VICTORIAN PLANNING AUTHORITY

SOIL DESKTOP ASSESSMENT - SODIC/DISPERSIVE SOILS AND CONTAMINATION RISKS

BANNOCKBURN SOUTH-EAST PRECINCT

FEBRUARY 2025

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Soil Desktop Assessment - Sodic/Dispersive Soils and Contamination Risks Bannockburn South-East Precinct

Victorian Planning Authority

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REV	DATE	DETAILS
A	12 October 2022	Draft for approval
B	22 December 2022	Final incorporating VPA comments
C	5 August 2024	Revision incorporating additional VPA/EPA comments relating to contamination likelihood, and the addition of one additional area of potentially contaminated land
D	7 February 2025	Revision to clarify findings at 418 Burnside Road and clarification in Table 8.1, per VPA request

	NAME	DATE	SIGNATURE
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EXECUTIVE SUMMARY

WSP Australia Pty Limited (WSP) was engaged by the Victorian Planning Authority (VPA) on 30 May 2022 to undertake a preliminary, desk-based, sodic/dispersive soils and contamination risk assessment at the Bannockburn South-East Precinct, at Bannockburn, Victoria.

The Bannockburn South-East precinct is located southeast of Bannockburn approximately 14 km northwest of Geelong and covers an area of approximately 524 hectares. The precinct is bounded by the existing Bannockburn township to the north, farmland to the east, the Gheringhap-Maroona freight railway to the south, and Bruce's Creek to the west. Currently the precinct comprises a mix of grazing/cropping land with minor rural residential.

This soil erosion risk and contamination risk assessment has been based upon a literature review and site visits and walkover (accessible areas). The risk ranking is general in nature and has been assessed at a Precinct scale.

Previous Land Capability Assessments were completed for the Bannockburn area by Meinhardt (2020) and SCA (1981). Soil mapping, erosion studies and master planning for Bruce's Creek have also been completed. In general, the erosion risk in previous studies was assessed as Low – Medium, and the contamination risk in the Meinhardt LCA was assessed as Low (assessed under the previous iteration of PPN30, now superseded).

On 25 March 2024, WSP conducted an additional site walkover assessing erosion features in the vicinity of Bruce's Creek. Disturbed, raised soil with steel and plastic inclusions was observed in the south-western corner. This area was added as an additional area of concern at the site following initial site inspections completed in 2022 by WSP.

SOIL EROSION RISK

- Soil erosion risk in the context of **soil erosion** was assessed as Low – Medium risk under the adopted risk scheme.
- Soil erosion risk in the context of **buildings and infrastructure** was assessed as Low – Medium risk under the adopted risk scheme.
- Soil erosion risk in the context of **water quality** was assessed as Low – Medium under the adopted risk scheme.

In addition to better informing the risk profile by undertaking intrusive investigations, controls may include protection of topsoil, stormwater treatment and retention, elimination of linear infrastructure (or management of backfill to limit risk of tunnel erosion).

Based on the desk study and site observations, excavations and cuttings in the study area east and west of Bruce's Creek may encounter dispersive soils and this potential should be confirmed with an intrusive investigation including collection and analysis of soil samples. Intrusive investigation is also recommended in the vicinity of Bruce's Creek (500 m buffer), including where mapping indicates presence of Sandringham Sandstone and/or Gellibrand Marl, to confirm the soil type(s) and soil properties.

CONTAMINATION RISK

Areas of interest which have been determined to have a "Medium" potential for contamination will require a Preliminary Risk Screen Assessment (PRSA) to be completed in accordance with the requirements of PPN30. The PRSA will determine if an Environmental Audit is required.

In areas (majority of the precinct) where land is unlikely to be contaminated, PPN30 does not include any recommendations for further assessment. In this case, the General Environment Duty (GED) applies to for any suspected risk to human health or the environment.

VPA may consider two pathways to meeting the requirements of PPN30:

- Strategic Planning approach: Meet the PRSA and/or Environmental Audit requirements prior to the amendment

- Statutory Planning approach: Defer meeting the PRSA and/or Environmental Audit requirements until after the amendment via application of an Environmental Audit Overlay

WSP recommends a Strategic Planning approach as the preferred approach, as it maximises potential to tap into local knowledge, ensures that persons in management or control of land meet their obligations under the GED, and may reduce the time and cost of required environmental investigations at the Precinct.

FURTHER ASSESSMENT

EROSION RISK

Based on the desk study and site observations, excavations and cuttings in the study area east and west of Bruce's Creek may encounter dispersive soils and this potential should be confirmed with an intrusive investigation including collection and analysis of soil samples. Intrusive investigation is recommended in the vicinity of Bruce's Creek (500 m buffer), including where mapping indicates presence of Sandringham Sandstone and/or Gellibrand Marl, to confirm the soil type(s) and soil properties.

It is recommended that VPA **prepare a precinct scale plan/map as part of the precinct structure plan (PSP) process**, which highlights areas of high risk, medium risk and low risk in relation to erosion potential, which will inform strategic and statutory controls.

It is recommended that **intrusive investigation may be better deferred to the proponent** as this enables scoping to be suited to the proposed development (e.g. deep vs shallow, structural vs vegetation, etc.). Intrusive investigations should be undertaken based on the erosion risk plan/map, and results should inform **preparation of an erosion control management plan** addressing risks and providing best-practice mitigations and which has been endorsed by a suitably qualified professional (e.g. a certified professional in erosion and sediment control or soil science).

A subsequent phase of more closely spaced investigations may be required in some areas if sodic and potentially dispersive soils are encountered to enable the site to be more closely zoned, because the presence and severity of sodic and dispersive soils can vary over relatively short distances.

CONTAMINATION RISK

To meet the requirements of Ministerial Direction No.1, further site assessment is required where the potential for contamination has been assessed as "Medium" as outlined in Planning Practice Note 30.

- Landowners participating in the precinct planning process may be encouraged to undertake the PRSA for the existing properties/lots within the Precinct, noting restrictions around the PRSA process can result in an Audit requirement if insufficient supporting information is available to close out contamination risk.
- Landowners participating in the precinct planning process may be approached to undertake site investigations to demonstrate consideration of the GED (e.g., by undertaking clean up of surface stockpiles, completing a PSI and/or DSI to address contamination concerns arising from desktop reviews and seeking to demonstrate absence of contamination.
- An advantage of undertaking the GED compliance work ahead of the PRSA may provide the Environmental Auditor with sufficient confidence to conclude that the site is not likely to be contaminated under the PRSA guidelines by providing robust evidence that can feed into the PRSA, thus reducing the potential that an Environmental Audit is recommended.

Alternatively,

- VPA may elect to defer meeting the PRSA and/or Environmental Audit requirements until after the amendment via application of an Environmental Audit Overlay or within the schedule of the new land zoning (e.g. Urban Growth Zone [UGZ]). This approach has potential to impose encumbrances on land that is not likely to be contaminated.

1 PURPOSE AND OBJECTIVES

WSP Australia Pty Limited (WSP) was engaged by the Victorian Planning Authority (VPA) on 30 May 2022 to undertake a preliminary, desk-based, sodic/dispersive soils and contamination risk assessment at the Bannockburn South-East Precinct, at Bannockburn, Victoria (precinct/site).

A precinct figure is provided as Figure 1, **Appendix A**.

1.1 PURPOSE

The purpose of the assessment was to assist VPA in understanding the likelihood of the presence of sodic/dispersive soils within the precinct (and the associated risks to development) and the likelihood that a historical land use may trigger a requirement for a Preliminary Risk Screen Assessment (PRSA) to comply with Environment Protection Authority Victoria (EPA) and/or planning regulations/guidelines; to inform the precinct structure planning being undertaken and provide management options in a property development context.

1.2 OBJECTIVES

The objectives of the proposed works were to:

- **Sodic/dispersive soils:** Provide a documented review of the likelihood for sodic/dispersive soils to be present in the precinct and detail potential risks in a land development context; and to recommend whether on-site soil testing is required and (if so) an outline scope of works for such an assessment in the context of precinct planning.
- **Contaminated land:** Provide a documented review of historical land use and assess the likelihood (at a precinct level) that a PRSA may be required under applicable EPA or Planning guidelines (Planning Practice Note 30, DELWP 2021).
- Provide a desktop assessment which builds on the existing land capability assessment report (Meinhardt, 2020) to assist with the identification and management of erosion risk associated with sodic/dispersive soils and contamination risk associated with historical land use in the precinct and provide recommendations for further assessment in a property development context.

