street - AM Peak Existing]

Bannockburn-Shelford Road/Bruce Street
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: RoadName												
1	L2	4	0.0	0.148	6.4	LOS A	0.6	3.9	0.57	0.81	0.57	49.7
3	R2	72	0.0	0.148	11.1	LOS B	0.6	3.9	0.57	0.81	0.57	49.5
Approach		76	0.0	0.148	10.9	LOS B	0.6	3.9	0.57	0.81	0.57	49.5
East: Bannockburn-Shelford Road												
4	L2	18	0.0	0.010	5.5	LOS A	0.0	0.0	0.00	0.58	0.00	53.6
5	T1	206	5.0	0.109	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
Approach		224	4.6	0.109	0.5	NA	0.0	0.0	0.00	0.05	0.00	59.4
West: Bannockburn-Shelford Road												
11	T1	360	5.0	0.152	0.0	LOS A	0.0	0.1	0.00	0.00	0.00	60.0
12	R2	1	0.0	0.152	6.5	LOS A	0.0	0.1	0.00	0.00	0.00	57.7
Approach		361	5.0	0.152	0.0	NA	0.0	0.1	0.00	0.00	0.00	60.0
All Vehicles		661	4.3	0.152	1.4	NA	0.6	3.9	0.07	0.11	0.07	58.4

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 101v [Bannockburn-Shelford Road/Bruce Street - AM Peak Post Dev]

Bannockburn-Shelford Road/Bruce Street
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: RoadName												
1	L2	7	0.0	0.275	6.9	LOS A	1.2	8.3	0.61	0.85	0.68	49.1
3	R2	132	0.0	0.275	12.1	LOS B	1.2	8.3	0.61	0.85	0.68	48.9
Approach		139	0.0	0.275	11.9	LOS B	1.2	8.3	0.61	0.85	0.68	48.9
East: Bannockburn-Shelford Road												
4	L2	33	0.0	0.018	5.5	LOS A	0.0	0.0	0.00	0.58	0.00	53.6
5	T1	206	5.0	0.109	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
Approach		239	4.3	0.109	0.8	NA	0.0	0.0	0.00	0.08	0.00	59.0
West: Bannockburn-Shelford Road												
11	T1	360	5.0	0.153	0.0	LOS A	0.0	0.2	0.01	0.00	0.01	59.9
12	R2	2	0.0	0.153	6.6	LOS A	0.0	0.2	0.01	0.00	0.01	57.7
Approach		362	5.0	0.153	0.0	NA	0.0	0.2	0.01	0.00	0.01	59.9
All Vehicles		740	3.8	0.275	2.5	NA	1.2	8.3	0.12	0.19	0.13	57.2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 101v [Bannockburn-Shelford Road/Bruce Street - PM Peak Existing]

Bannockburn-Shelford Road/Bruce Street
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: RoadName												
1	L2	1	0.0	0.068	7.3	LOS A	0.2	1.7	0.63	0.83	0.63	48.7
3	R2	27	0.0	0.068	12.6	LOS B	0.2	1.7	0.63	0.83	0.63	48.5
Approach		28	0.0	0.068	12.4	LOS B	0.2	1.7	0.63	0.83	0.63	48.5
East: Bannockburn-Shelford Road												
4	L2	63	0.0	0.034	5.5	LOS A	0.0	0.0	0.00	0.58	0.00	53.6
5	T1	387	5.0	0.205	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
Approach		451	4.3	0.205	0.8	NA	0.0	0.0	0.00	0.08	0.00	59.0
West: Bannockburn-Shelford Road												
11	T1	264	5.0	0.114	0.1	LOS A	0.0	0.3	0.02	0.01	0.02	59.9
12	R2	3	0.0	0.114	7.9	LOS A	0.0	0.3	0.02	0.01	0.02	57.6
Approach		267	4.9	0.114	0.1	NA	0.0	0.3	0.02	0.01	0.02	59.8
All Vehicles		746	4.4	0.205	1.0	NA	0.2	1.7	0.03	0.08	0.03	58.8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 101v [Bannockburn-Shelford Road/Bruce Street - PM Peak Post Dev]

Bannockburn-Shelford Road/Bruce Street
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: RoadName												
1	L2	2	0.0	0.129	7.4	LOS A	0.5	3.2	0.66	0.86	0.66	48.2
3	R2	49	0.0	0.129	13.4	LOS B	0.5	3.2	0.66	0.86	0.66	48.0
Approach		52	0.0	0.129	13.2	LOS B	0.5	3.2	0.66	0.86	0.66	48.0
East: Bannockburn-Shelford Road												
4	L2	116	0.0	0.062	5.5	LOS A	0.0	0.0	0.00	0.58	0.00	53.6
5	T1	387	5.0	0.205	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
Approach		503	3.8	0.205	1.3	NA	0.0	0.0	0.00	0.13	0.00	58.4
West: Bannockburn-Shelford Road												
11	T1	264	5.0	0.117	0.1	LOS A	0.1	0.6	0.04	0.01	0.04	59.7
12	R2	6	0.0	0.117	8.3	LOS A	0.1	0.6	0.05	0.02	0.05	57.4
Approach		271	4.9	0.117	0.3	NA	0.1	0.6	0.04	0.01	0.04	59.6
All Vehicles		825	3.9	0.205	1.7	NA	0.5	3.2	0.05	0.14	0.05	58.0

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101vv [Bannockburn-Shelford Road/Harvey Road - AM Peak Existing]

Bannockburn-Shelford Road/Bruce Street
Site Category: (None)
Stop (Two-Way)

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: RoadName												
1	L2	4	1.0	0.093	8.7	LOS A	0.3	2.5	0.52	0.95	0.52	49.5
3	R2	48	1.0	0.093	12.5	LOS B	0.3	2.5	0.52	0.95	0.52	49.3
Approach		53	1.0	0.093	12.2	LOS B	0.3	2.5	0.52	0.95	0.52	49.3
East: Bannockburn-Shelford Road												
4	L2	36	1.0	0.019	5.6	LOS A	0.0	0.0	0.00	0.58	0.00	53.6
5	T1	171	5.0	0.090	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
Approach		206	4.3	0.090	1.0	NA	0.0	0.0	0.00	0.10	0.00	58.8
West: Bannockburn-Shelford Road												
11	T1	312	5.0	0.173	0.0	LOS A	0.1	0.7	0.03	0.02	0.03	59.7
12	R2	9	1.0	0.173	6.5	LOS A	0.1	0.7	0.03	0.02	0.03	57.4
Approach		321	4.9	0.173	0.2	NA	0.1	0.7	0.03	0.02	0.03	59.7
All Vehicles		580	4.3	0.173	1.6	NA	0.3	2.5	0.06	0.13	0.06	58.2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101vv [Bannockburn-Shelford Road/Harvey Road - AM Peak Post Dev]

Bannockburn-Shelford Road/Bruce Street
Site Category: (None)
Stop (Two-Way)

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: RoadName												
1	L2	5	1.0	0.122	8.8	LOS A	0.5	3.3	0.53	0.96	0.53	49.4
3	R2	63	1.0	0.122	12.6	LOS B	0.5	3.3	0.53	0.96	0.53	49.2
Approach		68	1.0	0.122	12.3	LOS B	0.5	3.3	0.53	0.96	0.53	49.3
East: Bannockburn-Shelford Road												
4	L2	42	1.0	0.023	5.6	LOS A	0.0	0.0	0.00	0.58	0.00	53.6
5	T1	171	5.0	0.090	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
Approach		213	4.2	0.090	1.1	NA	0.0	0.0	0.00	0.11	0.00	58.6
West: Bannockburn-Shelford Road												
11	T1	312	5.0	0.173	0.0	LOS A	0.1	0.7	0.03	0.02	0.03	59.7
12	R2	9	1.0	0.173	6.5	LOS A	0.1	0.7	0.03	0.02	0.03	57.4
Approach		321	4.9	0.173	0.2	NA	0.1	0.7	0.03	0.02	0.03	59.6
All Vehicles		602	4.2	0.173	1.9	NA	0.5	3.3	0.07	0.16	0.07	57.9

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101vv [Bannockburn-Shelford Road/Harvey Road - PM Peak Existing]

Bannockburn-Shelford Road/Bruce Street
Site Category: (None)
Stop (Two-Way)

Movement Performance - Vehicles													
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: RoadName												
1	L2	4	1.0	0.094	9.6	LOS A	0.3	2.4	0.57	0.97	0.57	48.9
3	R2	43	1.0	0.094	13.5	LOS B	0.3	2.4	0.57	0.97	0.57	48.7
Approach		47	1.0	0.094	13.2	LOS B	0.3	2.4	0.57	0.97	0.57	48.8
East: Bannockburn-Shelford Road												
4	L2	52	1.0	0.028	5.6	LOS A	0.0	0.0	0.00	0.58	0.00	53.6
5	T1	336	5.0	0.178	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
Approach		387	4.5	0.178	0.8	NA	0.0	0.0	0.00	0.08	0.00	59.0
West: Bannockburn-Shelford Road												
11	T1	221	5.0	0.122	0.1	LOS A	0.0	0.4	0.02	0.01	0.02	59.8
12	R2	4	1.0	0.122	7.5	LOS A	0.0	0.4	0.02	0.01	0.02	57.5
Approach		225	4.9	0.122	0.2	NA	0.0	0.4	0.02	0.01	0.02	59.7
All Vehicles		660	4.4	0.178	1.5	NA	0.3	2.4	0.05	0.12	0.05	58.4

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101vv [Bannockburn-Shelford Road/Harvey Road - PM Peak Post Dev]

Bannockburn-Shelford Road/Bruce Street
Site Category: (None)
Stop (Two-Way)

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: RoadName												
1	L2	4	1.0	0.116	9.6	LOS A	0.4	3.0	0.59	0.99	0.59	48.8
3	R2	53	1.0	0.116	13.8	LOS B	0.4	3.0	0.59	0.99	0.59	48.6
Approach		57	1.0	0.116	13.5	LOS B	0.4	3.0	0.59	0.99	0.59	48.6
East: Bannockburn-Shelford Road												
4	L2	74	1.0	0.040	5.6	LOS A	0.0	0.0	0.00	0.58	0.00	53.6
5	T1	336	5.0	0.178	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
Approach		409	4.3	0.178	1.0	NA	0.0	0.0	0.00	0.10	0.00	58.7
West: Bannockburn-Shelford Road												
11	T1	221	5.0	0.123	0.1	LOS A	0.1	0.5	0.03	0.01	0.03	59.7
12	R2	5	1.0	0.123	7.7	LOS A	0.1	0.5	0.03	0.01	0.03	57.4
Approach		226	4.9	0.123	0.3	NA	0.1	0.5	0.03	0.01	0.03	59.7
All Vehicles		693	4.2	0.178	1.8	NA	0.4	3.0	0.06	0.15	0.06	58.0

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Project no. 220912

Date 24/01/2024

Bojan Ritonja
Planit Consulting Pty Ltd
PO Box 112
Geelong VIC 3220

Via email bojan@planitconsulting.com.au

Dear Bojan

Harvey Road Bannockburn Intersections – Intersection analysis and concept designs

Planit Consulting Pty Ltd engaged Trafficworks to undertake analysis and concept design work for the following intersections along Harvey Road in Bannockburn:

- Harvey Road and Bannockburn-Shelford Road (existing intersection)
- Harvey Road and Ormond Street (existing intersection)
- Harvey Road and new road (does not exist).

The intersections are located within the south west Precinct of the future Bannockburn PSP. Council has identified these intersections will require a contribution from the adjoining landowners and intersection designs are required to inform the contributions required.

The Bannockburn PSP area is shown in Figure 1.

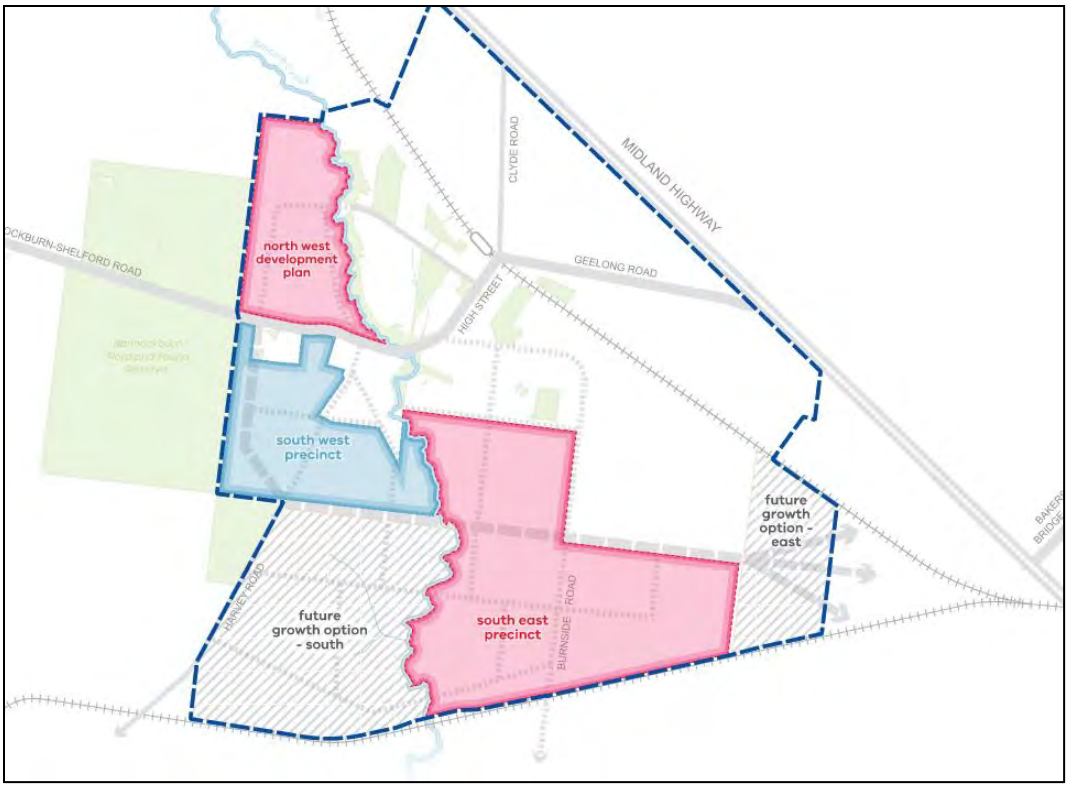


Figure 1: Bannockburn PSP

Intersection analysis

SIDRA analysis was undertaken to determine the indicative intersection layouts required to support the south west precinct of the future Bannockburn PSP. The following assumptions were made to determine the high-level impact of the residential growth area:

- Existing traffic volumes from 2018 were obtained for Harvey Road and Bannockburn-Shelford Road from the Cardno Traffic Modelling report (March 2019).
- The 2018 traffic volumes on Harvey Road and Bannockburn-Shelford Road were projected to the final year (2043) using a 2% compound annual growth rate.
- Ultimately, Bannockburn-Shelford Road will be downgraded to a connector road with the introduction of the bypass arterial road. Therefore, it was assumed that 50% of traffic currently utilising Bannockburn-Shelford Road will use the new bypass arterial road.
- 3% heavy vehicle volumes were applied.

- The lot yield of each area was based on the Bannockburn Growth Plan (May 2021).
- Based on the rates used in the Cardno report, peak hour traffic generation rates of 0.85 trips per dwelling in the AM peak hour and 0.9 trips per dwelling in the PM peak hour were adopted.

The 'south west precinct' includes 51.7ha of business park development. A high-level traffic generation rate of 200 trips / ha of developable land has been applied to estimate the traffic generation for the industrial and business land uses within the PSP. In addition, a ratio of 40% was applied to estimate the equivalent Gross Floor Area (GFA) as a percentage of the total developable land. This rate is equivalent to 5 daily trips / 100m² GFA as per the RTA Guide for Traffic Generating Developments.

Based on the above, the anticipated traffic generation of the key areas within the future Bannockburn PSP at full development are shown in Table 1.

Table 1: Traffic generation rates

Precinct	Measure	Peak hour traffic generation rates		Development traffic generation	
		AM Peak	PM Peak	AM Peak	PM Peak
North west	1,267 lots	0.9	0.85	1,140	1,077
South west (residential)	1,159 lots	0.9	0.85	1,043	985
Future growth area - South	2,693 lots	0.9	0.85	2,424	2,289
South west (business park)	206,721 m²	5 trips / 100 m² of GFA		1,344	
Total	**5,119**			**5,951**	**5,695**

- The following peak hour splits were applied:
  - AM: 20 % IN 80% OUT
  - PM: 70% IN 30% OUT
- Traffic distributed to / from the surrounding residential developments would generate:
  - 30% to / from Bannockburn town centre
  - 60% to / from Geelong
  - 10% to west

— Of the local traffic accessing the town centre that generates to the arterial road intersections:

    — 20% will utilise Harvey Road

    — 80% will utilise the arterial roads.

— The 'south east precinct' and 'future growth option east' of the Bannockburn PSP (refer to Figure 1) will not generate traffic to/from the intersections along Harvey Road and therefore have not been included as part of this analysis.

Ultimate conditions (i.e. full development)

Based on the above assumptions, the anticipated traffic volumes at full development at the three intersections are shown in Appendix 1.

The intersection layouts required to support the anticipated traffic volumes at each intersection and achieve a 10-year design life are shown in Figures 2 - 4. Detailed SIDRA outputs are provided in Appendix 2.

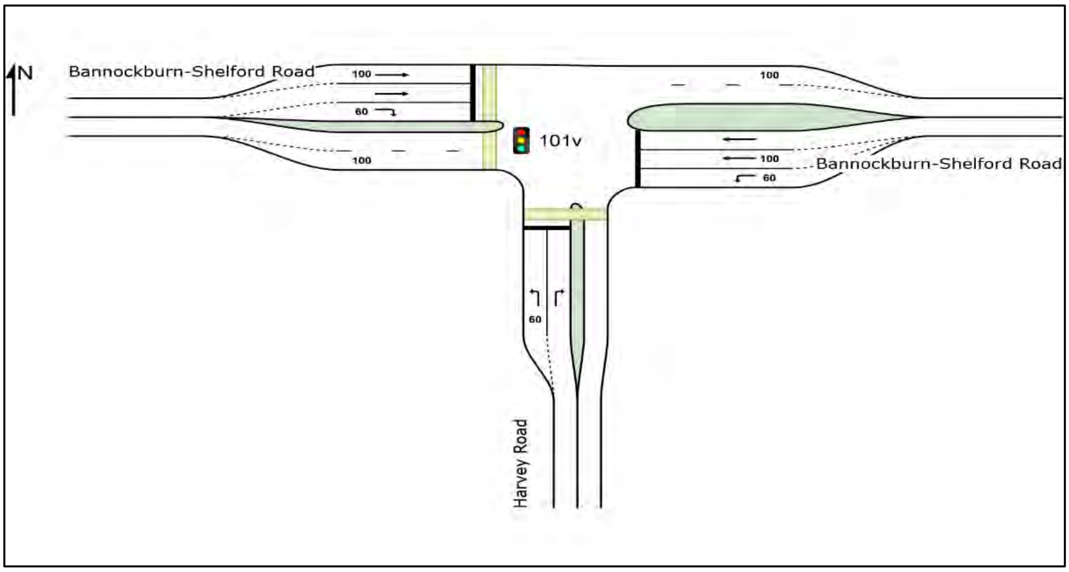


Figure 2: Harvey Road / Bannockburn-Shelford Road SIDRA intersection layout

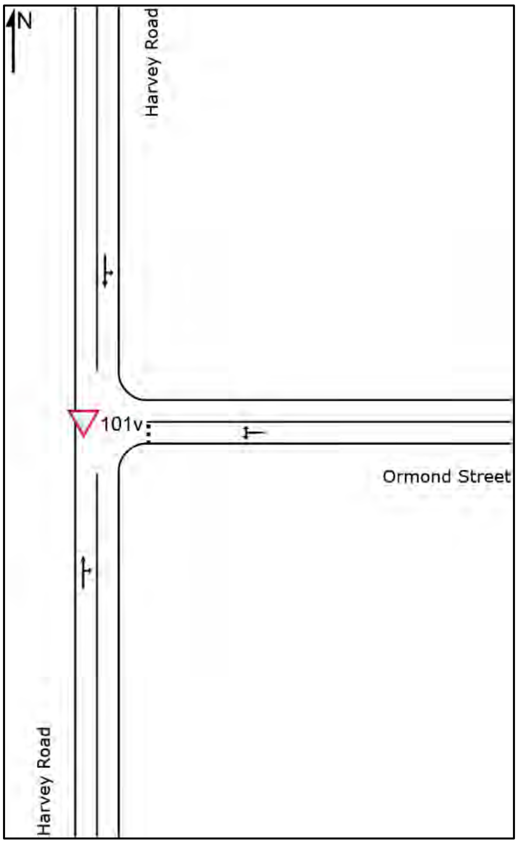


Figure 3: Harvey Road / Ormond Street SIDRA intersection layout

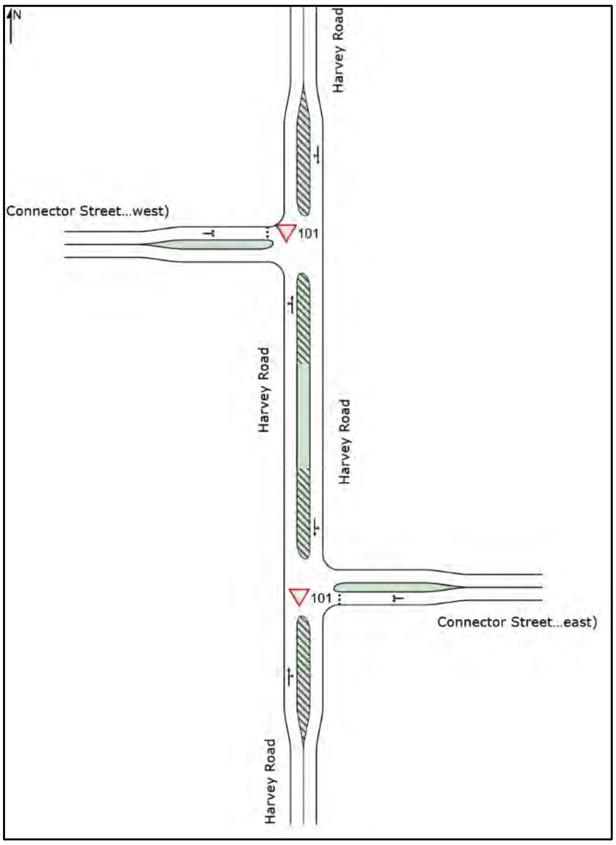


Figure 4: Harvey Road / future E-W connector road SIDRA intersection layout

Interim conditions

An interim roundabout treatment is proposed at the Harvey Road / Bannockburn-Shelford Road intersection to facilitate initial development. The proposed roundabout layout is shown in Figure 5.

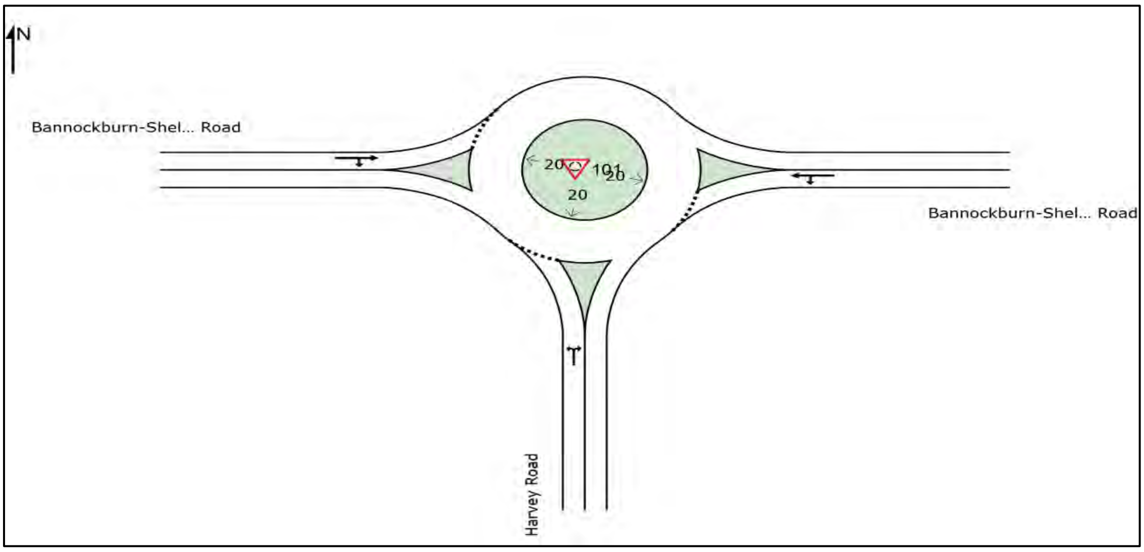


Figure 5: Harvey Road / Bannockburn-Shelford Road SIDRA interim intersection layout

SIDRA analysis was undertaken to determine the trigger to upgrade the interim intersection layout, based on the following additional assumptions:

- Of the traffic travelling to Geelong:
    - 70% will utilise Bannockburn-Shelford Road
    - 30% will utilise Hamilton Highway via Harvey Road.
- 10% heavy vehicle volumes were applied to Bannockburn-Shelford Road (as per the DTP Open Data Portal).

The SIDRA analysis indicates that the interim roundabout intersection treatment will operate satisfactorily with the development of:

- 1,000 lots from the south west development area only (i.e. no development occurs in the north west development area)
- a combined 1,050 lots from each development area (i.e. south west and north west) assuming the areas develop at the same rate (i.e. 525 lots in the south west and 525 lots in the north west development areas).

Concept designs

Based on the outcomes of the SIDRA analysis, concept plans were prepared for the interim intersection layouts and are provided in Appendix 3 and swept path analysis is provided in Appendix 4. It is noted that the interim and ultimate layout for the collector road intersections with Harvey Road are the same in both scenarios.

The intersection designs have adopted the following design principles:

- Road cross sections have been based on the standard cross sections prepared by the Victorian Planning Authority (VPA)
- Design speed - 60km/h
- Collector roads
    - Design vehicle - bus
    - Check vehicle – 19.0 m semi-trailer
- Bannockburn-Shelford Road
    - Design vehicle - 19.0 m semi-trailer
    - Check vehicle – B-double

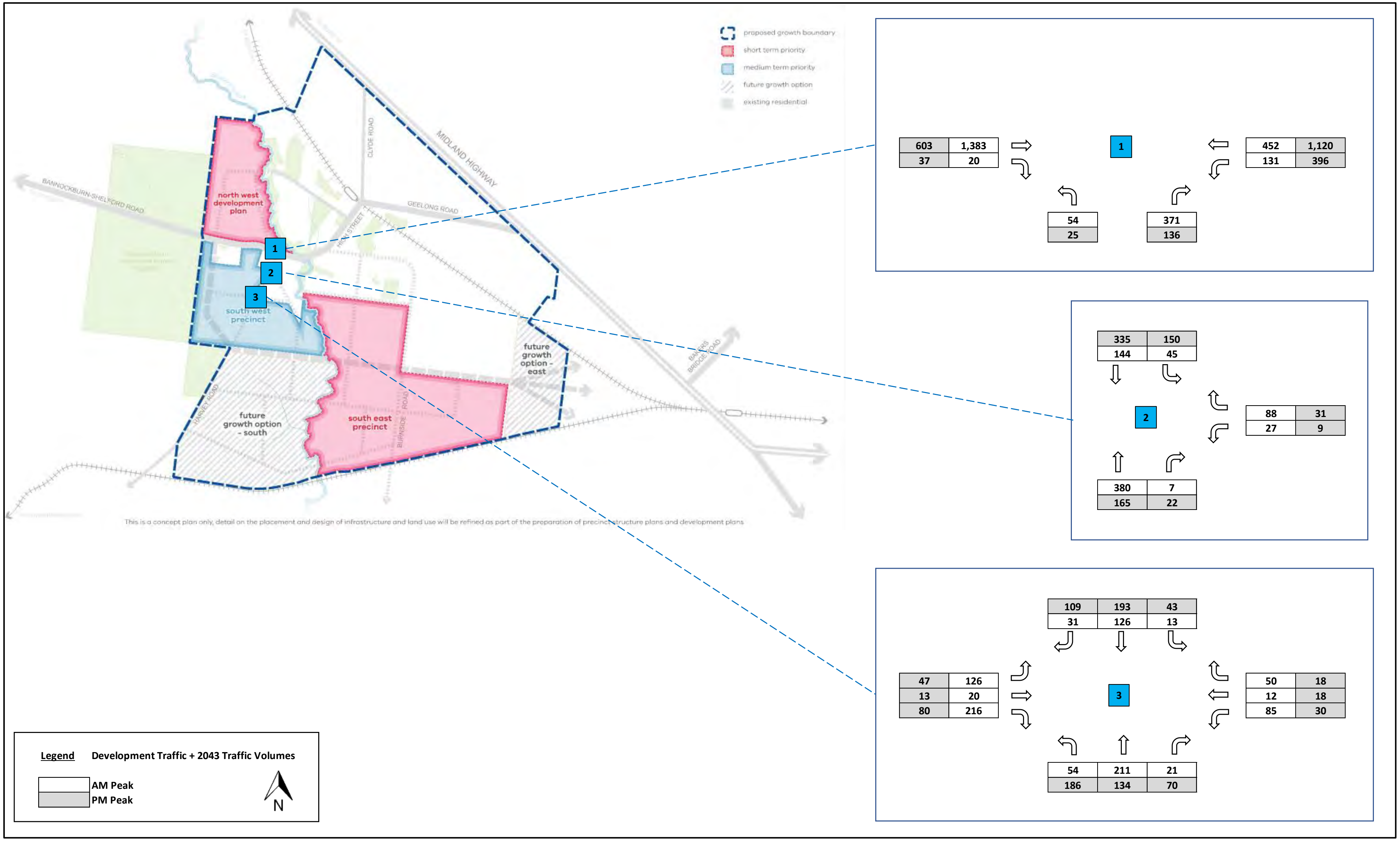
Please contact me on 0438 343 817 if you require additional information.
Yours sincerely,

Ali Abdou

Director BE (Civil) (Hons), MIEAust, CPEng (Civil, PM), RPEng (Civil)

Appendix 1 – Anticipated traffic volumes

TRAFFICWORKS™



TRAFFICWORKS™

Appendix 2 – Detailed SIDRA analysis

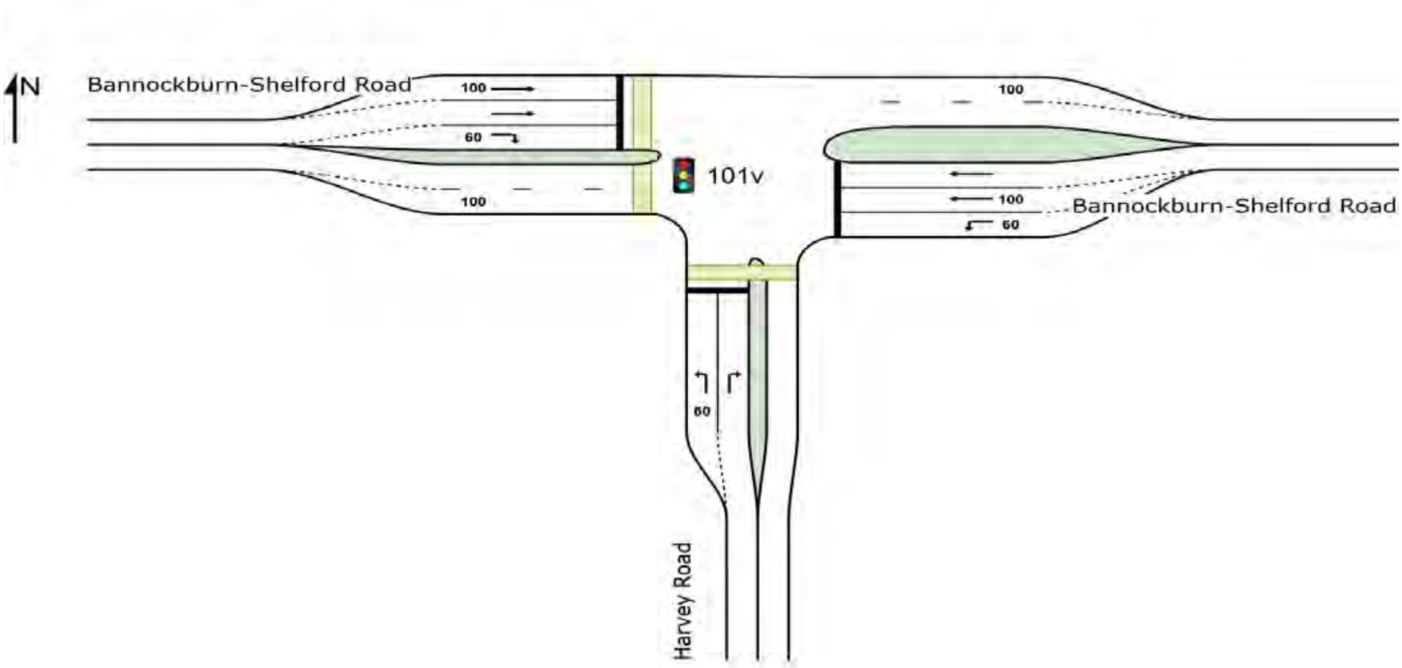
Site: 101v [Ultimate_BS Rd-Harvey_AM - signals (Site Folder: General)]

New Site
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Timings based on settings in the Site Phasing & Timing dialog
Phase Times determined by the program
Phase Sequence: Convert Function Default
Input Phase Sequence: A, B, C
Output Phase Sequence: A, B, C
Reference Phase: Phase A

Site Layout

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Harvey Road															
Lane 1	57	3.0	57	3.0	441	0.129	100	44.2	LOS D	2.2	15.7	Short	60	0.0	NA
Lane 2	391	3.0	391	3.0	484 [1]	0.807	100	52.7	LOS D	19.3	138.9	Full	500	0.0	0.0
Approach	447	3.0	447	3.0		0.807		51.6	LOS D	19.3	138.9				
East: Bannockburn-Shelford Road															
Lane 1	138	3.0	138	3.0	1451	0.095	100	8.1	LOS A	1.5	10.7	Short	60	0.0	NA
Lane 2	169	3.0	169	3.0	947	0.179	55 [6]	15.8	LOS B	4.6	32.7	Short	100	0.0	NA
Lane 3	307	3.0	307	3.0	947	0.324	100	16.5	LOS B	9.0	64.4	Full	500	0.0	0.0
Approach	614	3.0	614	3.0		0.324		14.4	LOS B	9.0	64.4				
West: Bannockburn-Shelford Road															
Lane 1	522	3.0	522	3.0	1179	0.443	55 [6]	399.7	LOS F	13.4	96.4	Short	100	0.0	NA
Lane 2	933	3.0	933	3.0	1163 [1]	0.803	100	24.5	LOS C	34.5	247.5	Full	500	0.0	0.0
Lane 3	21	3.0	21	3.0	110	0.191	100	65.4	LOS E	1.0	7.5	Short	60	0.0	NA
Approach	1477	3.0	1477	3.0		0.803		157.8	LOS F	34.5	247.5				
All Vehicles	2538	3.0	2538	3.0		0.807		104.4	LOS F	34.5	247.5				

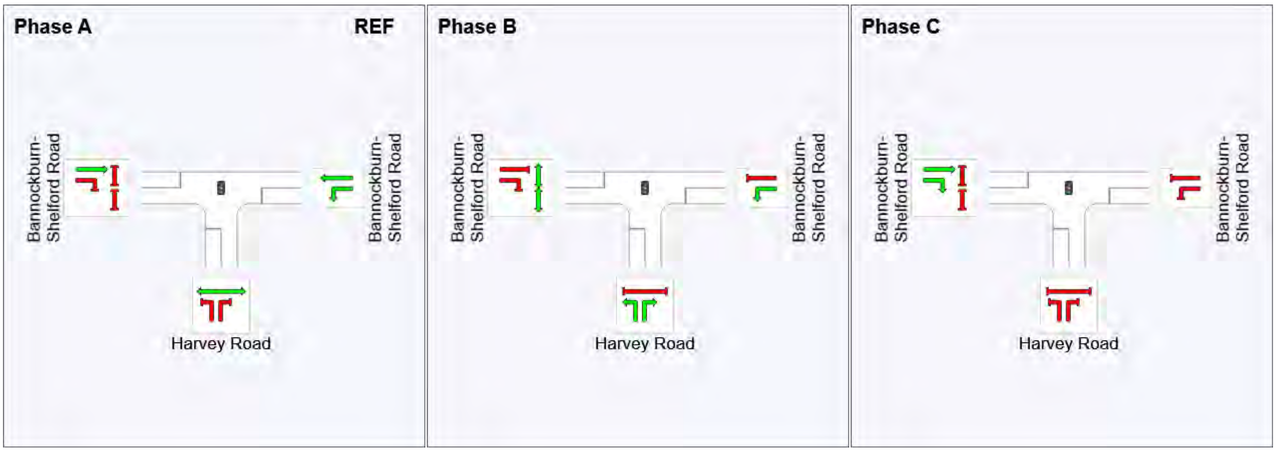
Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).

Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Green.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

1 Reduced capacity due to a short lane effect. Short lane queues may extend into the full-length lanes. Delay and stops experienced by drivers upstream of short lane entry have been accounted for.

6 Lane under-utilisation due to downstream effects

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase

Normal Movement	Permitted/Opposed
Slip/Bypass-Lane Movement	Opposed Slip/Bypass-Lane
Stopped Movement	Turn On Red
Other Movement Class (MC) Running	Undetected Movement
Mixed Running & Stopped MCs	Continuous Movement
Other Movement Class (MC) Stopped	Phase Transition Applied

Phase Timing Summary

Phase	A	B	C
Phase Change Time (sec)	0	55	88
Green Time (sec)	49	27	6
Phase Time (sec)	55	33	12
Phase Split	55%	33%	12%
Phase Frequency (%)	100.0	100.0	100.0

See the Timing Analysis report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Minor Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

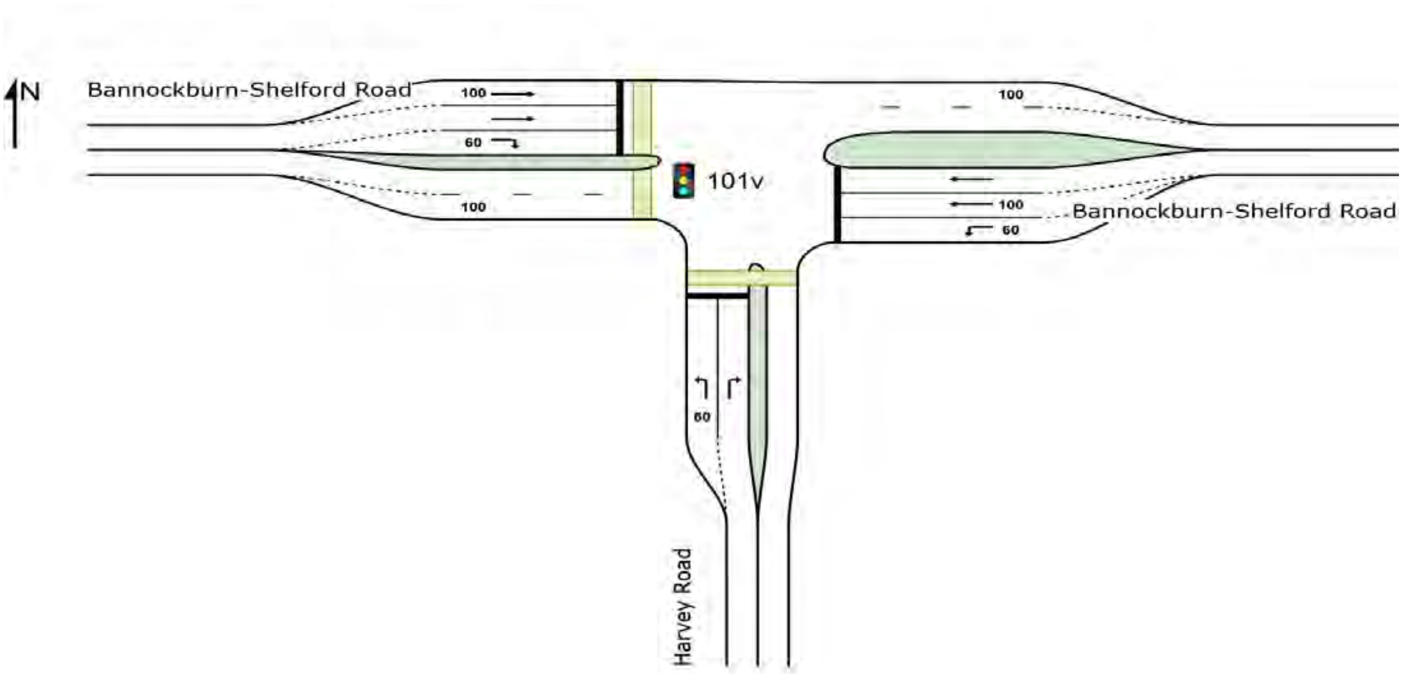
Site: 101v [Ultimate_BS Rd-Harvey_PM - signals (Site Folder: General)]

New Site
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Timings based on settings in the Site Phasing & Timing dialog
Phase Times determined by the program
Phase Sequence: Convert Function Default
Input Phase Sequence: A, B, C
Output Phase Sequence: A, B, C
Reference Phase: Phase A

Site Layout

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.

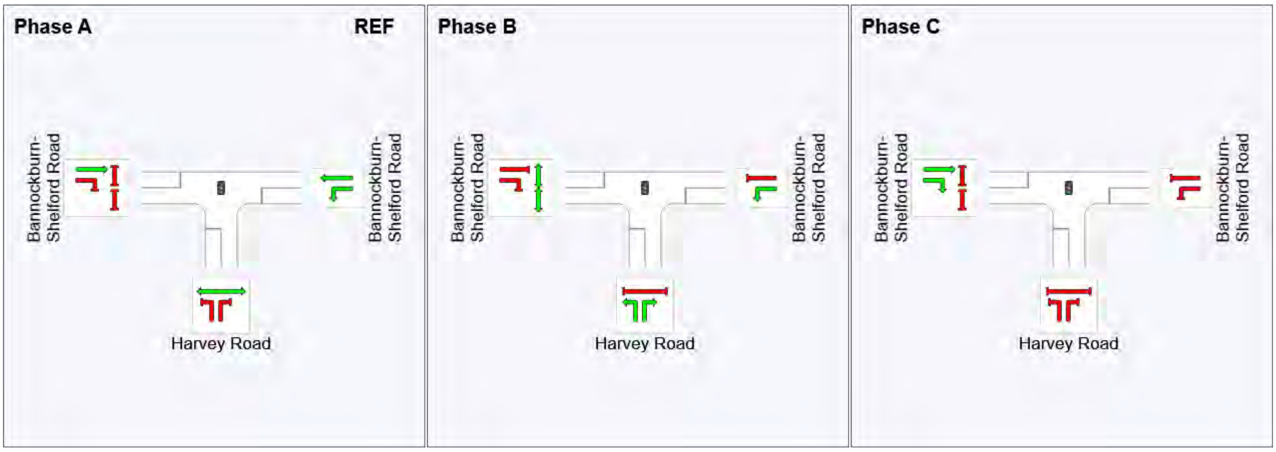


Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Harvey Road															
Lane 1	26	3.0	26	3.0	184	0.143	100	54.8	LOS D	1.2	8.7	Short	60	0.0	NA
Lane 2	143	3.0	143	3.0	239	0.599	100	51.7	LOS D	6.9	49.4	Full	500	0.0	0.0
Approach	169	3.0	169	3.0		0.599		52.2	LOS D	6.9	49.4				
East: Bannockburn-Shelford Road															
Lane 1	417	3.0	417	3.0	1451	0.287	100	8.6	LOS A	5.4	38.9	Short	60	0.0	NA
Lane 2	419	3.0	419	3.0	1218	0.344	55[6]	12.6	LOS B	9.5	68.3	Short	100	0.0	NA
Lane 3	760	3.0	760	3.0	1218	0.624	100	12.0	LOS B	22.3	160.1	Full	500	0.0	0.0
Approach	1596	3.0	1596	3.0		0.624		11.3	LOS B	22.3	160.1				
West: Bannockburn-Shelford Road															
Lane 1	226	3.0	226	3.0	1449	0.156	55[6]	5.1	LOS A	3.0	21.9	Short	100	0.0	NA
Lane 2	409	3.0	409	3.0	1449	0.282	100	4.2	LOS A	6.2	44.5	Full	500	0.0	0.0
Lane 3	39	3.0	39	3.0	110	0.353	100	57.8	LOS E	2.0	14.1	Short	60	0.0	NA
Approach	674	3.0	674	3.0		0.353		7.6	LOS A	6.2	44.5				
All Vehicles	2439	3.0	2439	3.0		0.624		13.1	LOS B	22.3	160.1				

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Green.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.
6 Lane under-utilisation due to downstream effects

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase

Phase Timing Summary

Phase	A	B	C
Phase Change Time (sec)	0	69	88
Green Time (sec)	63	13	6
Phase Time (sec)	69	19	12
Phase Split	69%	19%	12%
Phase Frequency (%)	100.0	100.0	100.0

See the Timing Analysis report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Minor Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

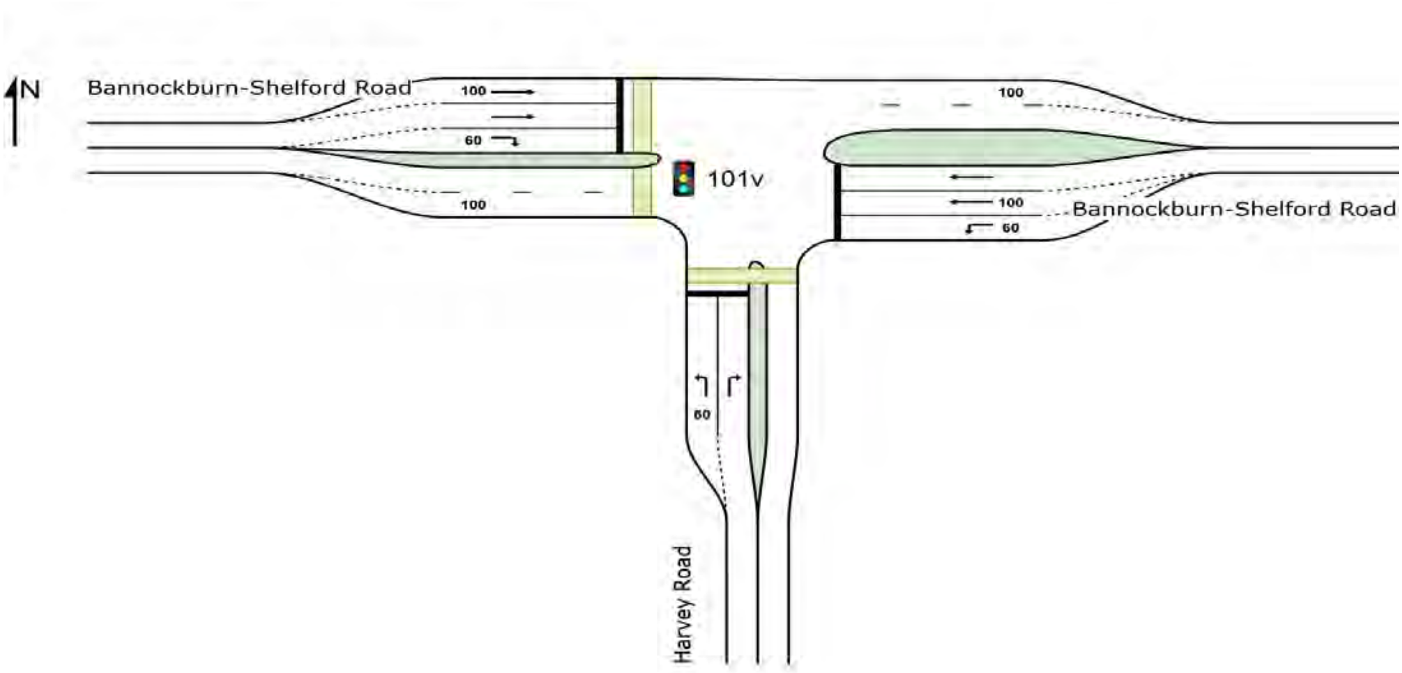
Site: 101v [Ultimate_BS Rd-Harvey_AM - signals - sensitivity (Site Folder: General)]

New Site
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 150 seconds (Site Practical Cycle Time)
Design Life Analysis (Practical Capacity): Results for 10 years

Timings based on settings in the Site Phasing & Timing dialog
Phase Times determined by the program
Phase Sequence: Convert Function Default
Input Phase Sequence: A, B, C
Output Phase Sequence: A, B, C
Reference Phase: Phase A

Site Layout

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



Lane Use and Performance

	Demand Flows [Total	HV]	Arrival Flows [Total	HV]	Cap.	Deg. Satn	Lane Util.	Aver. Delay	Level of Service	95% Back Of Queue [Veh	Dist]	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Harvey Road															
Lane 1	57	3.0	57	3.0	429	0.133	100	79.8	LOS E [11]	3.3	23.4	Short	60	0.0	NA
Lane 2	391	3.0	391	3.0	436 [1]	0.896	100	101.6	LOS F [11]	31.3	224.4	Full	500	0.0	0.0
Approach	447	3.0	447	3.0		0.896		98.8	LOS F [11]	31.3	224.4				
East: Bannockburn-Shelford Road															
Lane 1	138	3.0	138	3.0	1580	0.087	100	7.2	LOS A	1.5	10.6	Short	60	0.0	NA
Lane 2	206	3.0	206	3.0	1134	0.182	55 [6]	15.9	LOS B	6.8	48.8	Short	100	0.0	NA
Lane 3	374	3.0	374	3.0	1134	0.330	100	16.7	LOS B	13.7	98.1	Full	500	0.0	0.0
Approach	718	3.0	718	3.0		0.330		14.6	LOS B	13.7	98.1				
West: Bannockburn-Shelford Road															
Lane 1	637	3.0	637	3.0	1288	0.495	55 [6]	2167.4	LOS F [11]	22.6	162.4	Short	100	0.0	NA
Lane 2	1137	3.0	1137	3.0	1269 [1]	0.896	100	39.6	LOS D	68.9	494.5	Full	500	0.0	4.0
Lane 3	21	3.0	21	3.0	73	0.286	100	102.0	LOS F [11]	1.6	11.4	Short	60	0.0	NA
Approach	1796	3.0	1796	3.0		0.896		795.7	LOS F [11]	68.9	494.5				
All Vehicles	2961	3.0	2961	3.0		0.896		501.1	LOS F [11]	68.9	494.5				

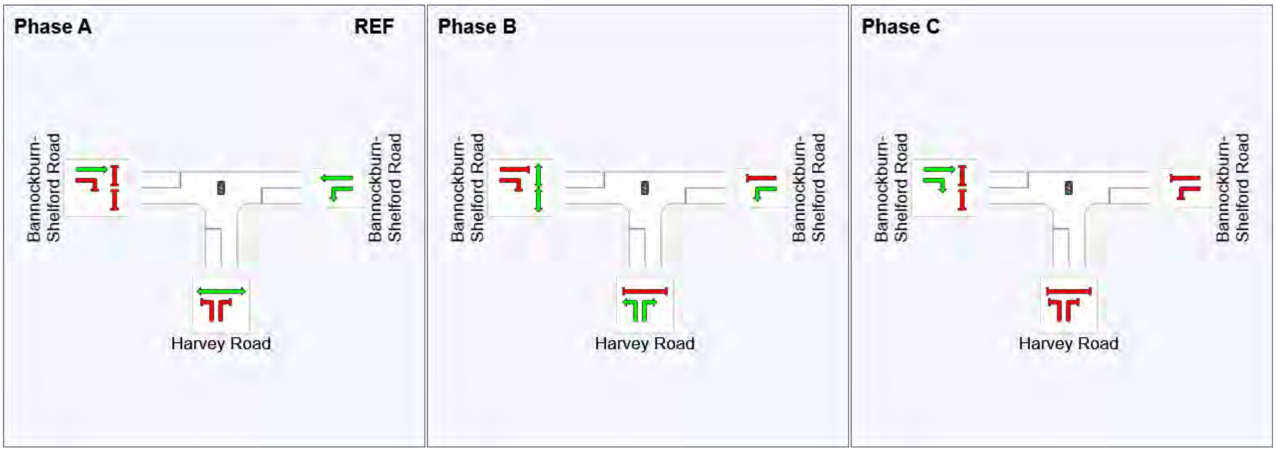
Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Green.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

1 Reduced capacity due to a short lane effect. Short lane queues may extend into the full-length lanes.
Delay and stops experienced by drivers upstream of short lane entry have been accounted for.