2 SCOPE OF WORKS

To achieve the assessment objectives identified in Section 1.2 the following scope of works was undertaken:

1. A Site inspection of the entire precinct was undertaken to enable familiarisation with local conditions, record relevant observations, and inform the literature review and assessment report. The inspection was undertaken by two field engineers (geotechnical and contaminated land specialists) within a single day, from public areas (roadways and stream reserves) and accessible areas (not cropped) within individual properties. The inspection included an assessment of the existing escarpment along Bruce's Creek and the local surface water conditions (storage dams and Bruce's Creek).
2. A literature review of publicly available information (including geology, soil type mapping, erosion risk, and site history) and summarise findings pertaining to the objectives of the assessment. The literature review included discussion of:
   - The land capability assessment (Meinhardt, 2020),
   - Risk ranking on a precinct scale for erosion risk and contamination risk,
   - Base this review on professional expertise and experience, industry accepted methodologies and relevant Australian standards and guidelines, and the findings of the site visits, and
   - Generate spatial maps indicating risk profile for soil and contamination, building on the Land Capability Assessment report.
3. Preparation of this report.

3 BANNOCKBURN SOUTH-EAST PRECINCT

The Bannockburn South-East precinct is located southeast of Bannockburn approximately 14 km northwest of Geelong and covers an area of approximately 524 hectares. The precinct is bounded by the existing Bannockburn township to the north, farmland to the east, the Gheringhap-Maroona freight railway to the south, and Bruce's Creek to the west. Currently the precinct comprises a mix of grazing/cropping land with minor rural residential.

The precinct boundary is shown in Figure 3.1 below.

Figure 3.1 Precinct boundary – Bannockburn South-East precinct (source: VPA)

WSP understands Bannockburn South-East is proposed to provide for sustainable growth of Bannockburn to 2050.

Most of the precinct is situated on a flat to slightly undulating area comprising a relatively thin Newer Volcanics basalt/clay cap overlying marl and/or sandstone sequences, with slope generally southwards parallel to Bruce's Creek, which is incised by approximately 10 metres from the surrounding surface.

The precinct location and layout is presented in further detail as Figure 1 in **Appendix A**, while pertinent site details are summarised in Table 3.1 below.

Table 3.1 Pertinent Site Details

PARAMETER	DETAILS
Locality	Bannockburn, Victoria
Address	The precinct is bounded by the following features: the existing Bannockburn township, including Charlton Road and Burnside Road (north), farmland (east), the Gheringhap-Maroona freight railway (south), and Bruce's Creek (west).
Lot and Plan number	— Lot 1, TP134465 (part) — Crown land, SPI 2011\PP3225 (Bruce's Creek) — Road reserve (unnamed), SPI 35A~21\PP3225 — Lots 1 and 2, TP134466

PARAMETER		DETAILS	
		— Levy Road — Lots 1, 2, 5 and 6, LP6088 — Road reserve (unnamed), Lot 35A Sec 21, TP76927 — Road reserve (unnamed), Lots 46A Sec 21 and 49A Sec 21, TP352340 — Lot 2, TP96373 (part) — Lot 13, LP6088 — Lot B, PS510752 (part) — Lot 17, LP6088 (part) — Lots 1 and 2, LP97121	
Site Owner(s)		Land parcels are understood to be owned by several individuals and developers, in addition to control of public roads by local and state government authorities. The riparian corridor along Bruce's Creek is partially Crown frontage (northern section) and partially private land.	
Current Land Use		Agricultural with associated homestead/farmhouse residential uses	
Past Land Use		Agricultural with associated homestead/farmhouse residential uses	
Site Investigation Area		Approximately 524 hectares (ha)	
Local Government Authority		Golden Plains Shire Council	
Coordinates (approx. centre of site):		N: 5782520, E: 252690	Projection: MGA Zone 55 (GDA2020)
Site Zoning		Farming Zone (FZ).	
Overlays		Environmental Significance Overlay – Schedule 2 (ESO) – protection of Bruce's Creek, Land Subject to Inundation Overlay (LSIO) – Bruce's Creek, Salinity Management Overlay (SMO) – small area of Bruce's Creek.	
Surrounding Land Use	**North**	Charlton Road and Burnside Road, followed by general and low density residential.	
	East	Agricultural (cropping/grazing), followed by railway line, and agricultural beyond (including farmhouses)	
	South	Railway line, followed by agricultural (predominantly cropping/grazing, and a series of chicken hatchery/breeder/rearer farms, and including farmhouses).	
	West	Bruce's Creek, followed by agricultural (predominantly cropping/grazing, and greenhouses, and including farmhouses), followed by bushland reserve.	

4 TECHNICAL FRAMEWORK

4.1 SODIC AND DISPERSIVE SOILS IN VICTORIA

4.1.1 DEFINITION OF SODIC AND DISPERSIVE SOILS

Sodic soils are clayey soils containing soils with relatively high exchangeable sodium between the clay platelets. When a sodic soil comes into contact with non-saline water or rainwater, water molecules are drawn in-between the clay platelets resulting in swelling of the clay and, often, the detachment of clay platelets into the water making the water cloudy in a process called dispersion. Dispersed clay particles are readily suspended in the water and can be transported in the water. Dispersion can lead to the development of tunnel, gully and surface erosion.

Figure 4.1 Tunnel erosion of dispersive clay subsoil, https://vro.agriculture.vic.gov.au (accessed 2022) (Left), and construction of dam in dispersive soils leading to rill erosion, https://nre.tas.gov.au (accessed 2022) (Right)

The sodium content in a soil (sodicity) is commonly categorised on the basis of Exchangeable Sodium Percentage (ESP) after Rengasamy and Churchman (1999) and Northcote and Skene (1972).

Table 4.1 Soil sodicity based on exchangeable sodium percentage (from vro.agriculture.vic.gov.au, map: sodicity – upper subsoil)

DESCRIPTION	EXCHANGEABLE SODIUM PERCENTAGE (ESP)
Non-sodic or low-sodic	< 6%
Sodic	6 -15%
Strongly sodic	15-25%
Very strongly sodic	>25%

Note that while sodic soils are generally dispersive, not all sodic soils disperse and not all dispersive soils are sodic. Evidence of historical dispersion at a site may be identified in the field while dispersion potential can be assessed using field and/or laboratory testing.

A common laboratory test to predict dispersive behaviour in soils is the Emerson soil crumb test (AS 1289.3.8.1-2017). Soils are divided into 7 classes (with an additional class for soil containing calcium rich minerals) based on their coherence in water. This empirical test was developed by Emerson in 1967, and updated in 2002 (Emerson, 2002). Figure 4.2 below shows the Emerson classes. Emerson Class 1 and 2 are considered susceptible to tunnel erosion (DPIPWE, 2009).

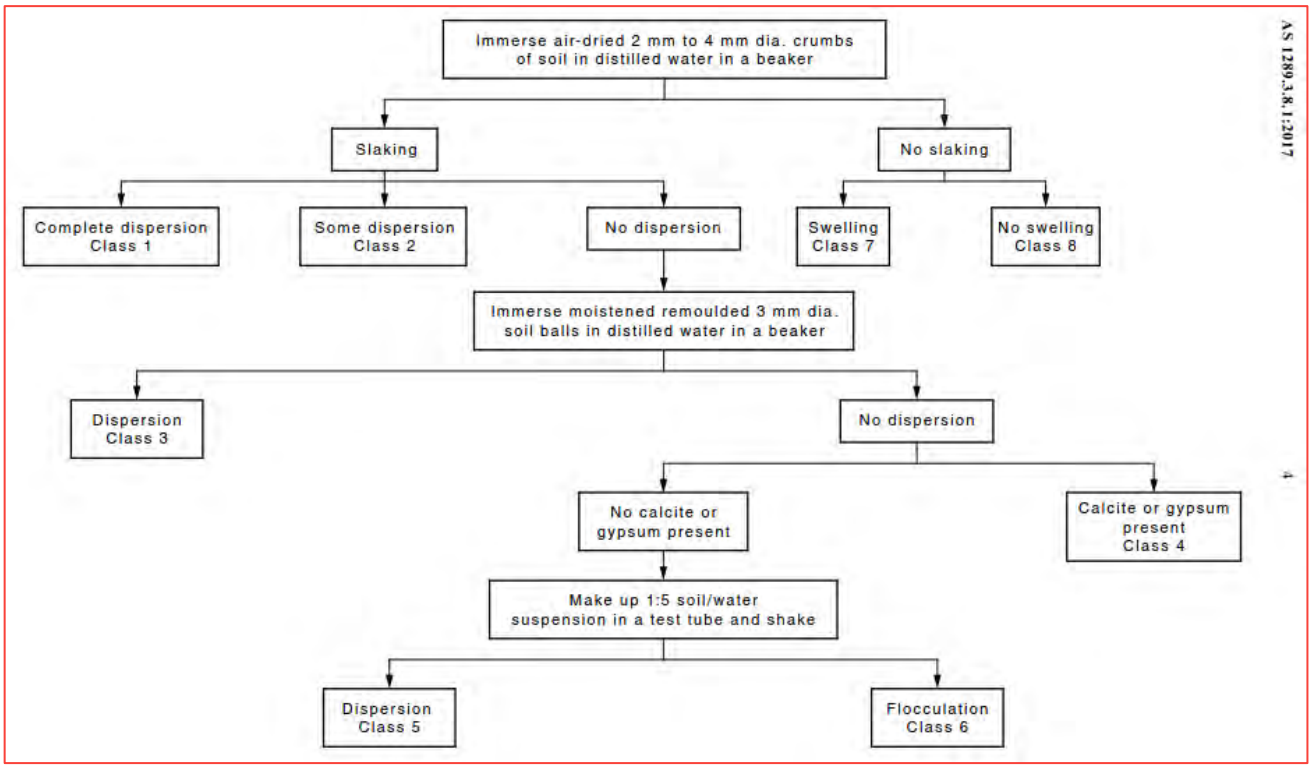


Figure 4.2 Emerson soil classes (extract from AS1289.3.8.9:2017)

4.1.2 MANAGEMENT OF SODIC AND DISPERSIVE SOILS

In Victoria, sodic soils are generally managed as a problem of agriculture, where routine management is required to maintain agricultural productivity of soils and limit adverse impacts such as erosion (e.g. application of gypsum, vegetation and slope management). Agriculture Victoria's (now Department of Jobs, Transport and Regions) Victorian Resources Online (VRO) website (now archived) contains a range of information on soils, including detailed mapping of sodic soils in Victoria (https://vro.agriculture.vic.gov.au, accessed August 2022) which forms the basis of the current body of knowledge.

As erosion can impact surface waters, Catchment Management Authorities (CMAs) in affected areas have an interest in influencing land use (including revegetation of riparian zones) to minimise sediment loading in waterways (e.g. Corangamite Catchment Management Authority [CMA]) and manage environmental water quality. CMAs seek to implement a range of legislation, strategies and policies; including international agreements to protect waterways (e.g. Ramsar), the national Environment Protection and Biodiversity Conservation Act 1999, and the Victorian Environment Protection Act and Water Act, amongst others.

Planning provisions in Victoria also require Planning Authorities to ensure waterways are protected and enhanced (e.g. Golder Plains Planning scheme, Clause 12.03-1S), and in particular, *"ensure development does not compromise bank stability, increase erosion or impact on a water body or wetland's natural ability to manage flood flow"*. One control that can be applied is an Environmental Significance Overlay (SLO) to ensure this protection through the planning process.

4.1.3 URBAN DEVELOPMENT IN AREAS OF SODIC AND DISPERSIVE SOILS

The presence of sodic and dispersive soils can lead to the development of tunnel and surface erosion resulting in an increased risk of damage to buildings and service infrastructure as a result of the undermining of foundations and/or slumping and collapse of ground into voids and cavities that have been formed.

In almost all cases, tunnel and surface erosion results from the surface disturbance of soil (such as during development of a precinct) though removal of stabilising vegetation and, where excavation occurs, allowing rainwater or stormwater to come into contact with dispersible subsoils. Changes to hydrology, including concentrating flow in culverts, runoff from hardstand areas, ponding of rainfall and land contouring further increase the risk of tunnel erosion. Typical activities that increase the risk of exposing dispersive subsoils to rainfall and stormwater include:

- the removal of topsoil,
- soil excavation and ground profiling works,
- trenching and supply of services,
- road and culvert construction, and
- the construction of dams and detention basins.

Increased run-off from developed land can lead to downstream environmental harm by:

- Increased sediment loading (and reduced water quality) in receiving water bodies, and
- Changes in stream hydrology (e.g. increased flow volumes or intensity) leading to bank instability and increased erosion risks in waterways.

In summary, the key hazards arising from urban development in areas of sodic and dispersive soils relate to surface erosion, damage to buildings, damage to infrastructure, and negative impacts to waterways. It is important to note that hazards can manifest in the short term (e.g. during construction phase) and the long term (e.g. loss of topsoil, channel instability and longer term water quality).

4.2 ENVIRONMENTAL PROTECTION ACT 2017

The Environment Protection Act 2017 (EP Act) was enacted on 1 July 2021 and changed Victoria's focus for environment protection and human health to a prevention-based approach, underpinned by the general environmental duty (GED). The GED requires everyone, including businesses and individuals, conducting activities that pose a risk to human health or the environment from pollution or waste, to understand those risks and take reasonably practicable steps to eliminate or minimise them.

4.2.1 CONTAMINATED LAND DUTIES

With respect to contamination, the EP Act includes special provisions within Regulations 8 to 15 which specifically concern the new duty to notify (DtN) of contaminated land, and the duty to manage (DtM) contaminated land. Notably, the new contaminated land duties apply to *"land under the management or control of a person"* and establishing which parties are in management or control of a site is a key step in apportioning these responsibilities.

Noting private ownership and management of the Bannockburn South-East precinct, which mainly comprises agricultural land use with some residences, VPA would not generally be considered to be 'in management or control' of the precinct. However, to inform the precinct planning process, it is important to understand the contamination status of the precinct, to assist VPA and key stakeholders to understand whether any environmental liabilities apply to the precinct under the new legislation.

The key contaminated land duties that are pertinent to the precinct during the planning phase are as follows:

- **Duty to Notify**: The duty of persons in management or control of land to notify EPA as soon as practicable if the contamination may pose a significant risk to human health or the environment.
- **Duty to Manage:** The duty of persons in management or control of land to minimise the risks of harm to human health and the environment from confirmed contamination.

While acknowledging that VPA is unlikely to be in management or control of any property within the precinct, it is also recognised that VPA may have a duty to inform any private property owners (stakeholders) about their obligations, if significant potential or known contamination sources are identified through the course of the assessment of contamination risk.

4.2.2 ENVIRONMENTAL AUDIT SYSTEM

One possible outcome of the assessment of potential for contamination may be the requirement for undertaking further environmental work such as a Preliminary Risk Screen Assessment (PRSA) and / or a statutory Environmental Audit within the restructured audit system.

- **PRSA:** The PRSA is expected by EPA Victoria to be applied predominantly in the context of a planning approvals process and provisions including cl 45.03 (the Environmental Audit Overlay), cl 13.04-1S (contaminated and potentially contaminated land), and Ministerial Direction No.1. A PRSA may only be conducted by an EPA appointed Environmental Auditor. The PRSA process is expected to mimic that of a Preliminary Site Investigation (PSI) outlined in the National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended) (NEPM [ASC], 1999). In accordance with EPA Victoria Publication 2021: Guidelines for Conducting Preliminary Risk Screen Assessments (EPA, 2023), a PRSA is a screening assessment used to assess the likelihood of the presence of contaminated land (which includes consideration of whether a risk of harm is likely to be present) and to determine if an Environmental Audit is required. **Therefore, if there is a likelihood that contaminated land is present at the site, the Environmental Auditor will determine if an audit is required, and if so, will need to determine the scope for that Audit.**
- **Environmental Audit:** When undertaking an environmental audit to assess the suitability of land for a proposed use, the Environmental Auditor assesses the nature and extent of the risk of harm to human health or the environment from contaminated land. This includes recommendations to manage the risk of harm, and recommendations to manage the contaminated land.

Further discussion of how the PRSA and Environmental Audit may relate to the precinct in the context of the planning system is provided in Section 4.3 below.

4.3 CONTAMINATION AND THE PLANNING SYSTEM

With the introduction of the EP Act in 2021, existing guidance regarding the relationship of potential contamination and the planning system has required revision to account for the new legislation.

4.3.1 MINISTERIAL DIRECTION NO.1

Ministerial Direction No.1 was issued by the Minister for Planning on 27 August 2022 and seeks to ensure that potentially contaminated land is suitable for a sensitive use proposed to be allowed under a planning scheme amendment. A sensitive use includes (even if ancillary to other uses) residential use, childcare centre, kindergarten, pre-school centre and primary school. Ministerial Direction No.1 also includes provision for the same controls to be applied to children's playground and secondary school uses in the same manner as a sensitive use.

In summary, the Direction sets out the pathway for the planning authority to satisfy itself that land is not likely to be contaminated, and if it is determined that the land (or part of the land) is potentially contaminated, that the planning authority can undertake to require a Preliminary Risk Screen Assessment (PRSA), an Environmental Audit, or implement an Environmental Audit Overlay to ensure that the land is suitable for a proposed sensitive use.

4.3.2 PLANNING PRACTICE NOTE 30

Planning Practice Note 30 (PPN30) was published in July 2021 and provides updated guidance detailing the pathway to meeting the requirements of Ministerial Direction No.1, by providing a process to determine suitability of land for a proposed sensitive use based on past land use and its potential for contamination to have occurred.

A planning or responsible authority must ensure that the effects of the environment on a planning proposal are considered, and that potentially contaminated land is suitable for its proposed use. PPN30 provides a recommended approach to assessing potentially contaminated land as presented in Table 4.2 below, which the Bannockburn South-East precinct may be compared against.