6 Lane under-utilisation due to downstream effects

11 Level of Service is worse than the Level of Service Target specified in the Parameter Settings dialog.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase

Normal Movement	Permitted/Opposed
Slip/Bypass-Lane Movement	Opposed Slip/Bypass-Lane
Stopped Movement	Turn On Red
Other Movement Class (MC) Running	Undetected Movement
Mixed Running & Stopped MCs	Continuous Movement
Other Movement Class (MC) Stopped	Phase Transition Applied

Phase Timing Summary

Phase	A	B	C
Phase Change Time (sec)	0	94	138
Green Time (sec)	88	38	6
Phase Time (sec)	94	44	12
Phase Split	63%	29%	8%
Phase Frequency (%)	100.0	100.0	100.0

See the Timing Analysis report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Minor Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

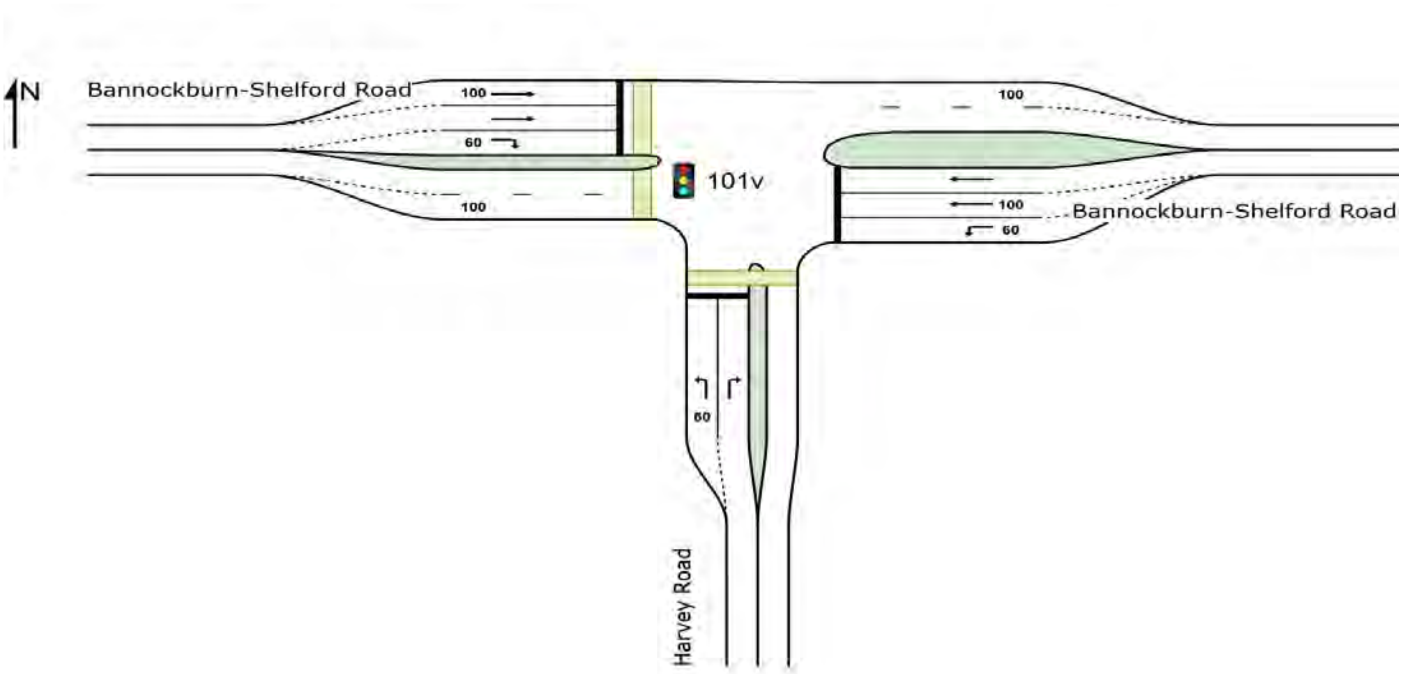
Site: 101v [Ultimate_BS Rd-Harvey_PM - signals - sensitivity (Site Folder: General)]

New Site
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Timings based on settings in the Site Phasing & Timing dialog
Phase Times determined by the program
Phase Sequence: Convert Function Default
Input Phase Sequence: A, B, C
Output Phase Sequence: A, B, C
Reference Phase: Phase A

Site Layout

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



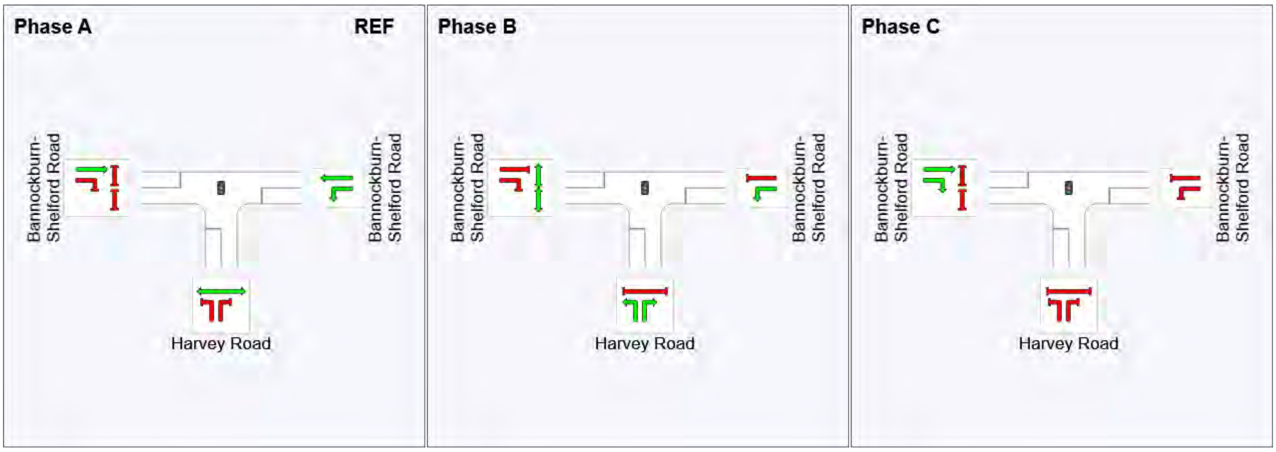
Lane Use and Performance

	Demand Flows [Total	HV]	Arrival Flows [Total	HV]	Cap.	Deg. Satn	Lane Util.	Aver. Delay	Level of Service	95% Back Of Queue [Veh	Dist]	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Harvey Road															
Lane 1	26	3.0	26	3.0	184	0.143	100	54.8	LOS D	1.2	8.7	Short	60	0.0	NA
Lane 2	143	3.0	143	3.0	239	0.599	100	51.7	LOS D	6.9	49.4	Full	500	0.0	0.0
Approach	169	3.0	169	3.0		0.599		52.2	LOS D	6.9	49.4				
East: Bannockburn-Shelford Road															
Lane 1	417	3.0	417	3.0	1451	0.287	100	8.6	LOS A	5.4	38.9	Short	60	0.0	NA
Lane 2	419	3.0	419	3.0	1218	0.344	55 [6]	12.6	LOS B	9.5	68.3	Short	100	0.0	NA
Lane 3	760	3.0	760	3.0	1218	0.624	100	12.0	LOS B	22.3	160.1	Full	500	0.0	0.0
Approach	1596	3.0	1596	3.0		0.624		11.3	LOS B	22.3	160.1				
West: Bannockburn-Shelford Road															
Lane 1	226	3.0	226	3.0	1449	0.156	55 [6]	5.1	LOS A	3.0	21.9	Short	100	0.0	NA
Lane 2	409	3.0	409	3.0	1449	0.282	100	4.2	LOS A	6.2	44.5	Full	500	0.0	0.0
Lane 3	39	3.0	39	3.0	110	0.353	100	57.8	LOS E	2.0	14.1	Short	60	0.0	NA
Approach	674	3.0	674	3.0		0.353		7.6	LOS A	6.2	44.5				
All Vehicles	2439	3.0	2439	3.0		0.624		13.1	LOS B	22.3	160.1				

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).

Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Green.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.
6 Lane under-utilisation due to downstream effects

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase

Normal Movement	Permitted/Opposed
Slip/Bypass-Lane Movement	Opposed Slip/Bypass-Lane
Stopped Movement	Turn On Red
Other Movement Class (MC) Running	Undetected Movement
Mixed Running & Stopped MCs	Continuous Movement
Other Movement Class (MC) Stopped	Phase Transition Applied

Phase Timing Summary

Phase	A	B	C
Phase Change Time (sec)	0	69	88
Green Time (sec)	63	13	6
Phase Time (sec)	69	19	12
Phase Split	69%	19%	12%
Phase Frequency (%)	100.0	100.0	100.0

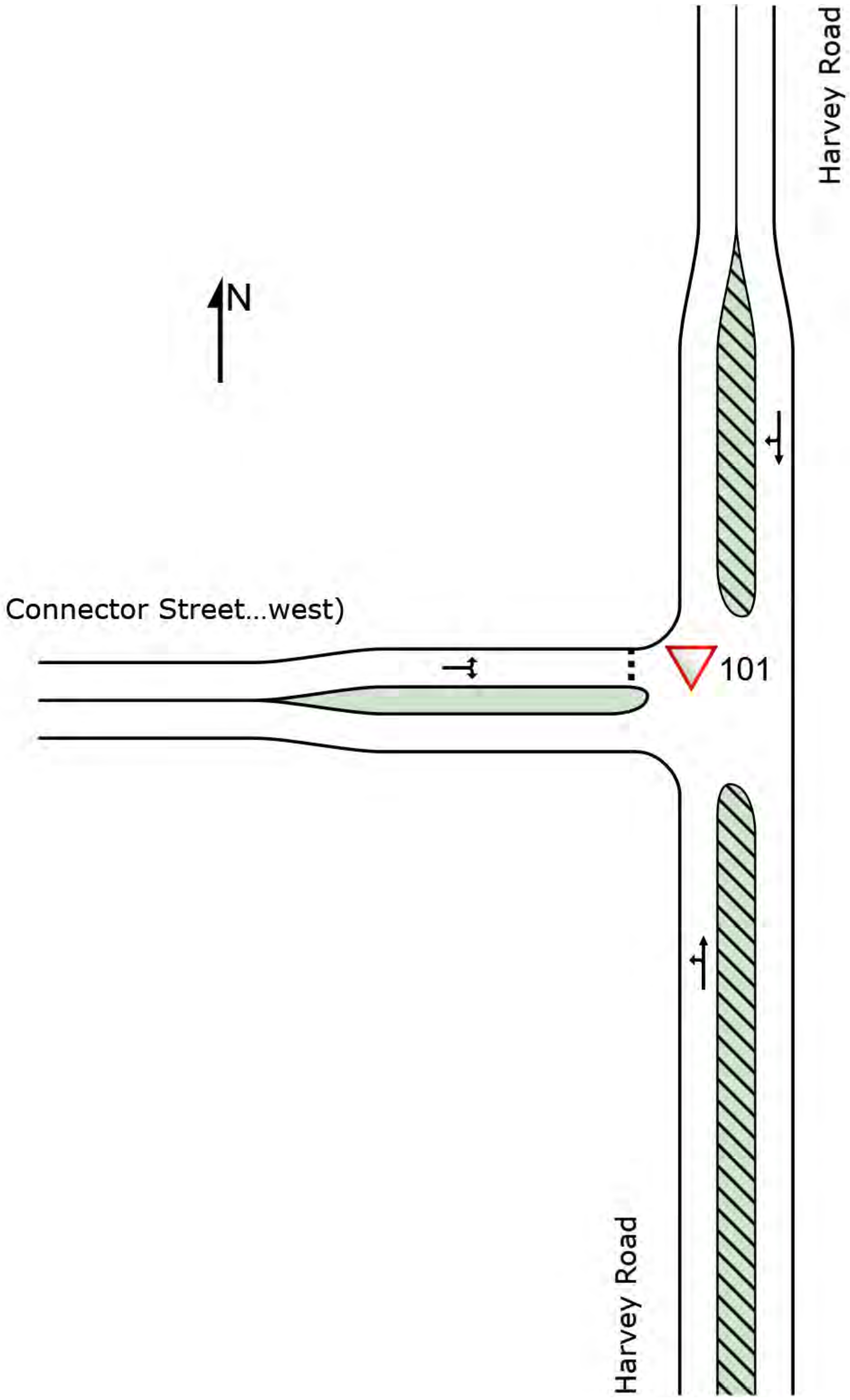
See the Timing Analysis report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Minor Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Site: 101 [Ultimate_Harvey-Connector west_AM (Site Folder: General)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Site Layout

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Harvey Road															
Lane 1	343	3.0	343	3.0	1912	0.179	100	0.5	LOS A	0.0	0.0	Full	10	0.0	0.0
Approach	343	3.0	343	3.0		0.179		0.5	NA	0.0	0.0				
North: Harvey Road															
Lane 1	179	3.0	179	3.0	1749	0.102	100	1.6	LOS A	0.3	1.9	Full	500	0.0	0.0
Approach	179	3.0	179	3.0		0.102		1.6	NA	0.3	1.9				
West: Connector Street (west)															
Lane 1	380	3.0	380	3.0	903	0.421	100	8.7	LOS A	2.4	16.9	Full	500	0.0	0.0
Approach	380	3.0	380	3.0		0.421		8.7	LOS A	2.4	16.9				
All Vehicles	902	3.0	902	3.0		0.421		4.2	NA	2.4	16.9				

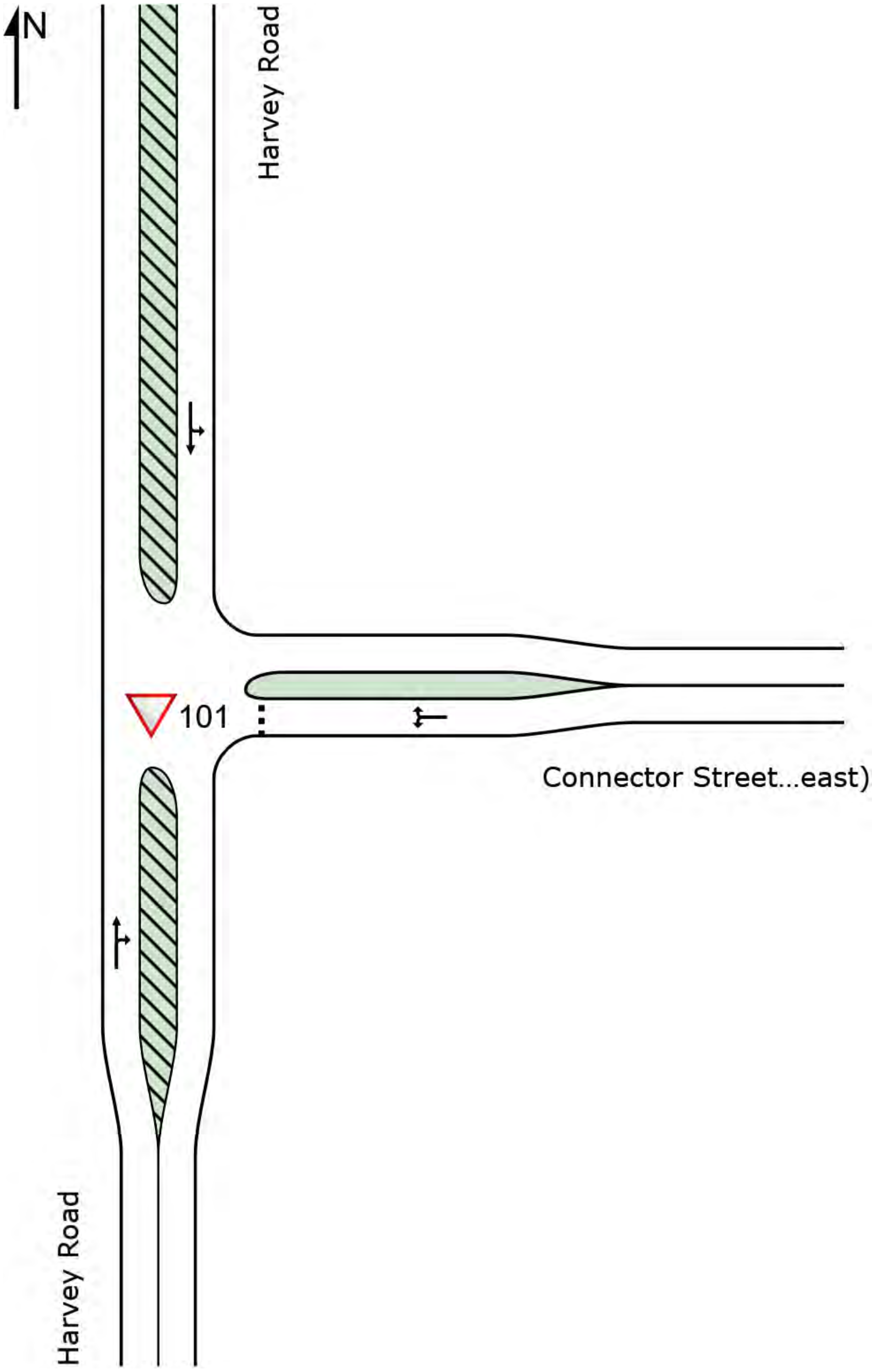
Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Two-Way Sign Control Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

Site: 101 [Ultimate_Harvey-Connector east_AM (Site Folder: General)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Site Layout

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



Lane Use and Performance

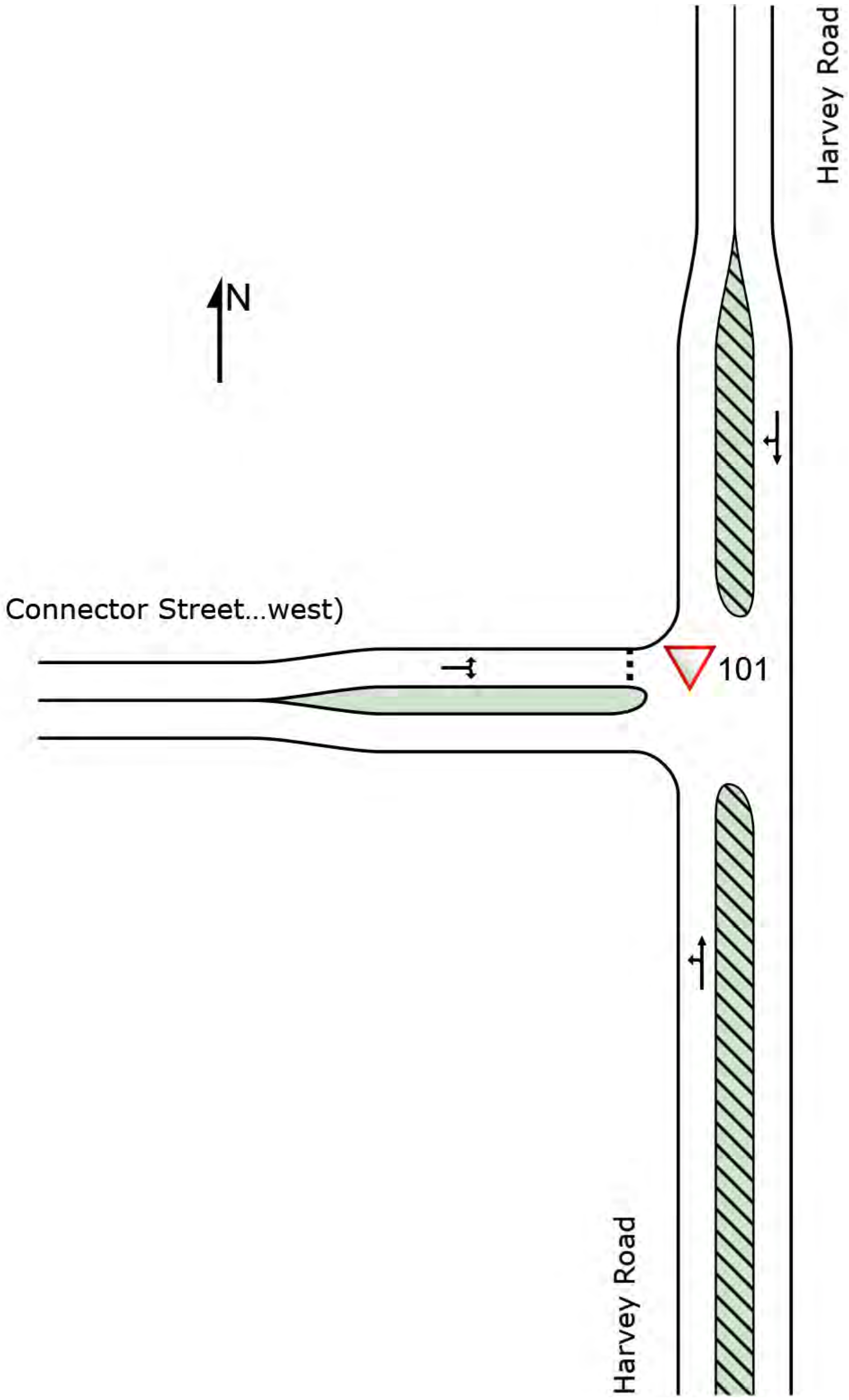
	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Harvey Road															
Lane 1	301	3.0	301	3.0	1842	0.163	100	0.7	LOS A	0.2	1.5	Full	500	0.0	0.0
Approach	301	3.0	301	3.0		0.163		0.7	NA	0.2	1.5				
East: Connector Street (east)															
Lane 1	154	3.0	154	3.0	851	0.181	100	8.1	LOS A	0.7	4.8	Full	500	0.0	0.0
Approach	154	3.0	154	3.0		0.181		8.1	LOS A	0.7	4.8				
North: Harvey Road															
Lane 1	394	3.0	394	3.0	1924	0.205	100	0.2	LOS A	0.0	0.0	Full	10	0.0	0.0
Approach	394	3.0	394	3.0		0.205		0.2	NA	0.0	0.0				
All Vehicles	848	3.0	848	3.0		0.205		1.8	NA	0.7	4.8				

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Two-Way Sign Control Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

New Site
Site Category: (None)
Give-Way (Two-Way)

Site Layout

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



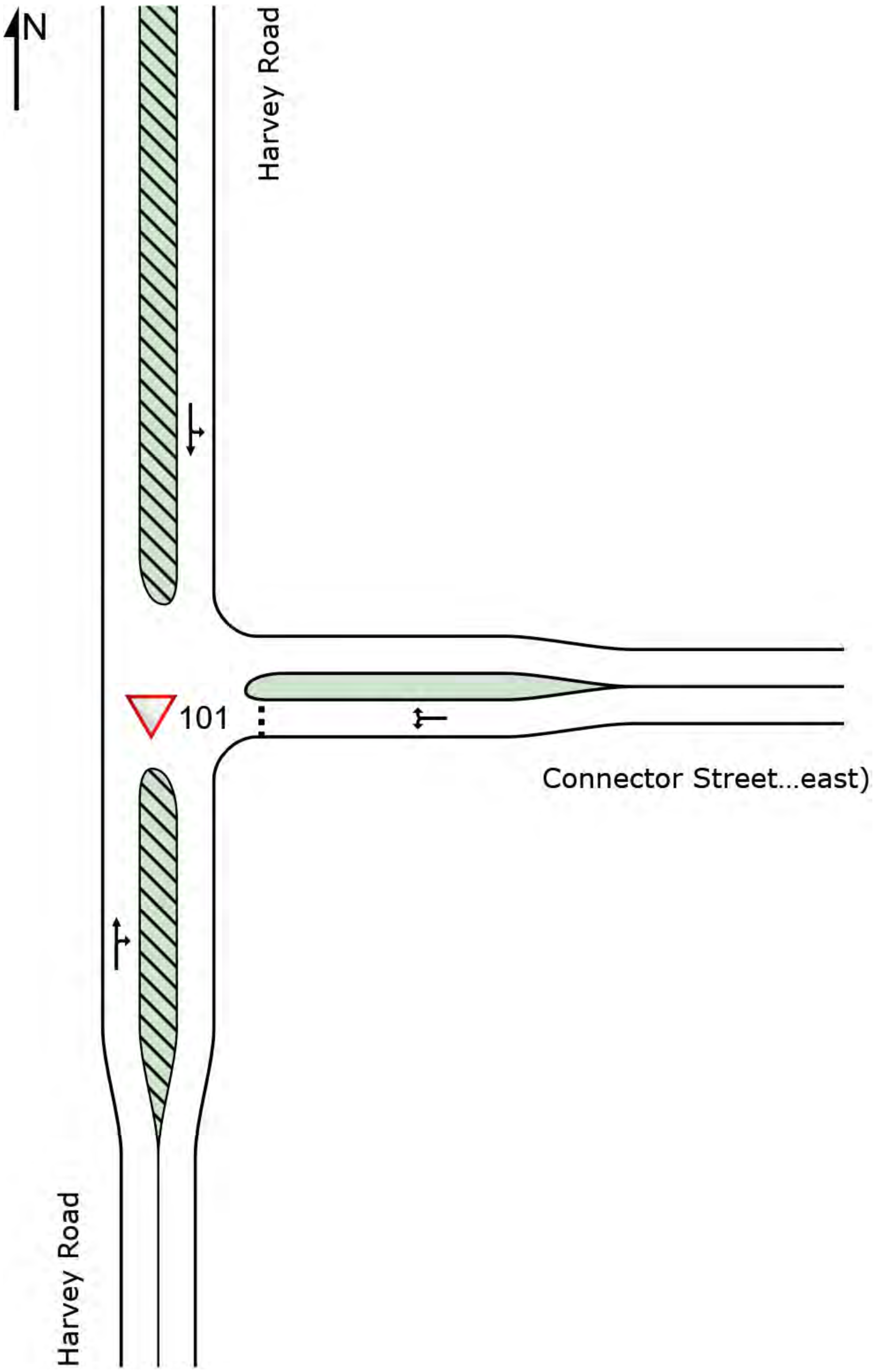
Lane Use and Performance															
	Demand Flows [Total	HV]	Arrival Flows [Total	HV]	Cap.	Deg. Satn	Lane Util.	Aver. Delay	Level of Service	Aver. Back Of Queue [Veh	Dist]	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Harvey Road															
Lane 1	343	3.0	343	3.0	1912	0.179	100	0.5	LOS A	0.0	0.0	Full	10	0.0	0.0
Approach	343	3.0	343	3.0		0.179		0.5	NA	0.0	0.0				
North: Harvey Road															
Lane 1	179	3.0	179	3.0	1749	0.102	100	1.6	LOS A	0.1	0.8	Full	500	0.0	0.0
Approach	179	3.0	179	3.0		0.102		1.6	NA	0.1	0.8				
West: Connector Street (west)															
Lane 1	380	3.0	380	3.0	903	0.421	100	8.7	LOS A	0.9	6.8	Full	500	0.0	0.0
Approach	380	3.0	380	3.0		0.421		8.7	LOS A	0.9	6.8				
All Vehicles	902	3.0	902	3.0		0.421		4.2	NA	0.9	6.8				

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Override Site Data tab).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Two-Way Sign Control Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

New Site
Site Category: (None)
Give-Way (Two-Way)

Site Layout

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



Lane Use and Performance

	Demand Flows [Total	HV]	Arrival Flows [Total	HV]	Cap.	Deg. Satn	Lane Util.	Aver. Delay	Level of Service	Aver. Back Of Queue [Veh	Dist]	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Harvey Road															
Lane 1	301	3.0	301	3.0	1842	0.163	100	0.7	LOS A	0.1	0.6	Full	500	0.0	0.0
Approach	301	3.0	301	3.0		0.163		0.7	NA	0.1	0.6				
East: Connector Street (east)															
Lane 1	154	3.0	154	3.0	851	0.181	100	8.1	LOS A	0.3	1.9	Full	500	0.0	0.0
Approach	154	3.0	154	3.0		0.181		8.1	LOS A	0.3	1.9				
North: Harvey Road															
Lane 1	394	3.0	394	3.0	1924	0.205	100	0.2	LOS A	0.0	0.0	Full	10	0.0	0.0
Approach	394	3.0	394	3.0		0.205		0.2	NA	0.0	0.0				
All Vehicles	848	3.0	848	3.0		0.205		1.8	NA	0.3	1.9				

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Override Site Data tab).

Lane LOS values are based on average delay per lane.

Minor Road Approach LOS values are based on average delay for all lanes.

NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).

Two-Way Sign Control Capacity Model: SIDRA Standard.

Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).

Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.

Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

Site: 101 [Ultimate_Harvey-Connector west_PM (Site Folder: General)]

Network: 2 [PM_Staggered intersection (Network Folder: General)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Site Layout

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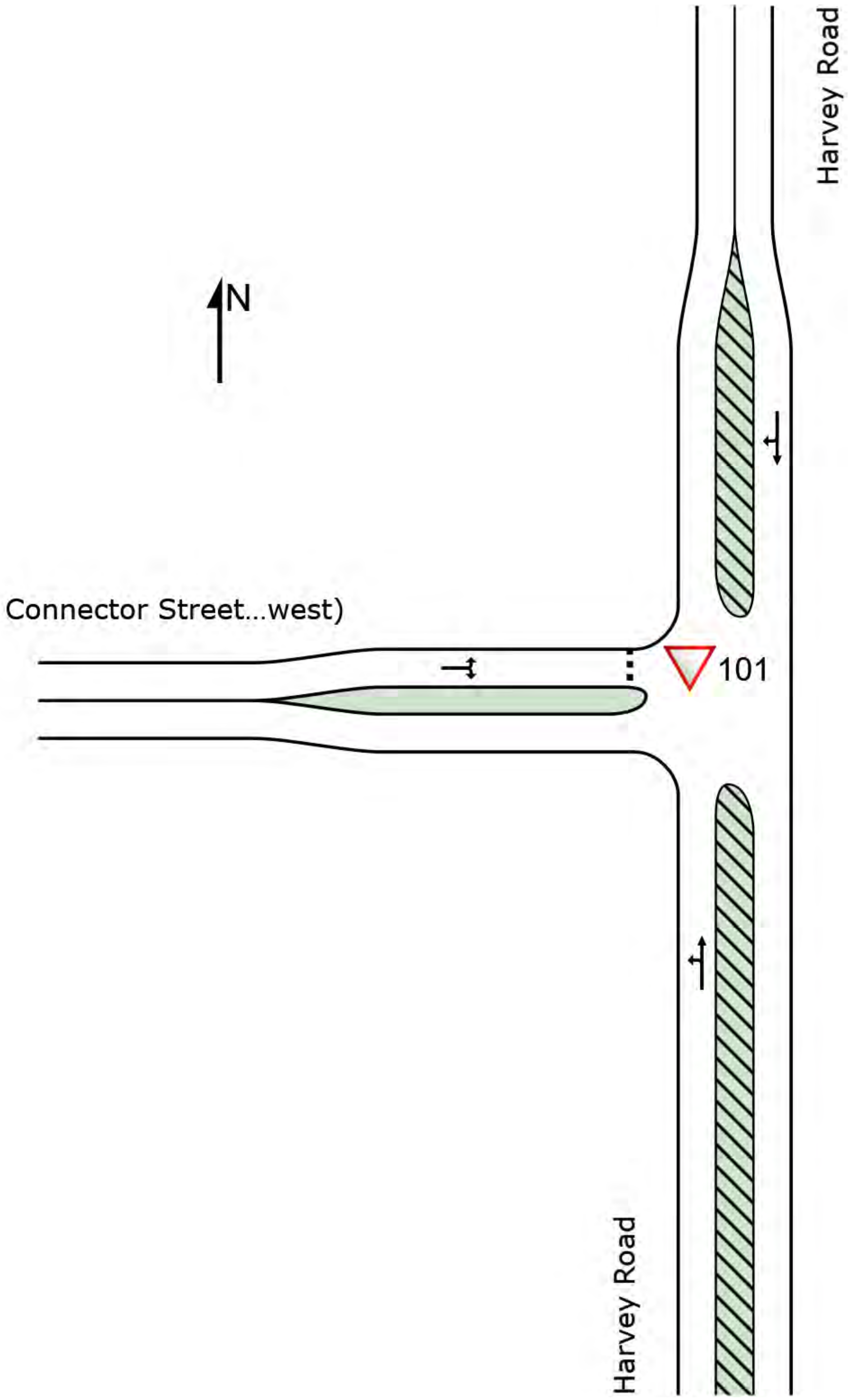


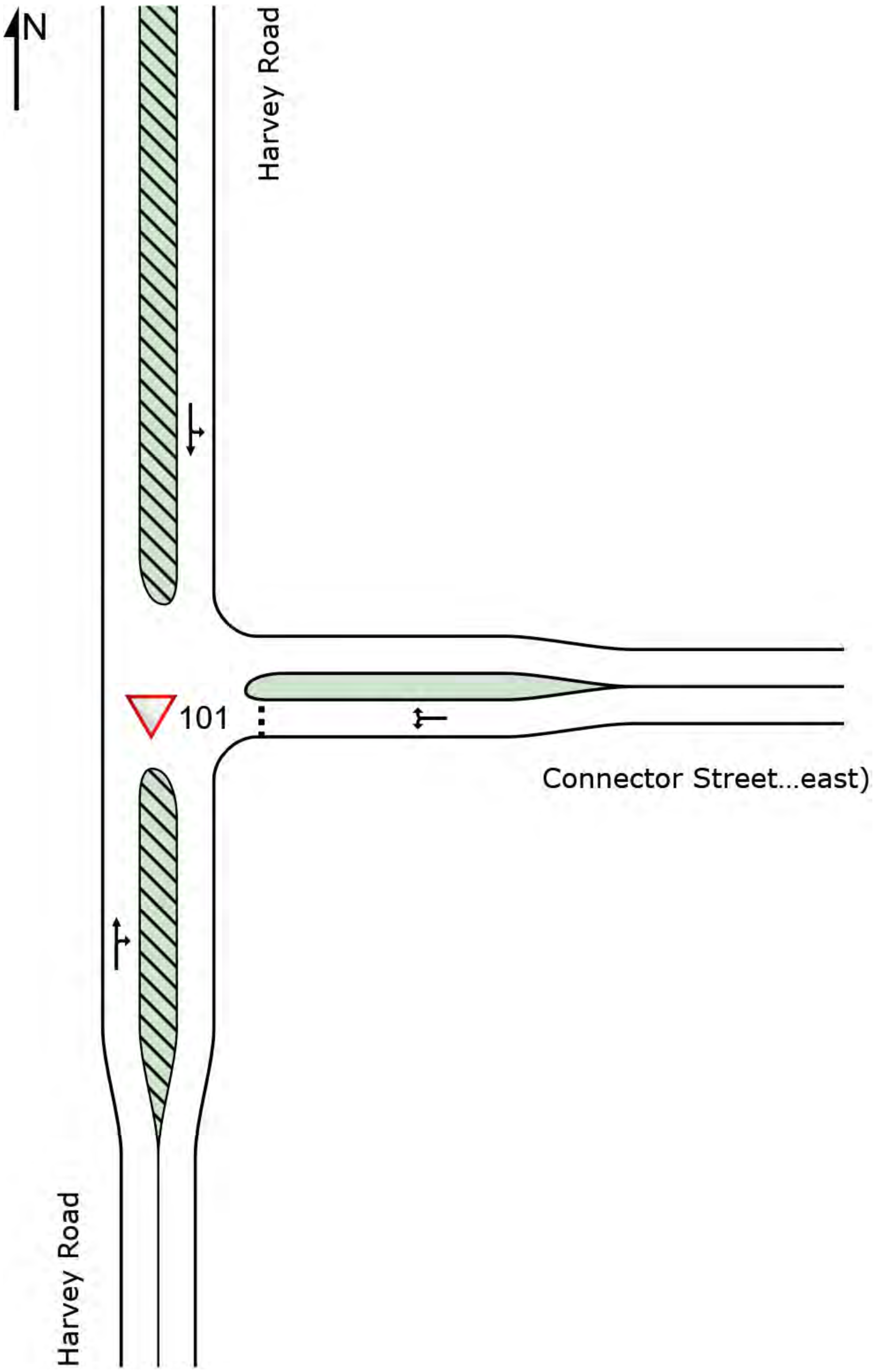
Lane Use and Performance															
	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Aver. Delay	Level of Service	Aver. Back Of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	[Total	HV]	[Total	HV]						[Veh	Dist]				
	veh/h	%	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Harvey Road															
Lane 1	374	3.0	374	3.0	1877	0.199	100	1.3	LOS A	0.0	0.0	Full	10	0.0	0.0
Approach	374	3.0	374	3.0		0.199		1.3	NA	0.0	0.0				
North: Harvey Road															
Lane 1	363	3.0	363	3.0	1615	0.225	100	2.9	LOS A	0.4	2.7	Full	500	0.0	0.0
Approach	363	3.0	363	3.0		0.225		2.9	NA	0.4	2.7				
West: Connector Street (west)															
Lane 1	146	3.0	146	3.0	810	0.181	100	8.2	LOS A	0.3	1.9	Full	500	0.0	0.0
Approach	146	3.0	146	3.0		0.181		8.2	LOS A	0.3	1.9				
All Vehicles	883	3.0	883	3.0		0.225		3.1	NA	0.4	2.7				

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Override Site Data tab).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Two-Way Sign Control Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

New Site
Site Category: (None)
Give-Way (Two-Way)

Site Layout

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



Lane Use and Performance															
	Demand Flows [Total	HV]	Arrival Flows [Total	HV]	Cap.	Deg. Satn	Lane Util.	Aver. Delay	Level of Service	Aver. Back Of Queue [Veh	Dist]	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Harvey Road															
Lane 1	411	3.0	411	3.0	1751	0.234	100	1.6	LOS A	0.3	1.9	Full	500	0.0	0.0
Approach	411	3.0	411	3.0		0.234		1.6	NA	0.3	1.9				
East: Connector Street (east)															
Lane 1	69	3.0	69	3.0	773	0.090	100	8.3	LOS A	0.1	0.9	Full	500	0.0	0.0
Approach	69	3.0	69	3.0		0.090		8.3	LOS A	0.1	0.9				
North: Harvey Road															
Lane 1	345	3.0	345	3.0	1916	0.180	100	0.4	LOS A	0.0	0.0	Full	10	0.0	0.0
Approach	345	3.0	345	3.0		0.180		0.4	NA	0.0	0.0				
All Vehicles	825	3.0	825	3.0		0.234		1.7	NA	0.3	1.9				

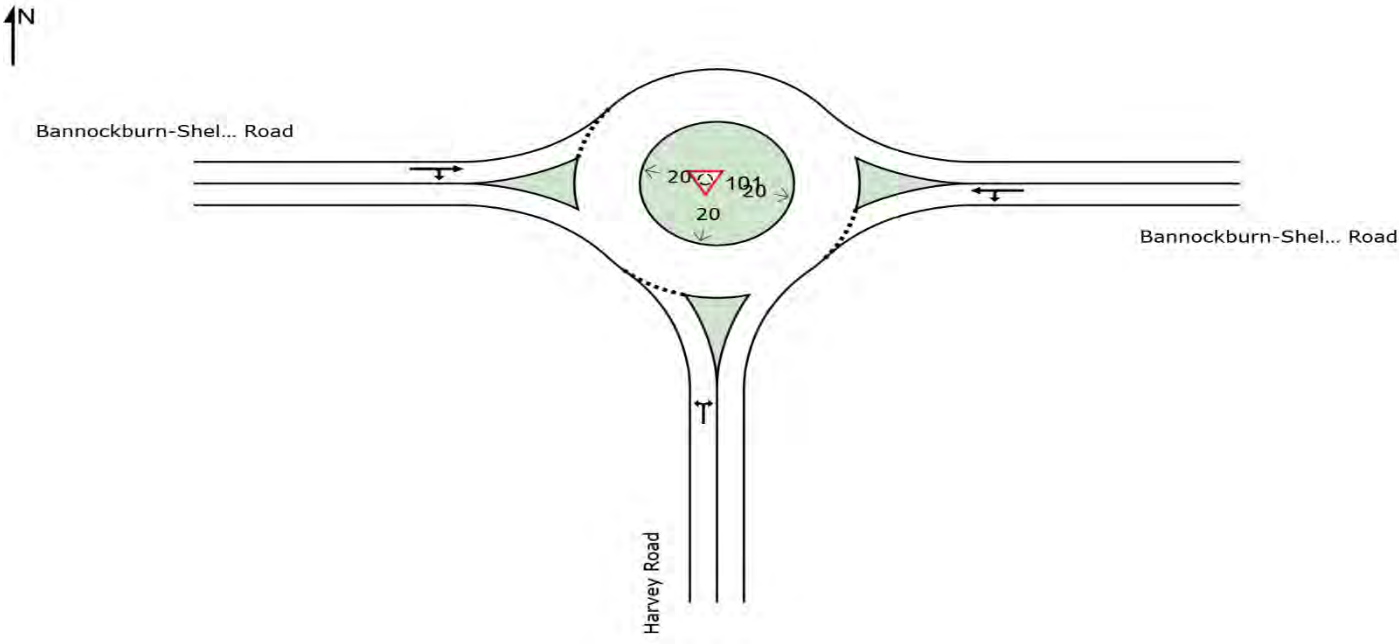
Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Override Site Data tab).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Two-Way Sign Control Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

Site: 101 [Interim_BS Rd-Harvey_AM - 1,000 lots - SOUTH only (Site Folder: General)]

New Site
Site Category: (None)
Roundabout

Site Layout

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Harvey Road															
Lane 1 d	713	3.0	713	3.0	946	0.753	100	16.9	LOS B	10.7	77.2	Full	500	0.0	0.0
Approach	713	3.0	713	3.0		0.753		16.9	LOS B	10.7	77.2				
East: Bannockburn-Shelford Road															
Lane 1 d	588	7.8	588	7.8	1441	0.408	100	4.4	LOS A	4.0	29.8	Full	500	0.0	0.0
Approach	588	7.8	588	7.8		0.408		4.4	LOS A	4.0	29.8				
West: Bannockburn-Shelford Road															
Lane 1 d	546	9.4	546	9.4	654	0.835	100	23.9	LOS C	13.9	104.9	Full	500	0.0	0.0
Approach	546	9.4	546	9.4		0.835		23.9	LOS C	13.9	104.9				
All Vehicles	1847	6.4	1847	6.4		0.835		15.0	LOS B	13.9	104.9				