Table 4.2 PPN30 (2021) recommended approach to assessing potentially contaminated land

PLANNING PROPOSAL		POTENTIAL FOR CONTAMINATION	
		HIGH	MEDIUM
Proposed uses defined in Ministerial Direction No. 1, the EAO, and clause 13.04-1S			
— Sensitive uses: — Residential use — childcare centre — kindergarten — pre-school — primary school — Children's playground — Secondary school	New use or buildings and works associated with a new use	**A**	**B**
	Buildings and works associated with an existing use	**B**	**B**
Proposed other land use			
— Open space — Agriculture — Retail or office — Industry or warehouse	New use, or buildings and works associated with a new or existing use	**C**	**D**

	PLANNING SCHEME AMENDMENT	PLANNING PERMIT APPLICATION
A	— PRSA or audit option applies — Proceeding directly to an audit is recommended.	— PRSA or audit option applies — Proceeding directly to an audit is recommended.
B	— PRSA or audit option applies — PRSA to determine need for audit is recommended.	— PRSA or audit option applies — PRSA to determine need for audit is recommended.
C	— PSI to inform need for audit is recommended	— PSI to inform need for audit is recommended
D	— Planning authority to document consideration of potential for contamination to impact proposal	— Responsible authority to document consideration of potential for contamination to impact proposal

Note: Where multiple uses are proposed, the most sensitive land use should be considered to inform the approach to determining whether an Environmental Audit may be required.

In summary, the recommended approach to ensuring land is suitable for the intended use is based on the potential for contamination (high, medium) to have occurred, and the sensitivity of the proposed land use.

4.3.3 APPLICATION TO THE BANNOCKBURN SOUTH-EAST PRECINCT

The potential for contamination within the context of PPN30 is related to previous and existing land uses. Land uses with potential to contaminate land are presented in Table 2 of PPN30, separated into High and Medium categories, though it is noted that this not an exhaustive list.

Within the context of the Bannockburn South-East precinct, there is potential for a range of previous land uses to influence the potential for contamination, as described in PPN30, Table 2:

- Agriculture and animal production (medium potential): while most agricultural land is not likely to be contaminated, the potential for specific contaminating activities to have occurred should be considered, such as commercial use of pesticides, biosolids application to land, farm waste disposal, and "high potential" activities (see below).
- Ancillary use or activities (medium potential): e.g., above ground storage of chemicals or fuels, waste disposal or dumping, stockpiles of imported fill.
- High potential activities associated with agriculture, including:
  - Fertiliser storage
  - Mass animal burial
  - Fuel storage
  - Stock dipping sites
- Adjacent contaminating activities (medium potential): industrial uses at adjoining land where onsite contamination may have migrated across land boundaries, such as in groundwater, via surface discharges and air emissions.

In summary, the agricultural land uses at the precinct would tend to designate parts of (or entire) properties within the precinct as "A" or "B", with the PRSA or environmental audit option applying.

4.3.3.1 TIMING OF PPN30 ACTIONS

The PPN30 recommends that environmental audit system requirements (i.e., PRSA or Environmental Audit) are met at the time of the amendment (i.e., rezoning of land to a sensitive use), *unless* the planning authority determines that compliance with this requirement is difficult or inappropriate:

- Meeting the PRSA requirement is preferred as the PRSA can support considerations of the effects of environment on the amendment.
- The PRSA may avoid unnecessary encumbrances *if the PRSA concludes no Environmental Audit is necessary*.
- The PRSA may assist the planning authority in determining appropriate planning controls to be included in the amendment (e.g. an Environmental Audit Overlay [EAO]).
- It is acknowledged that meeting the environmental audit requirement may be difficult in situations where the rezoning relates to a large strategic planning exercise, or involves multiple sites in separate ownership, or current land-use makes it difficult or hazardous to assess the land.

In cases where meeting the Environmental Audit system requirements may need to be deferred (e.g. by applying an EAO or other appropriate measure such as controls within a Schedule to Land Zoning), the planning authority is required to consider whether:

- There is reasonable confidence that the land can be made suitable for the proposed use (e.g. the land is not likely to be contaminated),
- There will be a practical mechanism available to mitigate or manage any contamination identified during the environmental audit process (e.g. the ability to amend the design), and,
- There will be a subsequent planning approval required, to include restrictions on use or conditions on development.

In summary, there is a preference that environmental audit system requirements are met at the time of the amendment to avoid unnecessary encumbrance of the land; however, it may be deferred in cases such as a precinct scale planning exercise (by applying an EAO[1] or similar controls such as Schedule to Urban Growth

[1] It is noted that the Environmental Audit Overlay (EAO), if applied, would mandate completion of a PRSA as a minimum *regardless* of the findings of a PPN30-based assessment of contamination potential in the future.

Zone) provided the planning authority has considered whether there is reasonable confidence that the land can practicably be made suitable for the proposed use, and with appropriate oversight of any required controls.

4.3.3.2 CONSTRAINTS OF THE PRELIMINARY RISK SCREEN ASSESSMENT

The completion of a PRSA (or multiple PRSAs) in the context of a precinct scale planning exercise may be considered to be constrained, depending on available information, the timing of the assessment, and also the ability of the planning authority to satisfy itself that land is suitable for the proposed use:

- **Land size:** At this phase of the project the existing land parcels are large, reflecting the current land use (predominantly agricultural). According to EPA Guideline 2021 (Section 3.1.1), a PRSA "site" should be identifiable by either title details or a plan prepared by a licenced surveyor. Notably, *no sub-area should be smaller than the corresponding lot in any existing or proposed subdivision* (i.e., the entire property forms part of the site). This means that the findings of the PRSA which may relate to a land use or observation at a small portion of a land parcel will apply to the entire parcel.
- **Stakeholder/proponent engagement:** Any PRSA undertaken on existing land parcels will require the landowner to commission the work. This will require each affected landowner to be willing and able to proceed with the PRSA and understand the potential outcomes. Alongside this, each landowner (along with any others in management or control of the land) has a duty under the EP Act to identify and manage contamination. Stakeholders may elect to defer the environmental audit process (i.e., abandon the application or similar) if there is insufficient capacity (e.g., funding, agreement, etc.) to proceed with the PRSA at precinct planning stage. On the other hand, stakeholders may act to meet their obligations under the GED and seek to remove potential sources of contamination and undertake sampling to confirm the management of that contamination is appropriate (i.e., risk to human health and the environment is managed).
- **Findings of likelihood vs. potential:** While PPN30 assigns a "grade" of **potential** for contamination based on previous land use, and this triggers the requirement for whether a PRSA or Environmental Audit is required to enable the planning authority to determine if the land is suitable for the proposed use, a PRSA must assess the **likelihood** that contamination (as defined in the NEPM [ASC]) is present, based on available data. EPA Guideline 2021.1 (Section 3.2.4) states that Table 3 of PPN30 should be a considered where an Auditor is considering whether to progress directly to an Environmental Audit rather than a PRSA (i.e., sites where "high" potential for contamination, "Type A" is identified based only on previous land use). In associating the *potential* for contamination with a *likelihood* that contamination is present, there is limited flexibility for an Environmental Auditor (in the absence of supporting information) within the PRSA to determine that an Environmental Audit is not required where a land use with potential for contamination has been identified (i.e., it is difficult to conclude under such scenario that contamination is **unlikely** to be present).
- **Information:** With all site assessments, the level of uncertainty decreases as the level of effort applied to assessing the site increases:
  - A site walkover is necessarily a limited assessment of the condition of a parcel of land. It aims to identify potential source areas for contamination to land, air and water, based on visual observation of equipment and infrastructure present at the site. The conclusions of such an assessment are therefore likely to be conservative and infer the potential for contamination in the absence of other information.
  - A desktop assessment reduces uncertainty by identifying past land uses and reviewing historical documentation to better understand the potential for contamination to have occurred.
  - Limited sampling in identified source areas (or judgemental sampling) can identify if a suspected source has led to contamination or not.

  A PRSA seeks to undertake all of the above steps (per the requirements of EPA Guideline 2021) but may be better able to assess the **likelihood** of contamination being present if the desktop review includes the outcomes of preliminary site investigations (including sampling) at areas of interest. Again, in the absence of this information, the PRSA may be unable to conclude that it is unlikely for contamination to be present, resulting in a recommendation that an Environmental Audit be undertaken.

- **Sampling:** While some sampling may be able to be undertaken as part of a PRSA, EPA Guideline 2021 specifies that:
  - Gridded sampling should not be undertaken – instead, the PRSA should conclude that an Environmental Audit is required.
  - Limited sampling may be undertaken to **confirm the absence** of contamination. Sampling should be targeted and focussed on specific locations where activities took place.
  - In areas where a history of non-contaminating activities is identified, and there is no other evidence or suspicion of contamination, sampling should not be automatically required.

  In the case of a large greenfield precinct with a history of agricultural use (including cropping), an Environmental Auditor may not be able to conclude that is it unlikely for contamination to be present with the restrictions to sampling available to them. Having available the results of a PSI undertaken for individual parcels to meet the obligations of the GED for landowners, including some sampling, may assist the Environmental Auditor in reaching their finding.
- **Uncertainty:** Available information is unlikely to be comprehensive or conclusive, with a degree of uncertainty remaining for any site. It may be that when conducting a PRSA the Environmental Auditor cannot be satisfied (e.g., due to the size of the land, quality of available data, etc.) that it is unlikely for contamination to be present. In these instances, the assessment of likelihood will tend to default to the potential for contamination, and an Environmental Audit will be recommended.

5 LITERATURE REVIEW

A literature review was undertaken of publicly available reports and information (including geology, soil type mapping, erosion risk, and site history) and summarise findings pertaining to the objectives of the assessment.

5.1 MEINHARDT (2020) LAND CAPABILITY ASSESSMENT

A Land Capability Assessment (LCA) was completed by Meinhardt (2020), prior to the increased focus by VPA on sodic/dispersive soils risk in the context of land development, and prior to changes to the Planning Practice Note 30 (PPN30) issued by Department of Environment, Water, Land and Planning (DELWP) in July 2021.

Where applicable, the summary below is restricted to observations relating to the Bannockburn South-East Precinct.

Meinhardt Infrastructure & Environment Pty Ltd (Meinhardt) was engaged in May 2020 by Golden Plains Shire Council (GPSC) to complete a Land Capability Assessment (LCA) for selected land parcels comprising an area of approximate 1,133 hectares (Ha) within the Bannockburn Growth Area Boundary (Meinhardt, 2020). Specifically, GPSC was interested in the growth prospects in the southern portion of Bannockburn because of development constrains to the west, north and east of the township (Meinhardt, 2020). The Study Area encompassed a total of 30 individual Properties (Meinhardt, 2020). Meinhardt (2020) assessed most properties were largely undeveloped and used for farming and/or other agricultural uses.

A figure showing the extent of the Meinhardt (2020) Study Area is presented as Figure 5.1 below.

Figure 5.1 Study Area, extracted from Meinhardt (2020)

WSP understood the overall objective of the Meinhardt assessment was to produce an LCA of the Study Area, which included the Bannockburn South-East Precinct (area east of Bruce's Creek), to understand capability of residential, commercial and industrial land uses.

Meinhardt (2020) indicated the Study Area was zoned for farming use. Overlays affecting the Study Area included a Bushfire Management Overlay (BMO), Environmental Significance Overlay (ESO), Salinity Management Overlay (SMO) and Land Subject to Inundation Overlay (LSIO) (Meinhardt, 2020). In addition, many properties within the Study area were noted by Meinhardt to have ecological constraints (e.g. contain native vegetation and / or the potential to

contain Groundwater Dependent and Ecosystems Inflow Dependent Ecosystems) and/or Cultural Heritage Constraints (e.g. contain registered Cultural Heritage Sensitivity).

5.1.1 SOIL AND GEOLOGY

Meinhardt (2020) indicated the soils in their Study Area to be Sodosols (Va6 and Va9) and Chromosols (Ob2) as per the Atlas of Australian Soils.

Meinhardt (2020) indicated the underlying geology of the Study Area was anticipated to consist predominantly of Miocene (5.3 to 23 million years old) to Pliocene (2.3 to 5.3 million years old) aged Black Rock Sandstone as the uppermost layer to the west of Bruce's Creek and Miocene to Holocene (0.01 million years old) aged Newer Volcanics basalt flows (overlying the BlackRock Sandstone) to the east of Bruce's Creek. Areas of Miocene-aged Gellibrand Marl and Quaternary-aged alluvium were interpreted to be present around Bruce's Creek (incised) (Meinhardt, 2020).

Meinhardt (2020) indicated that geotechnical constraints including settlement, slope stability, bearing capacity and erosion should be considered prior to development.

5.1.2 HYDROLOGY AND HYDROGEOLOGY

The Study Area is located within the Corangamite Catchment. Meinhardt (2020) considered surface water runoff from the Study Area was likely to flow towards Bruce's Creek which runs from north to south in the centre of the Study Area. Bruce's Creek feeds into the Barwon River which is located approximately 3.3 km south of the Study Area (Meinhardt, 2020).

The Study area is situated at approximately 60 to 100 m Australian Height Datum (mAHD) and is generally flat with a gentle slope to the south-east towards Bruce's Creek (Meinhardt, 2020).

Meinhardt (2020) noted that a number of dams exist within the Study Area. Where development requirements mean that the dams need to be decommissioned, Meinhardt recommended an experienced earthworks contractor should be utilised to complete the works.

The Victoria State Government Department of Environmental, Land, Water and Planning (DELWP), Groundwater Resource Reports, 2019, indicated that groundwater (GW) beneath the Study Area falls within the Hopkins – Corangamite GW Catchment and comprises five aquifers with variable yields and salinity (Meinhardt, 2020). The water tables of the uppermost (quaternary gravels and upper tertiary/quaternary basalt) aquifers were reported (Meinhardt, 2020) at depth range 0 – 16 metres, and with a salinity range of 1,000 mg/L – 3,500 mg/L (approximately Segment B under the Environmental Reference Standard).

5.1.3 HISTORICAL LAND USE

Meinhardt (2020) assessed that the Study Area (and much of its surrounds) at the time of their assessment was predominantly used for farming including generally non-intensive cropping and stock grazing. Some Properties also contain homesteads and associated equipment sheds.

Meinhardt (2020) assessed that the Bannockburn region comprised land predominantly used for agricultural uses with the majority of the region zoned for farming. Meinhardt (2020) assessed that residential and commercial developments have occurred to the immediate north, northeast and east of the Study Area, comprising the township of Bannockburn.

Meinhardt (2020) noted that there were a number of poultry broiler farms/ broiler farm buildings to the south-east of the Study Area, owned by Turi Foods Pty Ltd, along Burnside Road.

Meinhardt (2020) conducted a review of historical aerial photography for the precinct. This has not been summarised here, as a review of historical aerial imagery specific to the Bannockburn South-East Precinct was undertaken by WSP and is presented in Section 5.6.

5.1.4 CONTAMINATION

A Potential for Contamination (PFC) assessment was undertaken by Meinhardt (2020) for each of the properties within the Study Area. PFC Ratings were derived by Meinhardt based on the outcomes of the high-level desktop review under the guidance provided in the previous version of PPN30 (DSE, 2005).

Based on Meinhardt's (2020) findings of the desktop review, a total of 28 out of the 30 Properties were rated as having 'Low' potential for contamination whilst the remaining two (2) Properties located at north-west (Property 11 and Property 20) (and **outside** of the Bannockburn South-East Precinct) were rated as having 'Medium' potential for contamination (assessed under the previous iteration of PPN30, now superseded). Meinhardt recommended that properties with a 'Medium' potential for contamination rating were classified as requiring an Assessment Level 'B' as per the DSE 2005 guidance.

Meinhardt (2020) further recommended that those Properties with a 'Low' potential for contamination rating were classified as requiring an Assessment Level 'C' as per the DSE 2005 guidance, noting that where there is some uncertainty regarding filling of dams or use of agricultural sprays, further inspection of the Property should be undertaken, and consideration should be made regarding minor targeted assessment of surface soils for indicated CoPC.

Specific to the Bannockburn South-East Precinct, Meinhardt (2020) considered, based on the desktop review, that a number of potentially contaminating activities may exist or have occurred on and/or in the vicinity of the Study Area, which may have the potential to have led to contamination of soil and/or the underlying groundwater and/or may pose a vapour risk.

These potential contaminating activities were summarised as follows:

- Cropping, other non-intensive agricultural or farming activities (all properties)
- Importation of fill material for earthworks / construction / filling in dams (all properties)

Meinhardt (2020) considered that cropping alone, as observed at most of the properties within the Study Area, was considered unlikely to contribute significant potential for contamination.

Further, Meinhardt (2020) did not observe the presence of storage of significant volumes of chemicals, or the presence of carcass burial or burning pits that would lead to requirement for assessment of potential impacts or contamination from these.

In summary, Meinhardt (2020) considered that the actual or potential presence of contamination sources within the Study Area may need to be confirmed as part of any property-specific investigations prior to any redevelopment, and in accordance with the requirement of the PPN30 (now superseded).

5.2 ALLUVIUM (2020) CATCHMENT ASSESSMENT

Alluvium Consulting (Alluvium) was engaged by VPA to build upon the drainage assessment Alluvium completed for the Bannockburn South-West Precinct in 2019 and undertake a catchment assessment for a larger potential Bannockburn Growth Plan Investigation Area. Alluvium (2020) indicated the purpose of this initial catchment assessment was to assess the area at a larger scale than was previously undertaken and to identify opportunities for stormwater management across the growth area. The assessment identified the most likely locations for stormwater assets, and an approximate sizing (Alluvium, 2020).

5.2.1 EXISTING SERVICES AND INFRASTRUCTURE

Alluvium (2020) assessed that, as the site was mainly used for agricultural purposes, only local farm drains and dams existed, with swale drains along the frontage of properties along Harvey Road. Sewer and water mains were located within existing developments to the north of the investigation area (Alluvium, 2020).