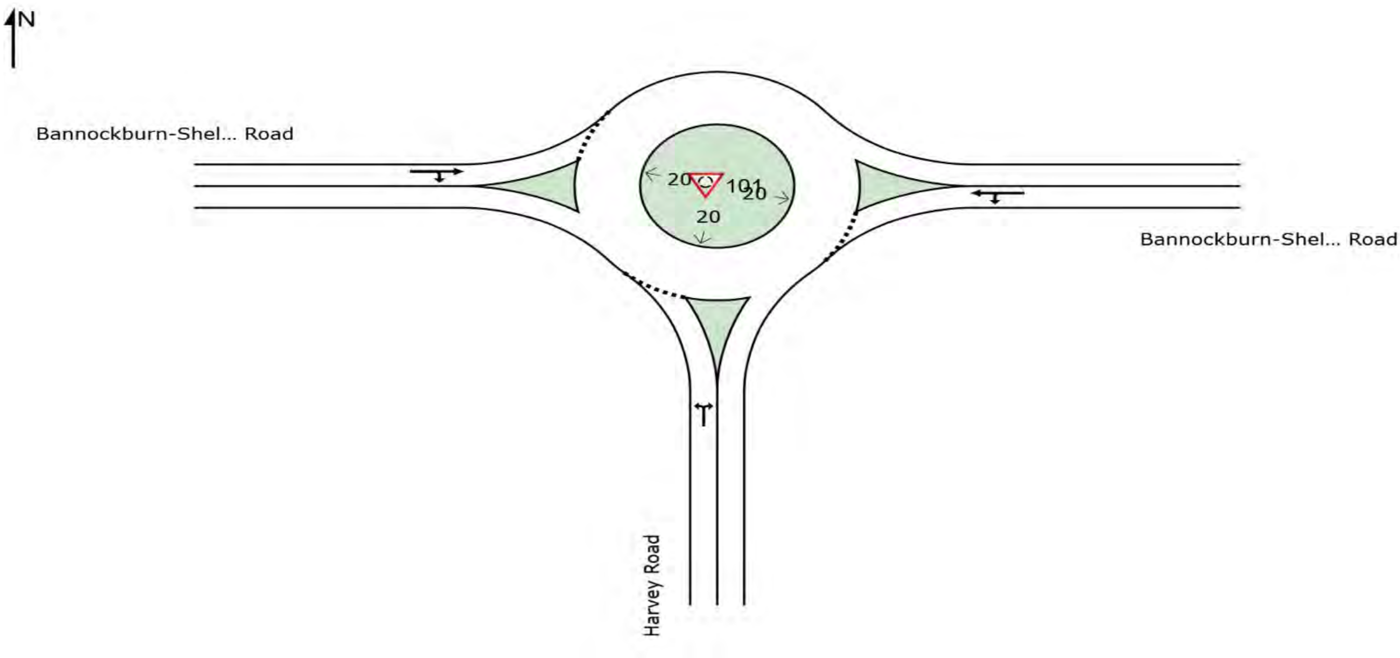
Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.
d Dominant lane on roundabout approach

Site: 101 [Interim_BS Rd-Harvey_PM - 1,000 lots - SOUTH only (Site Folder: General)]

New Site
Site Category: (None)
Roundabout

Site Layout

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



Lane Use and Performance

	Demand Flows [Total	HV]	Arrival Flows [Total	HV]	Cap.	Deg. Satn	Lane Util.	Aver. Delay	Level of Service	95% Back Of Queue [Veh	Dist]	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Harvey Road															
Lane 1 d	295	3.0	295	3.0	809	0.364	100	11.9	LOS B	2.6	18.9	Full	500	0.0	0.0
Approach	295	3.0	295	3.0		0.364		11.9	LOS B	2.6	18.9				
East: Bannockburn-Shelford Road															
Lane 1 d	1025	6.4	1025	6.4	1390	0.738	100	5.2	LOS A	11.0	81.3	Full	500	0.0	0.0
Approach	1025	6.4	1025	6.4		0.738		5.2	LOS A	11.0	81.3				
West: Bannockburn-Shelford Road															
Lane 1 d	494	8.8	494	8.8	1043	0.473	100	7.1	LOS A	4.0	29.9	Full	500	0.0	0.0
Approach	494	8.8	494	8.8		0.473		7.1	LOS A	4.0	29.9				
All Vehicles	1814	6.5	1814	6.5		0.738		6.8	LOS A	11.0	81.3				

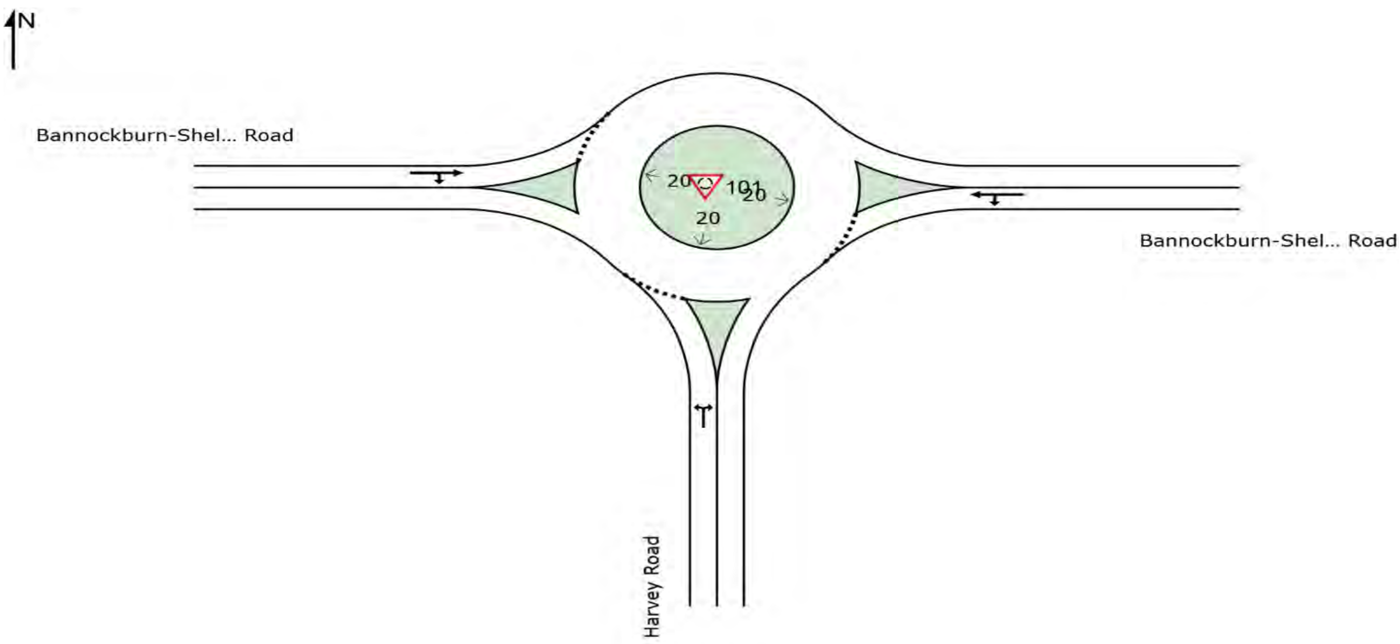
Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.
d Dominant lane on roundabout approach

Site: 101 [Interim_BS Rd-Harvey_AM - 1,050 total lots (Site Folder: General)]

New Site
Site Category: (None)
Roundabout

Site Layout

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



Lane Use and Performance

	Demand Flows [Total	HV]	Arrival Flows [Total	HV]	Cap.	Deg. Satn	Lane Util.	Aver. Delay	Level of Service	95% Back Of Queue [Veh	Dist]	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Harvey Road															
Lane 1 d	421	3.0	421	3.0	914	0.461	100	11.3	LOS B	3.5	24.9	Full	500	0.0	0.0
Approach	421	3.0	421	3.0		0.461		11.3	LOS B	3.5	24.9				
East: Bannockburn-Shelford Road															
Lane 1 d	521	8.5	521	8.5	1274	0.409	100	4.9	LOS A	3.7	28.0	Full	500	0.0	0.0
Approach	521	8.5	521	8.5		0.409		4.9	LOS A	3.7	28.0				
West: Bannockburn-Shelford Road															
Lane 1 d	808	9.1	808	9.1	959	0.843	100	16.0	LOS B	16.4	123.4	Full	500	0.0	0.0
Approach	808	9.1	808	9.1		0.843		16.0	LOS B	16.4	123.4				
All Vehicles	1751	7.5	1751	7.5		0.843		11.6	LOS B	16.4	123.4				

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
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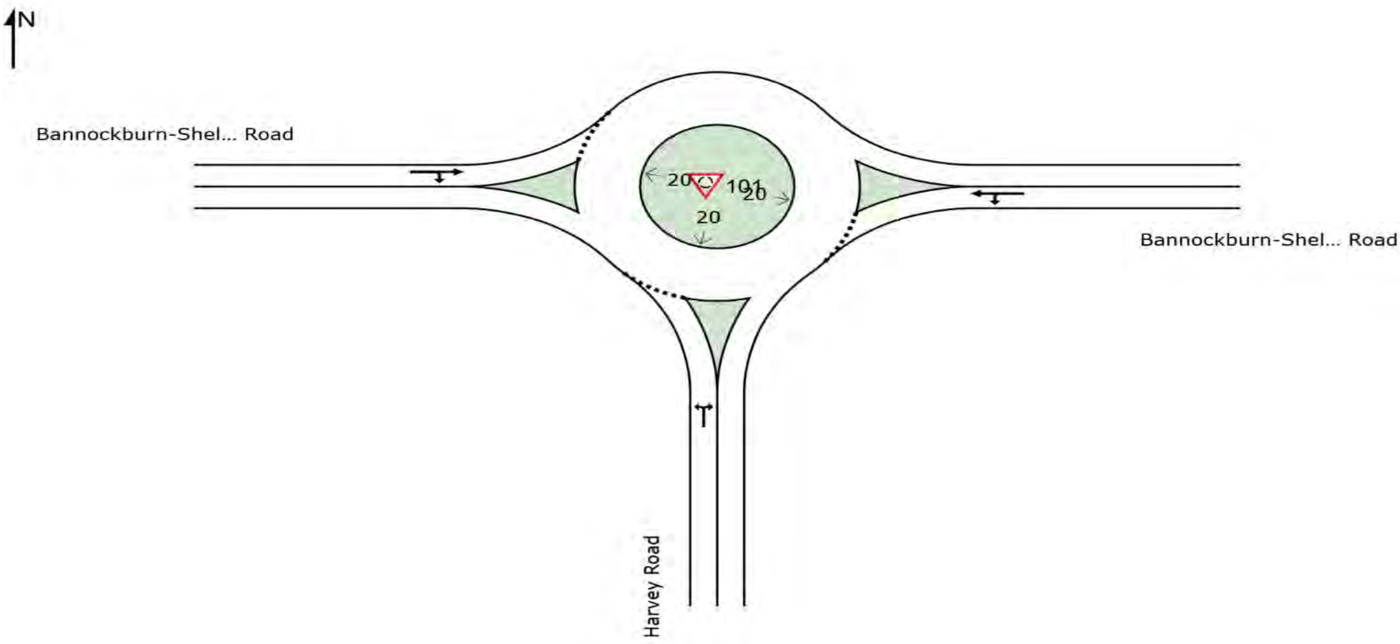
Intersection and Approach LOS values are based on average delay for all lanes.
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.
d Dominant lane on roundabout approach

Site: 101 [Interim_BS Rd-Harvey_PM - 1,050 total lots (Site Folder: General)]

New Site
Site Category: (None)
Roundabout

Site Layout

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



Lane Use and Performance

	Demand Flows [Total	HV]	Arrival Flows [Total	HV]	Cap.	Deg. Satn	Lane Util.	Aver. Delay	Level of Service	95% Back Of Queue [Veh	Dist]	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Harvey Road															
Lane 1 d	237	3.0	237	3.0	699	0.339	100	12.2	LOS B	2.4	17.3	Full	500	0.0	0.0
Approach	237	3.0	237	3.0		0.339		12.2	LOS B	2.4	17.3				
East: Bannockburn-Shelford Road															
Lane 1 d	954	7.8	954	7.8	1400	0.681	100	5.0	LOS A	8.9	66.4	Full	500	0.0	0.0
Approach	954	7.8	954	7.8		0.681		5.0	LOS A	8.9	66.4				
West: Bannockburn-Shelford Road															
Lane 1 d	520	9.0	520	9.0	1193	0.436	100	6.1	LOS A	3.8	28.7	Full	500	0.0	0.0
Approach	520	9.0	520	9.0		0.436		6.1	LOS A	3.8	28.7				
All Vehicles	1711	7.5	1711	7.5		0.681		6.3	LOS A	8.9	66.4				

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Roundabout Capacity Model: SIDRA Standard.
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Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
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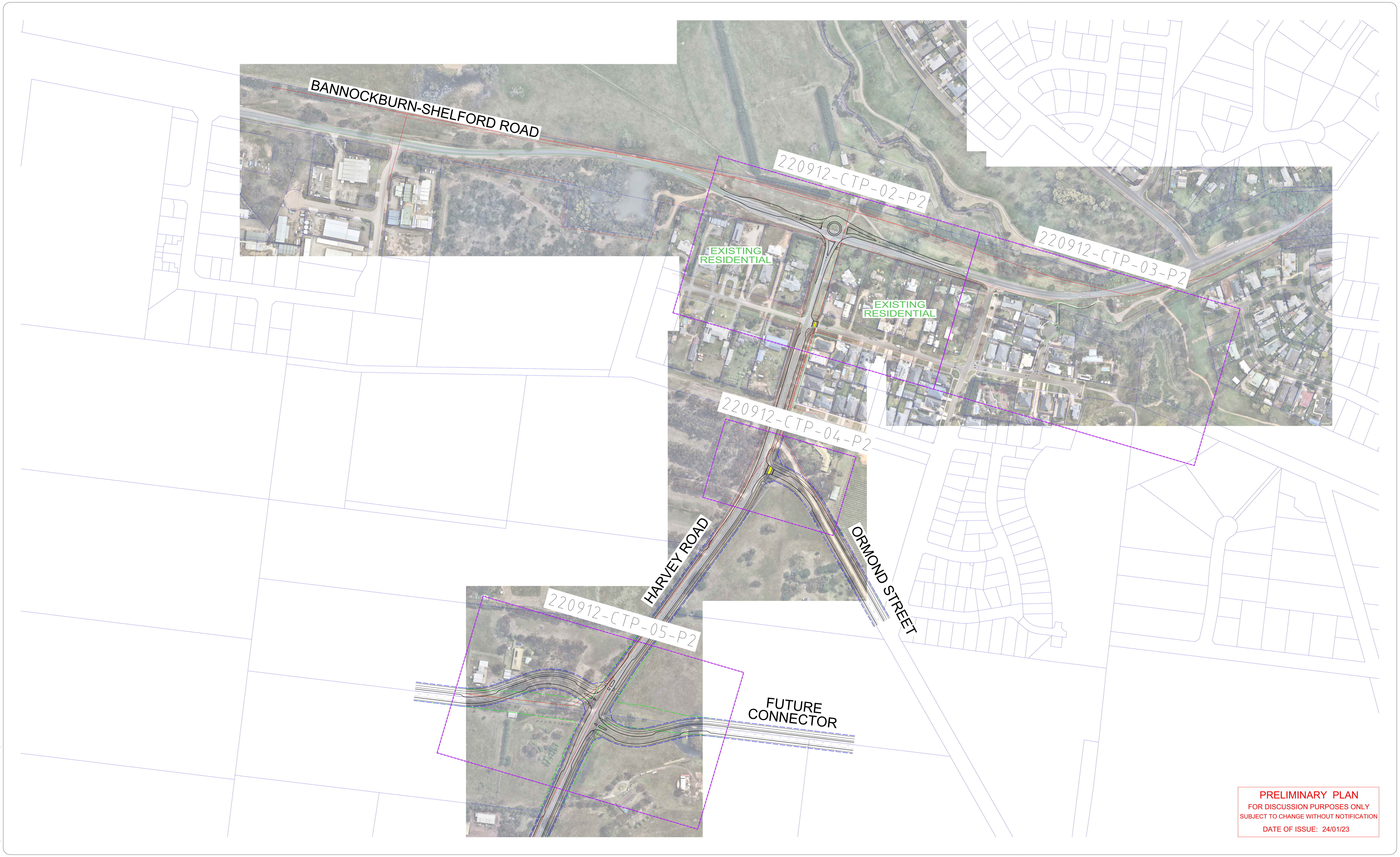
d Dominant lane on roundabout approach

Appendix 3 – Concept plans



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Drawing Record

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P2	JF	AA	24.01.23	PRELIMINARY ISSUE FOR COMMENT

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Notes & Legend

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2. ALL DIMENSIONS ARE TO FACE OF KERB UNLESS SHOWN OTHERWISE.

- Design by Trafficworks
- Cadastre
- Proposed ROW Boundary
- Existing
- Signalised Intersection Property Boundary

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N E S W
RACV VICROADS MAP 93 D2 BANNOCKBURN
SCALE OF METRES
0 50 100

Bannockburn Growth Plan
Golden Plains Shire Council
Key Plan

SHEET NO.	DRAWING NO.	ISSUE
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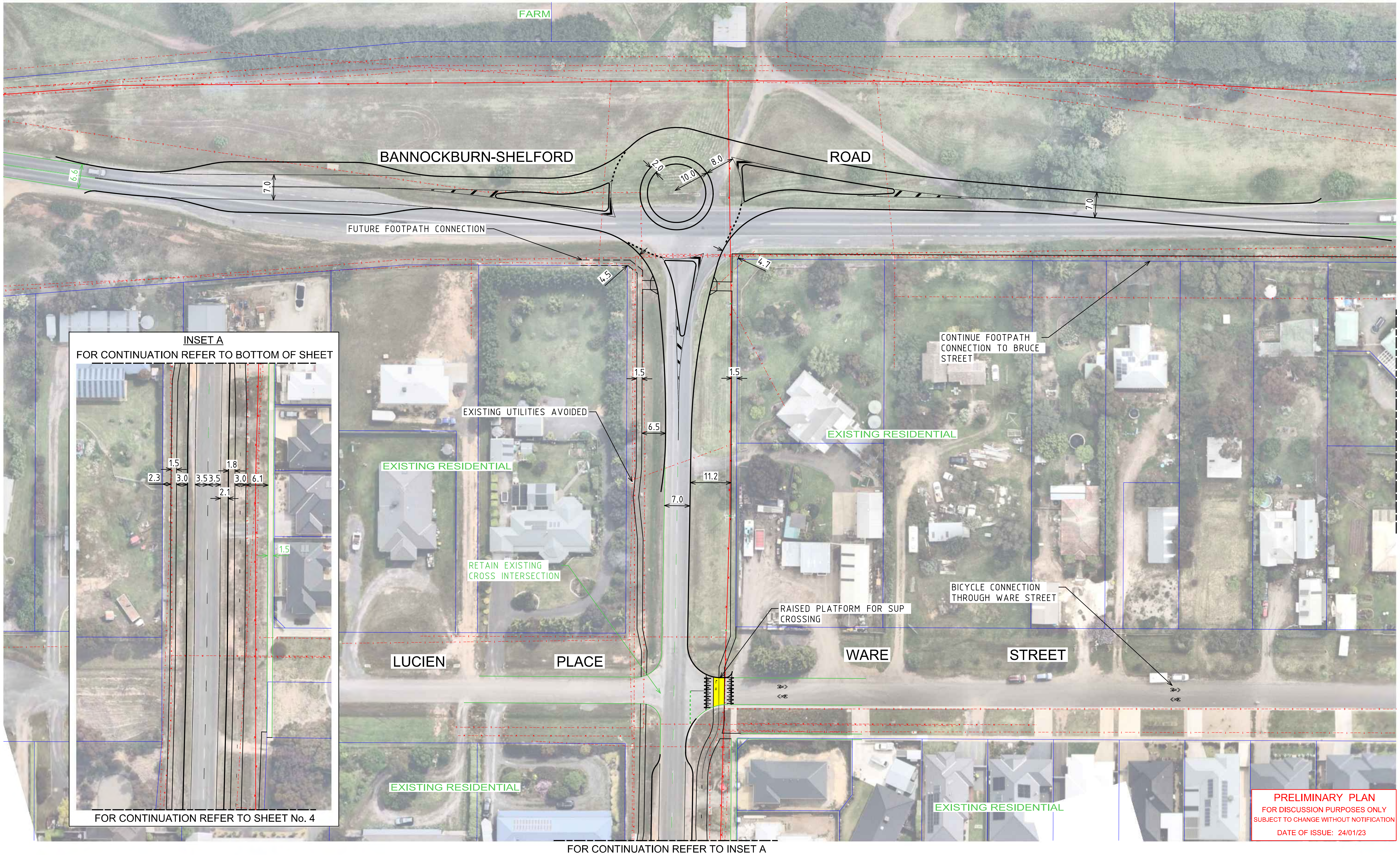

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- Existing
- Signalised Intersection Property Boundary

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N E S W
RACV VICROADS MAP 93 D2
BANNOCKBURN
SCALE OF METRES
0 10 20

Bannockburn Growth Plan

Golden Plains Shire Council

Concept Plan

SHEET NO.	DRAWING NO.	ISSUE
2	220912-CTP-02	P2

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- Signalised Intersection Property Boundary

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RACV VICROADS MAP 93 D2 BANNOCKBURN
SCALE OF METRES
0 10 20

Bannockburn Growth Plan

Golden Plains Shire Council

Concept Plan

SHEET NO.	DRAWING NO.	ISSUE
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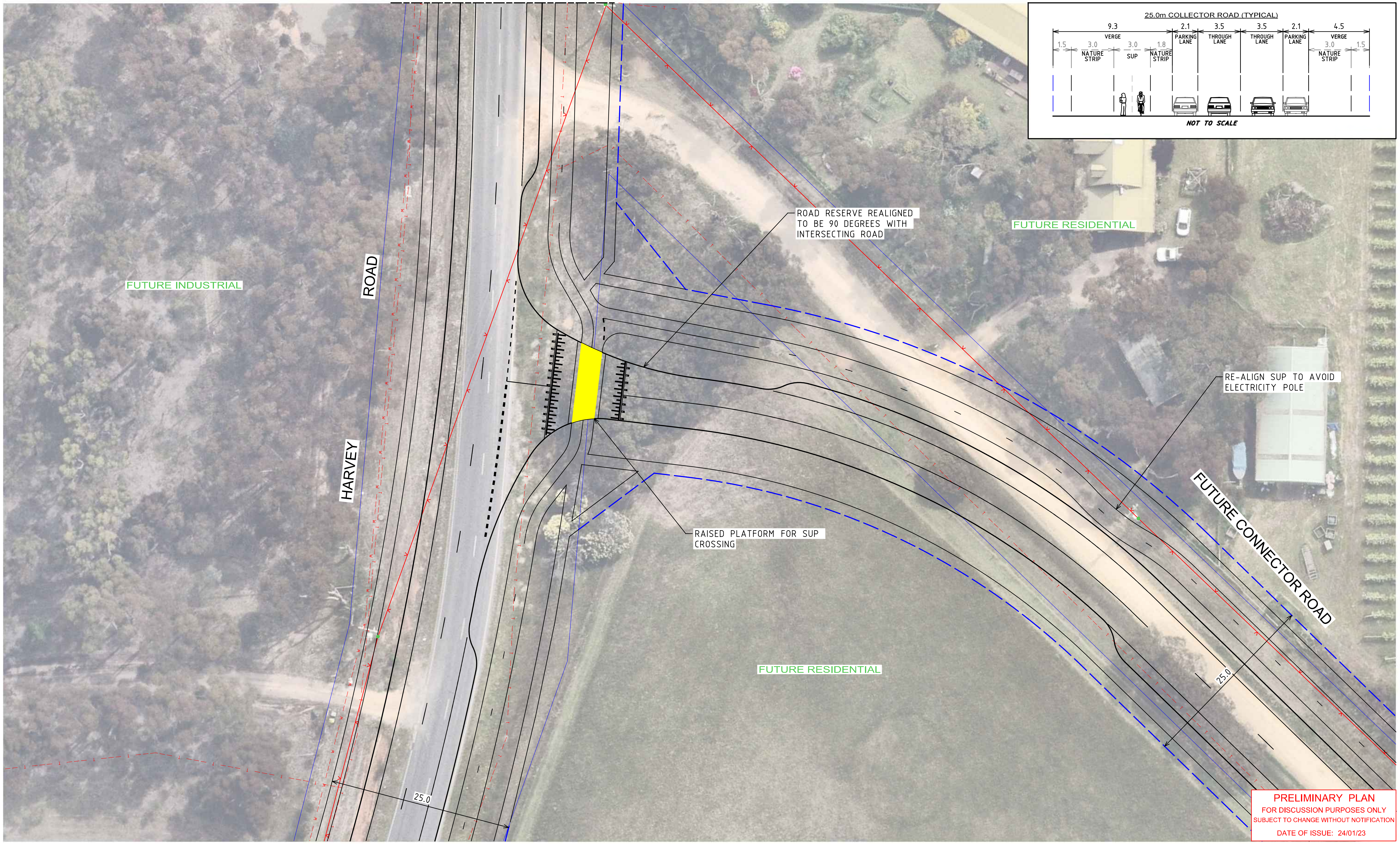
FOR CONTINUATION REFER TO SHEET No. 2



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- Cadastre
- Proposed ROW Boundary
- Existing
- Signalised Intersection Property Boundary

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RACV VICROADS
MAP 93 D2
BANNOCKBURN
SCALE OF METRES
0 5 10

Bannockburn Growth Plan
Golden Plains Shire Council
Concept Plan

SHEET NO.	DRAWING NO.	ISSUE
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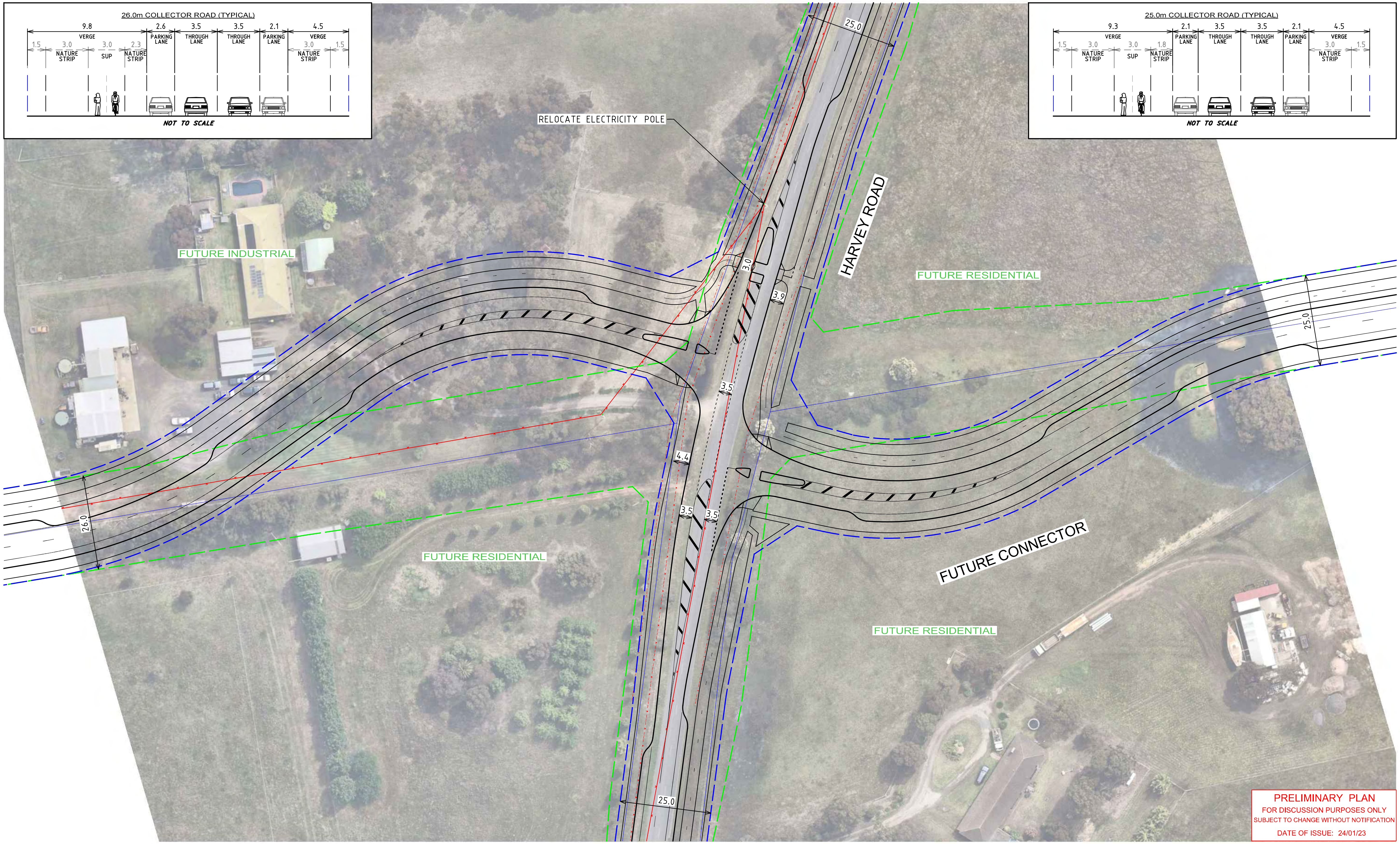

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- Cadastre
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- Existing
- Signalised Intersection Property Boundary

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RACV VICROADS MAP 93 D2 BANNOCKBURN
SCALE OF METRES
0 10 20

Bannockburn Growth Plan
Golden Plains Shire Council

Concept Plan

SHEET NO.	DRAWING NO.	ISSUE
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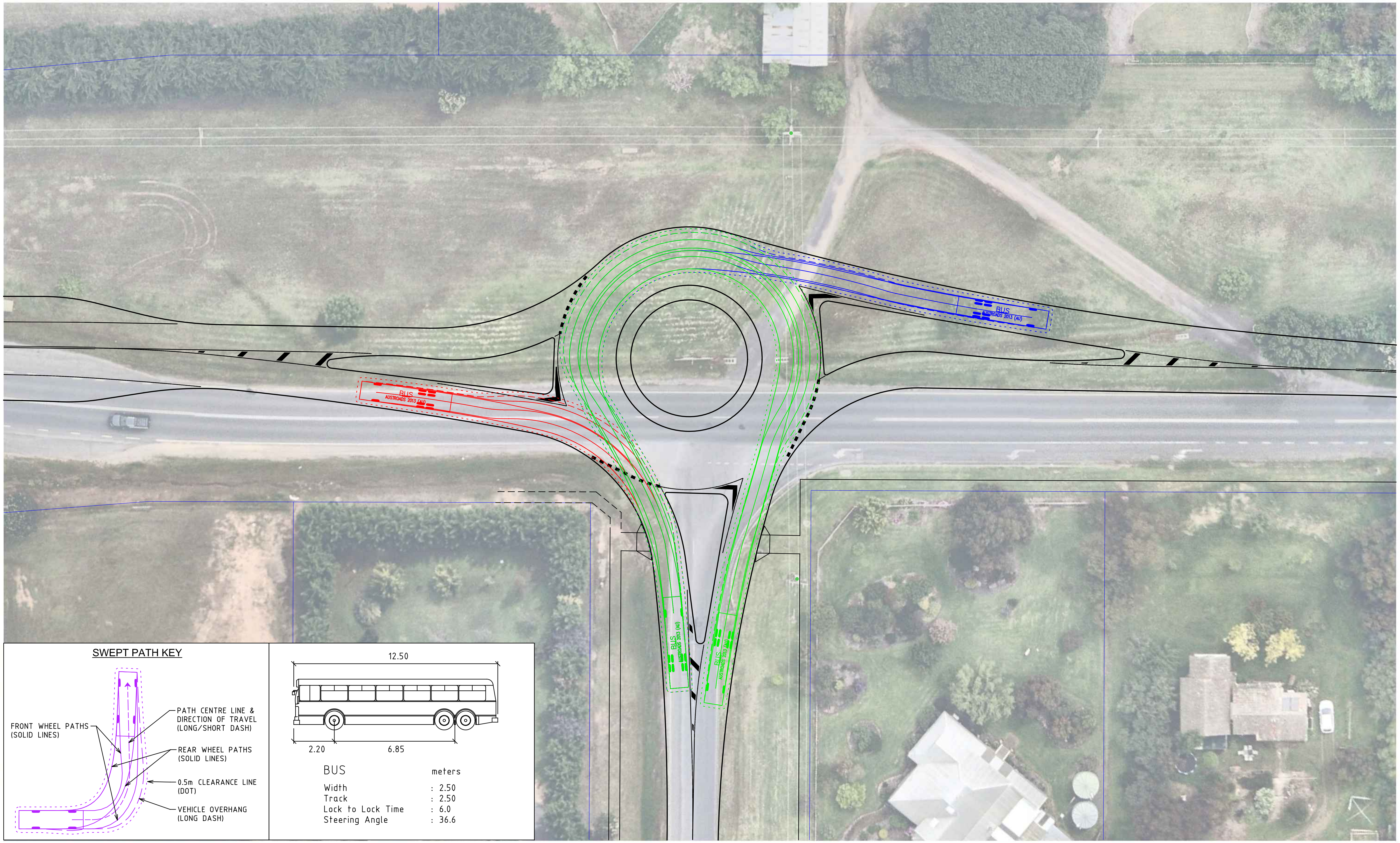
Appendix 4 – Swept path analysis



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SCALE OF METRES
0 5 10

Bannockburn Growth Plan

Golden Plains Shire Council

Swept Path Assessment

SHEET NO.	DRAWING NO.	ISSUE
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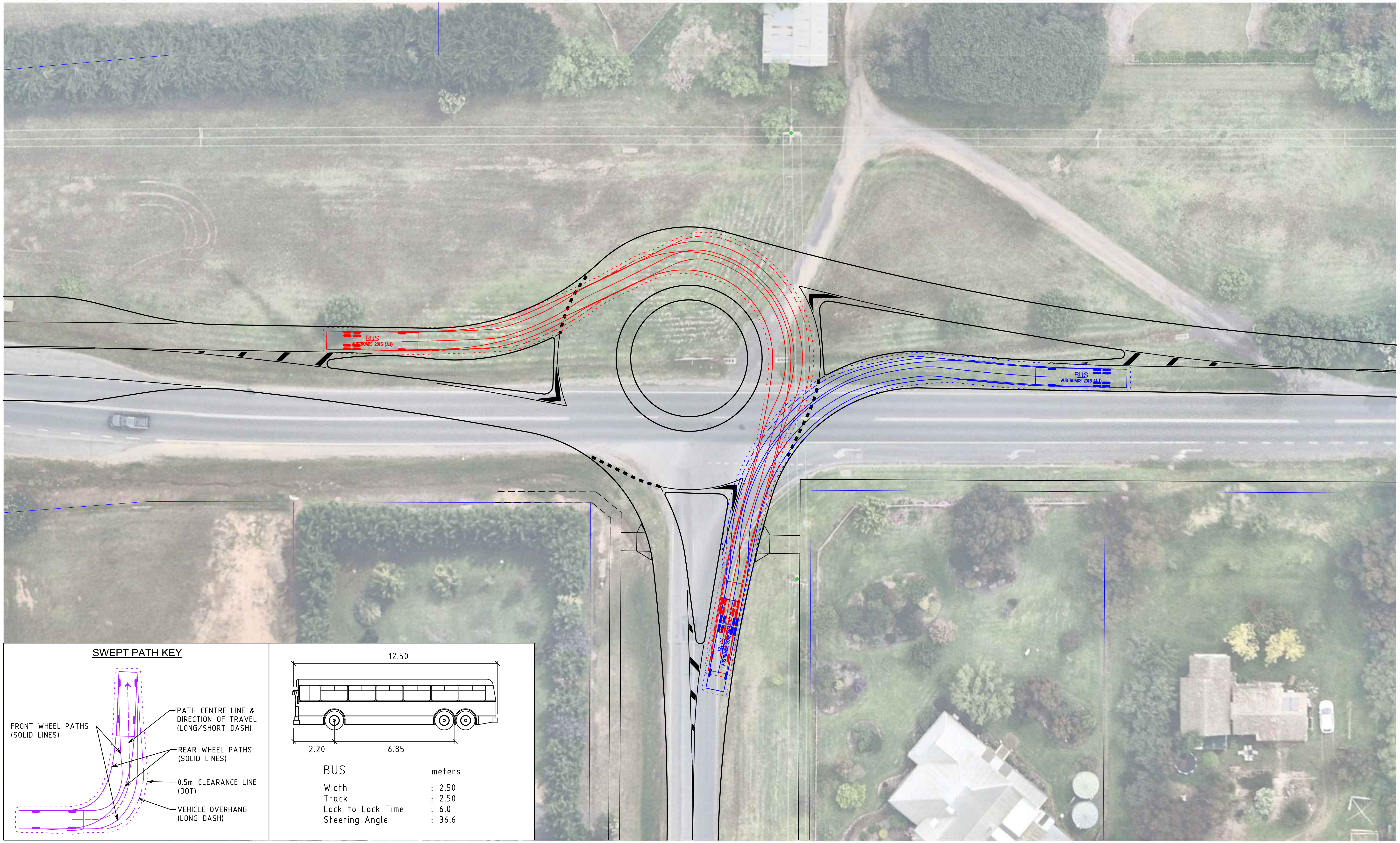

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MAPS 93 D2
BONNOCKBURN
SCALE OF METRES
0 5 10

Bannockburn Growth Plan

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Swept Path Assessment

SHEET NO.	DRAWING NO.	ISSUE
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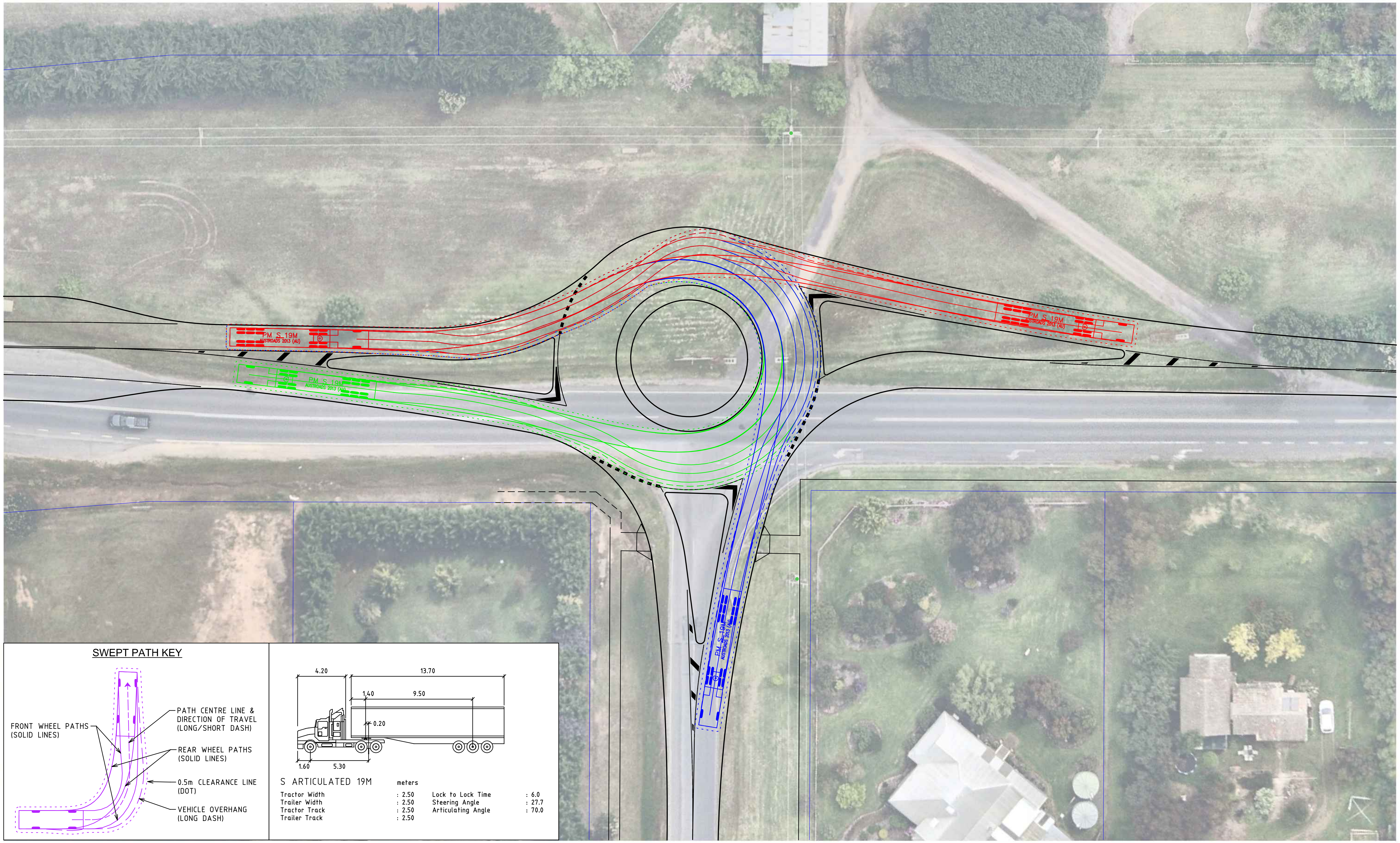

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BONNOCKBURN
SCALE OF METRES
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Bannockburn Growth Plan
Golden Plains Shire Council
Swept Path Assessment

SHEET NO.	DRAWING NO.	ISSUE
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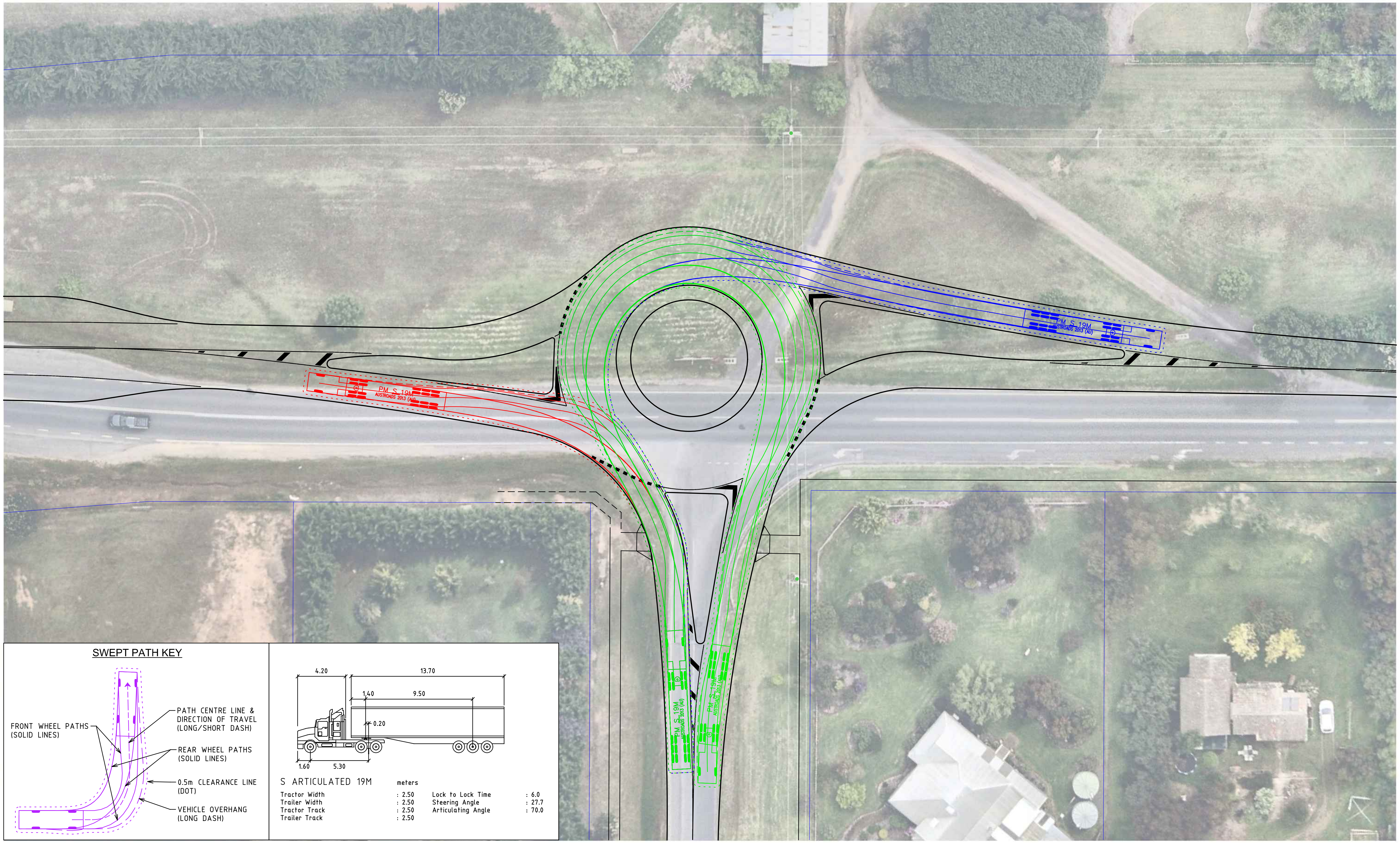

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BONNOCKBURN
SCALE OF METRES
0 5 10

Bannockburn Growth Plan
Golden Plains Shire Council

Swept Path Assessment

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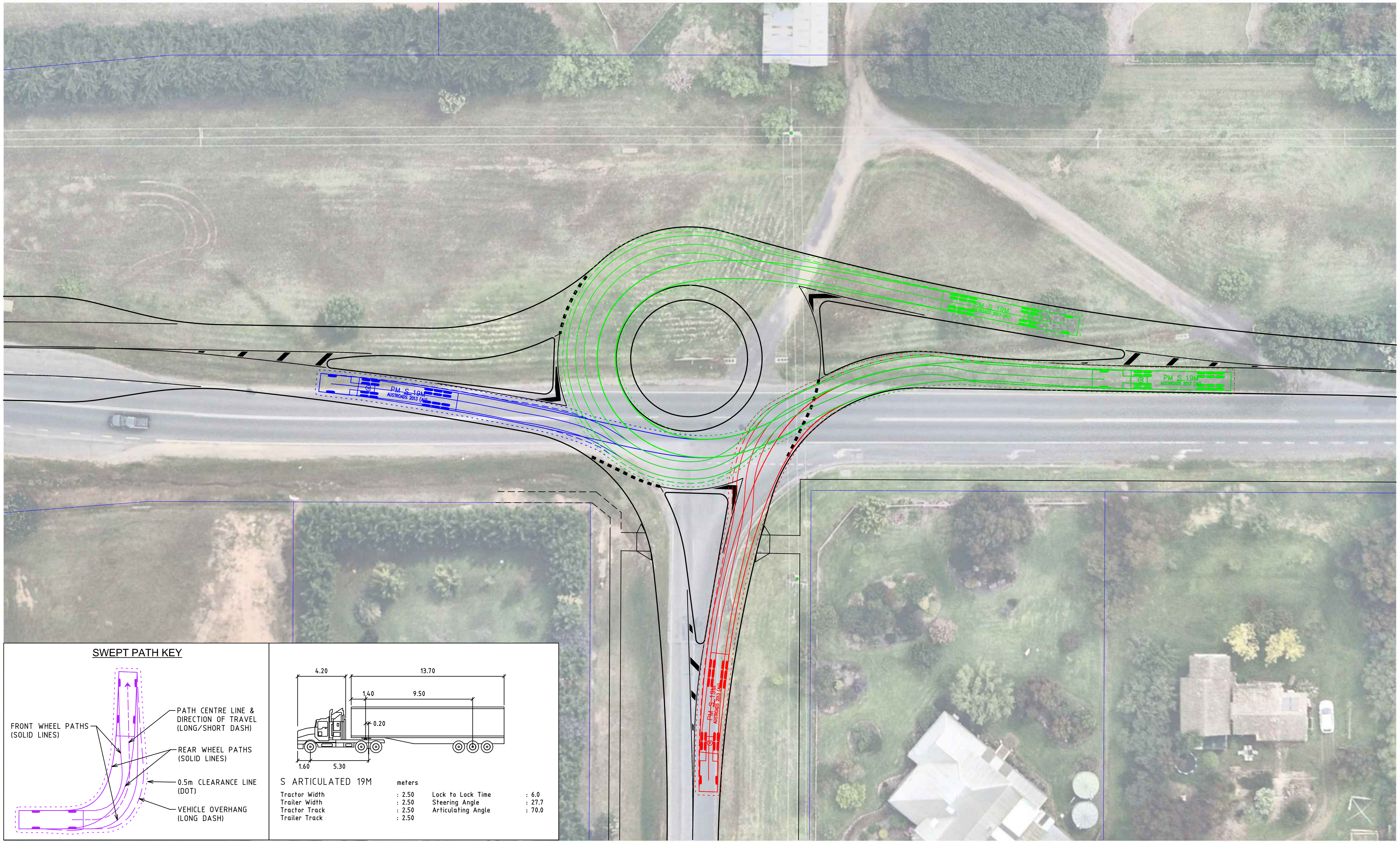

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SCALE OF METRES
0 5 10

Bannockburn Growth Plan

Golden Plains Shire Council

Swept Path Assessment

SHEET NO.	DRAWING NO.	ISSUE
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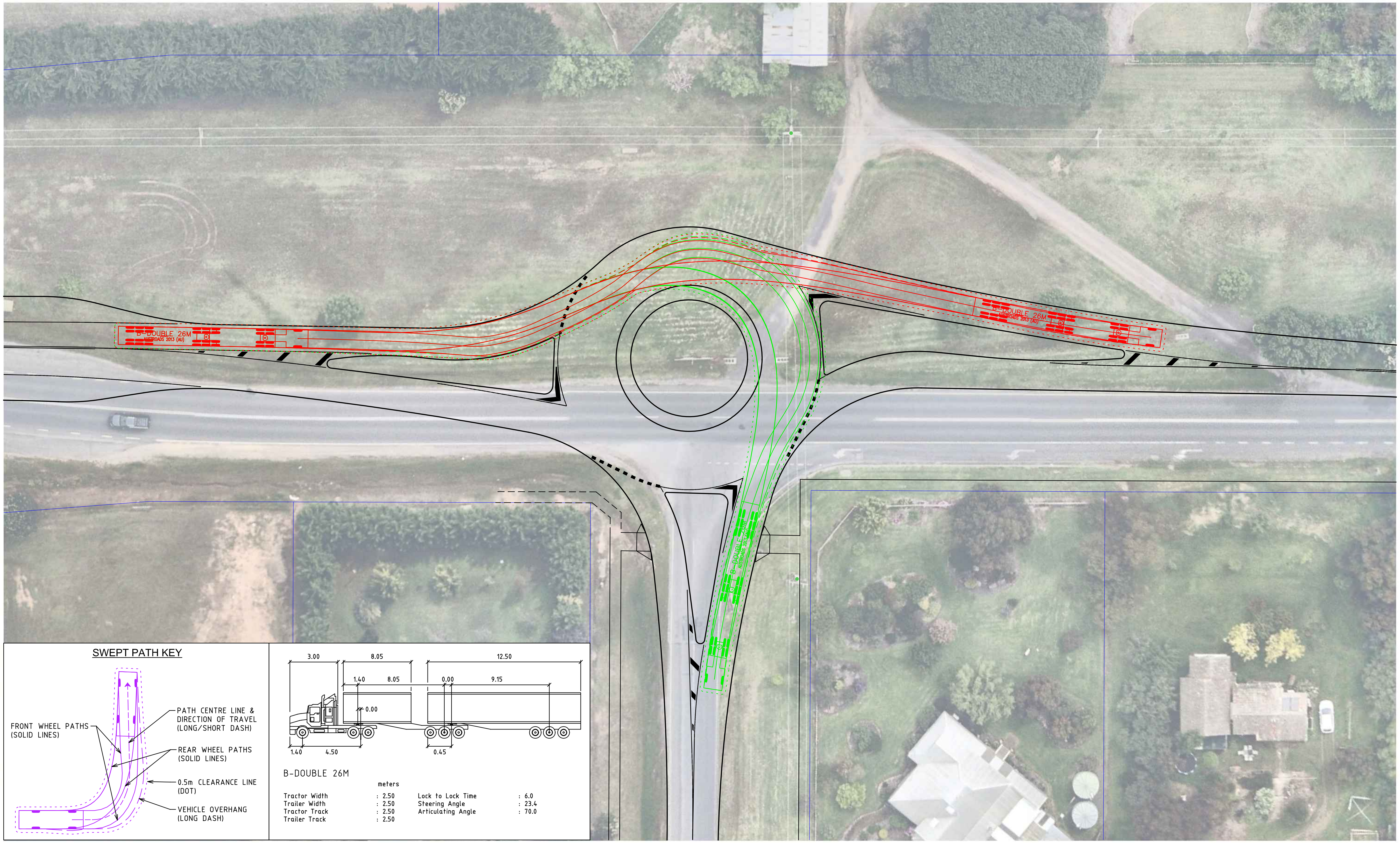

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- Cadastre
- Proposed ROW Boundary
- Existing

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RACV VICROADS MAPS 93 D2
BONNOCKBURN
SCALE OF METRES
0 5 10

Bannockburn Growth Plan
Golden Plains Shire Council

Swept Path Assessment

SHEET NO.	DRAWING NO.	ISSUE
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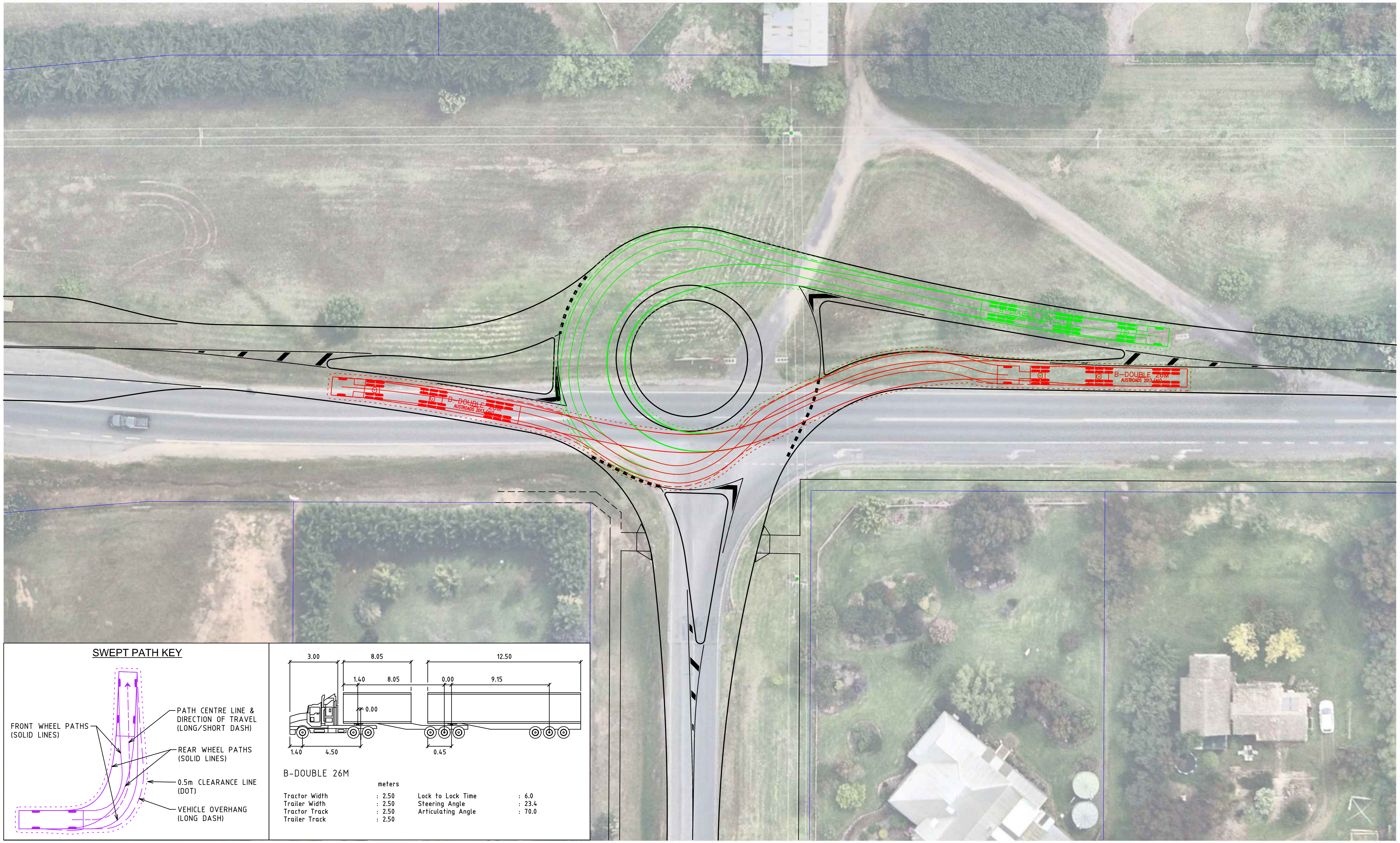

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- Existing

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RACV VICROADS MAPS 93 D2 BONNOCKBURN
SCALE OF METRES
0 5 10

Bannockburn Growth Plan
Golden Plains Shire Council

Swept Path Assessment

SHEET NO.	DRAWING NO.	ISSUE
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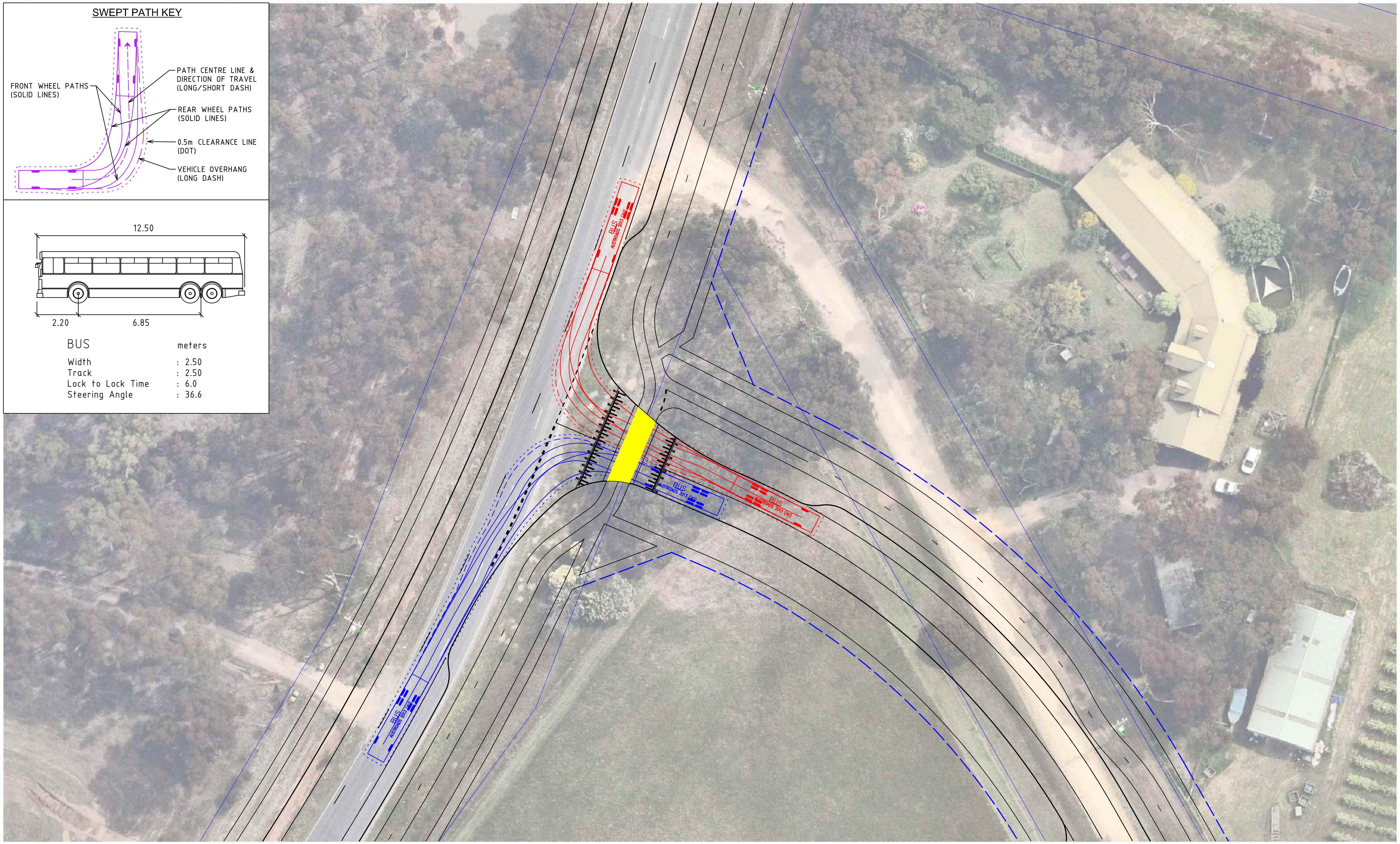

Drawing Record

ISSUE	DRAWN	APP'D	DATE	AMENDMENT
P2	JF	AA	24.01.23	PRELIMINARY ISSUE FOR COMMENT

WARNING
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PRELIMINARY PLAN
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DATE OF ISSUE: 24/01/23

Notes & Legend

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- Design by Trafficworks
- Cadastre
- Proposed ROW Boundary
- Existing

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N E S W
RACV VICROADS MAPS 93 D2
BONNOCKBURN
SCALE OF METRES
0 5 10

Bannockburn Growth Plan
Golden Plains Shire Council
Swept Path Assessment

SHEET NO.	DRAWING NO.	ISSUE
8	220912-SKT-02-01	P2

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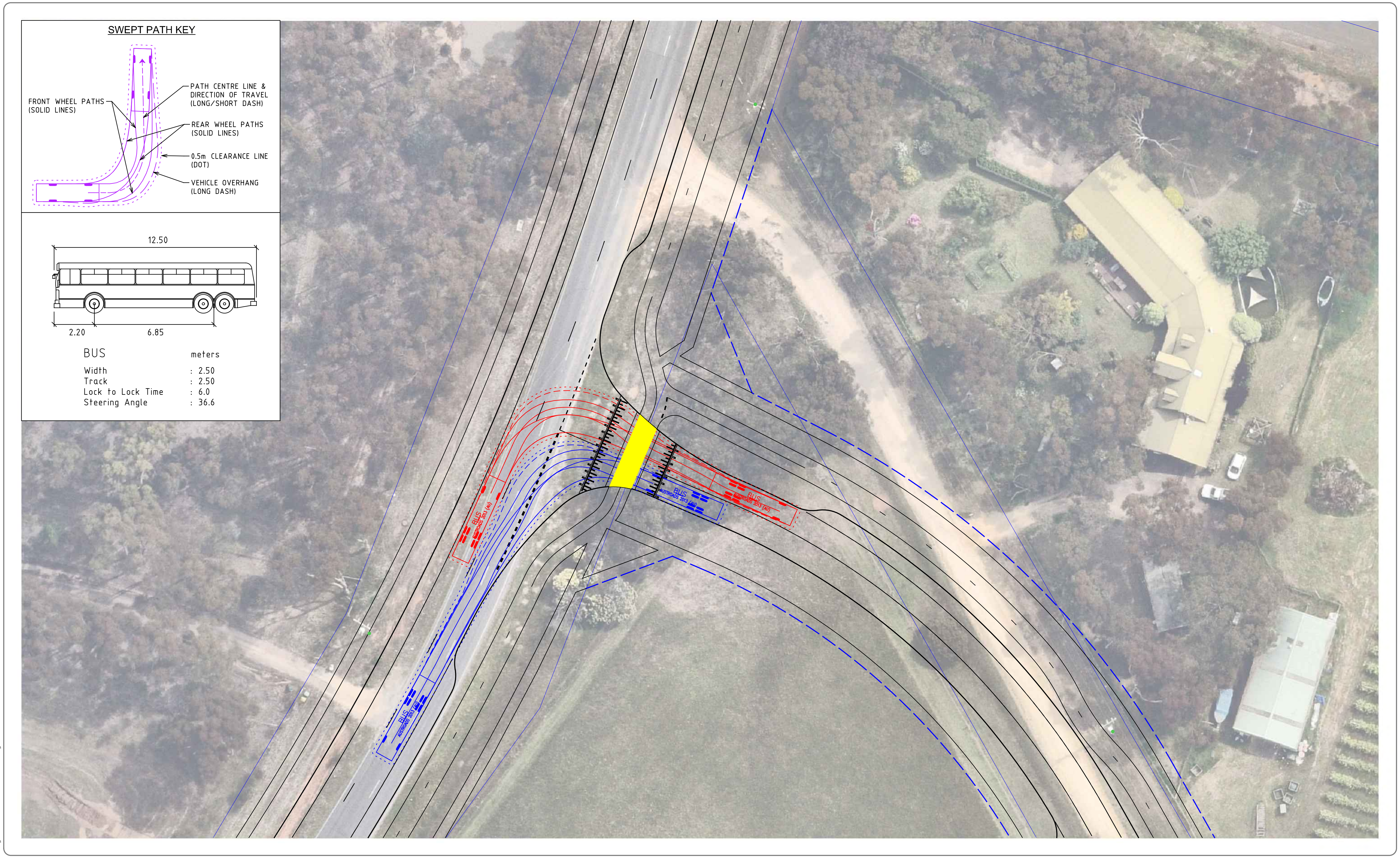

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Drawing Record

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P2	JF	AA	24.01.23	PRELIMINARY ISSUE FOR COMMENT

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BONNOCKBURN
SCALE OF METRES
0 5 10

Bannockburn Growth Plan
Golden Plains Shire Council
Swept Path Assessment

SHEET NO.	DRAWING NO.	ISSUE
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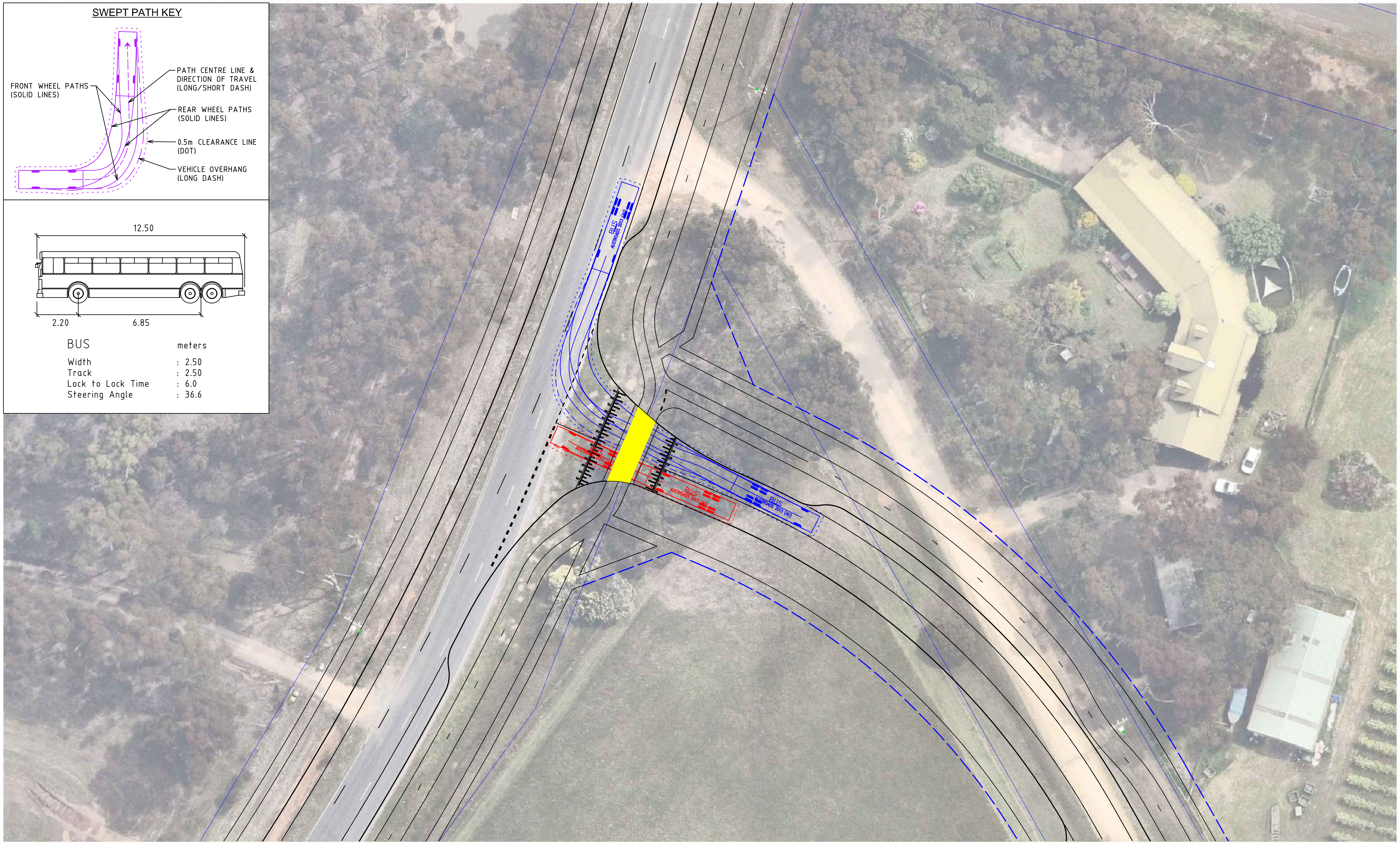

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P2	JF	AA	24.01.23	PRELIMINARY ISSUE FOR COMMENT

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RACV VICROADS MAPS 93 D2 BONNOCKBURN
SCALE OF METRES
0 5 10

Bannockburn Growth Plan
Golden Plains Shire Council

Swept Path Assessment

SHEET NO.	DRAWING NO.	ISSUE
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ISSUE	DRAWN	APP'D	DATE	AMENDMENT
P2	JF	AA	24.01.23	PRELIMINARY ISSUE FOR COMMENT

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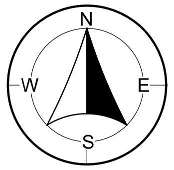

RACV VICROADS MAPS 93 D2
BONNOCKBURN
SCALE OF METRES
0 5 10

Bannockburn Growth Plan

Golden Plains Shire Council

Swept Path Assessment

SHEET NO.	DRAWING NO.	ISSUE
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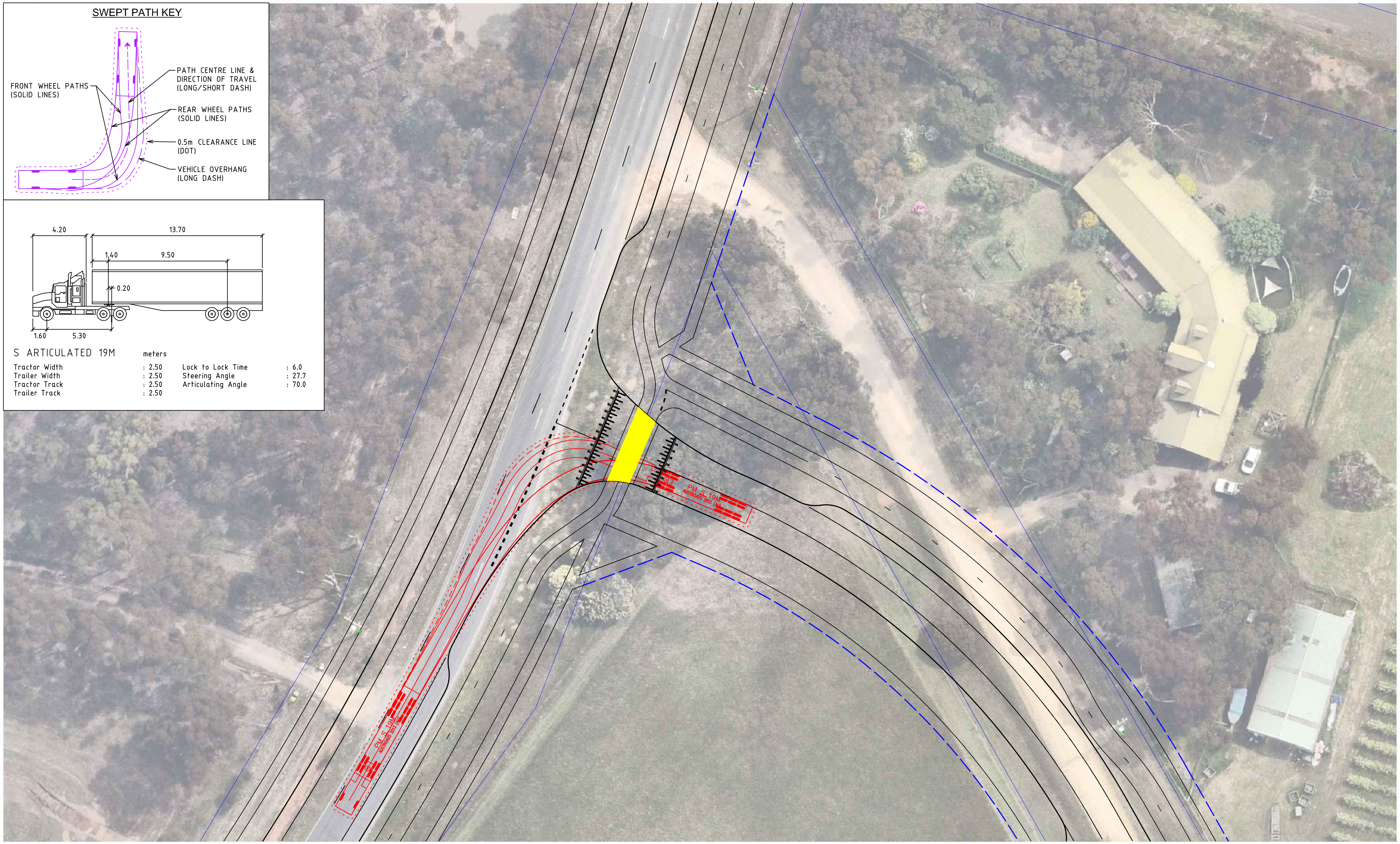

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SCALE OF METRES
0 5 10

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SHEET NO.	DRAWING NO.	ISSUE
12	220912-SKT-02-05	P2

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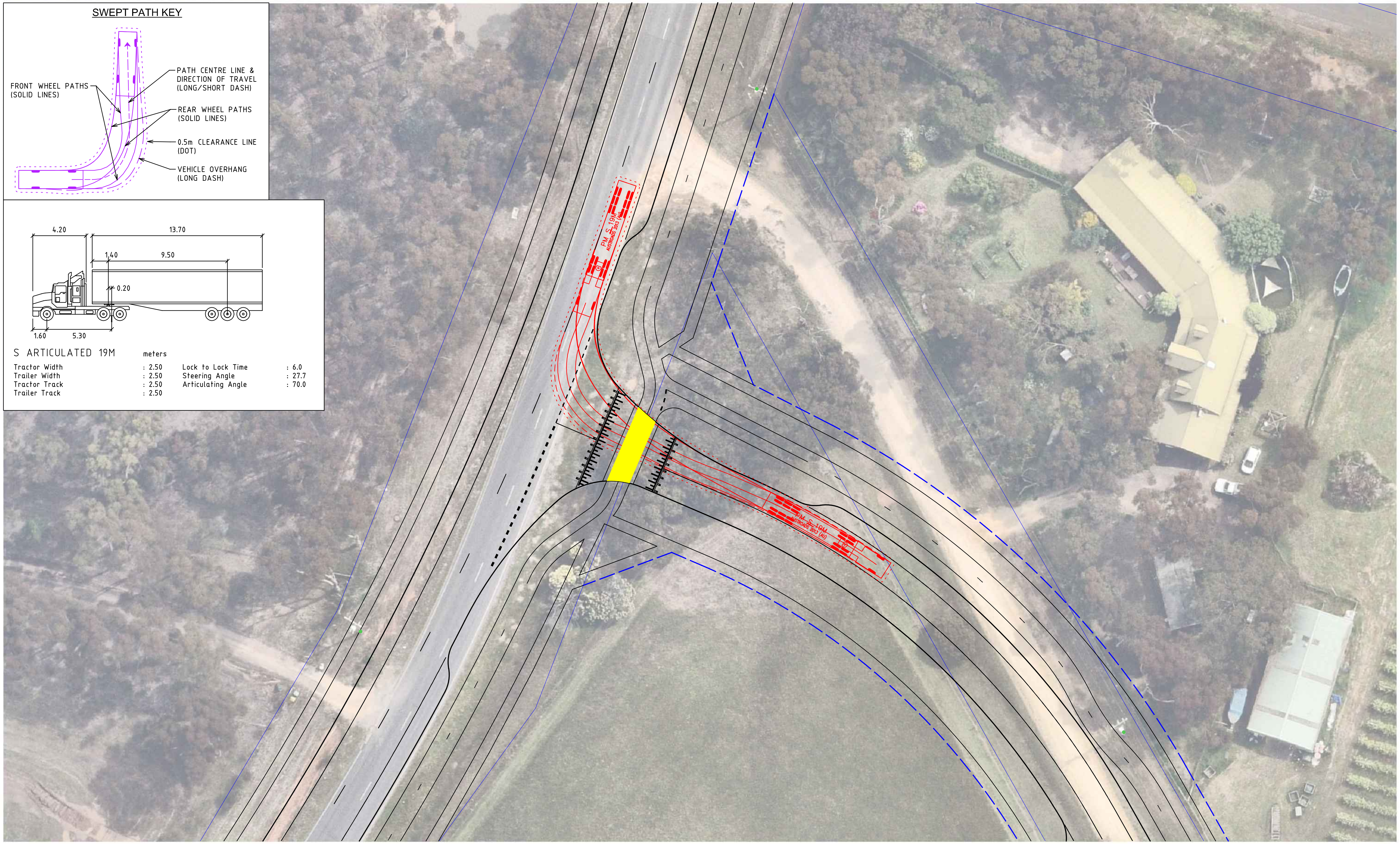

Drawing Record

ISSUE	DRAWN	APP'D	DATE	AMENDMENT
P2	JF	AA	24.01.23	PRELIMINARY ISSUE FOR COMMENT

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SCALE OF METRES
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Bannockburn Growth Plan

Golden Plains Shire Council

Swept Path Assessment

SHEET NO.	DRAWING NO.	ISSUE
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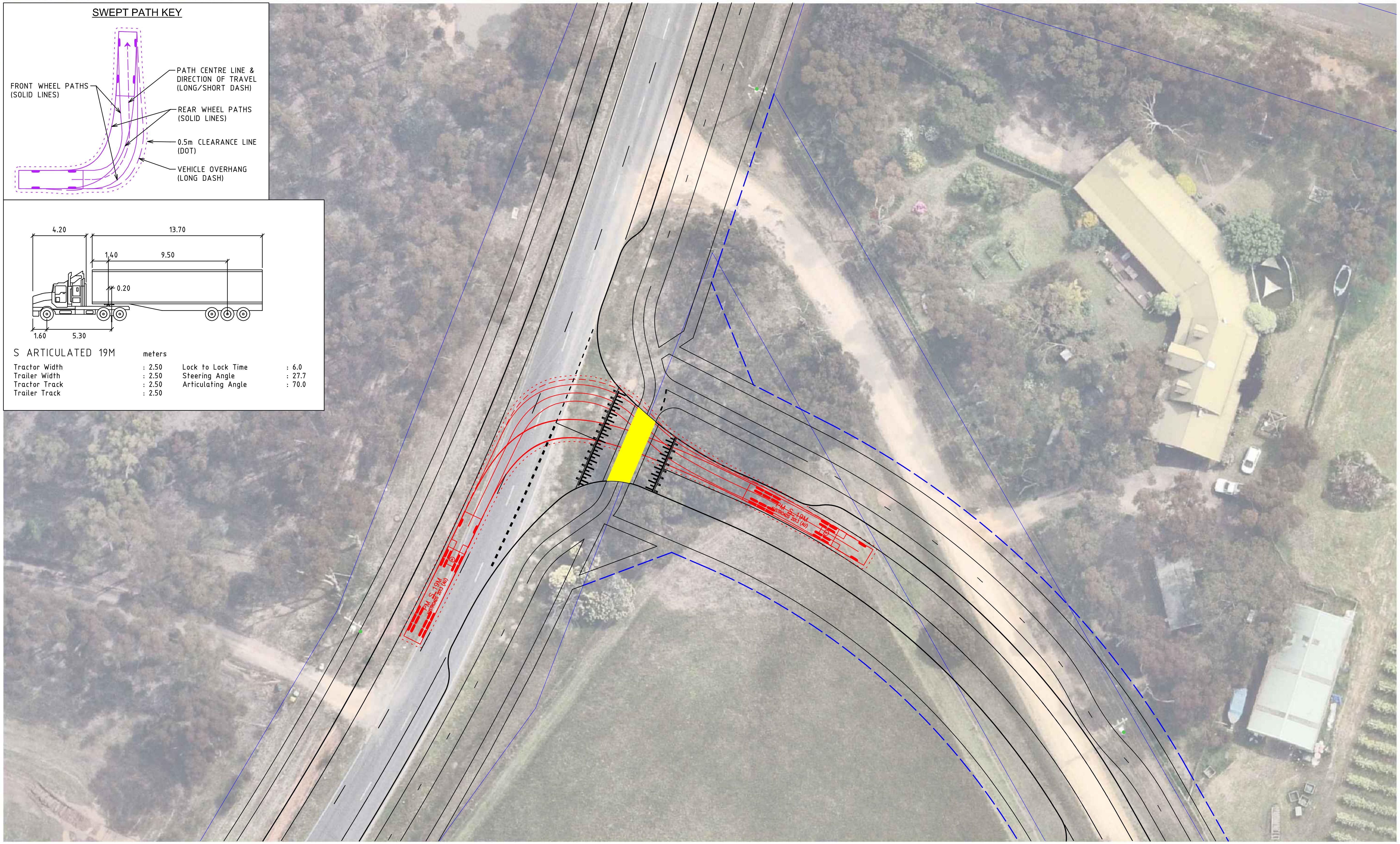

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P2	JF	AA	24.01.23	PRELIMINARY ISSUE FOR COMMENT

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SCALE OF METRES
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Bannockburn Growth Plan
Golden Plains Shire Council

Swept Path Assessment

SHEET NO.	DRAWING NO.	ISSUE
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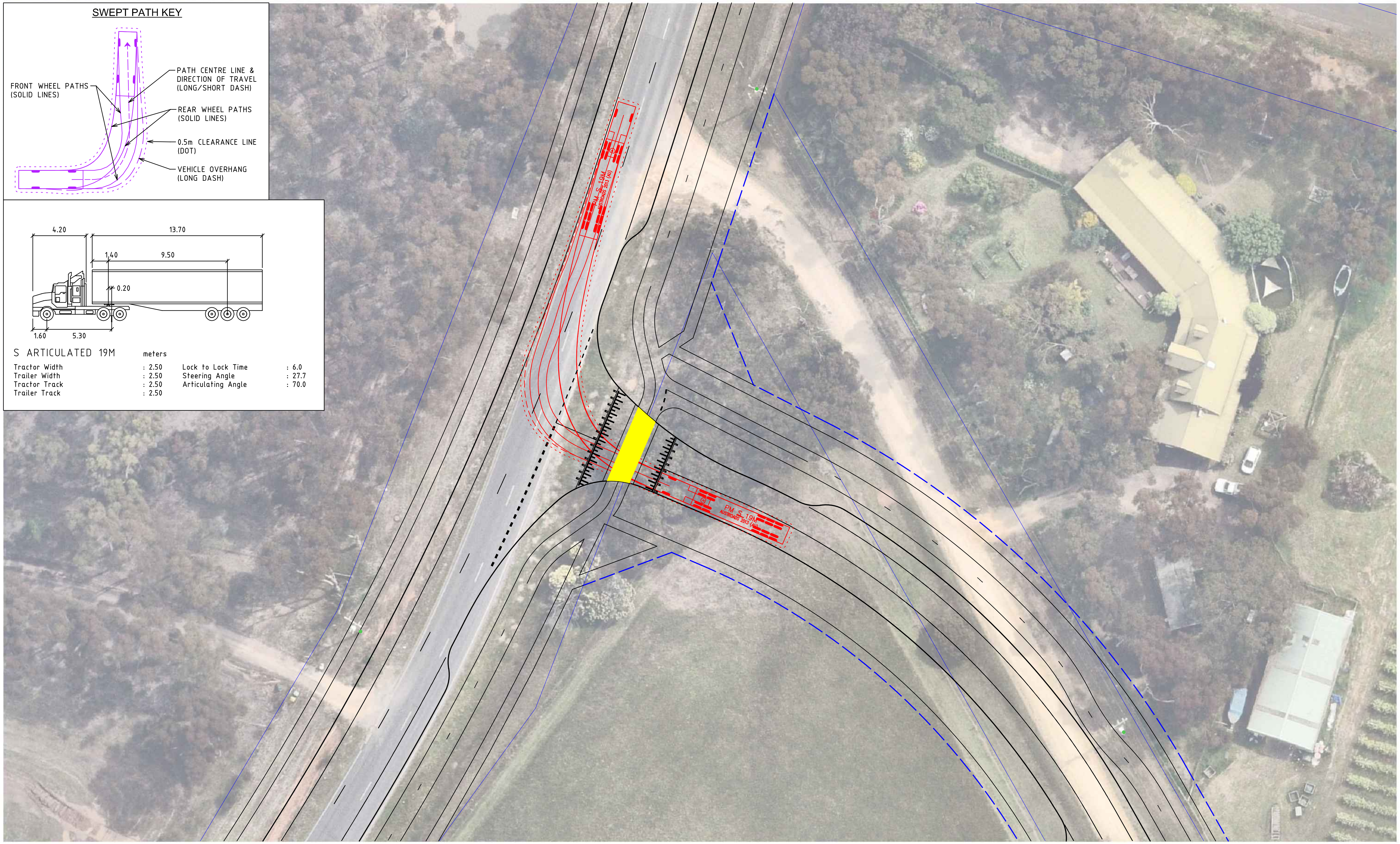

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P2	JF	AA	24.01.23	PRELIMINARY ISSUE FOR COMMENT

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SCALE OF METRES
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Bannockburn Growth Plan

Golden Plains Shire Council

Swept Path Assessment

SHEET NO.	DRAWING NO.	ISSUE
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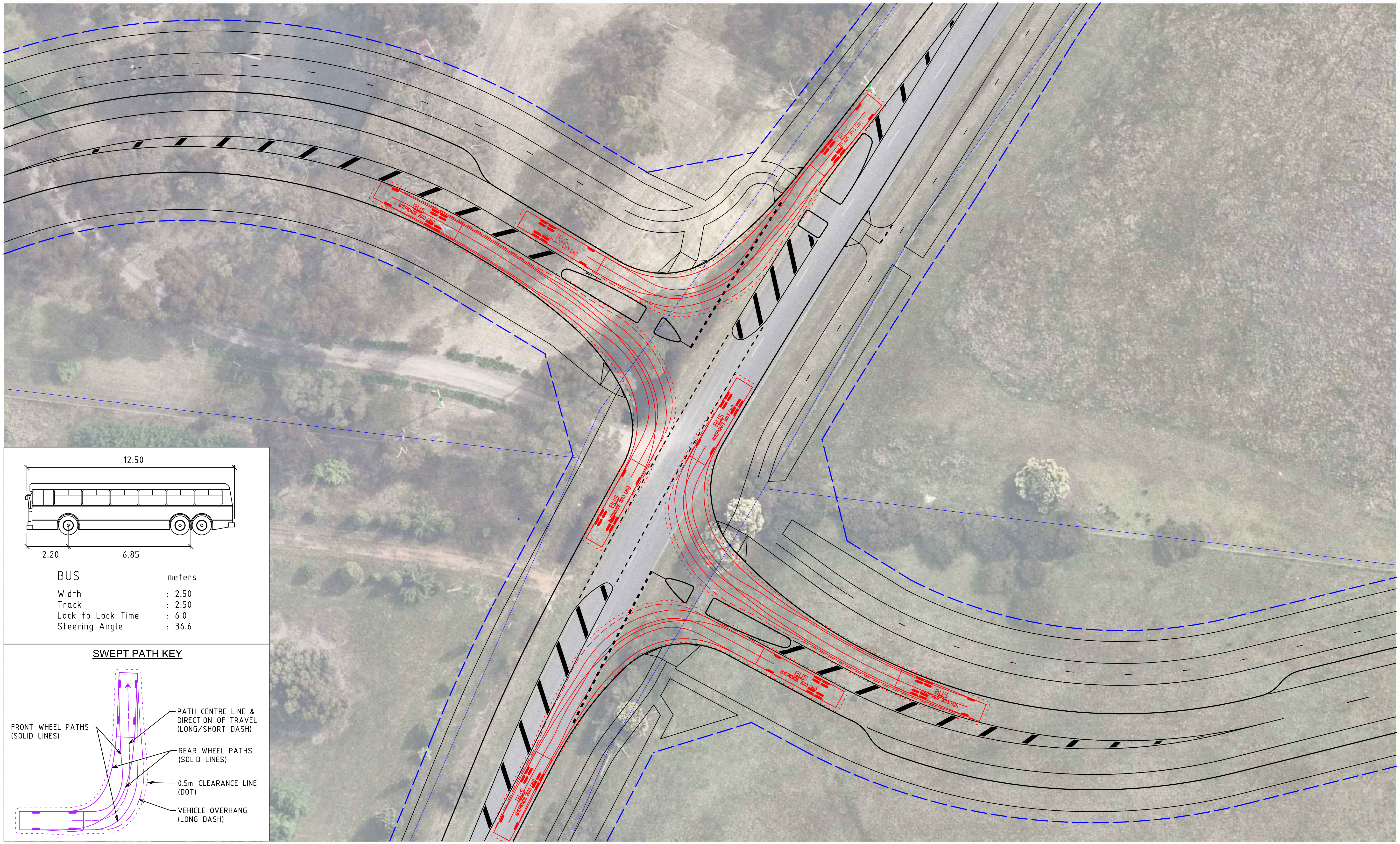

Drawing Record

ISSUE	DRAWN	APP'D	DATE	AMENDMENT
P2	JF	AA	24.01.23	PRELIMINARY ISSUE FOR COMMENT

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SCALE OF METRES
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Golden Plains Shire Council

Swept Path Assessment

SHEET NO.	DRAWING NO.	ISSUE
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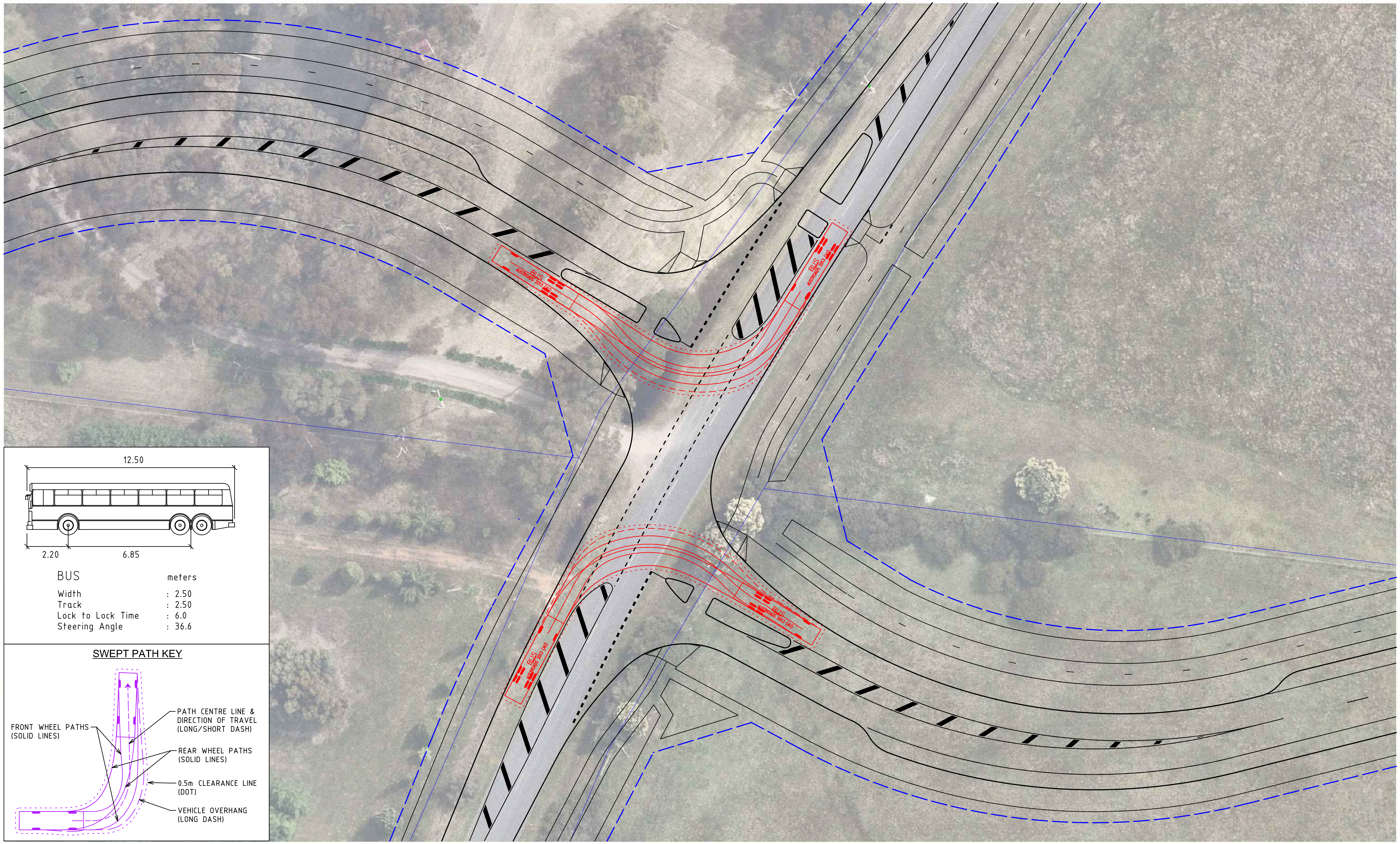

Drawing Record

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P2	JF	AA	24.01.23	PRELIMINARY ISSUE FOR COMMENT

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SCALE OF METRES
0 5 10

Bannockburn Growth Plan

Golden Plains Shire Council

Swept Path Assessment

SHEET NO.	DRAWING NO.	ISSUE
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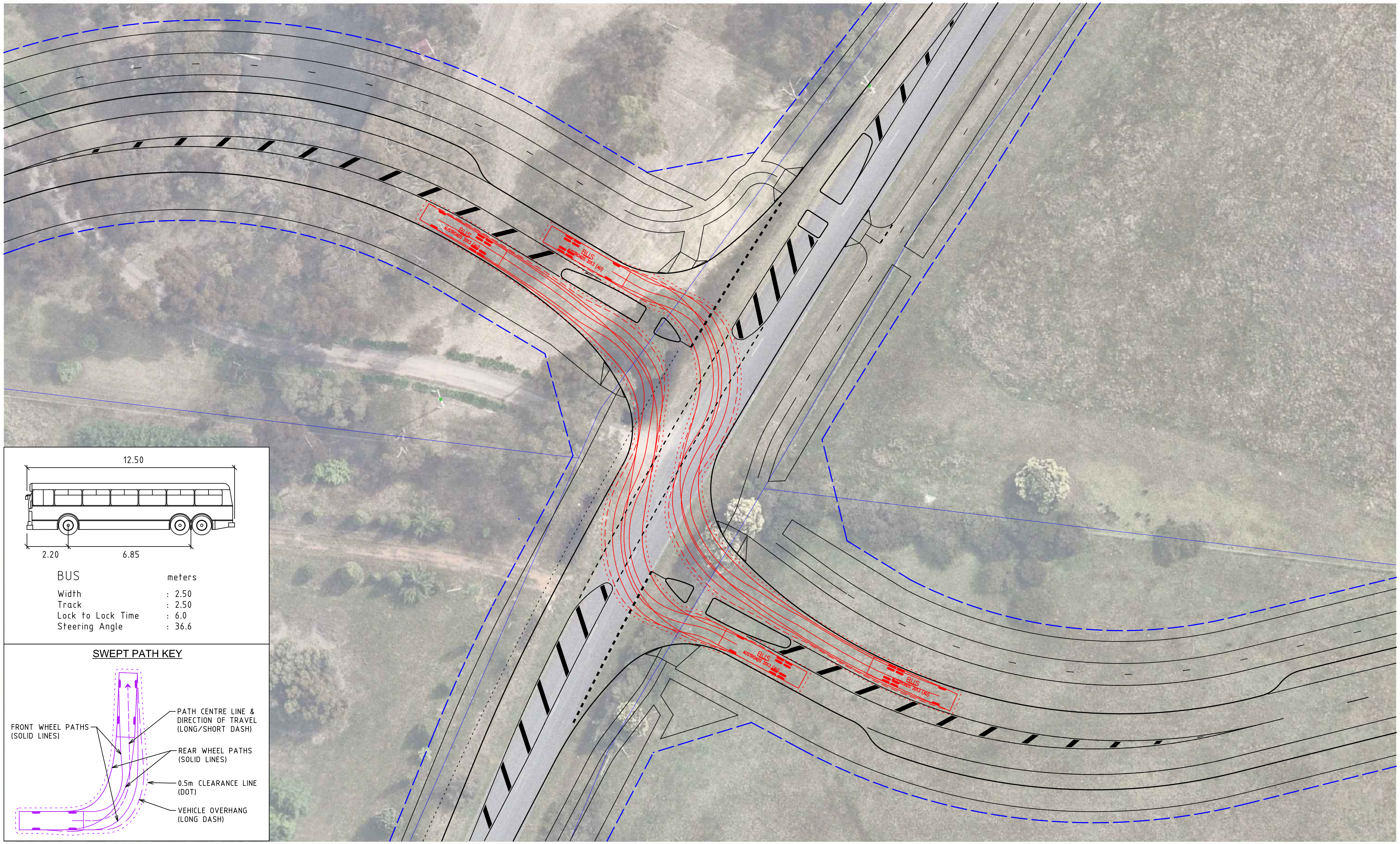