Bannockburn Lagoon is a large pond located to the northwest of the Bannockburn South-East Precinct along Bannockburn-Shelford Road. The existing industrial development (northwest of the Bannockburn South-East Precinct) drains into this lagoon (Alluvium, 2020).

5.2.2 ENVIRONMENTAL CONSTRAINTS

Alluvium (2020) indicated that the Corangamite CMA was contacted by the VPA for flood information and advice for the proposed Bannockburn Growth Plan Area. Alluvium (2020) reported the CMA reviewed the Draft Issues and Opportunities report and Briefing Note provided by the VPA with regards to the Bannockburn Growth Plan. The report identified two key issues and opportunities with respect to the Bannockburn Growth Area plan which are most relevant to the CMA, in particular (Alluvium, 2020):

- The challenges to drainage posed by flat topography, including flooding occurring in many areas in the region, and
- Enhancement of the environmental and recreational opportunities associated with Bruce's Creek.

Alluvium (2020) noted that Bruce's Creek and a small tributary (west side, adjacent the Precinct) are identified as designated waterway (Water Act 1989) and sit within the Mid Barwon River Landscape Zone. The CMA recognised Bruce's Creek as having ecological, cultural and social importance, with key threats to this area including encroachment of the waterway within the expanding urban area, degrading water quality, bank erosion and native vegetation degradation (Alluvium, 2020).

Alluvium (2020) identified that the Ecological Vegetation Class (EVC) varied throughout the investigation area, with the majority of the site classed as plains grassland and some areas of grassy woodland plains.

Alluvium (2020) notes that there are some locations within the growth plan area with existing vegetation which have been identified by Council as areas to be protected in the development of the site.

Alluvium (2020) assessed that the geology of the site consisted mostly of basalt capping, with clayey to sandy soils along Bruce's Creek.

Alluvium (2020) noted that the clayey to sandy soils appeared highly dispersive and eroded along the banks of the creek, which has heavily incised the landscape overtime.

5.2.3 CATCHMENT ANALYSIS

Alluvium (2020) undertook catchment analysis and high-level modelling to assess potential stormwater infrastructure requirements. For the Bannockburn South-East Precinct, the Alluvium (2020) modelling indicated:

- Several wetlands would be required to treat stormwater and attenuate flows.
- Wetlands would be located on the plateau to avoid building on the steep banks.
- As a general rule, discharge points into Bruce's Creek should be minimised and integrated into the landscape.
- Maximum flows should be limited to pre-development peak flow at the 1% Annual Exceedance Probability (AEP) (in line with planning guidelines).
- Further work was recommended to determine the 1% AEP peak flow for the sub-catchments to allow detailed design of stormwater infrastructure.

5.3 SOIL CONSERVATION AUTHORITY (1981) LAND CAPABILITY STUDY

A land capability study was undertaken by the Soil Conservation Authority (SCA) in February 1981 as an aid to planning (SCA, 1981). Its purpose was to advise planners of the physical characteristics of the land, and the likely effects of any changes of land use, particularly the subdivision of land.

The capability of the land to support three main activities was examined (SCA, 1981):

- Erosion risk associated with soil disturbance;
- Constraints on construction (small buildings, secondary roads, etc.); and
- Effluent disposal by soil absorption - risk of failure and difficulties of installation.

There are forty-two map units described in the SCA study. Many of these units are complex land systems containing up to three or four different but related types of land (i.e., land components). In some cases, individual land components were mapped as units. The relevant map units applicable to the Bannockburn South-East Precinct are listed in Table 5.1 below.

Table 5.1 Summary of Land Systems & Components (summarised from SCA, 1981)

MAP SYMBOL	AVERAGE ANNUAL RAINFALL	GEOLOGY	LANDSCAPE	SOILS	FORMS OF SOIL DETERIORATION
Tcg	540-570	Steep valley sides with duplex soils on variable tertiary sediments	Undulating plain	Red duplex soils on upper slopes (low to moderate dispersion), dark uniform clay on lower slopes (no dispersion).	May be prone to landslips (particularly dark clays)
Qbf	510-630	Pleistocene basalt	Plains	Mottled, dark sodic duplex soils, coarse structure	Minor sheet erosion
Qbgs	500-700	Pleistocene basalt	Stony plains in south	Stony, mottled dark grey sodic duplex soils, coarse structure	Minor sheet erosion, surface compaction

SCA (1981) assessed the relative dangers of erosion on the different map units as a result of land uses which tend to leave the soil unprotected for significant periods of time. Examples presented (SCA, 1981) included clearing, preparation for urban development or other extensive construction works, road building, overgrazing and cultivation.

Erosion risk was assessed (SCA, 1981) as follows:

- Tcg: Steep to moderate valley sides cut into various unconsolidated sediments. **Moderate to High concern**, erosion hazard increases with steepening slopes. SCA (1981) noted little evidence of erosion under sensible managed grazing land because soils are fertile and grow suitable protective vegetation.
- Qbf: Gentle to flat topography with moderately stable clayey soils, subsoil is highly sodic and topsoil is hard-setting. **Nil to Low concern**, no visible erosion, bare soil will sheet erode. SCA (1981) noted any sediment from disturbed areas consisted mainly of fine aggregates and easily settled particles. Poor drainage may hinder re-vegetation, particularly if topsoil is not re-spread (SCA, 1981).
- Qbgs: Gently sloping stony areas with finely pedal clay soils, no dispersible clay. **Nil – Low concern**. Any wash from exposed sites will consist of fine, easily settled aggregates. Soil are fertile and revegetate easily – stones will hinder resowing.

5.4 CORANGAMITE CMA (2006) EROSION STUDY

A case study report for Erosion and Landslides was prepared by A.S. Miner for Corangamite CMA in January 2006, detailing reactive treatment of active gully erosion at a property located at Robbies Road, Shelford, approximately 25 km northwest of the Bannockburn South-East Precinct.

The property is located along a tributary to the Leigh River west of the Leigh River Gorge. The geology at this property is considered to be similar to that found at the Bannockburn South-East Precinct, in that a dissected valley of the Newer Volcanic plain has formed at the uplifted southern edge of the West Victorian Uplands. Downstream of the Site the underlying Heytesbury Group limestones (Gellibrand Marl equivalents) are exposed in the base of the creek.

A.S. Miner (2006) assessed that the frequency of the trigger event for erosion was unknown, but has been linked with rainfall. The gully erosion had been observed by the landholder to have progressed several hundred meters in the past 30 years (A.S. Miner, 2006).

A.S. Miner (2006) assessed that successful remediation occurred, with the installation of a rock chute at the head of the gully, preventing further progression of erosion upstream.

5.5 LAND DESIGN (2009) BRUCE'S CREEK MASTERPLAN

A brief review of the Bruce's Creek Masterplan, prepared by Land Design Partnership Pty Limited (LDP) for Golden Plains Shire Council (LDP, 2009) found that recommendations around management of erosion included:

- Retaining the scarp along Bruce's Creek for public open space as development for housing was likely to increase erosion risk of this zone (LDP, 2009).
- Enhancing environmental values of the creek corridor included reducing environmental degradation by erosion (LDP, 2009).
- Council actively manages construction activities within and adjacent to the creek corridor to ensure appropriate procedures and practices are followed (LDP, 2009).

5.6 REVIEW OF ONLINE MAPPING

The Visualising Australasia's Soils (VAS) reported erosion gully/sheet risk adjacent to the Site. As shown in Figure 5.2 below, two areas are recorded for erosion risk, one adjacent to the north of the Precinct and one at the south of the Precinct, both in the vicinity of Bruce's Creek.

Figure 5.2 Erosion recorded by Visualising Australasia's Soils online soil mapping, along Bruce's Creek (erosion polygons in green outline along the creek line north and south of the site)

The reason for the erosion in these areas may be attributed to the same geology at these areas (i.e., Batesford Limestone [Ntb]). It is noted that different geology was found for the surrounding area with Black Rock Sandstone as the uppermost geology to the west of Bruce's Creek, and Newer Volcanics basalt overlying the sandstone to the east.

Review of data from VAS (https://data.soilcrc.com.au/map/about, accessed June 2022), and based on Corangamite Land Resource Assessment (CLRA) undertaken in 2003, indicated that:

- Mapping of Bannockburn Land Systems closely matched the SCA (1981) mapping.
- Soil group and landform mapping in the Bannockburn area matches descriptions provided in SCA (1981).
- Sheet erosion susceptibility was **low to moderate** on the plateau, and **low** within Bruce's Creek, but **high** in the south-west corner of the Precinct (CLRA, 2003).
- Gully erosion susceptibility was **low to moderate** across the Precinct (CLRA, 2003).
- Wind erosion risk was **moderate** across the Precinct (CLRA, 2003)
- Landslide risk was mapped as **very low** across the plateau, with **moderate** risk within Bruce's Creek. Landslides have been recorded and mapped within Bruce's Creek north of the Precinct, within Bannockburn township.