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P2	JF	AA	24.01.23	PRELIMINARY ISSUE FOR COMMENT

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Bannockburn Growth Plan

Golden Plains Shire Council

Swept Path Assessment

SHEET NO.	DRAWING NO.	ISSUE
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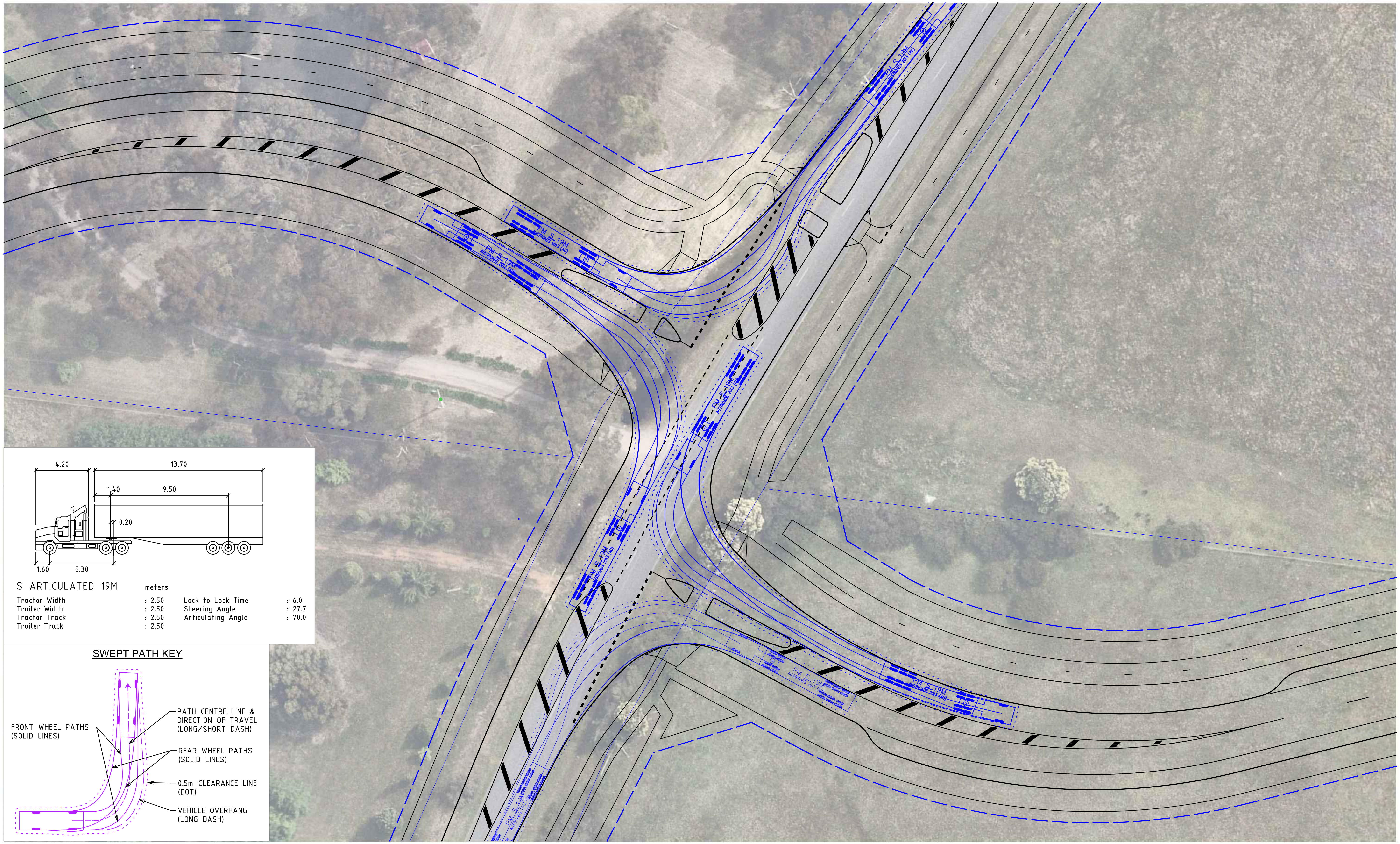

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SCALE OF METRES
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Swept Path Assessment

SHEET NO.	DRAWING NO.	ISSUE
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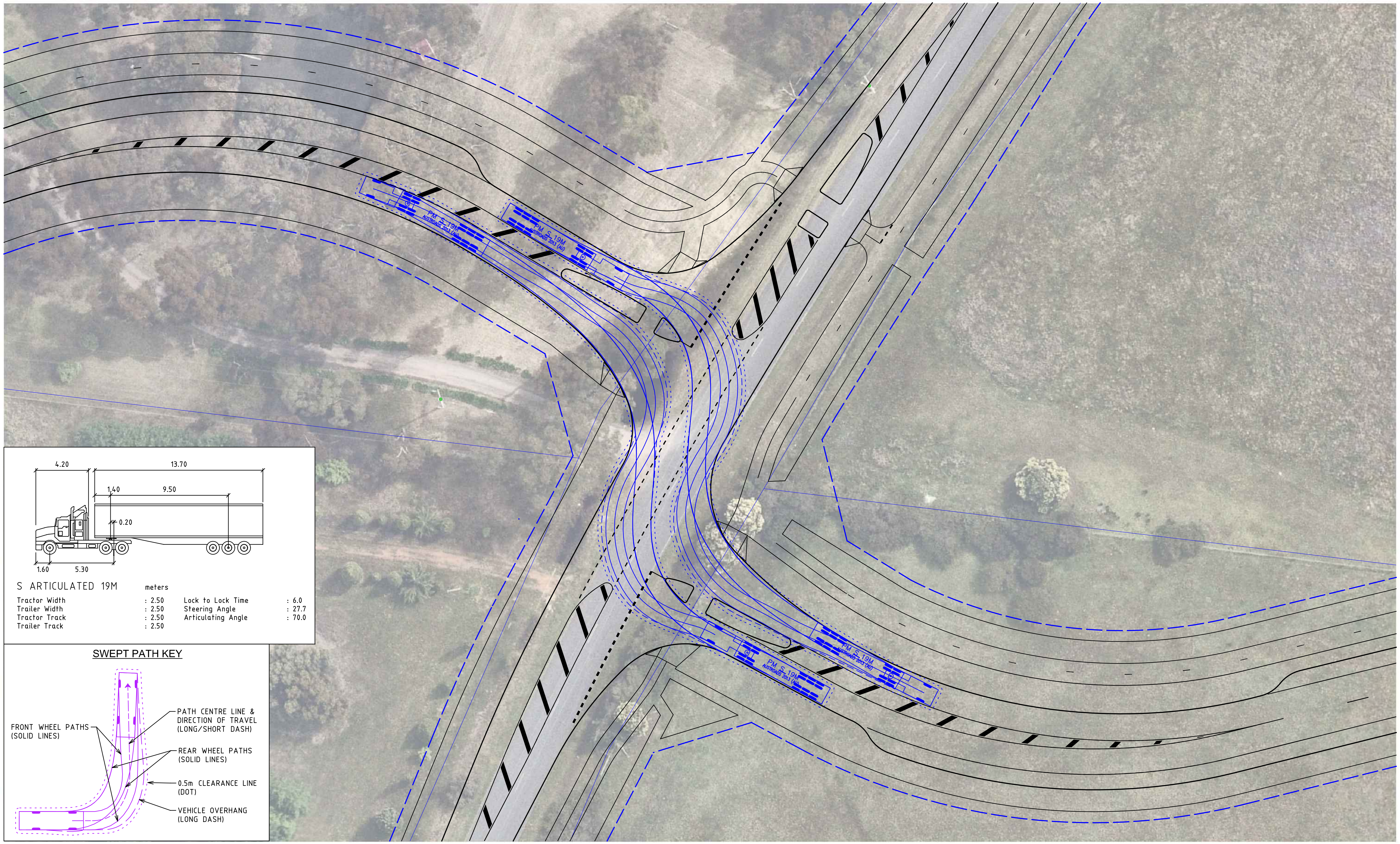

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P2	JF	AA	24.01.23	PRELIMINARY ISSUE FOR COMMENT

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SCALE OF METRES
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Golden Plains Shire Council

Swept Path Assessment

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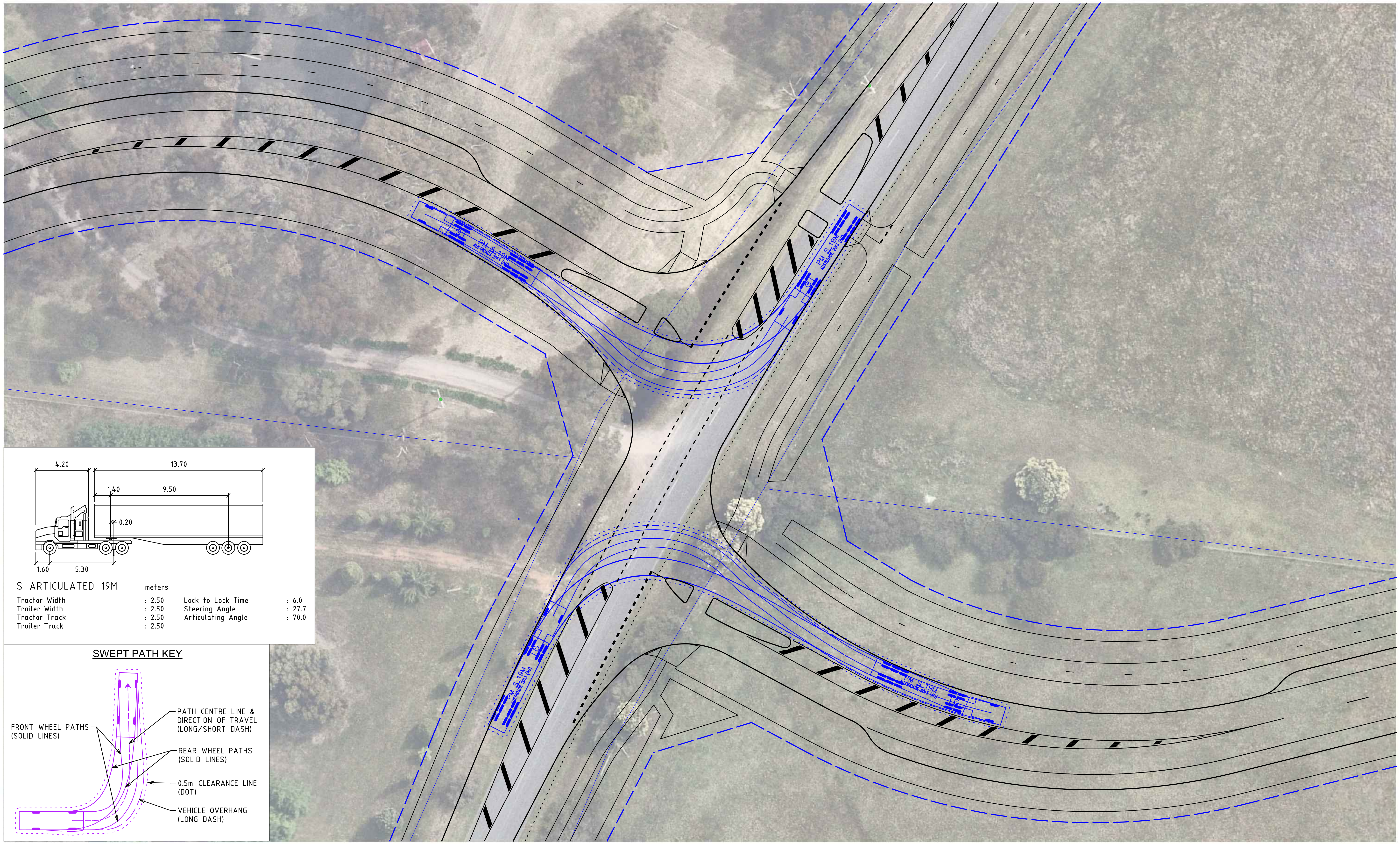

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Swept Path Assessment

SHEET NO.	DRAWING NO.	ISSUE
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Residential Subdivision: Ormond Street, Bannockburn

Cultural Heritage Management Plan: 15813

Sponsor: Cardno TGM Pty Ltd
Heritage Advisor: Daniel Barker (TerraCulture)
Authors: Emily Knowles and Daniel Barker (TerraCulture)
Date: 17 December 2020

TerraCulture
HERITAGE CONSULTANTS

113 Victoria Road
Northcote VIC 3070
Email: admin@terraculture.com.au
Website: www.terraculture.com.au

Residential Subdivision: Ormond Street, Bannockburn

Cultural Heritage Management Plan: 15813

Front Cover: Overlooking the Activity Area, facing south.

Activity Size: Large
Assessment: Desktop, Standard & Complex
Aboriginal Cultural Heritage: Present in the Activity Area

Sponsor: Cardno TGM Pty Ltd
Heritage Advisor: Daniel Barker (TerraCulture)
Authors: Emily Knowles and Daniel Barker (TerraCulture)
Date: 17 December 2020

TerraCulture
HERITAGE CONSULTANTS

113 Victoria Road
Northcote VIC 3070
Email: admin@terraculture.com.au
Website: www.terraculture.com.au

15th of January 2021

Aboriginal Heritage Act 2006 Section 63

Cultural Heritage Management Plan – Notice of Approval

The Wadawurrung Traditional Owners Aboriginal Corporation acting as the Registered Aboriginal Party hereby approve the cultural heritage management plan referred to below:

Residential Subdivision: Ormond Street, Bannockburn:

Cultural Heritage Management Plan number: 15813

Sponsor: Cardno TGM Pty Ltd

Heritage Advisor: Daniel Barker

Authors: Emily Knowles and Daniel Barker

Date: 17 December 2020

Pages: Cover Page, i-xii, 1-194

Received for Approval: 17th of December 2020

Pursuant to s.64 (1) of the Act this cultural heritage management plan takes effect upon the granting of this approval and once a copy is lodged with the Secretary of DPCD. *

Paul Davis	Stephanie Frydas
CEO	RAP Approvals Officer

*This notice of approval should be inserted after the title page and bound with the body of the management plan.

Executive Summary

Compliance requirements are set out in Part 1 of the Cultural Heritage Management Plan.

Nature and Extent of Proposed Works

The Activity Area is located on four parcels of land at 5, 20, 25, and 30 Ormond Street, Bannockburn, approximately 20km north-west of Geelong CBD. The Activity Area is part of Lot 1 TP174543, 10 22B, 11 22 B, 12 22B in the City of Greater Geelong and the Parish of Murgheboluc.

The proposed activity involves excavation over an area approximately 190,000 metres square (19ha) for the subdivision of 172-199 lots of less than 8 hectares each to be used for dwellings.

Results of the Cultural Heritage Assessment

The Desktop Assessment found ninety previously registered places within the geographic region, the nearest being 110 metres east from the Activity Area. Aboriginal cultural heritage is likely to be in the form of low-density artefact distributions or artefact scatters. However, the Activity Area has experienced some level of disturbance from European agricultural activities which may affect the distribution of possible archaeological material.

A pedestrian survey found that most of the surveyed area was covered by recently cut vegetation, a vineyard, houses, and associated amenities and therefore, the presence or absence of cultural material was unable to be identified across much of the Activity Area. Three surface stone artefacts were recorded within the Activity Area, on the ridgeline of Bruce Creek.

The subsurface testing program involved the manual excavation of four 1m x 1m test pits (TPs) and five 0.5m x 0.5m radial test pits (RTPs). A further forty-nine 2m x 1m machine test pits (MTPs) were excavated using a machine excavator. A total of 103.25m^2 was excavated, which resulted in the identification of a further three hundred and twelve stone artefacts.

Details of Aboriginal Cultural Heritage in the Activity Area

In total, three Aboriginal cultural heritage places were recorded in the Activity Area and will be affected by the proposed development: Ormond Street LDAD (VAHR 7721-1436), Bruces Creek Artefact Scatter (VAHR 7721-1435), and Manifold Street Artefact Scatter (VAHR 7721-1434). Ormond Street LDAD (VAHR 7721-1436) was registered as a low-density artefact distribution and consisted of twenty artefacts.

Manifold Street Artefact Scatter (VAHR 7721-1434) was registered as an artefact scatter and consisted of twenty-five artefacts. Bruces Creek Artefact Scatter (VAHR 7721-1435) consisted of two hundred and seventy artefacts and was merged with a previously registered site to the north.

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Part 1: Cultural Heritage Management Conditions

Note: These conditions become compliance requirements once the Cultural Heritage Management Plan is approved. Failure to comply with a condition is an offence under Section 67A of the *Aboriginal Heritage Act* 2006.

The Cultural Heritage Management Plan must be readily accessible to the Sponsor and their employees and contractors when carrying out the activity.

1.0 Cultural Heritage Management Conditions

1.1 General Management Conditions

1.1.1 Condition 1: CHMP on Site

A hard copy of the approved CHMP must be kept on site during all stages of the activity. The CHMP Conditions and Contingencies must be referred to if any suspected Aboriginal Cultural Heritage is identified.

1.1.2 Condition 2: Cultural Heritage Inductions

A cultural heritage induction must be conducted with all permanent site workers/contractors involved in ground disturbing works by a Heritage Advisor and the Wadawurrung Traditional Owners Aboriginal Corporation (WTOAC) prior to, or at the commencement of, construction works. The cultural heritage induction must be conducted by a representative of the Registered Aboriginal Party (RAP) with assistance of a Heritage Advisor.

All new personnel directly involved in construction works (i.e. site workers, contractors, sub-contractors) who have not previously been inducted as to cultural heritage for this project must be provided with cultural heritage information as part of their toolbox induction prior to commencing work in the activity area, throughout the life of the project.

Awareness of the CHMP, management conditions and contingency plans must be incorporated into any job safety, toolbox meetings, and Environmental Management Plan, and will be especially relevant for introducing the CHMP to new personnel working onsite alongside the RAP cultural heritage induction.

At least two weeks’ notice must be provided to the WTOAC when booking a representative to undertake the induction. If a salvage is required, the salvage must be completed before the induction occurs.

The purpose of the cultural heritage induction is to:

- Describe and demonstrate the Aboriginal cultural heritage relevant to the activity area or the locality for personnel engaged in the construction of activity works;
- Create awareness of Aboriginal cultural values; and

- Inform personnel about the specific conditions of Part 1 of the management plan and the procedures set out for reporting any suspected Aboriginal cultural heritage that may be discovered or uncovered.

The cultural heritage induction will include:

- A brief history of the Aboriginal occupation of the activity area and broader region;
- A summary of the assessments undertaken within the activity area during the preparation of the management plan;
- Specific details of all Aboriginal cultural heritage identified during the management plan assessments;
- A summary of the conditions and contingency plans contained within the management plan; and
- A discussion of the compliance responsibilities of the Sponsor and all personnel involved in work within the activity area and the requirements of the Aboriginal Heritage Act 2006 (Victoria).

This cultural heritage induction must be organised and paid for by the Sponsor.

1.1.3 Condition 3: Compliance Checks

The WTOAC have determined that a series of compliance inspections will be undertaken by WTOAC representatives during the activity in order to audit the works and ensure that the works comply with the management conditions and contingency plan contained within this CHMP. The representatives of the WTOAC must comply with all OH&S requirements of the activity area.

A minimum of three compliance inspections must occur throughout the lifetime of this activity. These inspections must occur at the following times:

- Prior to the commencement of the activity;
- During the excavation works; and
- At the completion of all works within the activity area.

If Aboriginal cultural material is located during the compliance inspection, the contingency measures included in Part 1, Section 2 of this CHMP must be enacted.

The WTOAC must be notified at least two weeks in advance before the required compliance inspections are to occur in order to book field representatives.

A WTOAC representative will conduct the inspection and complete the compliance checklist in Appendix B of this CHMP.

If the inspection reveals suspected non-compliance of the CHMP, then the procedure outlined in Section 2.4 of this CHMP will be initiated. If the inspection reveals a suspected breach of the Victorian Aboriginal Heritage Act 2006, then these actions must be reported to Aboriginal Victoria (AV) immediately and an Inspector may be called out and/or a Stop Order may be issued by AV.

This procedure must be organised and paid for by the site contractors and/or Sponsor.

1.1.4 Condition 4: Contingency Plans

There must also be a system for reporting any possible Aboriginal cultural heritage which may be discovered or uncovered during the conduct of the proposed activity. This must be built into any development or Environmental Management Plan (EMP) for the proposed activity. To this end, the contingency plans in Section 2 must be incorporated into the development or EMP for the project.

1.1.5 Condition 5: Retention of Excavated Material

All soil excavated during the conduct of the activity must be retained within the Activity Area. The excavated material may be used for landscaping or as fill for other grading purposes.

1.2 Specific Management Conditions for Ormond Street LDAD (VAHR 7721-1436)

1.2.1 Condition 6: Custody and Management

The reburial of artefacts must be undertaken in accordance with the following WTOAC standard procedures:

a) Cultural material to be reburied must be placed in a durable container manufactured by the WTOAC;
b) A separate container is to be manufactured for each Aboriginal Place to be reburied;
c) Where an Aboriginal Place is comprised of a large amount of cultural material it will be necessary to manufacture a number of containers to rebury the cultural material;
d) The contents of the container must include the cultural material to be reburied, a catalogue of the cultural material to be reburied on both paper and on an archive quality storage medium, a

copy of the relevant sections of the CHMP under which the reburial is being performed and a handful of soil from the Aboriginal Place from which the cultural material originated;

e) The reburial must be attended by a Wadawurrung Traditional Owner and a representative;
f) A smoking ceremony must be performed prior to the reburial of cultural material;
g) Flagging tape must be laid within the hole at a depth of 300mm above the reburied cultural material to identify that cultural material is buried below the flagging tape;
h) Once reburied, the reburial location must be recorded to sub-metre accuracy by the HA and be relocatable;
i) The relevant VAHR site record card must be updated by submitting an Object Collection component form with the reburial location details. This must be completed by the HA and lodged with AV;
j) Following the reburial, interpretive signage must be placed within the activity area. The content of that interpretive signage, the method of its construction and the location for its placement must be developed in consultation with the WTOAC; and
k) The cost of the manufacture of the container, the analysis and preparation of the cultural material for reburial, smoking ceremony, WTOAC attendance at the reburial and any consultation with the WTOAC or materials associated with the interpretive signage must be borne by the Sponsor.

The costs associated with the recording of the reburial location and updating of the relevant VAHR site record by the HA must be borne by the Sponsor.

1.3 Specific Management Conditions for Bruces Creek Artefact Scatter (VAHR 7721-1435)

1.3.1 Condition 7: Salvage Excavations

Prior to the commencement of the Activity, Bruces Creek Artefact Scatter (VAHR 7721-1435) must be subject to archaeological salvage excavations. The salvage excavation extent and methodology were developed during a pre-salvage consultation meeting with the WTOAC, and it was agreed that salvage excavations must occur at the locations of MTP61 (2m x 2m hand excavated salvage pit) and MTP25 (5m x 5m mechanical salvage pit). All excavated material must be screened using maximum 5mm gauge sieves. Relevant samples (should they be present) must be collected and sent to a laboratory for radiometric dating.

Reporting

A report on the salvage and the post-excavation analysis including all data must be sent to the RAP within six months of the completion of the salvage excavations. The report must follow the standards set out in the practice notes provided by AV and must include at a minimum the following:

- The background of the salvage including a summary of discussions on the excavation methodology.
- A full description of the field methods including timing and personnel.
- A full description of all cultural material including stone artefacts according to dimensions, technological attributes and functional types.
- Maps which show the spatial position of all cultural material documented using a DGPS and/or total station.
- The results of any radiometric/OSL dating.
- A discussion of the research questions.

1.3.2 Condition 8: Custody and Management

The reburial of artefacts must be undertaken in accordance with the following WTOAC standard procedures:

a) Cultural material to be reburied must be placed in a durable container manufactured by the WTOAC;
b) A separate container is to be manufactured for each Aboriginal Place to be reburied;
c) Where an Aboriginal Place is comprised of a large amount of cultural material it will be necessary to manufacture a number of containers to rebury the cultural material;
d) The contents of the container must include the cultural material to be reburied, a catalogue of the cultural material to be reburied on both paper and on an archive quality storage medium, a copy of the relevant sections of the CHMP under which the reburial is being performed and a handful of soil from the Aboriginal Place from which the cultural material originated;
e) The reburial must be attended by a Wadawurrung Traditional Owner and a representative;
f) A smoking ceremony must be performed prior to the reburial of cultural material;
g) Flagging tape must be laid within the hole at a depth of 300mm above the reburied cultural material to identify that cultural material is buried below the flagging tape;

h) Once reburied, the reburial location must be recorded to sub-metre accuracy by the HA and be relocatable;

i) The relevant VAHR site record card must be updated by submitting an Object Collection component form with the reburial location details. This must be completed by the HA and lodged with AV;

j) Following the reburial, interpretive signage must be placed within the activity area. The content of that interpretive signage, the method of its construction and the location for its placement must be developed in consultation with the WTOAC; and

k) The cost of the manufacture of the container, the analysis and preparation of the cultural material for reburial, smoking ceremony, WTOAC attendance at the reburial and any consultation with the WTOAC or materials associated with the interpretive signage must be borne by the Sponsor.

The costs associated with the recording of the reburial location and updating of the relevant VAHR site record by the HA must be borne by the Sponsor.

1.4 Specific Management Conditions for Manifold Street Artefact Scatter (VAHR 7721-1434)

1.4.1 Condition 9: Custody and Management

The reburial of artefacts must be undertaken in accordance with the following WTOAC standard procedures:

a) Cultural material to be reburied must be placed in a durable container manufactured by the WTOAC;

b) A separate container is to be manufactured for each Aboriginal Place to be reburied;

c) Where an Aboriginal Place is comprised of a large amount of cultural material it will be necessary to manufacture a number of containers to rebury the cultural material;

d) The contents of the container must include the cultural material to be reburied, a catalogue of the cultural material to be reburied on both paper and on an archive quality storage medium, a copy of the relevant sections of the CHMP under which the reburial is being performed and a handful of soil from the Aboriginal Place from which the cultural material originated;

e) The reburial must be attended by a Wadawurrung Traditional Owner and a representative;

f) A smoking ceremony must be performed prior to the reburial of cultural material;

g) Flagging tape must be laid within the hole at a depth of 300mm above the reburied cultural material to identify that cultural material is buried below the flagging tape;

h) Once reburied, the reburial location must be recorded to sub-metre accuracy by the HA and be relocatable;

i) The relevant VAHR site record card must be updated by submitting an Object Collection component form with the reburial location details. This must be completed by the HA and lodged with AV;

j) Following the reburial, interpretive signage must be placed within the activity area. The content of that interpretive signage, the method of its construction and the location for its placement must be developed in consultation with the WTOAC; and

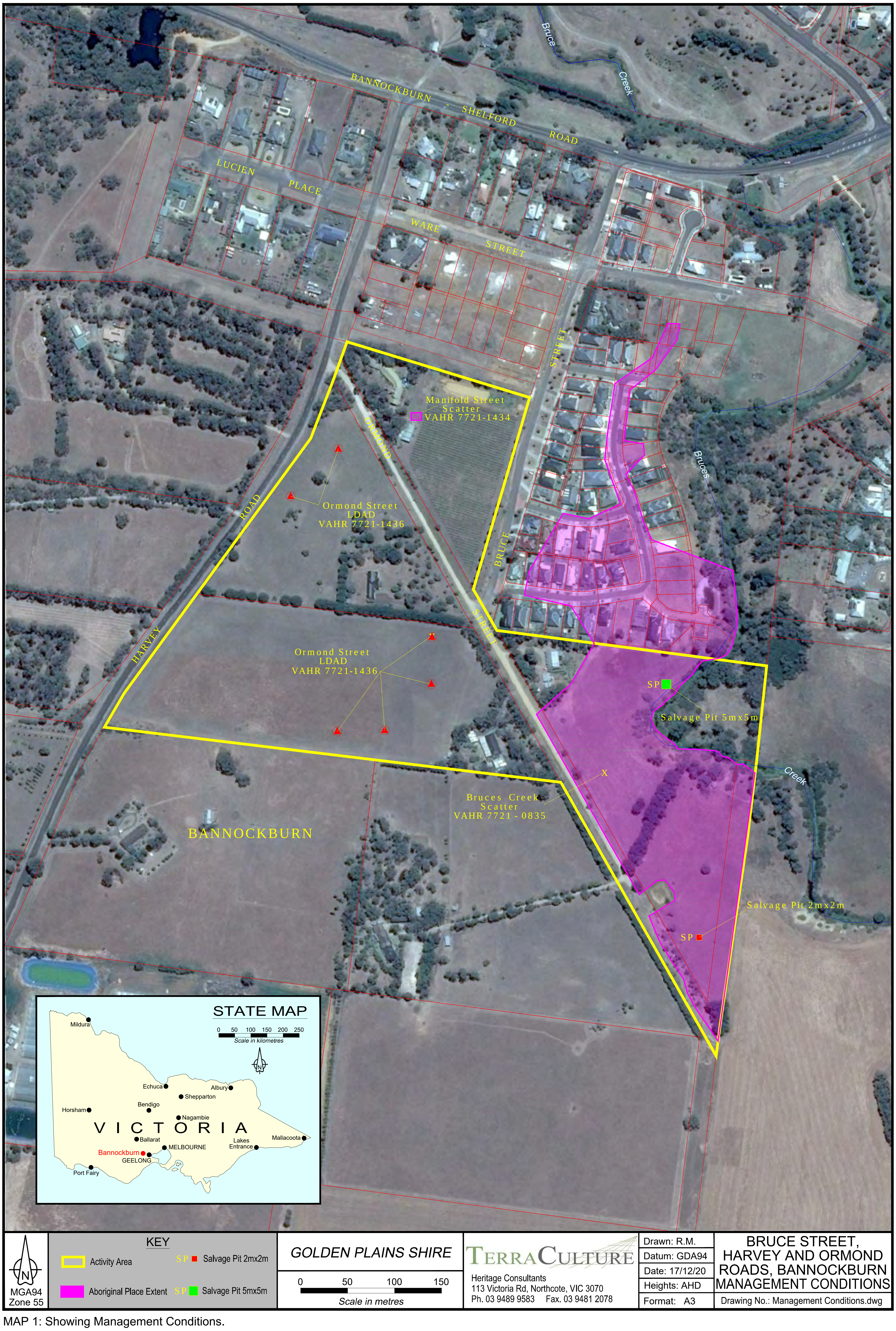
k) The cost of the manufacture of the container, the analysis and preparation of the cultural material for reburial, smoking ceremony, WTOAC attendance at the reburial and any consultation with the WTOAC or materials associated with the interpretive signage must be borne by the Sponsor.

The costs associated with the recording of the reburial location and updating of the relevant VAHR site record by the HA must be borne by the Sponsor.

1.5 Timing of the Management Conditions

Timing	Management Conditions
Prior to the Activity	• Cultural heritage inductions (Section 1.1.2) • Salvage excavations (Sections 1.3.1) • Compliance inspection prior to activity (Section 1.1.3)
During the Activity	• Approved CHMP on site (Section 1.1.1) • Retention of excavated material within the Activity Area (1.1.5) • Compliance inspection during ground excavations (Section 1.1.3) • Contingency plans in effect (Section 1.1.4)
After the Activity	• Compliance inspection following the completion of works (Section 1.1.3) • Custody and management of Aboriginal cultural heritage recorded during the assessment and during the activity (Sections 1.2.1; 1.3.2; 1.4.1)

Table 1: Timing of management conditions in relation to the activity.



MAP 1: Showing Management Conditions.

2.0 Contingency Plans

The approved form for a CHMP states that in accordance with Clause 13

1) Schedule 2 of the Aboriginal Heritage Regulations 2018, a management plan must also include specific contingency plans for:
    a) the matters referred to in Section 61 of the Aboriginal Heritage Act 2006;
    b) the resolution of any disputes between the Sponsor and the RAP in relation to the implementation of the plan or the conduct of the activity;
    c) reviewing compliance with the management plan and mechanisms for remedying noncompliance;
    d) the management of Aboriginal cultural heritage found during the activity; and
    e) the notification, in accordance with the Aboriginal Heritage Act 2006, of the discovery of Aboriginal cultural heritage during the carrying out of the activity. Contingency plans are required even in situations where it has been assessed that there is a low probability of Aboriginal cultural heritage being located within an activity area.

If the activity is a subdivision referred to in Regulation 49, a management plan must also include specific contingency plans [Clause 13(2) Schedule 2 of the Regulations] for:

1) How each lot is intended to be used or developed by the sponsor; or
2) If a lot is not intended to be used or developed by the sponsor; the use or development of the lot permitted under the relevant planning scheme.

2.1 Section 61 Matters

Section 61 of the Aboriginal Heritage Act 2006 is concerned with the avoidance and/or minimisation of harm to Aboriginal cultural heritage and with any specific measures required for the management of Aboriginal cultural heritage during and following the activity. Section 61 matters pertaining to previously unknown, unexpected or undiscovered cultural heritage that is discovered, uncovered or may become exposed during the conduct of the activity are discussed in Section 2.4.

2.2 Dispute Resolution

Dispute Resolution Clause 13(1) Schedule 2 of the Regulations requires that the CHMP must contain a contingency plan for the resolution of any disputes between the Sponsor and relevant RAPs in relation to the implementation of an approved CHMP or the conduct of the activity.

Disputes may occur at various stages during the activity. Procedures for dispute resolution aim to ensure that all Parties are fully aware of their rights and obligations; that full and open communication between Parties occurs; and that those Parties conduct themselves in good faith. If a dispute arises that may affect the conduct of the activity, resolution between Parties using the following Informal Dispute Resolution guidelines is recommended.

Informal Dispute Resolution

a) The Party raising the dispute must complete a Dispute Notification Form (included in Appendix G) and email or fax a copy to all parties listed below.
b) Project delegates of each Party (RAP and Sponsor) must attempt to negotiate a resolution to any dispute related to cultural heritage management of the activity area within 48 hours of written notice being received that a dispute between Parties is deemed to exist. If the project delegates cannot reach an agreement, representatives of both Parties must meet to negotiate a resolution to an agreed schedule.
c) If representatives of the relevant Parties fail to reach an agreement, an independent mediator must be initially sought to assist in resolving the dispute. A timeframe for the independent mediator must be agreed upon by both Parties. If an independent mediator cannot be agreed on, mediation shall be affected by a mediator nominated upon the application by either Party, by the Victorian Chapter of the Institute of Arbitrators and Mediators, or the Dispute Settlement Centre of Victoria.
d) If the matter remains unresolved after mediation, the Parties shall seek to agree upon the appointment of an independent arbitrator to hear and resolve the matter. In the absence of agreement as to an arbitrator, arbitration shall be effected by an arbitrator nominated upon the application by either Party by the Victorian Chapter of the Institute of Arbitrators and Mediators, or, failing such nomination within 28 days, appointed within the provisions of the Commercial Arbitration Act (Vic) 1984.

e) A reference to arbitration under this clause shall be deemed to be a reference to arbitration within the meaning of the laws relating to arbitration in force in the state of Victoria. The arbitrator shall have all the powers conferred by those laws. The arbitrator's decision shall be final, subject to any rights of appeal under the Commercial Arbitration Act (Vic) 1984.

f) The procedures concerning mediation and arbitration, including payment of costs, shall be agreed between the Parties.

g) These arrangements do not preclude any legal recourse open to the Parties being taken but the Parties agree the above avenues will be exhausted before such recourse is made.

In order to facilitate the above procedure:

a) The Party with the grievance must notify all other Parties of the problem at the earliest opportunity.

b) Throughout all stages of the procedure all relevant facts must be clearly identified and recorded.

c) All disputes will be jointly investigated.

d) Sensible time limits must be allowed for completion of the various stages of discussion. However, the Parties must cooperate to ensure that the dispute resolution procedures are carried out as quickly as possible.

Without prejudice to either Party, and except where a bona fide safety issue is involved, and/or when the nature of the work or the area affected by the work concerns the matter in dispute, work should continue in accordance with this Plan while matters in dispute between them are being negotiated in good faith. No Party shall be prejudiced as to final settlement by the continuance of work in accordance with this procedure.

Any corrective or remedial activities required by a resolution to a dispute under this clause (e.g. repairing damage to sites) will be overseen by representatives from the Wadawurrung Traditional Owners Aboriginal Corporation and will take place in accordance with their instructions.

Role	Contact Person	Phone	Email
Sponsor: TGM Group Pty Ltd	Chris Marshall	03 5202 4600	Chris.marshall@cardno.com.au
Site Supervisor:	*To be appointed*		
RAP: Wadawurrung Traditional Owners Aboriginal Corporation	Stephanie Frydas	03 4308 0420	stephanie@wadawurrung.org.au
RAP: Aboriginal Heritage Officer	Jesse Lovett	0416 220 493	jesse@wadawurrung.org.au
Heritage Advisor:	Daniel Barker	0478 142 809	dbarker@terraculture.com.au

Table 2: Contact details for dispute resolution.

2.3 Discovery of Aboriginal Human Remains during Works

Unexpected Discovery of Human Remains If suspected human remains are discovered, you must contact the RAP, Victoria Police and the State Coroner's Office immediately. If there are reasonable grounds to believe that the remains are Aboriginal, the Coronial Admissions and Enquiries hotline must be contacted on 1300 888 544. This advice has been developed further and is described in the following five step contingency plan. Any such discovery at the activity area must follow these steps.

Any such discovery at the activity area must follow these steps.

2.3.1 Stop Works

1. If suspected human remains are discovered, all activity in the vicinity must stop.
2. The remains must be left in place and protected from harm or damage.

2.3.2 Notification of Relevant Parties of Discovery

- If suspected human remains have been found, the State Coroner's Office and the Victoria Police must be notified immediately;
- If there are reasonable grounds to believe the remains are Aboriginal Ancestral Remains, the Coronial Admissions and Enquiries hotline must be immediately notified on 1300 888 544;

- The Wadawurrung Traditional Owners Aboriginal Corporation have requested that they also be independently informed of the discovery;
- All details of the location and nature of the human remains must be provided to the relevant authorities;
- Do not take any photographs without the express request of the State Coroner's Office;
- If it is confirmed by these authorities the discovered remains are Aboriginal Ancestral Remains, the person responsible for the activity must report the existence of them to the Victorian Aboriginal Heritage Council on (03) 8392 5392 in accordance with section 17 of the *Aboriginal Heritage Act 2006*.
- Do not contact the media.

2.3.3 Impact Mitigation of Salvage

- The Victorian Aboriginal Heritage Council, after taking reasonable steps to consult with any Aboriginal person or body with an interest in the Aboriginal Ancestral Remains, will determine the appropriate course of action as required by section 18(2)(b) of the *Aboriginal Heritage Act 2006*;
- An appropriate impact mitigation or salvage strategy as determined by the Victorian Aboriginal Heritage Council must be implemented by the Sponsor.

Note: In consultation with the Wadawurrung Traditional Owners Aboriginal Corporation, the Sponsor may consider incorporating a contingency plan to reserve an appropriate area for repatriation and reburial of any recovered Aboriginal Ancestral Remains that may be discovered during the activity. This may assist the Victorian Aboriginal Heritage Council in determining an appropriate course of action.

2.3.4 Curation and Further Analysis

- The treatment of salvaged Aboriginal Ancestral Remains must be in accordance with the direction of the Victorian Aboriginal Heritage Council.

2.3.5 Reburial

- Any reburial site(s) must be fully documented by an experienced and qualified archaeologist, clearly marked, and all details provided to Aboriginal Victoria.
- The Wadawurrung Traditional Owners Aboriginal Corporation must be involved in any repatriation and reburial process.

- Appropriate management measures must be implemented to ensure that the remains are not disturbed in the future.

2.4 Discovery of Aboriginal Cultural Heritage during Activity

The procedure outlined in this section applies in the event of the discovery of any unexpected Aboriginal Cultural Heritage or that changes the previously understood nature and extent of the registered place, excluding Aboriginal human remains (which are covered in Section 2.3 of this plan), during the course of the Activity.

2.4.1 Discovery

1. If any unexpected Aboriginal Cultural Heritage or suspected Aboriginal Cultural Heritage is discovered during the activity, then works at the immediate location must then be suspended.
2. The person in charge of works must be immediately notified of the discovery or suspected discovery.
3. An exclusion zone of at least 10 metres around the site must be established using fencing, safety webbing or another suitable barrier with "no-go zone" signage attached and visible at all times, pending evaluation of the Aboriginal Cultural Heritage and the determination of an appropriate course of action. Works can recommence and continue at least 10 metres away from the area in which the Aboriginal Cultural Heritage was uncovered and/or identified.

2.4.2 Notification

1. The Wadawurrung Traditional Owners Aboriginal Corporation must be contacted in the first instance. A heritage advisor must facilitate the involvement of the Wadawurrung Traditional Owners Aboriginal Corporation. This will include an on-site investigation and assessment of the significance of the suspected Aboriginal cultural heritage.

2.4.3 Evaluation

1. The suspected Aboriginal cultural heritage must be examined by a qualified heritage advisor, a representative of the Wadawurrung Traditional Owners Aboriginal Corporation and a representative of the Sponsor. Within a period not exceeding five working days, the heritage advisor, in consultation with the Wadawurrung Traditional Owners Aboriginal Corporation, will make a decision or recommendation regarding the appropriate management of the Aboriginal cultural heritage and how to proceed with works.

2. If the find is confirmed as Aboriginal cultural heritage, the heritage advisor must record and register the site with the VAHR. This includes recording the location of the cultural material with a differential GPS and photography of the location of the cultural heritage. Additional measures to manage or salvage the Aboriginal cultural heritage must also be provided (see Section 2.4.4).
3. If the find is determined to not be Aboriginal cultural heritage, works at the location may recommence and temporary fencing and signage must be removed.

2.4.4 Determination of Course of Action

Section 2.1 stipulates that Section 61 of the Aboriginal Heritage Act 2006 is concerned with the avoidance and/or minimisation of harm to Aboriginal cultural heritage during and following the activity. This subsection outlines the steps that must be followed when there is an unexpected discovery of Aboriginal cultural heritage during the activity (confirmed at time of inspection as outlined in Section 2.4.3).

1. The heritage advisor, in consultation with the Sponsor and the Wadawurrung Traditional Owners Aboriginal Corporation, must provide a process to be followed to manage or salvage the Aboriginal cultural heritage in a manner which complies with the Aboriginal Heritage Regulations 2018 and which is culturally appropriate. This process must be provided within a period not exceeding five working days of the Aboriginal cultural heritage being inspected and confirmed; and
2. A process to manage or salvage the Aboriginal cultural heritage must consider the significance of the find in relation to the known archaeological and cultural heritage significance of existing sites in the region surrounding the activity area (see below).

A site that is determined to be of low scientific significance, such as isolated stone artefacts or fewer than five (5) artefacts:

a) Must be collected (salvaged) and the appropriate documentation completed and submitted to AV. Post-salvage management of Aboriginal cultural material is discussed in Section 2.5; and
b) No further management of the site is required once the above step has been completed to the satisfaction of all parties involved.

A site that is determined to be of moderate scientific significance, such as medium to high density artefact scatters, stratified occupation deposits, hearths or, occasionally, middens:

a) Must be protected in the first instance. A meeting with the Sponsor, heritage advisor and Wadawurrung Traditional Owners Aboriginal Corporation must be held to discuss strategies for avoiding harm to the Aboriginal cultural heritage. If it is not possible to protect the site in its entirety, a process to minimise harm to the Aboriginal cultural heritage must be developed. If it is not possible to minimise harm, a salvage process must be designed that must use an appropriate methodology as defined in the Guide to Preparing a Cultural Heritage Management Plan (Aboriginal Victoria 2016a), Guidelines for Conducting and Reporting on Aboriginal Cultural Heritage Investigations (Aboriginal Affairs Victoria 2012) and Practice Note: Salvage Excavation (Aboriginal Victoria 2016b);
b) At the conclusion of salvage works, the Aboriginal cultural heritage removed from the location must be recorded, catalogued and analysed and a salvage report produced of the excavation. The salvage report must be submitted to AV, Wadawurrung Traditional Owners Aboriginal Corporation, and the Sponsor within three months of the completion of fieldwork, as well as registering any updates to the existing site registration on the VAHR. Post-salvage management of Aboriginal cultural material is discussed in Section 2.5;
c) In the event that the Aboriginal cultural heritage is protected, or a process of harm minimisation is developed, works may recommence near the location of the Aboriginal cultural heritage once the agreed measures have been put in place to the satisfaction of all parties involved; and
d) In the event that salvage of the Aboriginal cultural heritage is undertaken, works may recommence within or near the location of the Aboriginal cultural heritage when the on-site salvage and recording has been completed to the satisfaction of all parties involved.

A site that is determined to be of high scientific significance, such as earth features (mounds, rings and ovens), quarries, stone arrangements or middens:

a) Must be protected; and
b) Works may only recommence near the location of the Aboriginal cultural heritage once the agreed protection measures have been put in place to the satisfaction of all parties involved.

2.4.5 Recommencement of Works

1. Works can recommence in the relevant area once all necessary recordings have occurred by the Heritage Advisor, and:
    a) Works can resume without risk to the discovered Aboriginal Cultural Heritage; or

b) The discovered Aboriginal Cultural Heritage has been removed from the relevant part of the works area (i.e. through salvage excavations); or
c) The actions agreed under Section 2.4.4 have been fully implemented.

2. It is the responsibility of the Heritage Advisor to ensure all Aboriginal Cultural Heritage records are updated and approved by the VAHR.

2.4.6 Custody and Management of Aboriginal Heritage Identified during Works

1. Custody and management of any Aboriginal Cultural Heritage identified during works (other than Aboriginal human remains or sacred objects) should comply with the requirements established by the Act and be assigned in following order of Priority:
   a) The RAP (Wadawurrung Traditional Owners Aboriginal Corporation).
   b) Registered Native Title Holder.
   c) Native Title party.
   d) Relevant Aboriginal person(s) with traditional or familial links.
   e) Relevant Aboriginal body or organisation with historical or contemporary links.
   f) The owner of the land.
   g) Museum Victoria.
2. Appropriate treatment of the Aboriginal Cultural Heritage material may involve curation or storage of the material, or reburial of the material within the activity area pursuant to Section 2.4.4 and the WTOAC standards outlined below.
3. The Sponsor/Sponsor’s Agent must consult with the relevant Aboriginal stakeholders as to the ultimate location of any Aboriginal heritage material.

The reburial of artefacts must be undertaken in accordance with the following WTOAC standard procedures:

a) Cultural material to be reburied must be placed in a durable container manufactured by the WTOAC;
b) A separate container is to be manufactured for each Aboriginal Place to be reburied;
c) Where an Aboriginal Place is comprised of a large amount of cultural material it will be necessary to manufacture a number of containers to rebury the cultural material;
d) The contents of the container must include the cultural material to be reburied, a catalogue of the cultural material to be reburied on both paper and on an archive quality storage medium, a

copy of the relevant sections of the CHMP under which the reburial is being performed and a handful of soil from the Aboriginal Place from which the cultural material originated;

e) The reburial must be attended by a Wadawurrung Traditional Owner and a representative;
f) A smoking ceremony must be performed prior to the reburial of cultural material;
g) Flagging tape must be laid within the hole at a depth of 300mm above the reburied cultural material to identify that cultural material is buried below the flagging tape;
h) Once reburied, the reburial location must be recorded to sub-metre accuracy by the HA and be relocatable;
i) The relevant VAHR site record card must be updated by submitting an Object Collection component form with the reburial location details. This must be completed by the HA and lodged with AV;
j) Following the reburial, interpretive signage must be placed within the activity area. The content of that interpretive signage, the method of its construction and the location for its placement must be developed in consultation with the WTOAC; and
k) The cost of the manufacture of the container, the analysis and preparation of the cultural material for reburial, smoking ceremony, WTOAC attendance at the reburial and any consultation with the WTOAC or materials associated with the interpretive signage must be borne by the Sponsor.

The costs associated with the recording of the reburial location and updating of the relevant VAHR site record by the HA must be borne by the Sponsor.

2.5 Protocol for Handling Sensitive Information

Where Aboriginal cultural heritage is identified before, during or after the proposed activity, the Sponsor and heritage advisor must ensure that all actions carried out to manage and protect Aboriginal cultural heritage are completed in a culturally appropriate manner. The Secretary and the Wadawurrung Traditional Owners Aboriginal Corporation consider all Aboriginal Places, objects and Aboriginal Ancestral Remains to be culturally sensitive.

Accordingly, unless undertaken by the heritage advisor for the purposes of recording Aboriginal Places or objects, during the course of implementing the management requirements there must not be any contact with the media including the use of social media, photography, film and digital images in relation to any aspect of Aboriginal cultural heritage without the written permission of the Wadawurrung Traditional Owners Aboriginal Corporation.

2.6 Reporting Discovery of Aboriginal Cultural Heritage During Works

It is a requirement to report the discovery of an Aboriginal Place or object to the Secretary as soon as practicable under the Aboriginal Heritage Act 2006 (Section 24). A system of reporting any possible Aboriginal cultural heritage items which are discovered during works must be built into any development or Environmental Management Plan (EMP) for the site (see Section 2.4.1 and 2.4.2).

The project manager must appoint a suitably qualified heritage advisor for the duration of the project. The heritage advisor will need to:

1. Be available to visit the site and inspect any reported items of suspected Aboriginal cultural heritage that may be found during works;
2. Facilitate the involvement of the Wadawurrung Traditional Owners Aboriginal Corporation during the investigation of the suspected Aboriginal cultural heritage, completion of site documentation and the further management or salvage of the cultural heritage;
3. Facilitate the involvement of an appropriately qualified archaeologist for any required excavation works;
4. Document any items of Aboriginal cultural heritage that are found during works and report the site/s to AV by means of registering the cultural heritage on the VAHR;
5. Advise on appropriate treatment or salvage of any Aboriginal cultural heritage; and
6. Provide adequate reporting on the treatment of any Aboriginal cultural heritage to standards required by AV.

Management of Aboriginal Cultural Heritage Discovered during Works When previously unrecorded Aboriginal cultural material is located during the works, it will be the responsibility of the heritage advisor to:

1. Catalogue the Aboriginal cultural heritage;
2. Label and package the Aboriginal cultural heritage with reference to provenance;
3. Arrange storage of the Aboriginal cultural heritage in a secure location with copies of the catalogue and assessment documentation;
4. The Wadawurrung Traditional Owners Aboriginal Corporation request that at the conclusion of all site works and within a period of no longer than 12 months, the Aboriginal cultural heritage must be reburied together with relevant documentation in a durable sealed container within the activity area at a location agreed upon with the Wadawurrung Traditional Owners Aboriginal

Corporation and that the reburial location be recorded by a heritage advisor using a differential GPS, followed by lodgement of the relevant VAHR forms to AV for entry into the VAHR; and

5. The Sponsor, as well as the Wadawurrung Traditional Owners Aboriginal Corporation, must be involved in the discussions about the reburial location to ensure that the reburied cultural heritage will not be disturbed in the future.

2.7 Reviewing Compliance

To ensure that the work carried out follows the conditions of the CHMP, a copy of the checklist, included as Appendix B, must be present on site during the Activity and referred to as necessary.

1. All non-compliance issues must result in stop works until a meeting with the Sponsor and RAP is held to determine the process to be followed moving forward. The meeting must be held as soon as practicable;
2. Compliance with the conditions of an approved CHMP or Cultural Heritage Permit is mandatory under the *Aboriginal Heritage Act* 2006 (Vic). Non-compliance is an offence under the *Aboriginal Heritage Act* (2006) and the Sponsor may be charged accordingly;
3. Should the conditions of this approved CHMP not be followed, then the RAP and AV must be contacted immediately;
4. Should the conditions of the approved CHMP not be followed and harm has occurred to Aboriginal cultural heritage then the RAP and AV must be contacted immediately;
5. When non-compliance is suspected that has resulted in harm to Aboriginal cultural heritage, the Minister for Aboriginal Victoria may order a Cultural Heritage Audit under Section 80. An audit may be undertaken independently of an order from the Minister to ensure compliance; and
6. Where AV finds a breach of the CHMP has resulted in the harming of Aboriginal cultural heritage, the sponsor may be directed to remedy the harm.

Part 2: Assessment

3.0 Introduction

3.1 Reasons for Preparing the Management Plan

This CHMP has been prepared pursuant to s.46 (1)a of the *Aboriginal Heritage Act* 2006 (the 'Act'). The *Aboriginal Heritage Regulations* 2018 (the 'Regulations') specify the circumstances in which a CHMP is required for an activity or class of activity. Regulation 7 specifies that a CHMP is required if:

- All or part of the Activity Area is within an area of cultural heritage sensitivity; and
- All or part of the activity is a high impact Activity.

Regulation 26 states that a waterway or land within 200 metres of a waterway is an area of cultural heritage sensitivity. Bruce Creek runs through the south-eastern section of the Activity Area. Therefore, the activity area is situated in an area of cultural heritage sensitivity.

Division 5 of the Regulations defines what is considered a high impact activity. Regulation 49 states that (1) the subdivision of land into 3 or more lots is a high impact activity if (a) the planning scheme that applies to the activity area in which the land to be subdivided is located provides that at least 3 of the lots may be used for a dwelling or may be used for a dwelling subject to the grant of a permit; and (b) the area of each of at least 3 of the lots is less than 8 hectares. The proposed activity involves the subdivision of the activity area into between 172-199 lots of less than 8 hectares per lot to be used for dwellings. Therefore, it is a High Impact Activity under the *Aboriginal Heritage Regulations* 2018.

As a result, this is a *mandatory* Cultural Heritage Management Plan under Section 46 (1)a of the Act.

3.2 Notices Given

Under Section 54 of the *Act*, the sponsor has submitted a written *Notice of Intention to Prepare a Management Plan* (NOI) to Aboriginal Victoria, the LGA and the RAP. A copy of correspondence with the LGA, the Notice of Intention and the Notice to Evaluate from the RAP are included in this CHMP as Appendix A.

3.3 Relevant Parties

3.3.1 Sponsor

The sponsor for this CHMP is Cardno TGM Pty Ltd.

Chris Marshall
PO Box 1137, Geelong VIC 3220
Ph: 03 5202 4600
Email: chris.marshall@cardno.com.au
ABN: 11 125 568 461

3.3.2 Heritage Advisor

The Heritage Advisor for this project is Daniel Barker. Daniel holds a Bachelor of Archaeology (Honours) from La Trobe University (2015) and a Bachelor of Arts (International Studies) majoring in History from Victoria University (2009). Daniel is a qualified Heritage Advisor under the *Aboriginal Heritage Act* 2006.

3.3.3 Registered Aboriginal Parties (RAPs)

The *Aboriginal Heritage Act* 2006 requires consultation with any Registered Aboriginal Parties (RAPs) under the Act. The Wadawurrung Traditional Owners Aboriginal Corporation (WTOAC) is a Registered Aboriginal Party under the *Aboriginal Heritage Act* 2006 (Vic) and as defined in that Act, has responsibilities under that Act in relation to the management and administration of Aboriginal Cultural Heritage matters in the Activity Area.

The WTOAC has elected to evaluate the CHMP and the written notice to evaluate from the RAP is included in Appendix A.

3.3.4 Owners and Occupiers of Relevant Land

The following table lists the current owners and occupiers of the activity area:

Address	Lot No.	Owner/Occupier
5 Ormond Street, Bannockburn	Allotment 12 Section 22B	Kelly Inglis
20 Ormond Street, Bannockburn	Allotment 11 Section 22B	David and Ines Collins
25 Ormond Street, Bannockburn	Allotment 10 Section 22B	Phillip Kennedy
30 Ormond Street, Bannockburn	Lot 1 TP174543	Ian and Barbara Hinchcliffe

Table 3: Owners/Occupiers of the activity area.

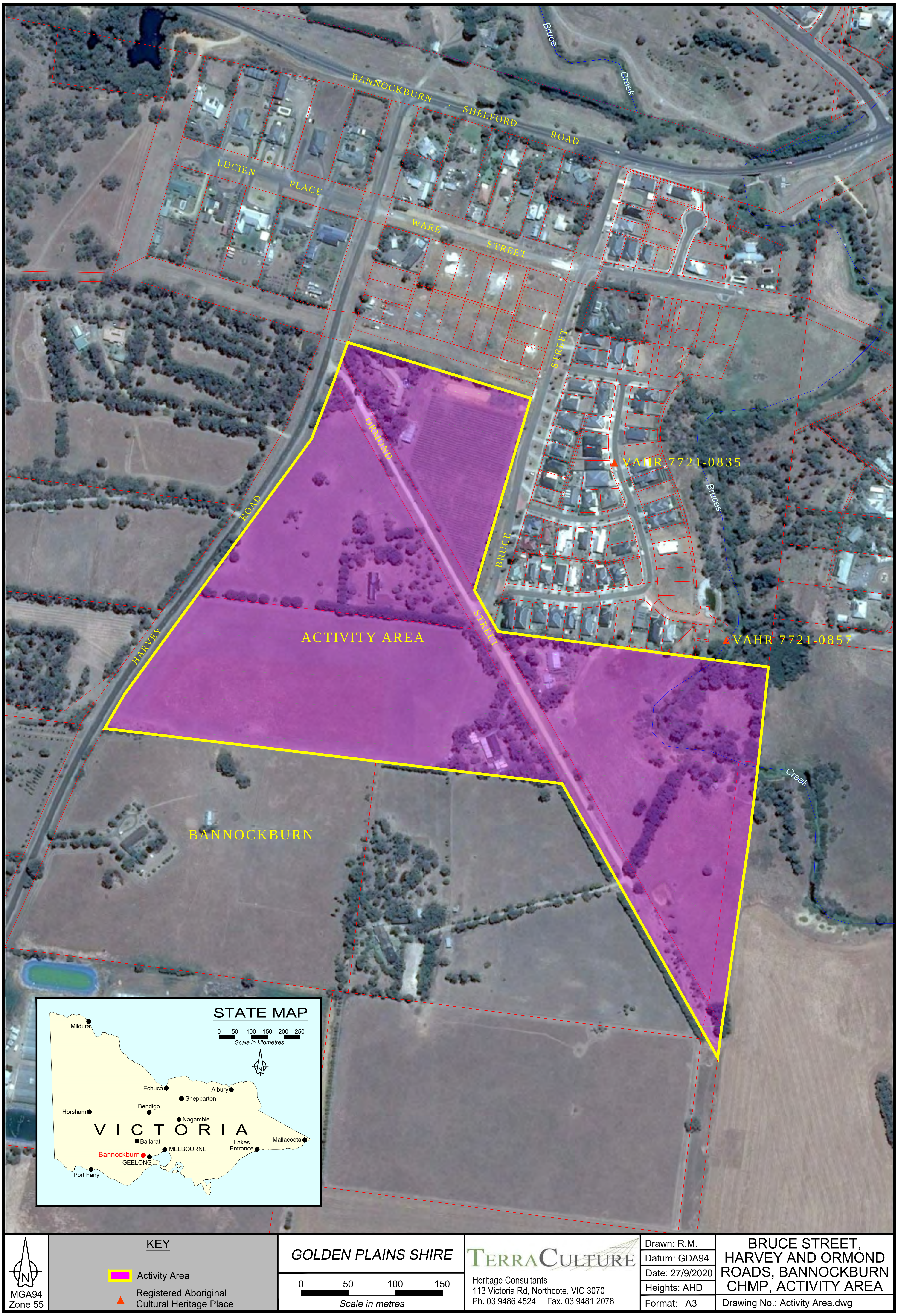
3.4 Location of Activity Area

The Activity Area is located on four parcels of land at 5, 20, 25, and 30 Ormond Street, Bannockburn, approximately 20km north-west of Geelong CBD. The Activity Area is part of Lot 1 TP174543, 10 22B, 11 22 B, and 12 22B in the City of Greater Geelong, Parish of Murgheboluc.

3.5 Acknowledgements

TerraCulture wishes to acknowledge the following people and organisations for their contribution to the preparation of this management plan:

- Chris Marshall & Nicole Dixon (Cardno TGM)
- Kelly Inglis, David & Ines Collins, Phillip Kennedy, and Ian & Barbara Hinchliffe (property owners/occupiers)
- Stephanie Frydas, Bonnie Chew, Blair Gilson, Kacie Mitchell, BJ O’Toole, Richard Fagan, Alisha Fagan, Ash Skinner, Kyle O’Toole, Chloe Clarke, Jon Naylor, and James Brown (WTOAC)
- Gary Paydon (Belmara Industries)



MAP 2: Showing the location of the Activity Area.

4.0 Activity Description

4.1 Proposed Activity

The proposed activity involves the rezoning and development of approximately 190,000m^2 (19ha) for the construction of a multi-lot residential subdivision, along with associated landscaping, footpaths, and vehicle access roads. The proposed subdivision is still in the development stages and is subject to changes. The current activity plans are presented in Appendix D of this report. Any changes to the plans will not affect the overall impact on Aboriginal cultural heritage. The activity area is currently zoned as Farming Zone (FZ) under the City of Greater Geelong planning scheme. However, the proposed development facilitates the rezoning of the activity area for residential purposes. The proposed development will include the following activities:

- The potential demolition of some (or all) of the existing house and outbuildings.
- The creation of between 172- 199 residential lots of varying size.
- An internal road will be constructed through the Activity Area.
- An area will be reserved along Bruce Creek for draining and municipal purposes.
- Infrastructure supply includes electricity, gas, water, sewerage and telecommunications.

4.2 Ground Disturbance

Ground disturbance will occur over most of the Activity Area to varying depths. Excavations for the construction of buildings, roads, drainage reserves and the installation of services will range from shallow to deep excavation. The exact depth of excavation required for the building construction is not currently known and will be determined by the structural engineer.

It is expected that the subdivision of the lots will require excavation to depths of up to approximately 3 metres for the building foundations. Associated services are expected to require excavations of depths up to approximately 1.5 metres for electricity, gas and telecommunications, 2 metres for water reticulation and 3 metres for sewer reticulation. The construction of the roadway and associated stormwater drainage will require excavation of depths up to approximately 2 metres. The construction of the wetlands and boardwalk will require excavations of up to 3 metres depth. There are areas of open space surrounding the wetland reserves which will likely only see minimal ground disturbance of up 0.5 metres in some places for footpaths and landscaping.

5.0 Extent of Activity Area

The Activity Area is located on four parcels of land at 5, 20, 25, and 30 Ormond Street, Bannockburn, approximately 20km north-west of Geelong CBD. The Activity Area is part of Lot 1 TP174543, 10 22B, 11 22 B and 12 22B in the City of Greater Geelong and the Parish of Murgheboluc. The Activity Area is approximately 19 hectares (190,000m^2).

5.1 Existing Conditions

The Activity Area samples two geological landforms, the Moorabool Viaduct Sand formation and the Fyansford Clay formation. The Moorabool Viaduct Sand formation covers the majority of the Activity Area, and is characterised by flat, volcanic plains. The Fyansford Clay formation covers the eastern section of the Activity Area around Bruce Creek and is characterised by plains and plains with low rises. The entirety of the Activity Area is currently being used for agricultural purposes, including viticulture and livestock grazing.

The majority of the Activity Area is comprised of agricultural paddocks with a thick cut grass cover. The northern section of the Activity Area contains a small vineyard and dam. Four houses and associated amenities including sheds are located throughout the Activity Area, in the north, east and southeast sections. The ground surface still shows the effects of prior land-use with corrugation from ploughing evident. Bruce Creek runs north-south through a small portion of the eastern section of the Activity Area.

6.0 Documentation of Consultation

6.1 Consultation in Relation to the Assessment

The following section provides details of the consultation in relation to the assessment of the Activity Area for the purposes of the management plan.

On Jun 19, 2018, Catherine Webb of TerraCulture lodged a Notice of Intent (NOI) to prepare Cultural Heritage Management Plan to AV. Once submitted, the NOI was sent to the WTOAC. The NOI was also sent to the LGA, which in this case is the City of Greater Geelong.

An inception meeting was held at the WTOAC Ballarat office to discuss the project. The WTOAC stated that they wanted a separate meeting following the Standard Assessment in which the subsurface testing methodology could be discussed. Following the inception meeting, the Standard Assessment was undertaken. This resulted in the recording of three Aboriginal stone artefacts on top of the ridge along Bruce Creek. It was determined that the ridgeline and slopes were the areas most likely to be sensitive for Aboriginal cultural heritage. It was also determined that the volcanic plains landform was likely to only contain low density artefacts. A post-Standard Assessment meeting was then held at the WTOAC Ballarat office to discuss the results of the survey and to develop the Complex Assessment methodology. It was determined that two 1m x 1m test pits were to be placed sampling both the ridgeline and Volcanic Plains landforms. A grid of 1m x 3m machine test pits were to be spaced every 25 metres on the ridgeline and slopes and spaced every 50 metres in order to test the entire activity area while focussing more closely on the area identified as more sensitive.

An additional meeting was organised to discuss further refinement of the subsurface testing methodology for the Complex Assessment due to budget constraints from the Sponsor. Stephanie Frydas (RAP Approvals Officer) identified a number of MTPs from the grid on the volcanic plains landform that were not required to be excavated as they were in areas not likely to be sensitive. Machine test pits containing artefacts on the ridgeline and slopes did not require extent testing as the place extent would be defined by landform. The size of excavation units was discussed, and SF suggested that 2m x 1m MTPs could be excavated instead of 3m x 1m previously proposed. MTPs containing artefacts on the Volcanic Plains landform did not require extent testing unless the density of artefacts was greater than the threshold for a LDAD registration.

The Complex Assessment was undertaken over seven days. Subsurface excavation involved four 1m x 1m test pits, five 0.5m x 0.5m radial test pits, and forty-nine 2m x 1m mechanical test pits. A total of three hundred and twelve artefacts were recorded during the Complex Assessment. The artefacts, along with the three artefacts found during the Standard Assessment, were registered as three distinct sites: Bruces Creek Artefact Scatter (VAHR 7721-1435), Manifold Street Artefact Scatter (VAHR 7721- 1434), and Ormond Street LDAD (VAHR 7721-1436). Blair Gilson (RAP Compliance Officer) visited the site on 16 January 2020 and was happy with the progress of the assessment.

The Post-Complex Assessment meeting was held via video conference to discuss the results of the assessment and to determine the management conditions. The results of the Aboriginal cultural heritage assessment were presented, showing the density and locations of Aboriginal cultural heritage in the activity area. Bonnie and Blair stated that they were happy with the amount of testing that was undertaken as part of the assessment. The management conditions were discussed, and it was agreed that these would include salvage excavations within the place extent for VAHR 7721-1435 at the locations of MTP61 (2m x 2m hand excavated salvage pit) and MTP25 (5m x 5m mechanical salvage pit). No salvage excavations were required for VAHR 7721-1436 and 7721-1434. Other standard conditions such as the approved CHMP on site, cultural heritage inductions, three compliance checks by the RAP, the retention of excavated material and the return of artefacts for reburial are also required.

Date	Participants	Consultation Type
19 Jun 2018	TerraCulture- Catherine Webb (Director) AV (Admin) WTOAC (Admin)	Notice of Intent to prepare Cultural Heritage Management Plan submitted and sent to WTOAC. Notice to Evaluate received from the WTOAC.
10-Dec-2020	LGA- City of Greater Geelong	Notice of Intent to prepare Cultural Heritage Management Plan sent to the LGA.
14 Sep 2018	TerraCulture- Daniel Barker (HA) WTOAC- Stephanie Frydas (RAP Approvals Officer) WTOAC- Danielle Dickie (Business Administrator) Cardno TGM- Chris Marshall (Sponsor)	Inception meeting.

Date	Participants	Consultation Type
1 Mar 2019	TerraCulture- Daniel Barker (HA) TerraCulture- Anna MacNeill (Field Archaeologist) WTOAC- Kacie Mitchell (RAP Field Rep) WTOAC- BJ O'Toole (RAP Field Rep)	Standard Assessment.
3 Apr 2019	TerraCulture- Daniel Barker (HA) WTOAC- Stephanie Frydas (RAP Approvals Officer) WTOAC- Danielle Dickie (Business Administrator) Cardno TGM- Andrew Grey (Sponsor's Rep)	Post-Standard Assessment meeting.
8 Aug 2019	TerraCulture- Daniel Barker (HA) WTOAC- Stephanie Frydas (RAP Approvals Officer) Cardno TGM- Chris Marshall (Sponsor)	Additional meeting to discuss further refinement of the subsurface testing methodology for the Complex Assessment.
15-16 & 20-24 Jan 2020	TerraCulture- Daniel Barker (HA) TerraCulture- Emily Knowles (Field Archaeologist) TerraCulture- Helene Athanasiadis (Supervising Archaeologist) WTOAC- Richard Fagan (RAP Field Rep) WTOAC- Alisha Fagan (RAP Field Rep) WTOAC- Ash Skinner (RAP Field Rep) WTOAC- Kyle O'Toole (RAP Field Rep) WTOAC- Chloe Clarke (RAP Field Rep) WTOAC- Jon Naylor (RAP Field Rep) WTOAC- James Brown (RAP Field Rep) WTOAC- Blair Gilson (RAP Compliance Officer) Belmara Industries- Gary Paydon (Excavator Operator)	Complex Assessment.

Date	Participants	Consultation Type
2 Mar 2020	TerraCulture- Daniel Barker (HA) WTOAC- Stephanie Frydas (RAP Approvals Officer) WTOAC- Bonnie Chew (Acting RAP Manager) WTOAC- Blair Gilson (RAP Compliance Officer) Cardno TGM- Chris Marshall (Sponsor)	Post-Complex Assessment Meeting.

Table 4: Documentation of consultation undertaken during the assessment.

6.2 Participation in the Conduct of the Assessment

Table 5 records the personnel and organisations that participated in the conduct of the Desktop, Standard and Complex Assessments for this CHMP.

Dates	Name	Organisation	Role
1 Mar 2019	Kacie Mitchell	WTOAC	RAP representative, Standard Assessment
1 Mar 2019	BJ O'Toole	WTOAC	RAP representative, Standard Assessment
15-16 and 24 Jan 2020	Richard Fagan	WTOAC	RAP representative, Complex Assessment
15-16 Jan 2020	Alisha Fagan	WTOAC	RAP representative, Complex Assessment
20 Jan 2020	Ash Skinner	WTOAC	RAP representative, Complex Assessment
20 and 22 Jan 2020	Kyle O'Toole	WTOAC	RAP representative, Complex Assessment
21 Jan 2020	Chloe Clarke	WTOAC	RAP representative, Complex Assessment
22 Jan 2020	Jon Naylor	WTOAC	RAP representative, Complex Assessment
23 Jan 2020	James Brown	WTOAC	RAP representative, Complex Assessment
1 Mar 2019, 15-16, 20-24 Jan 2020	Daniel Barker	TerraCulture	HA, Desktop, Standard and Complex Assessments, report writing
1 Mar 2019	Anna MacNeill	TerraCulture	Standard Assessment
15-16, 20-24 Jan 2020	Emily Knowles	TerraCulture	Complex Assessment, report writing
20-22 Jan 2020	Helene Athanasiadis	TerraCulture	Complex Assessment
	Catherine Webb	TerraCulture	Administration, editing
	Richard Marshall	TerraCulture	Mapping and spatial data

Dates	Name	Organisation	Role
20-21 and 23-24 Jan 2020	Gary Paydon	Belmara Industries	Excavator Operator

Table 5: List of participants and organisations involved in the assessment.

6.3 Summary of Outcomes of Consultation

The Wadawurrung Traditional Owners Aboriginal Corporation (WTOAC) is the designated Registered Aboriginal Party (RAP) for the study area. As a result, this CHMP will be evaluated by the WTOAC and they participated in and were consulted throughout the conduct of the assessment. The outcomes of the consultation process are as follows:

- Consultation with the RAP during the post-Standard Assessment meeting led to a proposed subsurface testing methodology that included manual and mechanical testing throughout the Activity Area.
- The fieldwork for the Standard and Complex Assessments resulted in the registration of three Aboriginal cultural heritage places, Ormond Street LDAD (VAHR 7721-1436), Bruces Creek Artefact Scatter (VAHR 7721-1435), and Manifold Street Artefact Scatter (VAHR 7721-1434).
- The Post-Complex Assessment meeting resulted in management conditions including salvage excavations of VAHR 7721-1435 at the locations of MTP61 (2m x 2m hand excavated salvage pit) and MTP25 (5m x 5m mechanical salvage pit). Other standard conditions such as the approved CHMP on site, cultural heritage inductions, three compliance checks by the RAP, the retention of excavated material and the return of artefacts for reburial are also required.

7.0 Desktop Assessment

7.1 Search of the Victorian Aboriginal Heritage Register (VAHR)

Aboriginal Victoria (AV) maintains the Victorian Aboriginal Heritage Register (VAHR). The VAHR is an online register of all recorded Aboriginal archaeological sites, Aboriginal Historic Places and a library of all published and unpublished reports describing investigations of Aboriginal Cultural Heritage Places in Victoria. The VAHR was accessed by Daniel Barker on 17 May 2019, and again by Emily Knowles on December 12, 2020.

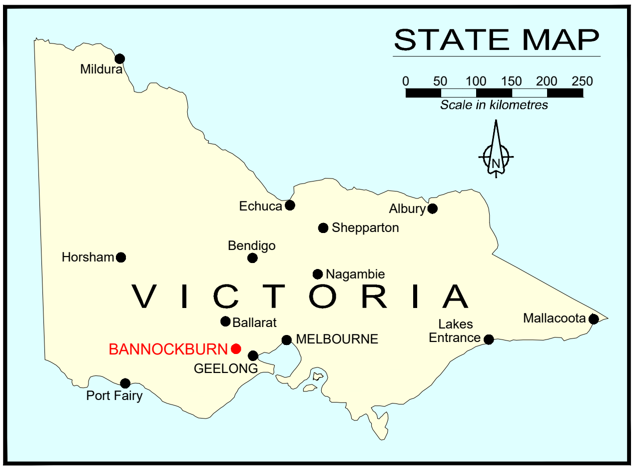
Background research was undertaken into the cultural heritage context and environmental history of the activity area. This involved reviewing existing information on the activity area including:

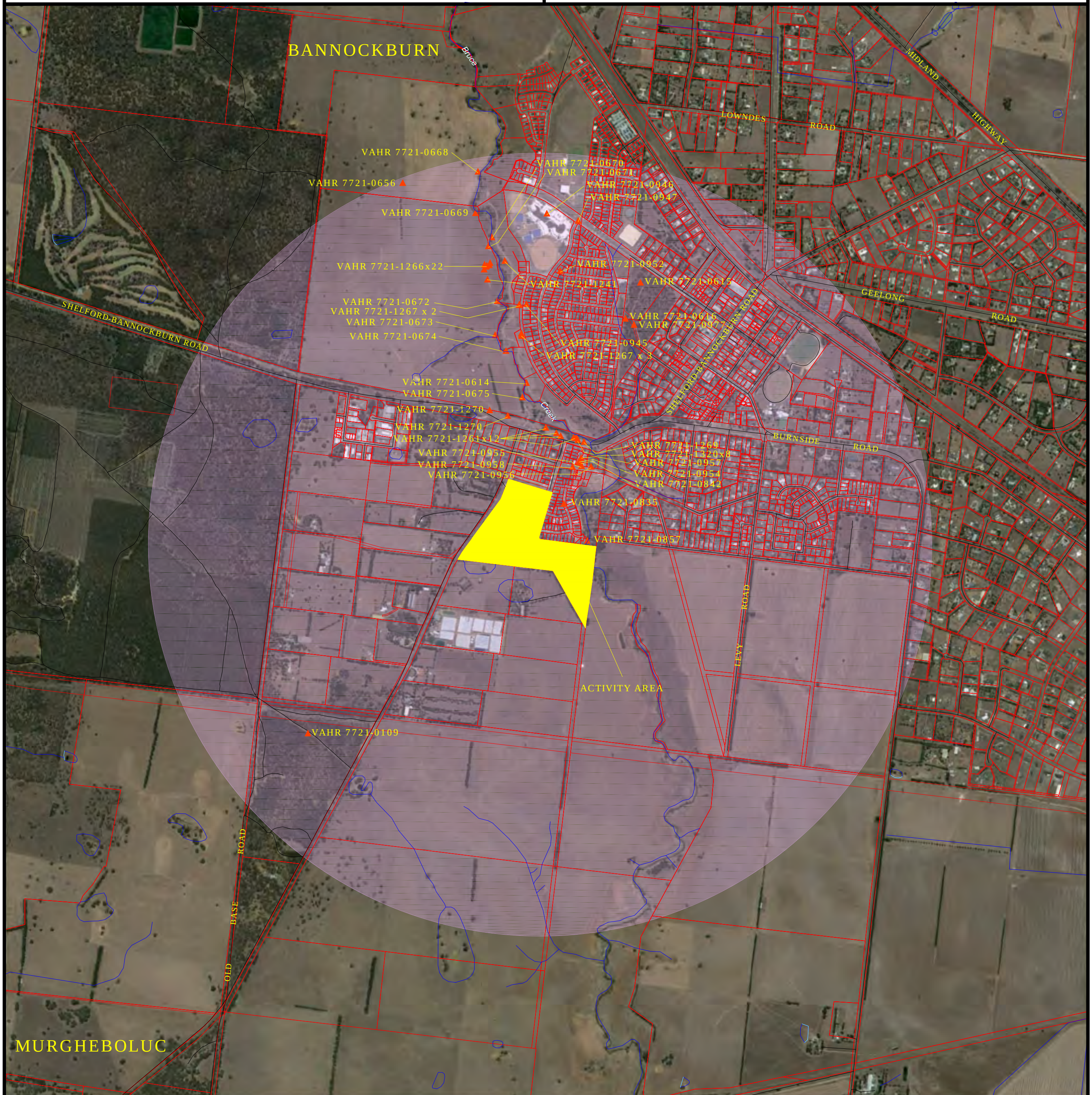
- Any reports from previous heritage surveys undertaken in or within the vicinity of the activity area or on any relevant cultural heritage matters;
- Any published works about cultural heritage in the relevant geographic region;
- Any historical and ethno-historical accounts of Aboriginal occupation of the relevant geographic region; and
- Any oral history relating to the activity area.

There were no limitations or obstacles in the conduct of the desktop assessment.

7.2 The Geographic Region

For the purposes of this CHMP the geographic region is arbitrarily defined as the area two kilometres from the centre of the Activity Area, providing a relevant sample of the landforms and geomorphological regions in the area (Map 3). The region has been selected as it provides an important dataset for predicting the nature, extent and significance of any Aboriginal cultural heritage places in the activity area. The geographic region samples a variety of geological formations and environmental vegetation classes (EVCs) which likely influenced Aboriginal occupation of the area in and around the activity area through the availability of resources. Geological formations of the area are comprised mainly of Moorabool Viaduct Sands, as well as Newer Volcanics to the north and east. The area also includes part of Bruce Creek.





KEY	GOLDEN PLAINS SHIRE	TerraCulture HERITAGE CONSULTANTS	Drawn: R.M.	BRUCE STREET BANNOCKBURN, CHMP GEOGRAPHIC REGION
MGA94 Zone 55; Activity Area; Geographic Region; Registered Aboriginal Cultural Heritage Place	0 .25 .5 .75 1 Scale in Kilometres	113 Victoria Road, Northcote, VIC 3070 Ph. 03 9486 4524 Fax. 03 9481 2078	Datum: GDA94; Date: 27/9/2020; Heights: AHD; Format: A3	Drawing No.: Map 2 - Geographic Region.dwg

MAP 3: Showing Geographic Region and Registered Aboriginal Cultural Heritage Places.

7.3 VAHR Search Results

7.3.1 Aboriginal Heritage Places within the Activity Area

An examination of the data held at the VAHR showed no previously registered Aboriginal places within the activity area at the time of preparation.

7.3.2 Aboriginal Heritage Places within the Geographic Region

A total of ninety Aboriginal Cultural Heritage Places are located within the geographic region. These places consist primarily of low-density artefact distributions, but also contain artefact scatters and four scarred trees. The nearest previously registered Aboriginal place is the Bruces Creek Artefact Scatter (VAHR 7721-0835). This artefact scatter was made up of one hundred and forty-three stone artefacts made of quartz, quartzite, and silcrete located approximately 110 metres to the east of the current Activity Area.

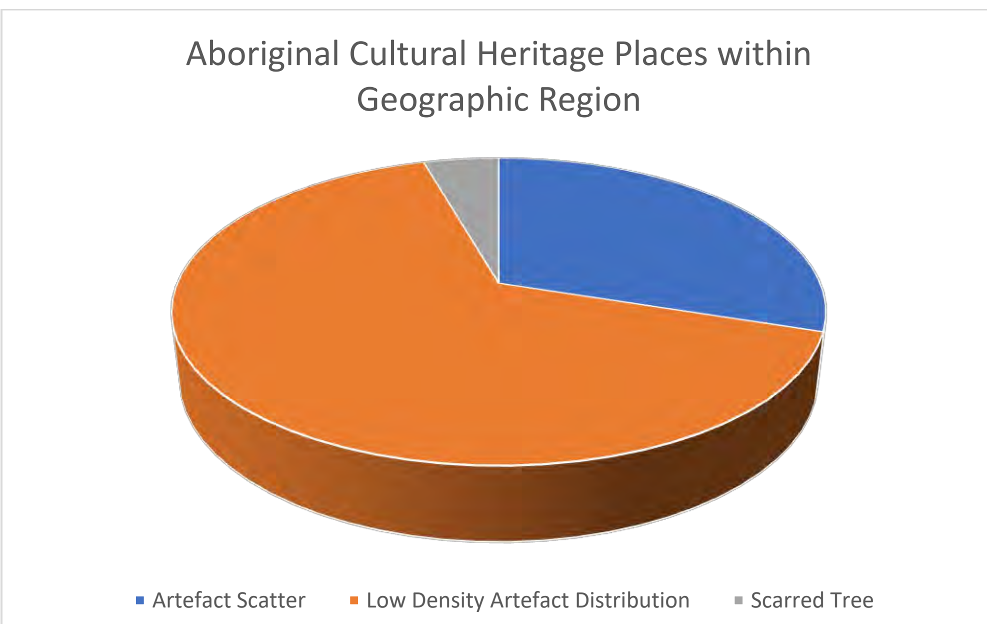
Aboriginal Place Name	Component Place Number	Component Type	Distance from Activity Area (m)
BANNOCKBURN 1	7721-0109-1	Scarred Tree	1314
BRUCES'S CREEK 5	7721-0614-1	Scarred Tree	492
WABDALLAH RESERVE 1	7721-0615-1	Artefact Scatter	1142
WABDALLAH RESERVE 2	7721-0616-1	Artefact Scatter	920
BRUCES'S CREEK 6	7721-0655-1	Artefact Scatter	1711
BRUCES'S CREEK 7	7721-0656-1	Artefact Scatter	1602
BRUCES'S CREEK 18	7721-0667-1	Artefact Scatter	1693
BRUCES'S CREEK 19	7721-0668-1	Artefact Scatter	1566
BRUCES'S CREEK 20	7721-0669-1	Artefact Scatter	1375
BRUCES'S CREEK 21	7721-0670-1	Scarred Tree	1257
BRUCES'S CREEK 22	7721-0671-1	Artefact Scatter	1194
BRUCES'S CREEK 23	7721-0672-1	Artefact Scatter	903
BRUCES'S CREEK 24	7721-0673-1	Artefact Scatter	725
BRUCES'S CREEK 25	7721-0674-1	Artefact Scatter	635
BRUCES'S CREEK 26	7721-0675-1	Artefact Scatter	413
BRUCES Creek ARTEFACT SCATTER	7721-0835-1	Artefact Scatter	110
BRUCES STREET 9	7721-0842-1	Artefact Scatter	225
MILTON STREET 1	7721-0945-1	Artefact Scatter	882
MILTON STREET 2	7721-0946-1	Artefact Scatter	1358
MILTON STREET 3	7721-0947-1	Artefact Scatter	1340
MILTON STREET 4	7721-0948-1	Artefact Scatter	1721
MILTON STREET 5	7721-0949-1	Artefact Scatter	1681
MILTON STREET 8	7721-0952-1	Scarred Tree	1068
WARE STREET 1	7721-0954-1	Artefact Scatter	219
WARE STREET 2	7721-0955-1	Artefact Scatter	218
WARE STREET 3	7721-0956-1	Artefact Scatter	255
WARE STREET 4	7721-0957-1	Artefact Scatter	243

Aboriginal Place Name	Component Place Number	Component Type	Distance from Activity Area (m)
WARE STREET 5	7721-0958-1	Artefact Scatter	176
Wabdallah Reserve 3	7721-0977-1	Artefact Scatter	947
Bruces Creek Bannockburn	7721-1241-1	Artefact Scatter	1091
Pullouds Bridge 1	7721-1261-1	Low Density Artefact Distribution	306
Pullouds Bridge 1	7721-1261-2	Low Density Artefact Distribution	306
Pullouds Bridge 1	7721-1261-3	Low Density Artefact Distribution	306
Pullouds Bridge 1	7721-1261-4	Low Density Artefact Distribution	306
Pullouds Bridge 1	7721-1261-5	Low Density Artefact Distribution	306
Pullouds Bridge 1	7721-1261-6	Low Density Artefact Distribution	306
Pullouds Bridge 1	7721-1261-7	Low Density Artefact Distribution	302
Pullouds Bridge 1	7721-1261-8	Low Density Artefact Distribution	285
Pullouds Bridge 1	7721-1261-9	Low Density Artefact Distribution	294
Pullouds Bridge 1	7721-1261-10	Low Density Artefact Distribution	290
Pullouds Bridge 1	7721-1261-11	Low Density Artefact Distribution	289
Pullouds Bridge 1	7721-1261-12	Low Density Artefact Distribution	289
Bruces Creek LDAD	7721-1266-1	Low Density Artefact Distribution	1077
Bruces Creek LDAD	7721-1266-2	Low Density Artefact Distribution	1084
Bruces Creek LDAD	7721-1266-3	Low Density Artefact Distribution	1084
Bruces Creek LDAD	7721-1266-4	Low Density Artefact Distribution	1084
Bruces Creek LDAD	7721-1266-5	Low Density Artefact Distribution	1084
Bruces Creek LDAD	7721-1266-6	Low Density Artefact Distribution	1126
Rosemond Way LDAD	7721-1267-1	Low Density Artefact Distribution	744
Rosemond Way LDAD	7721-1267-2	Low Density Artefact Distribution	744
Rosemond Way LDAD	7721-1267-3	Low Density Artefact Distribution	744
Rosemond Way LDAD	7721-1267-4	Low Density Artefact Distribution	880
Rosemond Way LDAD	7721-1267-5	Low Density Artefact Distribution	880

Aboriginal Place Name	Component Place Number	Component Type	Distance from Activity Area (m)
Bannockburn-Shelford Road LDAD	7721-1270-1	Low Density Artefact Distribution	313
Bannockburn-Shelford Road LDAD	7721-1270-2	Low Density Artefact Distribution	355
Bannockburn-Shelford Road AS	7721-1269-1	Artefact Scatter	314
Bruces Creek LDAD	7721-1266-7	Low Density Artefact Distribution	1077
Bruces Creek LDAD	7721-1266-8	Low Density Artefact Distribution	1084
Bruces Creek LDAD	7721-1266-9	Low Density Artefact Distribution	1084
Bruces Creek LDAD	7721-1266-10	Low Density Artefact Distribution	1084
Bruces Creek LDAD	7721-1266-11	Low Density Artefact Distribution	1084
Bruces Creek LDAD	7721-1266-12	Low Density Artefact Distribution	1084
Bruces Creek LDAD	7721-1266-13	Low Density Artefact Distribution	1084
Bruces Creek LDAD	7721-1266-14	Low Density Artefact Distribution	1084
Bruces Creek LDAD	7721-1266-15	Low Density Artefact Distribution	1126
Bruces Creek LDAD	7721-1266-16	Low Density Artefact Distribution	1126
Bruces Creek LDAD	7721-1266-17	Low Density Artefact Distribution	1084
Bruces Creek LDAD	7721-1266-18	Low Density Artefact Distribution	1084
Bruces Creek LDAD	7721-1266-19	Low Density Artefact Distribution	1084
Bruces Creek LDAD	7721-1266-20	Low Density Artefact Distribution	1084
Bruces Creek LDAD	7721-1266-21	Low Density Artefact Distribution	1084
Bruces Creek LDAD	7721-1266-22	Low Density Artefact Distribution	1084
Bruces Creek LDAD	7721-1266-23	Low Density Artefact Distribution	1084
Bruces Creek LDAD	7721-1266-24	Low Density Artefact Distribution	1084
Bruces Creek LDAD	7721-1266-25	Low Density Artefact Distribution	1084
Bruces Creek LDAD	7721-1266-26	Low Density Artefact Distribution	1084
Bruces Creek LDAD	7721-1266-27	Low Density Artefact Distribution	1084

Aboriginal Place Name	Component Place Number	Component Type	Distance from Activity Area (m)
Bruces Creek LDAD	7721-1266-28	Low Density Artefact Distribution	1084
Somerset Estate LDAD	7721-1315-7	Low Density Artefact Distribution	1676
Somerset Estate LDAD	7721-1315-8	Low Density Artefact Distribution	1676
Somerset Estate LDAD	7721-1315-9	Low Density Artefact Distribution	1676
Somerset Estate LDAD	7721-1315-10	Low Density Artefact Distribution	1676
Pullouds Bridge 1 COLLECTION	7721-1320-1	Low Density Artefact Distribution	309
Pullouds Bridge 1 COLLECTION	7721-1320-2	Low Density Artefact Distribution	309
Pullouds Bridge 1 COLLECTION	7721-1320-3	Low Density Artefact Distribution	309
Pullouds Bridge 1 COLLECTION	7721-1320-4	Low Density Artefact Distribution	309
Pullouds Bridge 1 COLLECTION	7721-1320-5	Low Density Artefact Distribution	309
Pullouds Bridge 1 COLLECTION	7721-1320-6	Low Density Artefact Distribution	309
Pullouds Bridge 1 COLLECTION	7721-1320-7	Low Density Artefact Distribution	309
Pullouds Bridge 1 COLLECTION	7721-1320-8	Low Density Artefact Distribution	309

Table 6: Showing Aboriginal cultural heritage in the geographic region.



7.4 Previous Archaeological Work in the Geographic Region

7.4.1 Previous reports and surveys in the Geographic Region

Richards & Jordan 1999 (Occasional Report No. 50/ Report 856)

Aboriginal Affairs Victoria (AAV) undertook a State-wide Survey Program investigation of the Barwon River basin. The investigation spanned three study areas of the Barwon River: Inverleigh, the Bellarine Peninsula, and the Otway Range. The goal of this investigation was to describe the nature of Aboriginal archaeological sites and to examine the distribution and density of sites throughout the landscape. Random sampling was utilised for the selection of survey areas, and shovel test quadrants were excavated. Within the Inverleigh study area (to which the geographic region relates), fifty-seven previously unrecorded sites were identified, including surface artefact scatters, scarred trees, and isolated artefacts. Stone artefact types included retouched blades and flakes, scrapers, flake cores, and geometric microliths, the raw material being comprised primarily of quartz (45.6%) and silcrete (20.4%). As the nearest known source of silcrete is over 40km away from the site, Richards and Jordan concluded that trading or interaction with other tribes must have occurred.

Marshall, Nicholls, & Paynter 2003 (AV Report no. 2628)

Grant St. Quentin Surveyors commissioned TerraCulture to complete a cultural heritage assessment in Bannockburn, approximately 400m from the Activity Area. A survey was conducted on the land, revealing four artefact scatters (VAHR 7721-0610) and a scarred tree (VAHR 7721-0614). Due to the identification of landforms likely to yield further archaeological material, a recommendation was made for an extended survey of the area and subsurface testing if required.

Marshall, Nicholls, & Paynter 2004 (AV Report no. 2849)

TerraCulture (2004) followed on from the recommendations made in 2003, surveying an additional 170 hectares of the Bruce Creek site at Bannockburn. During the survey, twenty-six additional Aboriginal sites were identified, comprising twenty-four artefact scatters and two scarred trees. A recommendation was again made to extend the survey of the paddocks at a time when they had been ploughed to allow for greater visibility.

Marshall & Hyett 2007 (AV Report no 3860)

Planning consultant James D Ramsey commissioned TerraCulture to conduct a cultural heritage assessment along Bruce Street in Bannockburn as part of a planning permit application. The survey undertaken at the site revealed nine low density stone artefact scatters. TerraCulture recommended further subsurface testing in the future to ensure a more inclusive significance assessment could be made.

7.4.2 Previous CHMPs in the Geographic Region

Clark 2007 (CHMP 10068)

Clark (2007) was commissioned by Samantha Ramsey to carry out Aboriginal investigations at the same Bruce Street site in Bannockburn first conducted by Marshall and Hyett earlier the same year, as the original investigations were not approved before the current legislation came into effect. A systematic survey of the entire area was completed, along with seven test pits at the location where TerraCulture had previously identified stone artefacts. An additional four test pits were then excavated to establish a boundary of cultural heritage material. Subsurface testing was conducted using a combination of hand and backhoe excavation, and Clark describes the soil as 'strongly duplex', comprising sandy-loam and clayey sand. A total of 143 stone artefacts were recovered and are registered as a single artefact scatter (VAHR 7721-0835).

Clark 2010 (CHMP 10861)

Clark (2010) conducted a Cultural Heritage Management Plan at a small residential site, located approximately 218m from the Activity Area. One Aboriginal place had been previously recorded at the site (VAHR 7721-0842). Following a foot survey of the site, the complex assessment involved excavation of five test pits using a combination of hand and backhoe excavation. Twenty stone artefacts were recorded comprised primarily of quartz, quartzite, and silcrete. A total of five additional Aboriginal places were subsequently recorded as small artefact scatters (VAHR 7721-0954, 7721-0955, 7721-0956, 7721-0957 & 7721-0958).

Light & Tuechler 2014 (CHMP 12604)

Ochre Imprints were commissioned by St Quentin on behalf of Bannockburn Holdings to complete a Cultural Heritage Management Plan on either side of Bruce Creek in Bannockburn, approximately 1048m from the Activity Area. During the Standard Assessment six stone artefacts were identified and registered as a Low-Density Artefact Distribution Aboriginal place (VAHR 7721-1266). During the Complex Assessment, two 1x1-metre excavation pits and thirty-two 0.5 x 0.5-metre shovel test pits were excavated. Sixty-five stone artefacts were discovered during the complex assessment and were registered as one Aboriginal place (VAHR 7721-1241), an artefact scatter.