Overall the mapping was consistent with technical reports reviewed as part of this assessment.

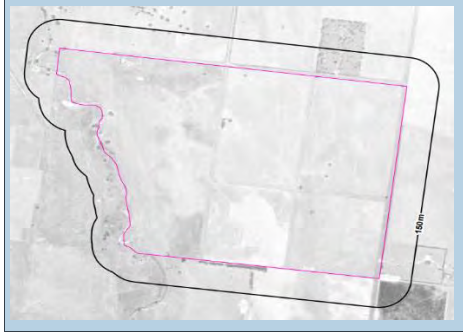
5.7 LOTSEARCH AERIAL IMAGERY REVIEW

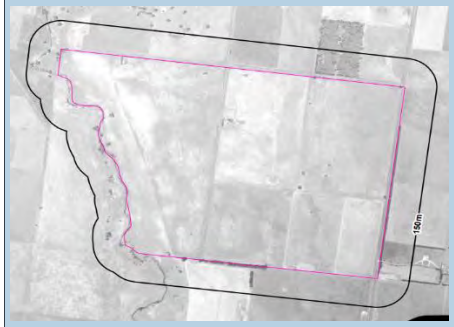
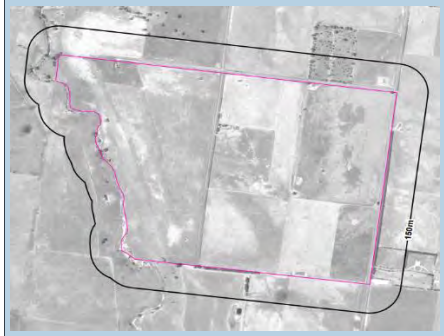
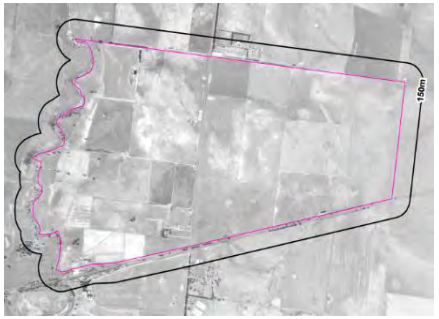
Among the 30 properties investigated by Meinhardt in the previous LCA (Meinhardt, 2020), WSP reviewed historical aerial photography for those properties within the Bannockburn South-East Precinct (a total of 5 properties).

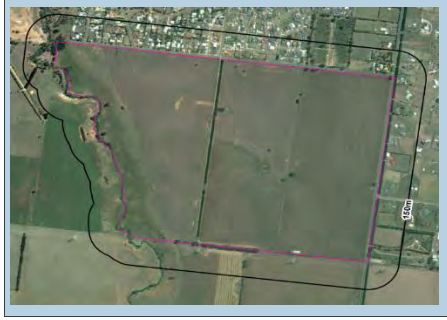
Several aerial images of the above properties and their surrounding area were obtained from Lotsearch. The earliest aerial image viewed was dated 1947 and the most recent was 2021. Aerial images are provided in two reports (north part and south part) within **Appendix C**.

A summary of the key findings from the aerial image review (from 1947 to 2021) is provided below in Table 5.2.

Table 5.2 Summary of Aerial Imagery review

NORTH PART	SOUTH PART	ON-SITE	OFF-SITE
1947 	**1947** 	Vacant land with scattered vegetation and land used for agriculture due to the presence of uniform lines that may indicate ridges and furrows along with homesteads. Several dams and/or ponds are observable within the Study Area. Bruce's creek runs through the centre of Property 1 (above image) and runs from north to south.	Generally vacant and agricultural land surrounds the study area. A railway track bounds Property 3 and 4 to the south.
1966 	**1966** 	Further development of the land for agricultural purposes is evident through the clearing of vegetation and the construction of dams (Property 2 and 4 located at the South part).	The property north and south of Property 3 has undergone development and a pair of sheds/workshops can be observed.

NORTH PART	SOUTH PART	ON-SITE	OFF-SITE
1970 	**1970** 	Further development of the land for agricultural purposes is evident through the clearing of vegetation, construction of dams (Property 3) and the presence of uniform lines which may indicate ridges and furrows (Property 2, 4 and 3).	Further development of the surrounding land for agricultural purposes
1978 	**1978** 	Similar to 1970 with backfilling of previously identified dams (Property 3).	Further development of the land with several possible buildings/structures observable at the southern boundary
1984 	**1984** 	Construction of dams and dirt tracks (Property 2), and the presence of uniform lines which may indicate ridges and furrows (Property 1). Visible discolouration of land which may indicate burn off crop stubble (Property 1). Electrical pylons have been erected within the northern property boundary of Property 2 and 3.	The property north of Property 3 has undergone further development and more potential sheds/workshops can be observed.

NORTH PART	SOUTH PART	ON-SITE	OFF-SITE
1990 	**1990** 	Unchanged from 1984	Unchanged from 1984
2005 	**2005** 	Further development of the land for agricultural purposes and minor development of buildings, dams and tracks. Soil discolouration which may indicate earthworks (Property 1 and 3).	North of the Site has undergone significant development for low-density residential land use.
2011 	**2011** 	Further development of the land for agricultural purposes and construction of buildings/silos (Property 3)	North of Property 1 and 3 has undergone further development for residential land use. The property north of Property 3 has visible stockpiles of soil and scrap metal.

NORTH PART	SOUTH PART	ON-SITE	OFF-SITE
2016 	**2016** 	Unchanged from 2011	Further development of commercial/industrial buildings to the north and east of the Site. Further evidence of stockpiled soil and scrap metal on the property north of Property 3.
2021 	**2021** 	Similar to the 2016 imagery with construction of structures and/or feedlots (Property 1).	Further development of commercial/industrial buildings and residential properties to the north and east of the Site.

5.8 SUMMARY OF SITE HISTORY

The Bannockburn South-East precinct is located southeast of Bannockburn approximately 14 km northwest of Geelong and covers an area of approximately 524 ha. The precinct is bounded by the existing Bannockburn township to the north, farmland to the east, the Gheringhap-Maroona freight railway to the south, and Bruce's Creek to the west. Historically the precinct comprises a mix of grazing/cropping land with minor rural residential. A series of chicken breeder farms is currently located immediately south of the precinct along Burnside Road.

In general, the topography across the Study Area is relatively flat, with areas around Bruce's Creek having the lowest elevation with land sloping towards this feature from the west and also east.

The Bannockburn region comprises land predominantly used for agricultural uses (cropping and livestock) with the majority of the region zoned for farming. Residential and commercial developments have occurred to the immediate north, northeast and east of the Study Area, which make up the township of Bannockburn.

Various planning overlays exist within the Study Area. Where a planning overlay has been identified, a permit may be required before development of the Property can commence:

- Environmental Significance Overlay – Bruce's Creek;
- A Salinity Management Overlay – small portion of Bruce's Creek, central to precinct west boundary;
- Land Subject to Inundation Overlay – Bruce's Creek;

While landslides and erosion has been reported within Bruce's Creek to the north and south of the Precinct, erosion risk (various types) has generally been mapped as low – moderate, with isolated areas (slopes in Bruce's Creek and southwest corner of the precinct) with elevated risk.

6 ADOPTED METHODOLOGY

The following methodology was adopted to assess **soil erosion risk** and **contamination risk** at the precinct.

6.1 SOIL EROSION RISK SCHEME

The following methodology was adopted to assess the soil erosion risk to the precinct and assess the need for further investigation to inform precinct planning activities.

This desktop assessment of erosion risk has been based on available guidance relating to sodic/dispersive soil risk, taking into consideration observations of the site inspection and the proposed land use at the precinct.

The assessment of erosion risk is based on the potential impacts associated with proposed development in both the short (i.e., during construction) and long term (i.e., topsoil conservation, channel instability), associated with soil erosion, and impacts to buildings, infrastructure and waterways.

The level of this risk has been allocated based on likelihood, and the level of effort required to inform precinct planning activities and mitigate the risk. We consider that where immediate surface changes are relatively minor (e.g., construction of a stand-alone residential dwelling connected to services with topsoil reinstated on exposed surfaces), the risk of surface erosion is relatively low, especially if the landform is stable/flat. There may be a higher risk profile associated with stormwater infrastructure which is constructed as linear infrastructure, especially if this is built close to waterways and associated steeper landforms (banks).

Separately, the risk ranking may be higher in consideration of:

- the quantum of works required (e.g., as part of an integrated water management plan for the precinct) to identify controls to manage changes to catchment hydrology
- the quantum of changes to precinct hydrology (e.g. higher peak flow, higher total discharge volumes, quality of inflows) requiring control by built infrastructure

That is, the effort required to maximise water quality (e.g., bank stability and water clarity) may be significant, affecting the risk ranking.