Stone 2014 (CHMP 12673)

The Barwon River Water Corporation commissioned Dr Tim Stone to complete a Cultural Heritage Management Plan at the proposed 5.4km sewer rising main construction site along Stephens Road, Bannockburn. The Complex Assessment saw the excavation of one 1x1m test pit and sixteen shovel probes. One Aboriginal place (VAHR 7721-1261) represented by a Low-Density Artefact Distribution was registered as a result of the discovery of twelve stone artefacts both on the surface and during the subsurface excavation. This place is located approximately 300m from the current Activity Area.

Bullers, Beaton, & Harbour 2014 (CHMP 13073)

Ecology and Heritage Partners were commissioned by AusNet services to conduct a Cultural Heritage Management Plan for the proposed construction of a City Gate station and gas supply main network. The Activity Area spanned 11.5km across the majority of the Bannockburn Township. The Standard Assessment consisted of a pedestrian surface survey, during which two previously registered Aboriginal places were identified (VAHR 7721-1261 & 7721-1269). AusNet agreed to realign the supply main network away from the registered places, and as no areas of Aboriginal heritage likelihood was identified in the impact area, Ecology and Heritage Partners concluded that no further testing was necessary.

Bullers, MacManus, Beaton & Harbour 2014 (CHMP 13120)

Ecology and Heritage Partners were commissioned by AusNet services to conduct a Cultural Heritage Management Plan for stage two of the proposed Gas supply development, involving the construction of a gas pipeline lineally spanning 37.68km across the Bannockburn township. Two previously registered Aboriginal sites (VAHR 7721-0952 & 7721-1947) located within the Activity Area were identified during the Desktop Assessment. During the Standard Assessment, a survey of the Activity Area led to the identification of seven Aboriginal stone artefacts, comprised of quartz, quartzite, and silcrete. Two additional Aboriginal places were thus registered as Low-Density Artefact Distributions (VAHR 7721-1267 & 7721-1270). Due to the high level of previous disturbance, and agreement by AusNet to avoid areas identified as likely to hold cultural sensitivity during construction, Ecology and Heritage determined that a Complex Assessment would not be necessary.

7.5 Aboriginal History in the Geographic Region

By at least 40,000 years BP, all parts of the Australian continent (Sahul) had been colonised by Aboriginal people, including the south-eastern corner of the continent in what is currently known as Victoria (see

Frankel 1995:15). Late Pleistocene dated Aboriginal archaeological sites in Victoria are uncommon and in open contexts are usually associated with specific types of landforms such as lunettes, terraces and swamps.

Geomorphologically, it is generally accepted that due to the unique preservation qualities of these specific landforms, they have the potential to preserve archaeological evidence that is demonstrably a consequence of Late Pleistocene Aboriginal activity.

The ways Aboriginal people adapted to climatic changes during the late Pleistocene and Holocene periods are difficult to determine without a detailed chronology and other palaeoenvironmental and archaeological evidence. Certainly, these changes would have affected the demography of Aboriginal groups and the timing, duration and reasons for occupying different parts of Victoria. Some aspects of the local landscape may have remained relatively constant, such as the local hydrology and by extension, the importance of major creeks as the principal source of water. Other features like vegetation would have evolved with changes in climate and sea levels.

In Victoria, there are few Aboriginal cultural heritage places with late Pleistocene dates south of the Great Dividing Range (Coutts 1978: 152). In contrast, there is significant evidence of Aboriginal occupation in the Late Holocene period across Victoria.

Climatic changes during the late Pleistocene and Holocene periods led to the occupation of the volcanic plains to the north of Port Phillip Bay. During the Holocene, Aboriginal people seasonally occupied both the coast and hinterland (Coutts 1981: 15). The small tool tradition of the last 4,000 years represents the most prevalent artefact types identified in this southern region of Victoria (Bird and Frankel 1991: 141).

7.5.1 Ethno-historical Accounts in the Geographic Region

As one of the two locations from which Europeans colonised much of Victoria, Geelong has a number of written and illustrated historical accounts on the Aboriginal people of the area. Europeans first made written observations of the Aboriginal people of the Bellarine Peninsula from 1802, when explorers began to chart the entrance of Port Phillip Bay. Most of the accounts however relate to 1836 onwards when there was a permanent European presence. Clark (1990) collated the primary sources of this ethnohistory in his reconstruction of traditional language boundaries in western Victoria. These sources include journal entries and government correspondence produced by explorers such as Matthew Flinders and Charles Grimes, as well as settlers and missionaries, particularly G.A. Robinson, the Chief Aboriginal Protector.

According to Clark (1990: Fig 11), Bannockburn falls within the known traditional boundaries of the *Wathaurong* or *Wadawurrung* language group, whose territory included the coast west of the Werribee River to Painkalac Creek at Aireys Inlet. It extended north as far as Fiery and Mt Emu creeks.

The identity of the clan who occupied the Bannockburn area is not precisely known, but following Clark is likely to be the *Wada wurrung balug*, the Barrabool Hills peoples. The Barwon and Moorabool Rivers is believed to have provided the boundary between these and neighbouring clans but were known to have eeled at Lake Modewarre and joined the *Bengalat Balug* of the Bellarine Peninsula, and spent several months of the year with them on their hunting grounds. It is probable that this arrangement was reciprocated.

Corris (1968) cited in Clark (1990) believes '(that) there is so little known about the social organisation of the *Wadawurrung* bespeaks the rapidity with which they were physically destroyed by settlers seeking undisputed possession of their land' (Clark 1990: 277). As noted by Clark:

> *By the end of 1836, the sheep runs of the 'ngamadjig' spread round Geelong within a semi-circle of twenty-five miles radius. In the following year streams of squatters from Melbourne and Geelong met and thrust westwards towards the Colac district. The Bacchus Marsh lands were next to be occupied, and then the head-waters of the Leigh and Buninyong.*

William Buckley, an escaped convict from an aborted 1803 settlement at Sorrento, was adopted by the *Wadawurrung* and lived with them until July 1834. As recorded by Morgan (1852), Buckley's reminiscences have also become an important source of historical data on the Aboriginal clans of the *Wadawurrung* area. Excluding Morgan (1852), most of the historical accounts of the early contact period refer to specific events, usually involving contact and conflict between settlers and the local Aboriginal clan. There is little historical data from this period. However, it may be assumed that at least some clans continued to live in traditional ways.

7.5.2 Linguistic and Social Organisation

Following Clark (1990), at the time of European contact, Bannockburn was part of the *Wadawurrung* language area. The social and spatial organisation of traditional Aboriginal society has been the subject of considerable debate. It is considered by most that Aboriginal society was organised according to local descent groups called clans. Clans were the 'landowning, land renewing and land sustaining unit of Aboriginal society' (Clark 1990: 4, 5). Clans occupied estates or home country and the area of land over which the clan hunted and gathered has been called the range. As explained by Clark:

> *…the tract or stretch of country identifiable as the economic range, normally included the estate and was thus owned by clans. The band seasonally occupied and utilised various parts of the range in a settlement pattern that was a response to the group's habitat* (Clark 1990: 4, 5).

Clark suggests there were twenty-seven *Wadawurrung* clans at the time of European contact.

> *I have been able to reconstruct 27 Wada wurrung clans. Using Lourandos' (1977) estimates that clan sizes ranged from between 40 to 60, this would give a Wada wurrung population of between 1080 and 1620 at the time of contact. Dawson (1991) estimated clan sizes were 120, and this would give Wada wurrung a population of 3240. The real figure was probably somewhere between 1620 and 3240 (Clark 1990: 307).*

Wadawurrung clans were patrilineal and organised into moieties belonging to either the *Waa* (crow) or *Bunjil* (eaglehawk) moiety – marriage partners were required to belong to different moieties (Clark 1990: 276-7, also see Barwick 1984: 105). Clark noted that:

> *Clan heads were known as either Nourenit/Narenit or Arweet. The Wada wurrung were the most powerful and influential people in the western district. During his 1841 tour Robinson met with many Wada wurrung clan heads.*

Marriage was not allowed between two people from the same tribe: 'the object of these laws is to prevent marriages between those of one flesh.' (Dawson 1881: 26).

> *Every person is considered to belong to his father's tribe and cannot marry into it. Besides this division, there is another which is made solely for the purpose of preventing marriages with maternal relatives. The aborigines are everywhere divided into classes, as everyone is considered to belong to his mother's class, and cannot marry into it in any tribe, as all of the same class are considered brothers and sisters (*Dawson 1881: 26).

According to Dawson, the Aboriginals he wrote about within the Western District of Victoria believed in supernatural beings – celestial, infernal and terrestrial. These included good and bad spirits 'Of terrestrial spirits there are devils, wraiths, ghosts and witches, the difference between them being somewhat indefinite' (Dawson 1881: 50). There were many creation stories, (which differed slightly in other areas) which played an important role within belief system of the *Wadawurrung* clans. Within these creation stories, animals have a significant role. One such story is recounted by Dawson:

> *There is a tradition that fire, such as could be safely used, belonged exclusively to the crows inhabiting the Grampian mountains; and as these crows considered it of great value, they would not allow any other animal to get light, However a little bird called Yuulion keer –'fire tail wren'- observing the crows amusing themselves by through firesticks about, picked up on and flew away with it. A hawk called Tarrakukk took the firestick from the wren, and set the whole country on fire. From that time there have always been fires from within lights could be obtained* (Dawson 1881: 54).

> *This religious system people were identified with a particular animal plant or natural feature, which like themselves was endowed with life essence by creation ancestors in the Dreamtime* (Flood 1995: 273).

The *Wadawurrung* clans who lived on the coast were the first to come into direct contact with the *'ngamadjig/amerjig'* or white man. As noted above, this occurred by at least 1802 *'…when Lieut. John Murray in the Lady Nelson, charted part of Indented Head and named Swan Bay'* (Clark 1990: 227). The clan that occupied the areas around Grovedale, the *Wada wurrung balug*, was probably the next to have direct contact with the white explorers and continued to have the same between 1802 and 1835.

The *Wada wurrung balug*

According to Clark, as noted above, the clan who occupied the Geelong region including Barrabool Hills and Bannockburn are thought to be the *Wada wurrung balug* (Clark 1990: Figure 2). Their clan name *Wada wurrung balug* means 'Witto' or 'no' (Clark 1990: 333). As noted by Clark, it is thought that the *Wada wurrung balug* were the clan who adopted William Buckley in 1803, who became familiar with the clan's dialect (Clark 1990: 331 and see Morgan 1852 in Clark 1990). Buckley's recollections reveal that the *Wada wurrung balug* would eel at Lake Modewarre and would hunt with the *Bengalat bulluk* clan of Indented Head (Clark 1990: 331).

Clark notes that according to Robinson (1842), the *Wada wurrung balug* "exercised a control and influence over other clans in the eastern portion of the Western District" (Clark 1990: 331). Corris (1968) cited in Clark (1990) believes '(that) there is little known about the social organisation of the *Wadawurrung* bespeaks the rapidity with which they were physically destroyed by settlers seeking undisputed possession of their land' (Clark 1990: 277). Wynd (1992) suggests that the *Wada wurrung balug* were low in numbers at the time of its settlement, citing Dr. Thomson who claimed that the number was at only

279 in 1836, when he had attempted to distribute blankets to the tribe (Wynd 1992: 12). Clark (1990: 307-308) further notes:

> *According to Lloyd (1862:456) the Barrabool Hill tribe numbered 300 in 1837, and by May 1853 had been reduced to nine women, seven men and one child. He considered the births among his clan had not exceeded 24 in a period of seven years. He listed the causes of this rapid diminution as the lessening of the changes of obtaining their natural food, owing to the entire occupation of the best grassed portions of their country; influenza, association with colonists: brandy, rum, and tobacco; and the fact that each tribe regarded the others with implacable enmity, and intrusion on its hunting ground was the signal for deep revenge.*

Clark goes on to cite Brownhill (1955), who stated that the last surviving member of this clan, Bill Gore/King Billy died on 11/11/1885 (Clark 1990: 333).

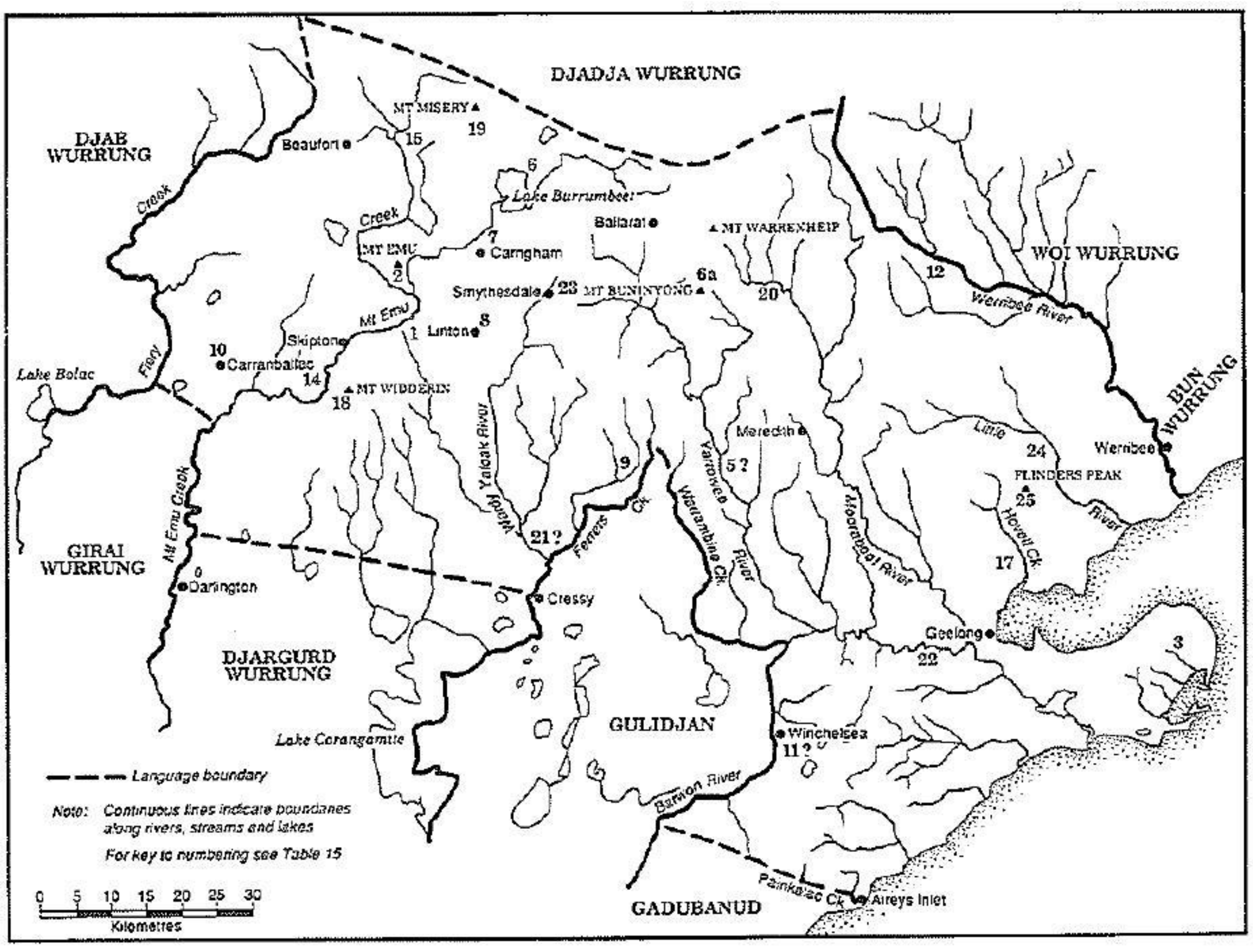


Figure 1: Wadawurrung language area and clans (Clark 1990: 311).

7.5.3 Daily Life and Subsistence Economy

The details of traditional *Wadawurrung* settlement patterns, technology and social organisation were not well recorded by the early European explorers and the destruction of the traditional lifestyles following colonisation has meant a lot of knowledge has been lost. It has long been assumed that the *Wadawurrung* were mobile hunters and gatherers who occupied a specific range over which they moved according to subsistence requirements and trading and social obligations.

Plains fauna such as kangaroo and emu were hunted for food. Dawson (1881) writes that several kinds of kangaroo were eaten, as well as wombat, wild dog, echidna, possum and other smaller animals. Fish was also consumed such as eel and shellfish.

> *Of fish, the eel is the favourite; but besides it, there are many varieties of fish in the lakes and rivers, which are eaten by the natives* (Dawson 1881).

Smaller foods such as grubs were also part of Indigenous people's diet. These were usually cut out of trees and eaten alive.

> *The grubs are about the size of the little finger, and are cut out of trees and dead timber, and are alive, while the work of chopping is going on… that caution is necessary to avoid their powerful mandibles, ever ready to bite the lips or tongue* (Dawson 1881).

It is likely that plants formed the vast majority of the *Wadawurrung* diet and that the land was carefully managed by Aboriginal people to cultivate plants and to maximise the harvest (Pascoe 2014). The introduction of domestic animals such as sheep and cattle destroyed much of the native grasslands, and the replacement of native grains and tubers with introduced crops limited the food range.

The western basalt plains probably provided edible plant species such as murnong. These were gathered by women using digging sticks with the tubers eaten raw or cooked (Zola and Gott 1990: 52).

> *It is much esteemed on account of its sweetness and is dug up by the women with the* muurang *pole. The roots are washed and put into a rush basket made on purpose and placed on the oven in the evening to be ready for next morning's breakfast. …the cooking of the* muurang *entails a considerable amount of labour on the women, in as much as the baskets are made by them; and as these often get burnt they're rarely served more than twice. The* muurang *root, when cooked, is called* yuwatch*. It is often eaten uncooked* (Dawson 1881: 21).

Root plants such as these were abundant as they are safer from animals and birds growing beneath the soils. Plants were also used for medicines, including River mint and Old Man Weed, which were used for colds and chest problems. Gum from gum trees and wattle barks were also used for burns and stomach issues. Plants for medical uses could be prepared in a number of ways; Infusion, steaming, smoking, poultices, and binding of the plants around the head (Zola and Gott 1990: 52).

Figure 2: Aboriginal women using digging sticks to collect murnong ('Native women, Indented Head, 1835' JH Wedge La Trobe Collection, State Library of Victoria).

7.5.4 Aboriginal Post-Contact History

The presence of *Wadawurrung* people in the Geelong area continued to be written about, mostly in government correspondence, until they were forced onto mission stations such as at Buntingdale or until their integration into the broader community. As an indication of their decline Clark records:

> *Fyans noted that when he arrived in the Geelong district in 1837, he was ordered to assemble all the Aboriginal population to receive gifts. Assisted by William Buckley all the Aborigines within 30 miles of Geelong were assembled, amounting to 297 men, women and children. Each received a blanket and a portion of flour. In 1858 Fyans considered that no more than 20 of these 297 people were alive* (Clark 1990: 299).

In 1861, the surviving *Wadawurrung* were gathered onto a parcel of land at Mt Duneed, the Duneed Reserve, on which a 'shelter hut' had been installed (Clark 1990: 300). The remnant population, which around this time appears to have numbered eleven people, were encouraged to stay at the Duneed Reserve and were prohibited from staying in the Geelong Township after sundown. There is considerable historical detail on the fate of particular individuals. According to Clark, the last 'full blood' *Wada wurrung balag* who was known as 'King Billy… whose Aboriginal name was *Waurn Bunyip* or *Worm Banip* died at the Geelong hospital on the 11th of November 1885' (Clark 1990: 306). In relation to other *Wada wurrung* clans Clark records the demise of Billy Leigh of the *Yaawangi* (You Yangs):

> *Billy Leigh, purported to be the last of the Yawangi (Yaawangi) clan, died on the 9th of August 1912. Billy had been adopted by Fredrick Armytage and his wife, the owners of Wooloomanata Station. He was baptized and confirmed in the Trinity Church of England in Lara, and when he died the Armytages erected a memorial above his grave in the eastern cemetery in Geelong* (Clark 1990: 335).

Wadawurrung Post-Contact history continues to this day and *Wadawurrung* people are represented by the Wadawurrung Traditional Owners Aboriginal Corporation and continue the tradition of caring for country.

7.6 Land-Use History of the Activity Area

7.6.1 Early European Settlement of Victoria

In the mid-1830s permanent European settlement of Victoria commenced with the arrival of the first squatters. A 'treaty' was signed in 1835 by John Batman and elders of the local Aboriginal inhabitants for an arrangement to exchange supplies of basic goods for the provision of 600,000 acres of land (Kociumbas 1992: 190-191). The treaty was not approved by the Government in NSW as it acknowledged Aboriginal ownership of the land and contradicted the policy of *Terra nullius* and was thus, granted no legal standing.

Wynd noted that while "most people are aware that 600,000 acres around Melbourne were purchased (through a deed – 'Batman's Treaty'), it is not so well known that in a separate deed, 100,000 acres around Geelong, including the whole of the Bellarine Peninsula, were purchased" (Wynd 1988: 11).

By 1838 squatters had moved into large areas of Victoria and usurped large tracts of land from the resident Aboriginal people for the purpose of grazing livestock. Spreadborough and Anderson (1983: ix) discuss the 'squatting expansion' between 1834 and 1860, noting that '…it was the early squatters who were permitted to become 'free' selectors, choosing and learning about their land with a fair degree of independence from official control'. The first decade of this expansion saw squatters taking up land across

Victoria, particularly on the plains north of Melbourne and running westward to Geelong (Spreadborough & Anderson 1983).

7.6.2 Settlement of The Golden Plains Shire and Bannockburn

Early European settlement in Geelong and surrounding regions were characterised by squatters occupying large pastoral runs close to major rivers and creeks including the Barwon, Moorabool, and Leigh Rivers (Wynd 1992: 9). In the late 1830s, many settler groups were competing for land in and around the Golden Plains region. Land stretching from Fyansford to Native Creek Station was staked out by George and Phillip Russell in 1837. Around the same time, Yuille brothers claimed land near Murgheboluc, and Joseph and Robert Sutherland settled at present-day Sutherland's Creek (Beaurepaire 2005: 10). According to Beaurepaire (2005), one of the main restraints in settling within the area surrounded by the Moorabool River, Barwon River, and Sutherland's Creek was gaining access, when many of the fords were 'jealously' guarded by the owners of the land in which they were located:

> *Generally, there was much closer development on the Eastern side of the Moorabool and the Sutherland's Creek boundary, and it is said that some of the squatters were not in any hurry to build bridges or fords, or even roads* (Beaurepaire 2005: 10).

The bridge upstream in Fyansford thus became a focus of settlement. Fyans was also appointed to issue pasturing licenses in the area, the first official recognition that Geelong existed. Area was surveyed between the Barwon River and Corio Bay and the town of Geelong officially came into existence on 26th October 1838. Large parcels of land were purchased from the Crown from 1840 onwards. In 1841 the number of European settlers in the Geelong region was 454, and by 1854, this number had increased to 20,115 (Beaurepaire 2005: 12).

Township of Bannockburn

Originally, the area which is now Bannockburn encompassed parts of the Shire of Meredith and the Borough of Steiglitz (Beaurepaire 2005: 17). According to Beaurepaire, Bannockburn was named after an early Scottish settler, James Bruce, likely commemorating the Battle of Bannockburn in Scotland, headed by Robert the Bruce in 1314 (Beaurepaire 2005: 17). James Bruce also gave his name to Bruce Creek, the stream that runs through the current Activity Area. The establishment of Leigh Road, now known as the Hamilton Highway, provided the primary source of movement and settlement into Bannockburn, and the opening of the railway line travelling from Geelong to Ballarat in 1862 secured the formation of Bannockburn as a township (Victorian Places 2015). Land was offered for sale in one acre lots in the area around Bruce Creek at the time of the first subdivision, opposite the Somerset Hotel (Beaurepaire 2005: 84).

Along with the railway station, the shire offices, built in 1864; court and police gaol, built in 1869; and school, opened in 1866, contributed to an established township of more than one hundred residents by the beginning of the twentieth century (Victorian Places 2015).

7.6.3 Land Use History of the Activity Area

The early European settlers of Bannockburn mainly focussed their work on the production of wool, grazing merino and other breeds of sheep (Beaurepaire 2005: 10). A large pastoral run was taken up along Bruce Creek by the Clyde company in 1848, with a portion being licenced to James Bruce in 1849 and named Bruce’s Creek run. The run was sold to Peter Sharp in 1851, and it was closed down in the 1890s when the area was subdivided (Spreadborough and Anderson 1989: 268).

In 1855, district surveyor A. J. Skene describes the agricultural potentials for the land on a map depicting the towns and suburbs of Bannockburn, stating:

> *The suburbans generally consist of good agricultural land, lightly timbered with gum and she oak. The water in Bruces Creek is slightly brackish in the summer months.*

The map also includes various descriptions of spaces within the Activity Area. Ormond Street, which runs north-west to south-east through the Activity Area, was already established by this time. The plot between Ormond Street and Bruce Street seems to have been subdivided into small blocks of land, the space east of Ormond Street is labelled as being made up of ‘dry, sandy soil’, while the area south-west of Ormond Street is described as ‘thickly timbered with Gum, She-oak, and Honeysuckle’ (Figure 4). By 1879, the land within Bannockburn had been subdivided further and rapidly taken up by settlers (Figure 5). A map of the township in 1879 shows the Activity Area being subdivided into several plots of land. To the north, between Ormond and Harvey road, Esther Petterent is listed as the owner, while to the south and east, several members of the Keanan family own five separate plots of land (Figure 5). It is likely that the land was used for agricultural use and domestic living until the present day. An aerial photograph from 1978 shows that the land was comprised of livestock grazing paddocks and homesteads, similar to its present state (Figure 6).

Figure 3: Township and suburbs of Bannockburn on Bruce Creek, County of Grant, 1855 (State Library of Victoria).

Figure 4: 'Murghe Boluc, County of Grant', compiled by R. N. Lowe, June 5th, 1879 (State Library of Victoria).

Figure 5: Aerial photograph of Bannockburn, 1978, showing approximate location of the Activity Area (Department of Lands and Survey).

7.7 Oral History

No specific oral history was provided by the WTOAC regarding Aboriginal history in the Activity Area or geographic region.

7.8 Landforms and Geomorphology

7.8.1 Geology and Geomorphology

Bannockburn falls within the Geological Survey of Victoria's Geelong 1:63,360 map sheet. According to this map, the geological composition of the Activity Area is comprised of Moorabool Viaduct Sands, dating to the Pliocene period, and much older Fyansford Clay, dating from the Miocene to the Oligocene period (Department of Mines 1:63,360 map sheet). In his explanatory notes for the Geelong Geological Map, Spencer-Jones (1970) describes the geological structure of Geelong and the Surrounding region as:

> *Broadly speaking the area is a plain, consisting of extensive basalt flows overlying and partly blanketing flat-lying Tertiary sediments. This plain has been broken into several units by block faulting and is dominated by the raised Barrabool Hill fault or horst, which exerts a controlling*

influence on the outcrop geology and drainage pattern. The Roswell Fault and Lovely Banks Monocline, both orientated broadly north south, are part of the major fault system, which forms the western side of the Port Phillip Sunklands or graben. These structures progressively step down the plain level of the country from the northwest to the east across the Geelong standard sheet area (Spencer-Jones 1970: 7).

The majority of the Activity Area falls within the Moorabool Viaduct Sand formation. The formation was first introduced as Moorabool Valley Beds by Hall and Pritchard in 1894, later to be renamed and described by Bower in 1963 (VandenBerg 2016: 8). The foundation is described by Spencer-Jones as:

A thin, but widespread, succession of calcareous sands, sandy limestones, sands, quartzite and ferruginous sandstone, blankets the area of Tertiary sedimentation including a large area of the Bellarine Peninsula... It overlies the Fyansford Clay with a slight angular disconformity. At the disconformity there is a discontinuous but very widespread phosphatic nodule bed containing nodules eroded from the underlying sediments (Spencer-Jones 1970: 5).

A small portion of the east of the Activity Area lies within the Fyansford Clay formation, formerly known as Newport Silt. According to VandenBerg (2016), the creation of the Newport Bore and coal shafts dug in Altona Bay in the 1890s revealed the presence of marine Miocene clays with Limestone Bands. Thomas and Baragwanath gave it the name Newport Formation in 1950. In 1963, however, Bowler gave the name Fyansford Clay to the same rock unit "outcropping further west in the valleys of the Moorabool and Barwon rivers, and in the Batesford limestone quarry" (VandenBerg 2016: 21). This formation is described by Spencer-Jones as consisting of:

Calcareous clays, marls and some impure silty and salty limestones, and is one of the most widespread and persistent Tertiary units in this area. Continuous outcrop is found along the valleys of the Leigh and Moorabool Rivers, Bruce Creek and along the Barwon River upstream from Pollock's Ford, 9 road miles from Geelong… to the northwest and west along the Leigh River it is often difficult to distinguish between the sands of the Fyansford Clay and the younger Moorabool Viaduct Sands (Spencer-Jones 1970: 4).

Further east of the Activity Area, the region is dominated by the Newer Volcanic Group. The Newer Volcanics consist of Quaternary basaltic lava flows (Plio-Pleistocene in age). The flows originate from several eruption points including Mt Moriac, Mt Pollack and Mt Duneed (Spencer-Jones 1970: 5). Spencer-Jones (1970: 5) distinguishes between Older (NV1) and Newer (NV2) flows noting that the former is deeply weathered and pre-dates the formation of the Moorabool and Barwon River valleys. The latter flowed down these valleys to join near Fyansford to the east and are usually associated with the lower reaches of the Moorabool River as well as the Barwon River (Spencer-Jones 1970: 5).

To the east of the Activity Area lies the Rowsley Fault. This fault, along with the Lovely Banks Monocline, forms part of the "major fault system which forms the western side of the Port Phillip Sunklands or graben" (Spencer-Jones 1970: 7). Geomorphologically, the Activity Area and surrounding region is comprised of gently undulating sedimentary plains, consisting of low relief and slow site drainage (Jeffery & Costello 1981). The landform is made up of long gentle slopes, drainage lines, and stony rises. The soil types of this geomorphic division include unconsolidated sediments with *in situ* weathered rock, alluvium, and *in situ* weathered basalt. The soils are alkaline in texture, while surface soils are "light, with a limited nutrient holding capacity and poor structure, influenced by the sodic subsoil" (Jeffery & Costello 1981). According to ACHRIS, the Activity Area is comprised of plains and plains with low rises to the west, and plains with poorly developed drainage and shallow regolith to the east.

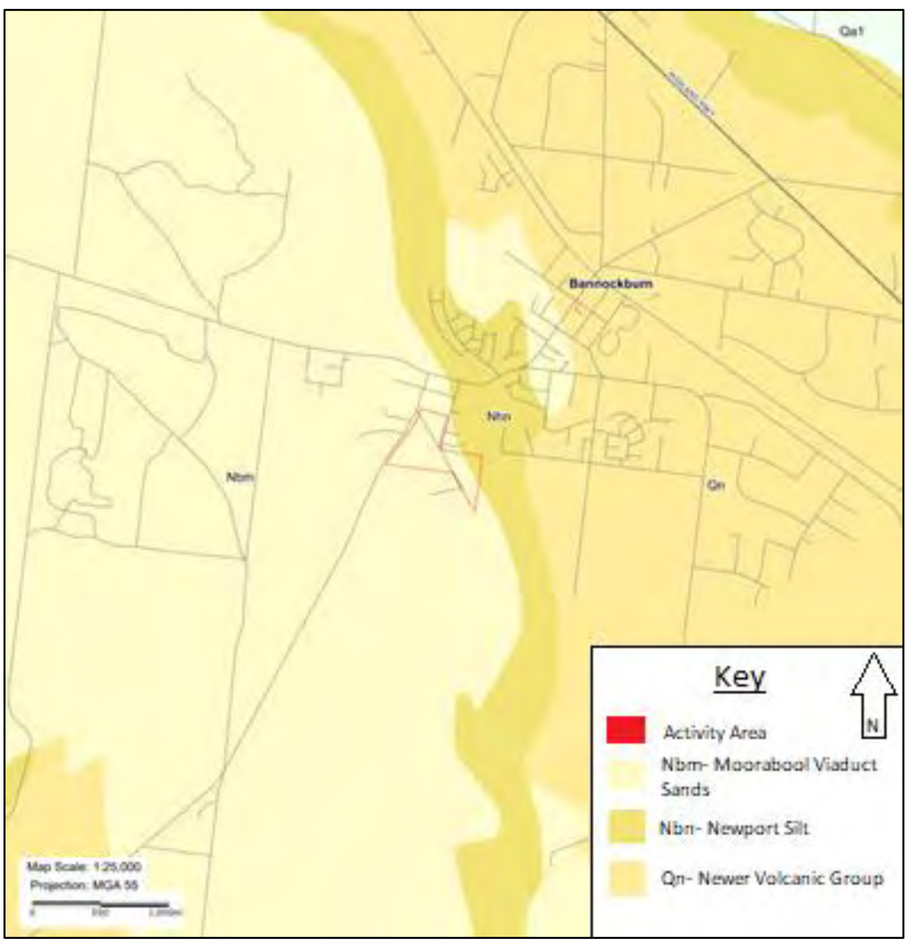


Figure 6: Geological map of the geographic region (GeoVic).

7.8.2 Climate

Toward the end of the Late Pleistocene during the Last Glacial Maximum (LGM) around 18,000 years ago, temperatures in south-eastern Australia were considerably cooler and drier than today (Mulvaney & Kamminga 1999). This caused more water to be stored in glaciers and the polar icecaps resulting in much lower sea-levels. A land-bridge connected mainland Australia across Bass Strait to Tasmania and the increased aridity resulted in a reduction of forests and wooded areas. By the Holocene, around 12,000 years ago temperatures warmed and the climate stabilised with vegetation likely similar to what existed at the time of European contact.

The current climate in the region is described as temperate with dry summers and an average maximum temperature of 24 degrees Celsius. The winters are described as cool with an average minimum temperature of 7 degrees Celsius. Average annual rainfall is between 700-100 mm (Bureau of Meteorology 2019).

7.8.3 Water Resources

Bruce Creek runs through a small portion of the Activity Area. It has its confluence with the Barwon River, approximately 5km the south. Bruce Creek is comprised of moderately to steeply sloping sides, with a total area of 3.6km. The height and slope of the creek decrease at the north, with the inner bends containing small flat terraces (Jeffery & Costello 1981).

Sandy Creek flows to the west of the Activity Area, which also converges with the Barwon River at the south. The Moorabool River flows from the northeast of the Activity Area. Again, it has its confluence with the Barwon River below Buckley’s Falls at Fyansford. The Moorabool River has cut into the underlying Tertiary sediments, forming steep valleys and prominent escarpments.

7.8.4 Flora and Fauna

Remnant vegetation provides a good indicator to the degree of ground disturbance and in turn a measure of the likelihood of *in situ* Aboriginal archaeological deposits, at least in shallow deposits. It is also a good indicator of the range of plant species available for use by the local Aboriginal groups during recent pre-contact times.

According to the Department of Environment, Land, Water and Planning (DELWP) bio-diversity mapping, the pre-European settlement Ecological Vegetation Class (EVC) of the majority of the Activity Area would have been freely draining plains woodlands or forests (EVC 55). This would have been made up of grassy or sedgy woodland, up to 15m tall, with "large, inter-tussock spaces potentially supporting a range of annual or geophytic herbs adapted to low summer rainfall, with low overall biomass" (DSE EVC Bioregion benchmark fact sheet 2007). The soil is described as fertile and silty with heavy subsoils, originating from former Quaternary swamp deposits. The EVC of Bruce Creek is described as a swampy creek line, and 'riverine grassy woodlands or forests' (EVC 68). Vegetation in the area would have included eucalyptus tree varietals, golden wattle (*Acacia pycnanth*), and sheep's burr (*Acaena echinate*) (DSE EVC Bioregion benchmark fact sheet 2007).

The Bannockburn region would have supported a large number of animals including kangaroos, possums, lizards, emus and many other bird species. Early European explorers described seeing large numbers of swans, eagles and gulls in the region (Wynd 1988: 4).

7.9 Conclusions of the Desktop Assessment

The Desktop Assessment indicates that the Golden Plains and Bannockburn area would have been occupied by Aboriginal people before and after the arrival of Europeans to Port Phillip Bay. A review of the Victorian Aboriginal Heritage Register (VAHR) found a total of ninety Aboriginal places within two kilometres of the centre of the Activity Area. The registered Aboriginal places consist of low-density artefact distributions, artefact scatters, and four scarred trees. The nearest registered Aboriginal place was recorded approximately 110 metres east of the Activity Area and was comprised of one-hundred and forty-three stone artefacts made of quartz, quartzite, and silcrete. Due to the high number of Aboriginal places in the geographic area and the close proximity of the area to Bruce Creek, it is expected that Aboriginal cultural heritage is located within the Activity Area, likely in the form of stone artefacts.

Settlement of the Golden Plains and Bannockburn area was characterised by large pastoral runs from the mid-1830s. Maps of the township in 1855, 1879, and an aerial photograph taken in 1978 reveals that the land within the Activity Area was likely used for agricultural farming and domestic living until the present day. Disturbance has occurred over most of the Activity Area due to the construction of Ormond Street, houses and sheds, as well as agricultural and pastoral activities suggesting that Aboriginal cultural heritage (if present) is unlikely to be well preserved or *in situ*.

Due to the likelihood of the presence of Aboriginal heritage, particularly in the form of low-density artefact distributions or artefact scatters, the CHMP will proceed to a Standard Assessment according to Section 62 of the Regulations.

8.0 Standard Assessment

8.1 Aims and Methods

The aims of the Standard Assessment were to investigate the presence or absence, nature and extent of Aboriginal cultural heritage within the Activity Area and to determine the likelihood for archaeological material to exist within the existing landforms. The pedestrian survey involved a systematic ground surface survey of all accessible areas of the Activity Area following the standards set in Burke and Smith (2004). The participants involved walked transects of two-metre spacing, roughly east-west where practical. The purpose of the survey was to collect the following information:

- Information regarding surface exposure and ground surface visibility;
- Notes and photographs were taken to illustrate prior ground disturbance, as well as changes in aspect or landform;
- A dumpy level was used to record relative heights across the Activity Area for the purpose of marking contours; and
- In the case of Aboriginal Heritage Places being encountered, their contents, GPS location (in GDA94) and visible extent were to be recorded.

The following division has been used to assess ground surface visibility. The higher the number the less vegetation:

- Excellent visibility 90-100%
- Good 50-90%
- Poor 30-50%
- Very Poor 0-30%

8.1.1 Participants

Date	Personnel	Organisation
1 Mar 2019	Daniel Barker	TerraCulture (Supervising Archaeologist)
	Anna MacNeill	TerraCulture
	Kacie Mitchell	Wadawurrung Traditional Owners Aboriginal Corporation
	BJ O'Toole	Wadawurrung Traditional Owners Aboriginal Corporation

Table 7: Summary of participants involved in the Standard Assessment.

8.1.2 Limitations and Obstacles

Limitations and obstacles to the Standard Assessment were confined to the very poor ground surface visibility caused by the grass and recently cut vegetation. There were no other limitations or obstacles to the conduct of the Standard Assessment.

8.2 Results of the Standard Assessment

A pedestrian survey was taken across the Activity Area on 1 March 2019 by Daniel Barker and Anna MacNeill from TerraCulture and Kacie Mitchell and BJ O'Toole representing the Wadawurrung Traditional Owners Aboriginal Corporation (WTOAC). The Activity Area can be divided into four sections along property boundaries which were surveyed separately (Figure 8). Generally, ground surface visibility was very poor across the entire activity area, however some sections had better visibility than others. Overall, approximately 10% of the activity area had exposed ground and could be effectively surveyed for archaeological deposits.

Section 1 of the activity area consisted of a house and garden in the north-west corner and a vineyard in the remaining portion of the property. Other amenities include a large dam which has been excavated to the north of the vineyard as well as driveways and sheds. Ground surface visibility in this section was very poor (20%) with most areas of visibility caused by disturbance, such as from the excavation of the dam. The entirety of the property appeared to have been disturbed by either the construction of the house and gardens, the construction of outbuildings, the construction of the vineyard or the excavation of the dam. The landform was very flat apart from where the dam had been excavated and there were no other natural features.

Section 2 of the activity area consisted of a house and large garden in the south-east corner of the property with other amenities such as a tennis court, gravel driveway and sheds. In the rear of the property was a large grassed open space previously used for grazing. Along the southern boundary of section 2 was a row of introduced trees. There were several other trees, both native and introduced throughout the property, however they were all planted within the last forty years. Ground surface visibility in this section was very poor (15%) with short grass covering most of the open areas. Patches of ground surface visibility were present particularly in the rear of the house and garden along the southern tree line and in the tennis court. The landform was very flat and there were no other natural features.

Section 3 of the activity area consisted of a house and garden in the south-eastern corner of the property and large paddocks for grazing in the remaining portion. The northern boundary of this section abuts the southern boundary of section 2. Ground surface visibility was very poor (5%) with only patches of visible ground, particularly in the far eastern margin and around fence lines. Approximately 60% of the paddock was covered by long grass with no visibility. The only disturbance appeared to be associated with the house, garden and outbuildings. The landform was very flat and there were no other natural features.

Section 4 of the activity area consisted of a house and garden in the north-west corner of the property and large paddocks and open space in the remaining parts which backs onto Bruce Creek. Other smaller outbuildings were present elsewhere on the property. Ground surface visibility in this section was very poor (10%) with only patches of exposed ground, particularly around a row of introduced trees running north-east through the centre of the property. This section slopped heavily toward Bruce Creek and in some places had very steep drop-offs. There was some remnant native vegetation including a large river red gum close to Bruce Creek, however there was no evidence of cultural scarring or bark stripping. Three stone artefacts were recorded during the survey of section 4. Artefact no.1 was exposed by rabbit burrowing and no.2 and no.3 were exposed on the surface near the row of introduced trees. The artefacts were all found on the ridgeline before the steep drop-off to Bruce Creek.

There were no caves, rock shelters or cave entrances in the activity area and there were no trees with cultural scarring.

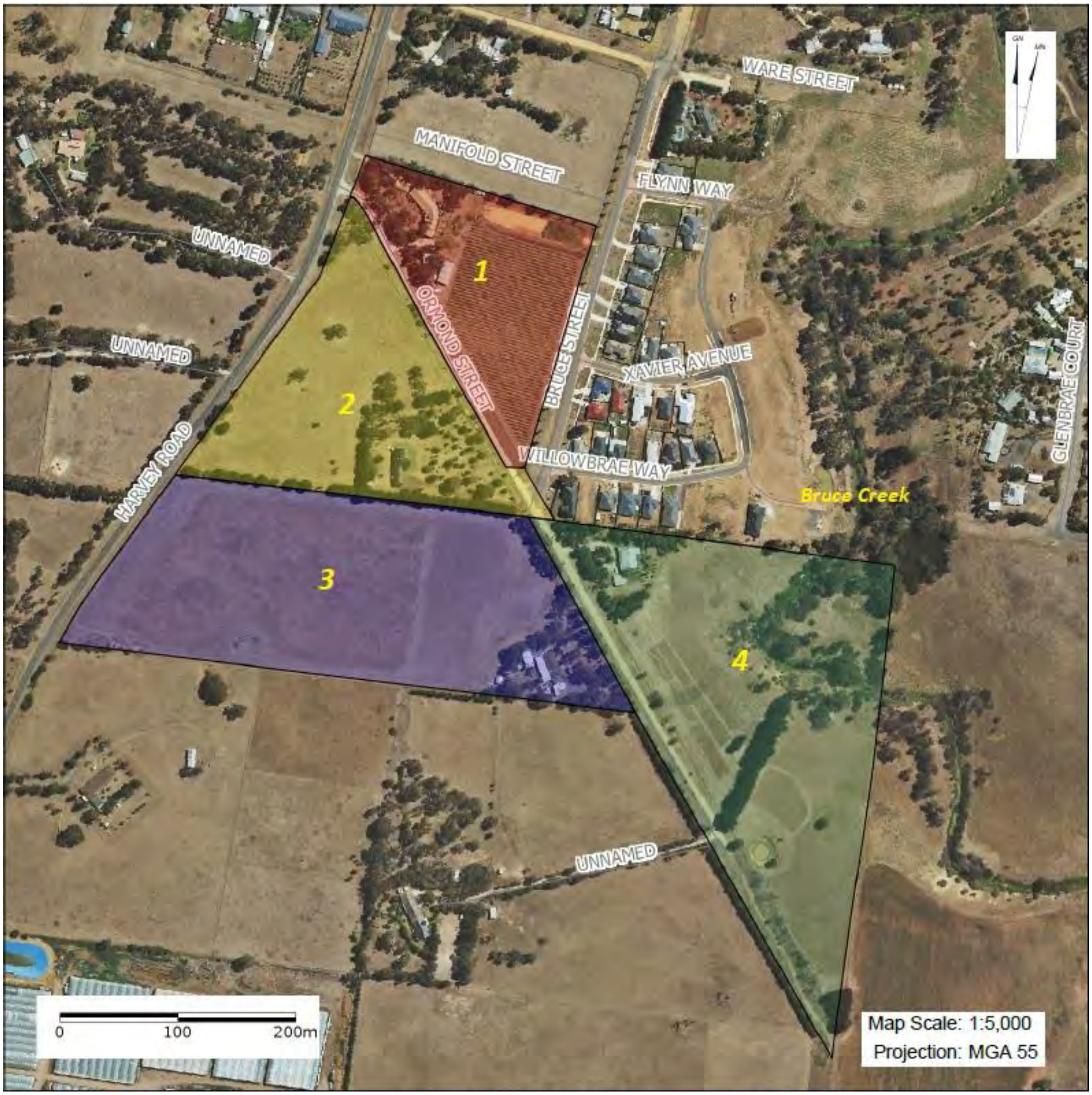


Figure 7: Showing the division of the activity area into four sections.

Art. No.	Coordinates MGA/GDA94 Zone 55 (Easting/Northing)	Depth (m)	Raw Material	Primary Form	Cortex %	% Edge of Retouch/ Use-wear	Flake Platform	Flake Termination	Number of Complete Scars	Longest Scar (mm)	Formal Tool/Core type	Length (mm)	Width (mm)	Thickness (mm)	Max. Dimension (mm)
1	251025/5783968	Surface	Quartz	Flake- Complete	0	0	Plain	Feather				27	12	10	27
2	250972/5783988	Surface	Quartzite	Flake- Proximal	0	0	Flaked					23	20	11	23
3	250973/5783985	Surface	Quartz	Angular Fragment	0	0						14	8	2	14

Table 8: Aboriginal cultural heritage recorded during the Standard Assessment.

Photograph 1: Northern edge of section 1 showing the dam, facing east.

Photograph 2: Eastern edge of section 1 showing the vineyard, facing west.

Photograph 3: Southern edge of section 2, facing west.

Photograph 4: North-east edge of section 2, facing south-west.

Photograph 5: Section 3 eastern edge, facing north.

Photograph 6: Section 3 eastern edge, facing west.

Photograph 7: Section 3 north-eastern corner, facing west.

Photograph 8: Section 3 centre, facing west.

Photograph 9: Section 3 southern edge, facing west.

Photograph 10: Western edge of section 4, facing north.

Photograph 11: Eastern edge of section 4, facing south-west.

Photograph 12: Surface artefact no. 1, quartz complete flake found in section 4.

Photograph 13: Mature river red gum in section 4, no cultural scarring present.

Photograph 14: Over-looking Bruce Creek in section 4.

Photograph 15: Surface artefact no.2, quartzite proximal flake in section 4.

Photograph 16: Surface artefact no.3, quartz angular fragment in section 4.

Photograph 17: Section 4 centre, facing north-east toward Bruce Creek.

Photograph 18: Section 4 northern edge, facing south-west.

Photograph 19: Showing vegetation and slope along Bruce Creek, from northern edge section 4 facing south.

Photograph 20: Showing Bruce Creek from top of the slope facing north.

8.2.1 Landforms

The activity area comprises two distinct landforms. The majority of the activity area consists of very flat volcanic plains while the area around Bruce Creek consists of a ridge and steep embankment down to the creek. Most of the activity area was covered by short grass, but patches of exposed ground showed that the upper topsoil consisted of brown compact silty sand on both landforms. There were several areas where the landform had been disturbed or modified through the construction of houses, landscaping, agriculture and other amenities such as the dam.

8.2.2 Areas of Archaeological Potential

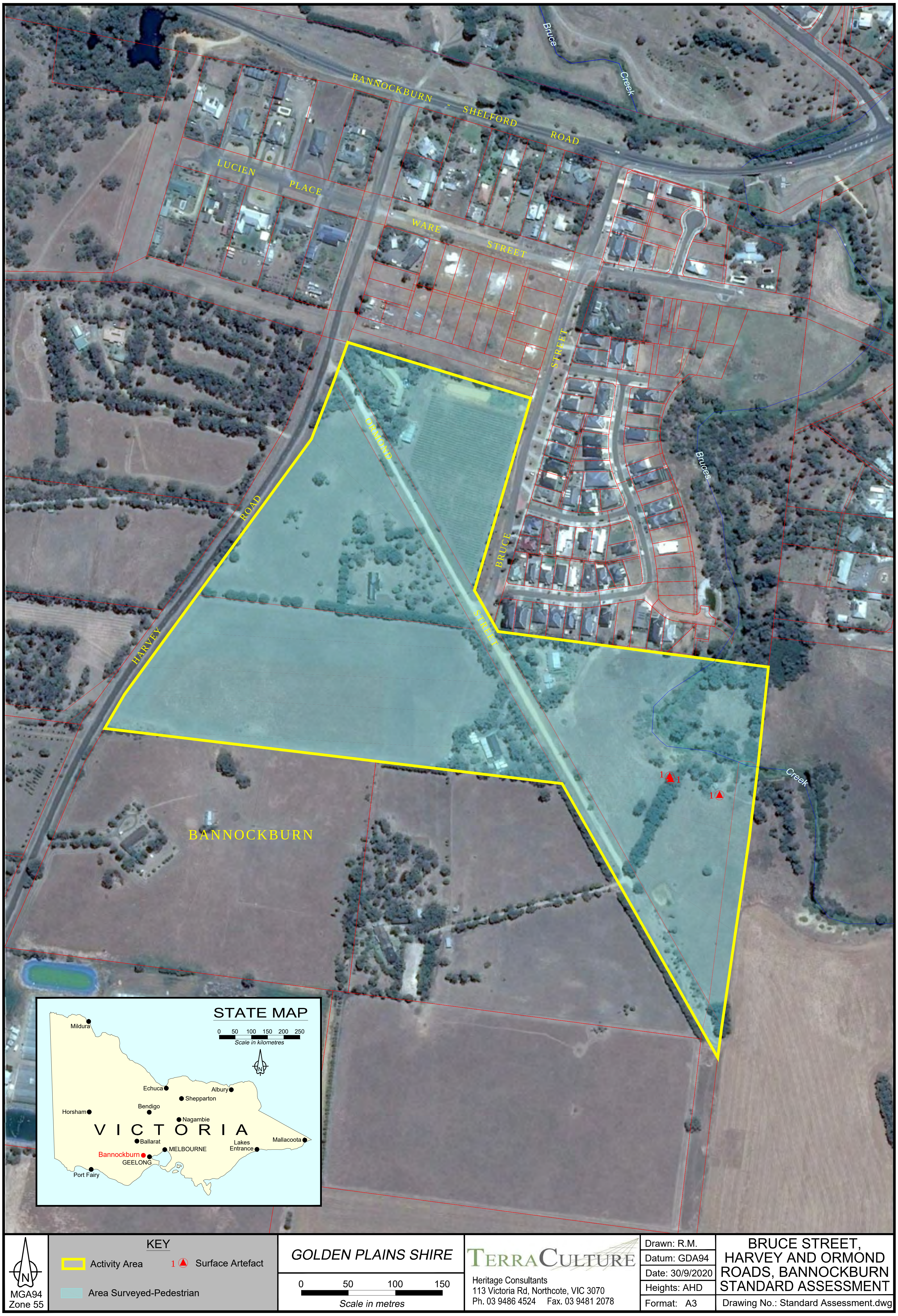
The designated area of cultural heritage sensitivity 200 metres from Bruce Creek incorporates all the ridge and embankment landform and a small part of the volcanic plains landform. The ridgeline and parts of the slope have the most potential for archaeological deposits. The identification of Aboriginal stone artefacts on the surface in these parts reflects the sensitivity of these areas. The flat volcanic plains are less likely to be sensitive and areas where significant disturbance has taken place have likely affected any Aboriginal cultural heritage that may have been present. This fits with the conclusions of the Desktop Assessment that the activity area is likely to have Aboriginal cultural heritage, likely in the form of low-density artefact distributions or stone artefact scatters.

8.3 Conclusions of the Standard Assessment

The Standard Assessment involved a pedestrian survey of all parts of the Activity Area. Ground surface visibility was generally very poor over most of the Activity Area (10% overall) with grass and other vegetation covering most of the ground surface. There were a few patches of visible ground surface, most notably along tree lines and areas where grazing has exposed the ground surface.

The activity area comprises two distinct landforms. The majority of the activity area consists of very flat volcanic plains while the area around Bruce Creek consists of a ridge and steep embankment down to the creek.

Three Aboriginal stone artefacts were recorded within the activity area during the survey. They were all located on the slopes and ridgelines along Bruce Creek in section 4 of the activity area and it is likely that subsurface artefacts exist elsewhere in the activity area. Therefore, the assessment must progress to a Complex Assessment under Section 64 of the Regulations.



MAP 4: Showing Area Surveyed and results of the Standard Assessment.

9.0 Complex Assessment

9.1 Aims and Methods

The aims of the Complex Assessment were to investigate the presence or absence, nature and extent of Aboriginal cultural material and whether prior land-use activities have impacted on the integrity of the landform within the Activity Area. A subsurface testing program was developed during the post-Standard Assessment meeting with the WTOAC. The Complex Assessment was undertaken over seven days between January 15-16 and 20-24, 2020.

The Complex Assessment involved the excavation of four 1m x 1m test pits (TP1-4), forty-nine 2m x 1m mechanical test pits (MTP1-6, 8-38, 42, 45-46, 51, 53, 55, 58-59, 61, 63-64), and five 0.5m x 0.5m radial test pits. The subsurface testing program comprehensively sampled all parts of the Activity Area and a total area of 103.25m^2 was excavated. The following methods were used during subsurface testing:

- All 1m x 1m and 0.5m x 0.5m test pits were excavated manually using hand tools, such as shovels, crow bars and trowels.
- The 1m x 1m and 0.5m x 0.5m test pits were excavated in 100mm spits to a culturally sterile layer and soil information was recorded for each spit, including Munsell colour, pH levels, photographs and drawings.
- The 2m x 1m mechanical test pits were excavated with a 5-tonne machine excavator in 100mm spits to a culturally sterile layer and soil information was recorded for each spit, including Munsell colour, pH levels, photographs and drawings.
- All excavated material was screened using 5mm-gauge hand sieves or 5mm-gauge mechanical table sieves. Spoil piles were placed a reasonable distance from the testing area, before being backfilled after recording.
- When archaeological material was identified in subsurface conditions, it was collected for analysis and recorded according to AV guidelines.

9.1.1 Participants

Date	Name	Organisation	Role
15-16, 20-24 Jan 2020	Daniel Barker	TerraCulture	Supervising Archaeologist
15-16, 22-24 Jan 2020	Emily Knowles	TerraCulture	Archaeologist
20-22 Jan 2020	Helene Athanasiadis	TerraCulture	Archaeologist
15-16 and 24 Jan 2020	Richard Fagan	WTOAC	Field Representative

Date	Name	Organisation	Role
15-16 Jan 2020	Alisha Fagan	WTOAC	Field Representative
20 Jan 2020	Ash Skinner	WTOAC	Field Representative
20 and 22 Jan 2020	Kyle O'Toole	WTOAC	Field Representative
21 Jan 2020	Chloe Clarke	WTOAC	Field Representative
22 Jan 2020	Jon Naylor	WTOAC	Field Representative
23 Jan 2020	James Brown	WTOAC	Field Representative
20-21 and 23-24 Jan 2020	Gary Paydon	Belmara Industries	Excavator Operator

Table 9: Summary of participants during the Complex Assessment.

9.1.2 Limitations and Obstacles

The landform and topography of the Activity Area, specifically the steep embankment leading to Bruce Creek, restricted the amount of MTPs that could be excavated across the site. Due to these restrictions, some MTPs could not be excavated, however where possible, some test pits were able to be moved from their original position within the grid. Sixty-five MTPs were originally planned for excavation; however, a total of forty-nine were excavated during the Complex Assessment.

There were no other obstacles encountered during the Complex Assessment.

9.2 Results of the Complex Assessment

Test Pit	Coordinates MGA/GDA94 Zone 55 Easting/Northing	Depth (mm)	Description	Artefacts
TP1	250620/5784085	142	**0-140mm:** Hard brown silty sand **140mm-142mm+:** Compact yellowish-brown clay	0
TP2	250700/5784370	190	**0-190mm:** Very hard compact dark brown blocky clayey silt **190mm+:** Orange-brown hard silty clay	4
TP3	250620/5784085	190	**0-100mm:** Loose brown sandy silt **100-190mm:** Brownish grey compact silty sand. PVC pipe encountered and excavation thus terminated at this depth.	0
TP4	250955/5783990	300	**0-100mm:** Loose brown sandy silt **100-300mm:** Light greyish brown compact silty sand **300mm+:** Compact orange brown clay	23

Table 10: Summary results of the test pits (1m x 1m).

Test Pit	Coordinates MGA/GDA94 Zone 55 Easting/Northing	Depth (mm)	Description	Artefacts
RTP4.1	250697/5784370	230	**0-100mm:** Brown sandy silt **100-230mm:** Light greyish brown compact silty sand **230mm+:** Orange brown clay	0
RTP4.2	250702/5784375	300	**0-100mm:** Brown sandy silt **100-300mm:** Compact light greyish brown silty sand **300mm+:** Orange brown clay	0
RTP4.3	250707/5784370	320	**0-100mm:** Brown sandy silt **100-320mm:** Compact light greyish brown silty sand **320mm+:** Orange brown clay	2
RTP4.4	250707/5784375	330	**0-90mm:** Brown sandy silt **90-330mm:** Light greyish brown compact silty sand **330mm+:** Orange brown clay	0
RTP 4.5	250707/5784365	350	**0-90mm:** Brown sandy silt **90-280mm:** Light greyish brown silty sand **280-350mm+:** Orange brown clay	0

Table 11: Summary results of the radial test pits (0.5m x 0.5m).

Test Pit	Coordinates MGA/GDA94 Zone 55 Easting/Northing	Depth (mm)	Description	Artefacts
MTP1	250620/5784335	400	**0-250mm:** Brown sandy silt with historic glass inclusions **250-350mm:** Lighter brown firm sandy silt **350-400mm+:** Reddish-brown mottled clay	5
MTP2	250570/5784285	350	**0-200mm:** Compact brown sandy silt **200-350mm:** Lighter brown firm sandy silt **350mm+:** Mottled orange-brown compact clay	10
MTP3	250620/5784285	380	**0-180mm:** Compact brown sandy silt **180-280mm:** Lighter brown sandy silt with buckshot inclusions **280-380mm:** Reddish-brown mottled clay	0
MTP4	250670/5784285	350	**0-150mm:** Brown compact sandy silt **150-250mm:** Compact orange-brown sandy silt **250-350mm:** Lighter brown firm sand **350mm:** Reddish-brown mottled clay	0
MTP5	250520/5784235	400	**0-400mm:** Undulating brown sandy silt with buckshot and patches of lighter brown sand **400mm+:** Compact mottled orange-brown clay	0

Test Pit	Coordinates MGA/GDA94 Zone 55 Easting/Northing	Depth (mm)	Description	Artefacts
MTP6	250570/5784185	350	**0-250mm:** Loose brown sandy silt with buckshot inclusions **250-350mm:** Lighter brown firm sandy silt **350mm+:** Mottled orange-brown compact clay	0
MTP7	N/A	N/A	Unexcavated	N/A
MTP8	250520/5784135	360	**0-290mm:** Brown sandy silt with patches of lighter brown sand **290-360mm+:** Orange brown mottled clay	0
MTP9	250620/5784135	300	**0-250mm:** Brown sandy silt with damp patches of lighter brown sand **250-300mm+:** Mottled orange brown clay	0
MTP10	250670/5784135	290	**0-290mm:** Brown sandy silt with patches of lighter brown sand **290mm+:** Mottled orange brown clay	0
MTP11	250720/5784135	400	**0-250mm:** Brown sandy silt with buckshot inclusions **250-350mm:** Lighter brown firm sand **350mm+:** Compact mottled orange-brown clay	1
MTP12	250420/5784085	180	**0-180mm:** Brown sandy silt **180mm+:** Damp orange brown mottled sandy clay	0
MTP13	250470/5784085	230	**0-180mm:** Brown damp sandy silt **180-230mm+:** Damp, sticky, blocky orange brown mottled clay	0
MTP14	250570/5784085	310	**0-250mm:** Brown sandy silt with patches of lighter brown sand **250-310mm+:** Orange brown mottled clay	0
MTP15	250670/5784085	320	**0-320mm:** Brown sandy silt **320mm+:** Orange brown mottled clay	0
MTP16	250720/5784085	450	**0-300mm:** Loose brown sandy silt **300-450mm:** Lighter brown firm sand **400mm+:** Mottled orange brown clay	1
MTP17	250770/5784085	300	**0-250mm:** Brown sandy silt **250-300mm:** Lighter brown firm sand **300mm+:** Mottled orange brown clay	0
MTP18	250520/5784035	300	**0-200mm:** Brown sandy silt **200-300mm:** Lighter brown firm sand **300mm+:** Mottled orange brown clay	0
MTP19	250620/5784035	350	**0-250mm:** Brown sandy silt with buckshot inclusions **250-350mm:** Lighter brown firm sand **350mm+:** Mottled orange-brown clay	1

Test Pit	Coordinates MGA/GDA94 Zone 55 Easting/Northing	Depth (mm)	Description	Artefacts
MTP20	250670/5784035	430	**0-300mm:** Loose brown sandy silt **300-430mm:** Lighter brown firm sand **430mm+:** Mottled orange-brown clay	2
MTP21	250720/5784035	430	**0-250mm:** Loose brown sandy silt **250-430mm:** Lighter brown firm sand **430mm:** Mottled orange-brown clay	0
MTP22	250935/5784110	2000	**0-2000mm:** Fine, homogenous brown sand **2000mm:** Compact reddish-brown clay	38
MTP23	250880/5784090	370	**0-200mm:** Brown sandy silt **200-370mm:** Brown sandy silt with ironstone buckshot inclusions, large stones, and quartz pebbles **370mm+:** Reddish brown mottled clay	3
MTP24	250905/5784090	450	**0-250mm:** Brown sandy silt **250-450mm:** Brown sandy silt with ironstone inclusions **450mm+:** Reddish-brown mottled clay	0
MTP25	250970/5784085	560	**0-500mm:** Brownish-grey very compact clayey silt **500-560mm:** Dark brown silty clay	7
MTP26	250880/5784065	330	**0-150mm:** Brown sandy silt **150-330mm:** Brown sandy silt with ironstone buckshot **330mm+:** Reddish brown mottled clay	1
MTP27	250905/5784065	740	**0-230mm:** Brown sandy silt **230-650mm:** Brown silty sand with undulating reddish-brown clay from 500mm **650-740mm:** Light brown silty sand with undulating reddish-brown clay **740mm+:** Reddish-brown clay	1
MTP28	250855/5784040	320	**0-150mm:** Brown sandy silt **150-280mm:** Brown sandy silt with buckshot inclusions **280-320mm+:** Reddish brown mottled clay	9
MTP29	250880/5784040	250	**0-100mm:** Brown sandy silt **100-250mm:** Brown sandy silt with buckshot **250mm+:** Reddish brown mottled clay	0
MTP30	250905/5784040	290	**0-160mm:** Brown sandy silt **160-220mm:** Brown sandy silt with ironstone buckshot inclusions **220-290mm+:** Reddish brown mottled clay	0

Test Pit	Coordinates MGA/GDA94 Zone 55 Easting/Northing	Depth (mm)	Description	Artefacts
MTP31	250880/5784015	310	**0-180mm:** Brown sandy silt **180-280mm:** Brown sandy silt with buckshot inclusions **280-310mm+:** Reddish brown mottled clay	4
MTP32	250905/5784015	440	**0-200mm:** Brown sandy silt **200-310mm:** Brown sandy silt with stone and pebble inclusions **310-440mm+:** Reddish brown clay	5
MTP33	250930/5784015	200	**0-100mm:** Brown sandy silt **100-200mm+:** Reddish-brown clay with ochre nodules	1
MTP34	250905/5783990	330	**0-200mm:** Brown sandy silt **200-330mm:** Brown sandy silt with buckshot inclusions **330mm+:** Reddish brown mottled clay	28
MTP35	250930/5783990	330	**0-250mm:** Brown sandy silt **250-330mm:** Sticky brown silty clay with yellow ochre **330mm+:** Reddish brown sticky clay	3
MTP36	250905/5783965	340	**0-200mm:** Brown sandy silt **200-340mm:** Brown sandy silt with stones and buckshot inclusions **340mm+:** Reddish brown clay	7
MTP37	250930/5783965	450	**0-370mm:** Brown sandy silt **370-450mm+:** Orange brown mottled clay	4
MTP38	250955/5783965	400	**0-280mm:** Brown sandy silt with tree roots **280-400mm+:** Reddish-brown sticky clay	9
MTP39	N/A	N/A	Unexcavated	N/A
MTP40	N/A	N/A	Unexcavated	N/A
MTP41	N/A	N/A	Unexcavated	N/A
MTP42	250930/5793940	320	**0-190mm:** Brown sandy silt **190-290mm:** Brown sandy silt with buckshot inclusions **290-320mm+:** Orange brown mottled clay	12
MTP43	N/A	N/A	Unexcavated	N/A
MTP44	N/A	N/A	Unexcavated	N/A
MTP45	251030/5783940	1000	**0-1000mm:** Rich brown loose sandy silt **1000mm+:** Reddish-brown mottled clay	20
MTP46	250930/5783915	290	**0-150mm:** Brown sandy silt **150-260mm:** Brown sandy silt with buckshot inclusions **260-290mm+:** Orange brown mottled clay	1
MTP47	N/A	N/A	Unexcavated	N/A

Test Pit	Coordinates MGA/GDA94 Zone 55 Easting/Northing	Depth (mm)	Description	Artefacts
MTP48	250980/5783915	280	**0-280mm:** Rich brown sandy silt **280mm+:** Reddish brown mottled clay	0
MTP49	N/A	N/A	Unexcavated	N/A
MTP50	N/A	N/A	Unexcavated	N/A
MTP51	250955/5783890	370	**0-160mm:** Loose brown sandy silt **160-370mm:** Brown sandy silt with buckshot inclusions **370mm+:** Reddish-brown mottled clay	2
MTP52	N/A	N/A	Unexcavated	N/A
MTP53	251005/5783890	600	**0-550mm:** Compact rich brown sandy silt **550-600mm+:** Reddish brown mottled clay	1
MTP54	N/A	N/A	Unexcavated	N/A
MTP55	251005/5783865	190	**0-190mm:** Rich brown sandy silt **190mm+:** Reddish brown mottled clay	8
MTP56	N/A	N/A	Unexcavated	N/A
MTP57	N/A	N/A	Unexcavated	N/A
MTP58	251005/5783840	340	**0-160mm:** Brown sandy silt **160-270mm:** Brown sandy silt with ironstone buckshot **270-340mm+:** Reddish brown mottled clay	18
MTP59	251030/5783840	330	**0-210mm:** Brown, loose sandy silt **210-330mm:** Brown sandy silt with ironstone inclusions **330mm+:** Compact reddish-brown clay	5
MTP60	N/A	N/A	Unexcavated	N/A
MTP61	251005/5783815	370	**0-350mm:** Brown sandy silt with lighter sand patches **350-370mm+:** Reddish brown mottled clay	68
MTP62	N/A	N/A	Unexcavated	N/A
MTP63	251005/5783790	370	**0-190mm:** Brown sandy silt **190-370mm:** Brown sandy silt with ironstone buckshot **370mm+:** Reddish brown mottled clay	5
MTP64	251030/5783790	400	**0-150mm:** Brown sandy silt **150-300mm:** Brown sandy silt with ironstone buckshot **300-400mm+:** Reddish brown clay	3
MTP65	N/A	N/A	Unexcavated	N/A

Table 12: Summary results of mechanical test pits (2m x 1m).

9.2.1 Test Pits (TP1-4)

Four 1m x 1m test pits were excavated in the activity area. The test pits were measured and marked using a string line. The test pits were excavated manually using hand tools such as shovels, crow bars and trowels. All excavated material was hand screened using 5mm gauge sieves. The test pits were excavated in arbitrary spits of 100mm until a culturally sterile basal layer was reached or it became unsafe to excavate further. One test pit in Section 3, one test pit in Section 4, and two test pits in Section 1 of the Activity Area were excavated as part of the Complex Assessment.

Test Pit 1 (TP1) was located in the centre of the southern paddock (Section 3). The surface of the test pit was characterised by long, dead grass. The stratigraphic profile consisted of a hard, brown silty sand topsoil to 140mm overlaying a compact yellowish-brown clay at a final depth of 142mm. No Aboriginal cultural heritage was recorded in TP1.

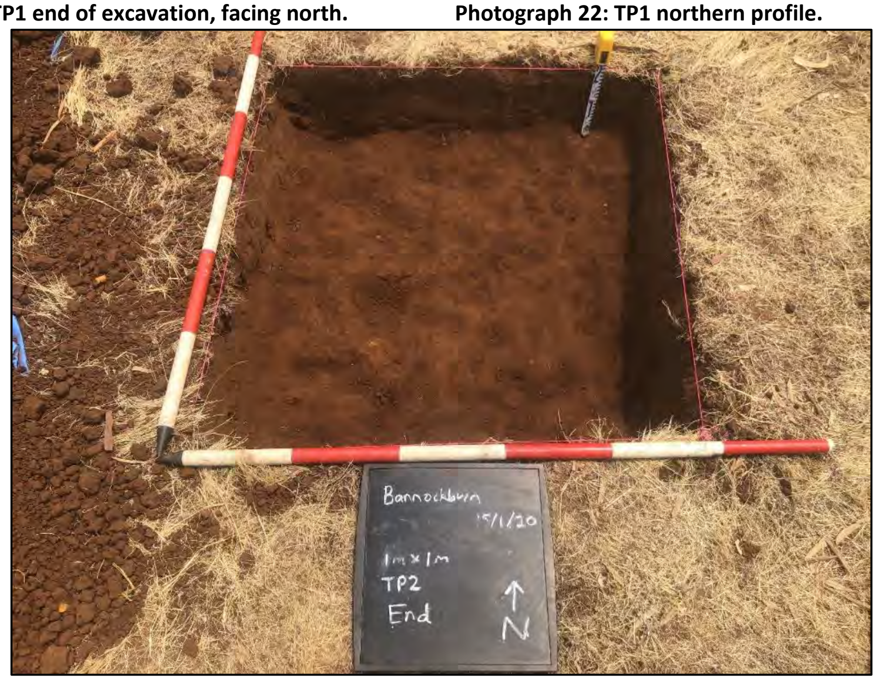
Test Pit 2 (TP2) was located in Section 4 of the Activity Area, at the top of the ridgeline leading down to Bruce Creek. The stratigraphic profile consisted of very hard compact dark brown blocky clayey silt to 190mm overlaying a hard orange-brown silty clay to a depth of 190mm. One quartzite core, one quartzite angular fragment, and two flakes make of silcrete and quartz were recorded within the very hard compact dark brown blocky clayey silt layer at a depth of between 50-100mm.

Test Pit 3 (TP3) was located in Section 1 of the Activity Area, approximately 10m west of an agricultural dam at 5 Ormond Street. Test Pit 3 is the northernmost test pit within the Activity Area. The stratigraphic profile consisted of a loose brown sandy silt topsoil to a depth of 100mm, overlaying a brownish grey compact silty sand to 190mm. At this point a PVC pipe was encountered and excavations within this test pit were subsequently terminated. No Aboriginal cultural heritage was recorded in TP3.

Test Pit 4 (TP4) was located in Section 1 of the Activity Area, approximately 30m south of TP3. The stratigraphic profile consisted of a loose brown sandy silt to 100mm overlaying a light greyish brown compact silty sand with artefacts throughout. This layer sat above a compact orange-brown clay to a final depth of 300mm. A total of 23 silcrete artefacts were recorded at depths of between 150-200mm.

Photograph 21: TP1 end of excavation, facing north.


Photograph 22: TP1 northern profile.



Photograph 23: TP2 end of excavation, facing north.

Photograph 24: TP2 northern profile.

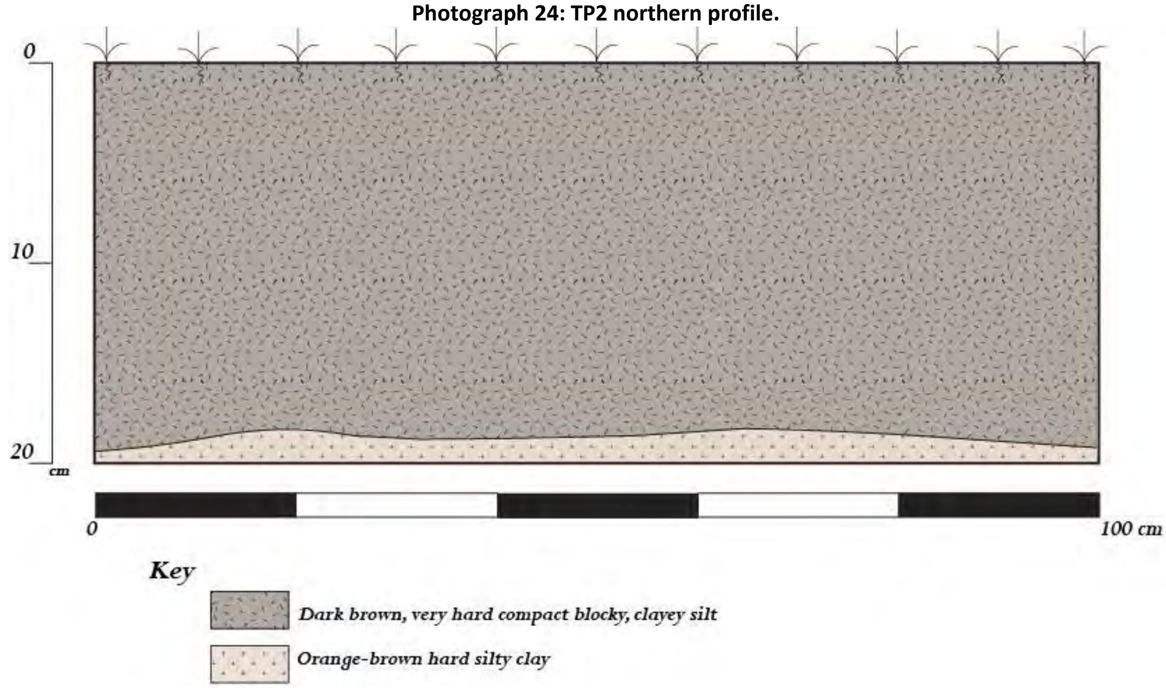


Figure 8: TP2 stratigraphic profile, facing north

Photograph 25: TP3 end of excavation, facing north.

Photograph 26: TP3 northern profile.

Photograph 27: TP4 end of excavation, facing north.

Photograph 28: TP4 northern profile.

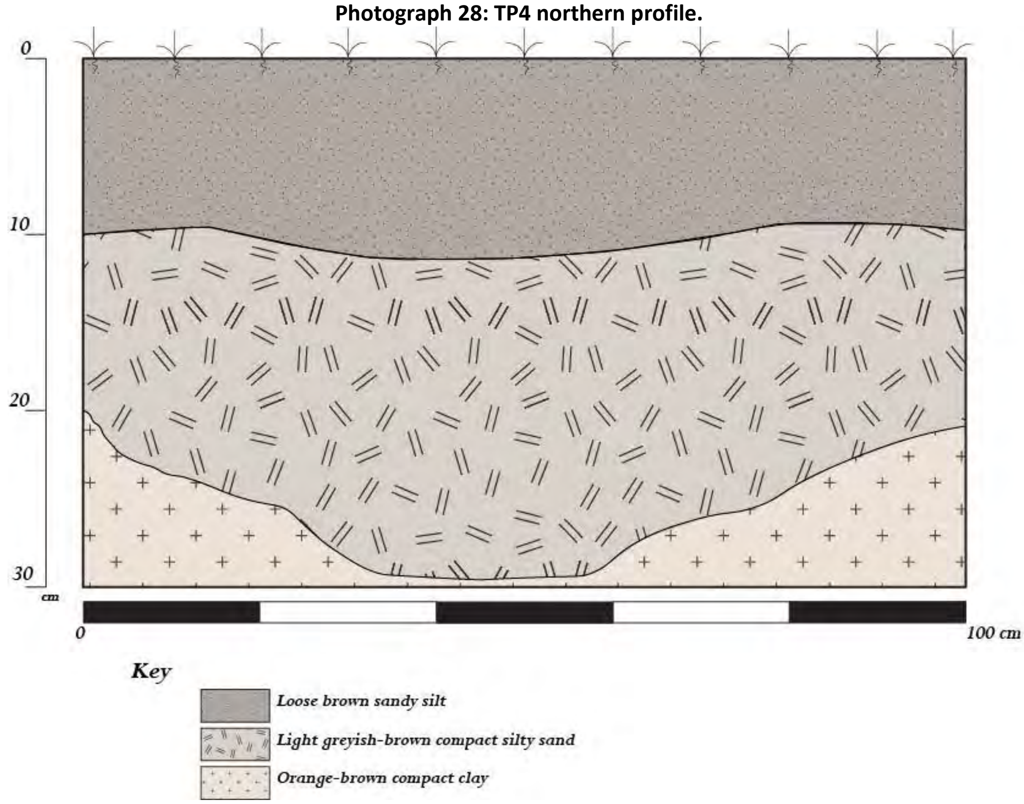


Figure 9: TP4 stratigraphic profile, facing north

9.2.2 Radial Test Pits (RTP4.1-4.5)

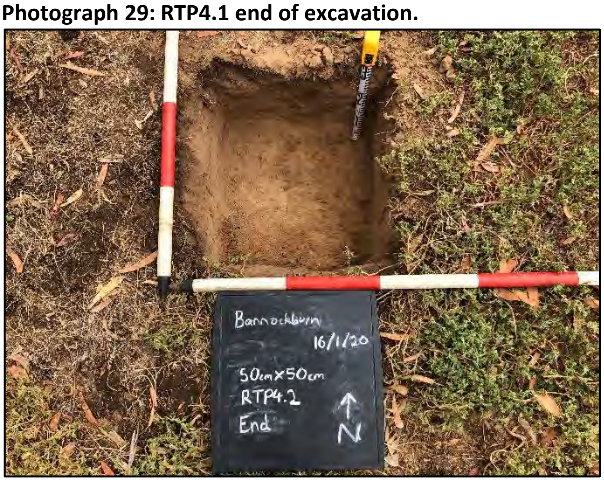
A total of five 0.5m-0.5m radial test pits were excavated as a result of the positive identification of Aboriginal cultural heritage within TP4. RTP4.1-4.3 were excavated five metres to the west, north, and east of TP4 respectively. The presence of a shed and animal pen to the south of TP4 inhibited abilities to conduct testing to the south of TP4. Upon the positive identification of artefacts in RTP4.3, two additional RTPs were excavated, RTP4.4 and RTP4.5, five metres to the north and five metres to the south of RTP4.3 respectively. All RTPs were hand excavated using shovels, crow bars and trowels. All excavated material was hand screened using 5mm gauge sieves. The RTPs were excavated stratigraphically until a culturally sterile basal layer was established and all exhibited a similar stratigraphic profile.

The stratigraphic profile of the RTPs generally consisted of a brown, sandy silt topsoil overlaying a light greyish brown compact silty sand. This layer sat above a compact orange-brown clay. The depth of the basal clay layer varied from 230mm in RTP4.1 to 350mm in RTP4.5.

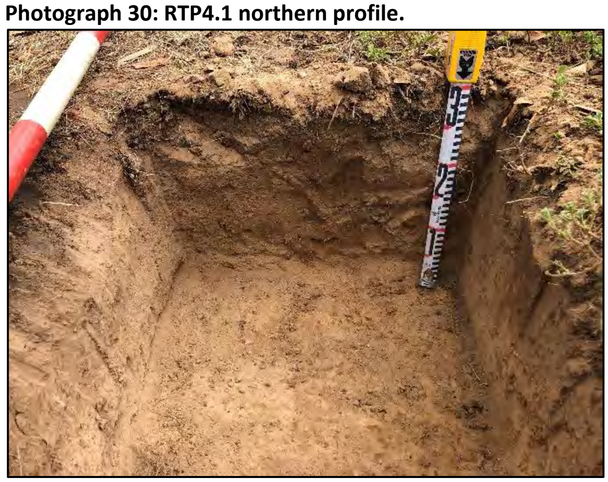
A total of two Aboriginal stone artefacts were recorded in RTP4.3 within the light greyish brown compact silty sand layer, at depths of between 150mm-250mm. These comprised two quartzite flakes.

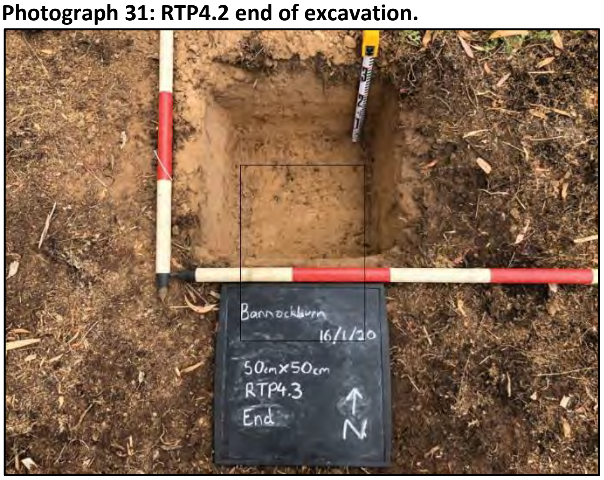
Photograph 29: RTP4.1 end of excavation.


Photograph 30: RTP4.1 northern profile.

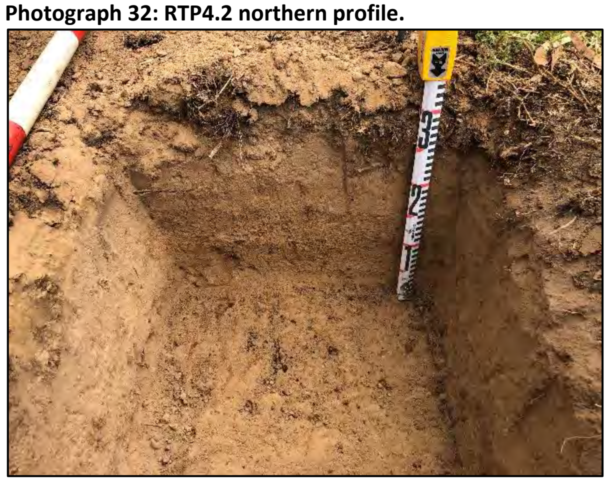


Photograph 31: RTP4.2 end of excavation.


Photograph 32: RTP4.2 northern profile.



Photograph 33: RTP4.3 end of excavation.


Photograph 34: RTP4.3 northern profile.

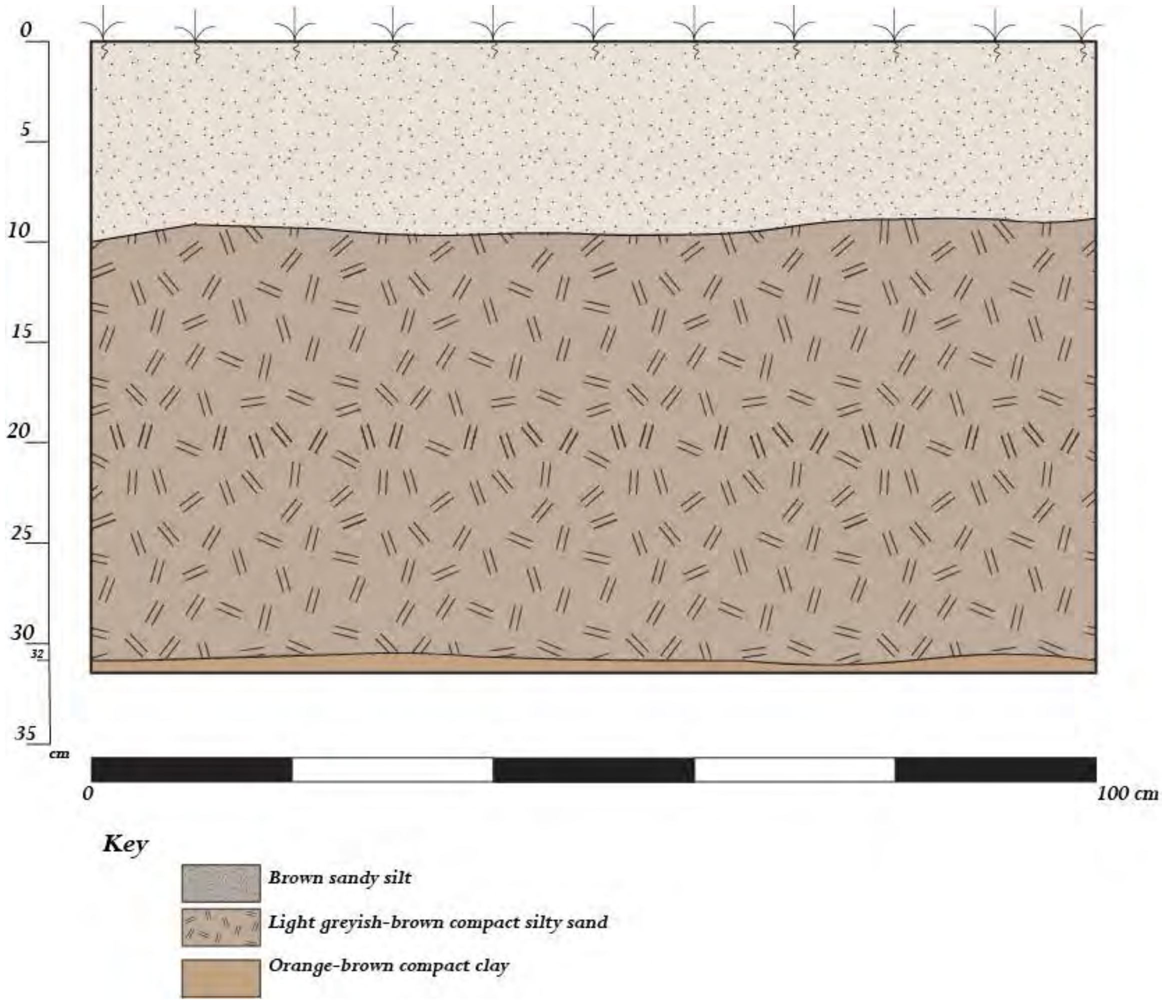


Figure 10: RTP4.3 stratigraphic profile, facing north

Photograph 35: RTP4.4 end of excavation.

Photograph 36: RTP4.4 northern profile.

Photograph 37: RTP4.5 end of excavation.

Photograph 38: RTP4.5 northern profile.

9.2.3 Machine Test Pits (MTP1-6, 8-38, 42, 45-46, 48, 51, 53, 55, 58-59, 61, 63-64)

A total of forty-nine machine test pits (MTPs) were excavated in the activity area. Six MTPs were excavated in Section 2, thirteen in Section 3, and thirty in Section 4. The machine test pits were excavated using an excavator with an attached mud bucket and measured 2m x 1m. All excavated material was screened using a 5mm gauge mechanical table sieve. The machine test pits were excavated in approximate 100mm spits until a culturally sterile basal layer was established or it became unsafe to excavate further. The depth and stratigraphy of the machine test pits varied depending on the location and landform.

In Sections 2 and 3, the stratigraphic profile of the machine test pits generally consisted of an upper layer of compact brown sandy silt overlaying a lighter brown firm sandy silt, above a basal layer of reddish to orange brown compact mottled clay. In some instances, such as in MTPs 5, 8-10, and 14, a combination of the two top layers were exhibited. In MTP12 and MTP13, the upper layer of compact brown sandy silt sat directly above the orange brown clay basal layer. The depth of the basal clay depended on the presence or absence of the intermediate layer, ranging from 180mm and 230mm in MTP12 and MTP13 respectively and 450mm in MTP16.

Aboriginal cultural heritage in the form of stone artefacts was recorded within MTP1-2, 11, 16, 19, and 20.

In Section 4, the stratigraphic profile of the machine test pits generally consisted of a compact brown sandy silt layer overlaying a brown sandy silt with pebble or ironstone buckshot inclusions, sitting above a basal layer of very compact mottled reddish to orange-brown clay. In some test pits, the compact brown sandy silt layer sat directly on top of the basal clay layer, however this did not seem to influence the depth of the basal clay layer. MTP27 consisted of a brown silty sand with undulating reddish-brown clay beneath the compact brown sandy silt layer, which overlayed a light brown silty sand with undulating reddish-brown clay. This lay above a reddish-brown mottled clay basal layer. The depth of the basal clay varied greatly across Section 4, but generally the test pits located within the Fyansford Clay Formation landform and closest to Bruce Creek tended to hold the greatest depth, between 560mm (MTP25) and 2000mm (MTP22). Test pits located away from the contours of Bruce Creek and on the flat plain to the west and south of Section 4 varied in depths of between 190mm (MTP55) and 740mm (MTP27).

Aboriginal cultural heritage in the form of stone artefacts were recorded in all but five of the machine test pits within Section 4. In two of the machine test pits, MTP33 and MTP35, ochre was recorded just above the clay layer.

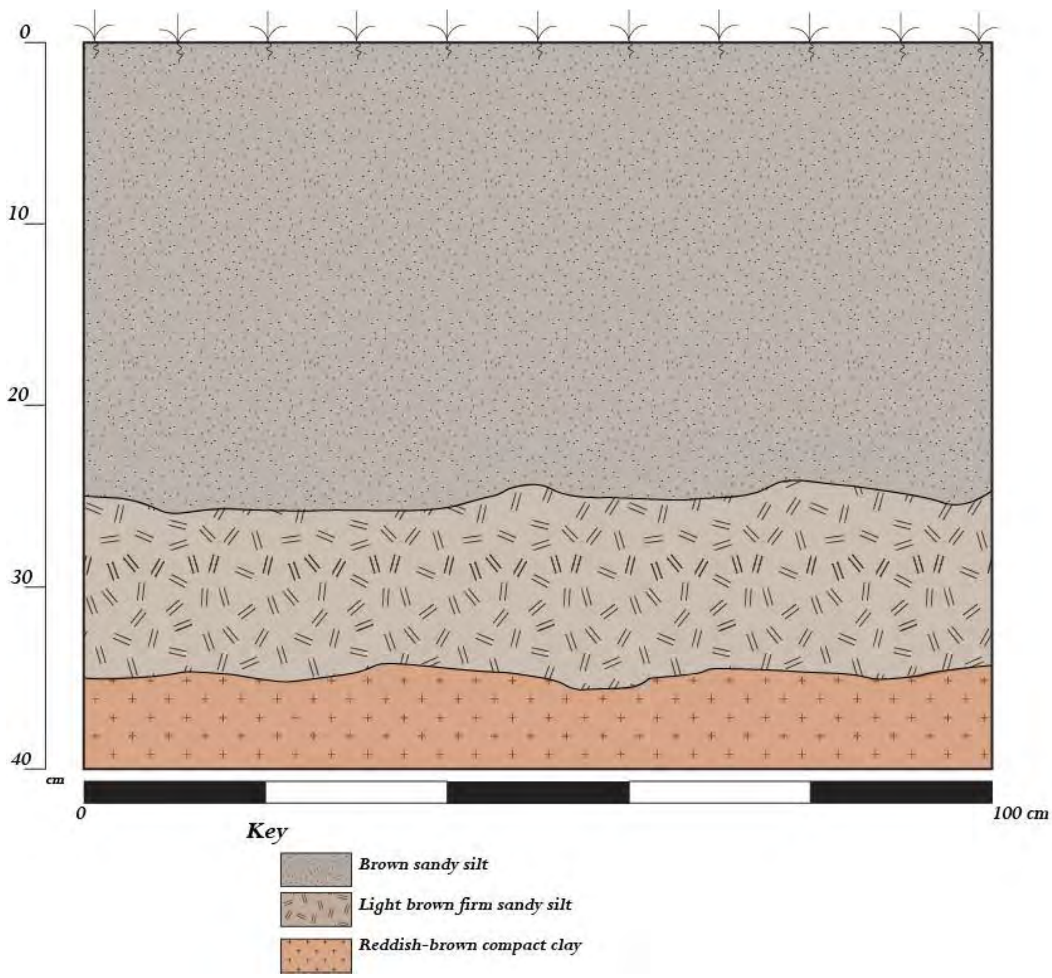


Figure 11: MTP1 stratigraphic profile, facing north

Photograph 39: MTP10 end of excavation, facing west

Photograph 40: MTP10 southern profile

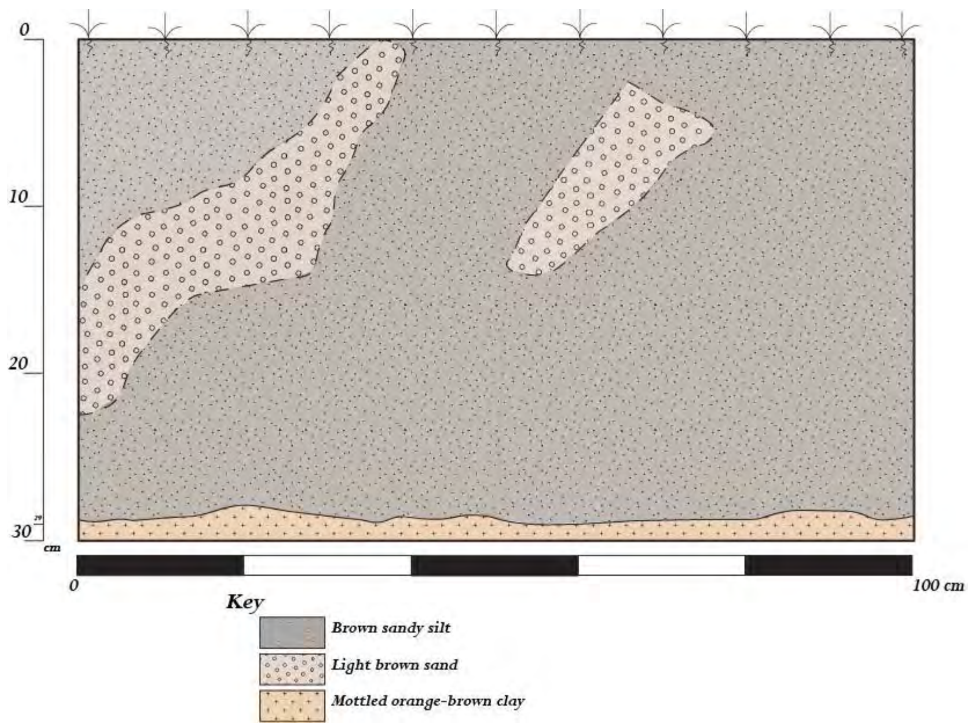


Figure 12: MTP10 stratigraphic profile, facing south