Based on these considerations, and to support the identification of areas requiring further consideration, the recommended approach to assessing erosion risk has been aligned to the following:

- **Risk Level:** High risk, Medium risk, Low risk or Very low risk designations for detrimental erosion potential.
- **Precinct Context:** Range of precinct scenarios where development may be impacted by soil erosion risk.
- **Potential for Erosion:** Landforms within the precinct where erosion risk may be higher/lower, based on geological formation and topography.
- **Controls:** Ability to control/mitigate impact of erosion risk.

The resultant soil erosion risk scheme, as presented in **Table 6.2** below, has been used in this assessment.

Table 6.1 Soil Erosion Risk Scheme and Precinct Context

RISK LEVEL	PRECINCT CONTEXT	POTENTIAL FOR EROSION	CONTROLS
Soil erosion			
High risk	**High risk** of significant erosion of surface soils leading to: — Inability to sustain vegetation — Unstable soils — Long term ongoing requirement for remedial works. Likely to affect all aspects of development, including residential dwelling construction.	Soil erosion more likely: — In areas where soil erosion is visible pre-development — Where extensive soil disturbance occurs — On sloping land — Sodicity/dispersiveness tests indicate higher likelihood — If topsoil is not appropriately retained during and post construction	Can be controlled with typical construction environment management techniques during construction phase, plus: — Topsoil disturbance to be minimised — Topsoil layer (minimum 150 mm) to be retained/placed on all open areas — Protective matting to prevent erosion on slopes required until vegetation established — Ongoing maintenance to be programmed
Medium risk	**Medium risk** of significant erosion of surface soils leading to: — Inability to sustain vegetation — Unstable soils — Potential ongoing requirement for remedial works. Likely to affect most aspects of development, particularly deep/extensive excavations and sloping ground.	Soil erosion more likely: — In areas where soil erosion is visible pre-development — Where extensive soil disturbance occurs — On sloping land — Sodicity/dispersiveness tests indicate higher likelihood — If topsoil is not appropriately retained during and post construction	Can be controlled with typical construction environment management techniques during construction phase, plus: — Topsoil disturbance to be minimised — Topsoil layer (minimum 150 mm) to be retained/placed on all open areas — Protective matting to prevent erosion on slopes required until vegetation established
Low risk	**Low risk** of significant erosion of surface soils leading to: — Inability to sustain vegetation — Unstable soils — Potential requirement for remedial works. Likely to affect some aspects of development, particularly deep/extensive excavations.	Soil erosion more likely: — In areas where soil erosion is visible pre-development — Where extensive soil disturbance occurs — On sloping land — Sodicity/dispersiveness tests indicate higher likelihood — If topsoil is not appropriately retained during and post construction	Can be controlled with typical construction environment management techniques during construction phase, plus: — Topsoil disturbance to be minimised — Topsoil layer (minimum 150 mm) to be retained/placed on all open areas
Very low risk	**Negligible risk** of significant erosion of surface soils leading to: — Inability to sustain vegetation — Unstable soils — Remedial works. Unlikely to affect any aspects of development as erosion potential is low.	Soil erosion is unlikely: — In areas where soil erosion has not been observed pre-development — On flat ground — Where soil sodicity/dispersiveness tests indicate non-sodic — Where topsoil is appropriately retained during and post construction.	Can be controlled with typical construction environment management techniques during construction phase, plus: — Topsoil disturbance to be minimised

RISK LEVEL	PRECINCT CONTEXT	POTENTIAL FOR EROSION	CONTROLS
Building and Infrastructure Impact			
High risk	**High risk** of significant erosion of subsurface soils leading to: — Tunnel erosion — Structural failure of infrastructure/foundations — Long term ongoing requirement for remedial works. Likely to affect all aspects of development, including residential dwelling construction.	Building and infrastructure impact is more likely: — In areas where soil erosion is visible pre-development — Where extensive soil disturbance occurs and exposes susceptible soils — Sodicity/dispersiveness tests indicate higher likelihood — If topsoil is not appropriately retained during and post construction	Can be controlled with typical construction environment management techniques during construction phase, plus: — Topsoil disturbance to be minimised — Linear infrastructure backfill designed to minimise potential for tunnel erosion — Linear infrastructure avoided/above ground — Foundations designed to minimise soil disturbance
Medium risk	**Medium risk** of significant erosion of subsurface soils leading to: — Tunnel erosion — Structural failure of infrastructure/foundations — Potential ongoing requirement for remedial works. Likely to affect most aspects of development, particularly linear underground infrastructure and sloping ground.	Building and infrastructure impact is more likely: — In areas where soil erosion is visible pre-development — Where extensive soil disturbance occurs and exposes susceptible soils — Sodicity/dispersiveness tests indicate higher likelihood — If topsoil is not appropriately retained during and post construction	Can be controlled with typical construction environment management techniques during construction phase, plus: — Topsoil disturbance to be minimised — Linear infrastructure backfill designed to minimise potential for tunnel erosion — Linear infrastructure avoided/above ground
Low risk	**Low risk** of significant erosion of subsurface soils leading to: — Tunnel erosion — Structural failure of infrastructure/foundations — Potential requirement for remedial works. Likely to affect some aspects of development, particularly linear underground infrastructure and sloping ground.	Building and infrastructure impact is more likely: — In areas where soil erosion is visible pre-development — Where extensive soil disturbance occurs and exposes susceptible soils — On sloping land — Sodicity/dispersiveness tests indicate higher likelihood — If topsoil is not appropriately retained during and post construction	Can be controlled with typical construction environment management techniques during construction phase, plus: — Topsoil disturbance to be minimised — Linear infrastructure backfill designed to minimise potential for tunnel erosion
Very low risk	**Negligible risk** of significant erosion of subsurface soils leading to: — Tunnel erosion — Structural failure of infrastructure/foundations — Remedial works. Unlikely to affect any aspects of development as erosion potential is low.	Building and infrastructure impact is unlikely: — In areas where soil erosion has not been observed pre-development — Where susceptible soils are not exposed — Where soil sodicity/dispersiveness tests indicate non-sodic — Where topsoil is appropriately retained during and post construction.	Can be controlled with typical construction environment management techniques during construction phase, plus: — Topsoil disturbance to be minimised

RISK LEVEL	PRECINCT CONTEXT	POTENTIAL FOR EROSION	CONTROLS
Impact to Water Quality			
High risk	**High risk** of significant erosion of soils and stream channels leading to: — Undesirable impacts to protected Environmental Values (sediment loading, poor water quality) — Erosion in Bruce's Creek requiring intervention works/management. Likely to affect all aspects of development, including residential dwelling construction and Bruce's Creek.	Soil and channel erosion more likely: — In areas where soil erosion is visible pre-development, and sodicity/dispersiveness tests indicate higher likelihood — Due to increased peak streamflow following development — Due to increased catchment discharge (reduced infiltration)	Can be controlled with typical riparian land management techniques[1], plus: — Stormwater treatment/settlement to minimise sedimentation — Stormwater retarding to manage peak and total flows within waterways — Treatment/management to prevent soil erosion within the catchment area — Engineered erosion control (such as grade control structures) to protect channels
Medium risk	**Medium risk** of significant erosion of soils and stream channels leading to: — Undesirable impacts to protected Environmental Values (sediment loading, poor water quality) — Erosion in Bruce's Creek requiring intervention. Likely to significantly affect stormwater management infrastructure design/maintenance and Bruce's Creek.	Soil and channel erosion more likely: — In areas where soil erosion is visible pre-development, and sodicity/dispersiveness tests indicate higher likelihood — Due to increased peak streamflow following development — Due to increased catchment discharge (reduced infiltration)	Can be controlled with typical riparian land management techniques[1], plus: — Stormwater treatment/settlement to minimise sedimentation — Stormwater retarding to manage peak and total flows within waterways — Treatment/management to prevent soil erosion within the catchment area
Low risk	**Low risk** of significant erosion of soils and stream channels leading to: — Undesirable impacts to protected Environmental Values (sediment loading, poor water quality) — Erosion in Bruce's Creek requiring intervention. Likely to affect some aspects of stormwater management infrastructure design/maintenance and Bruce's Creek.	Soil and channel erosion more likely: — In areas where soil erosion is visible pre-development, and sodicity/dispersiveness tests indicate higher likelihood — Due to increased peak streamflow following development — Due to increased catchment discharge (reduced infiltration)	Can be controlled with typical riparian land management techniques[1], plus: — Stormwater treatment/settlement to minimise sedimentation — Stormwater retarding to manage peak and total flows within waterways
Very low risk	**Negligible risk** of significant erosion of soils and stream channels leading to: — Undesirable impacts to protected Environmental Values (sediment loading, poor water quality) — Erosion in Bruce's Creek. Unlikely to affect aspects of stormwater management infrastructure design or Bruce's Creek.	Soil and channel erosion more likely: — In areas where soil erosion is visible pre-development, and sodicity/dispersiveness tests indicate higher likelihood — Due to increased peak streamflow following development — Due to increased catchment discharge (reduced infiltration)	Can be controlled with typical riparian land management techniques[1], plus: — Stormwater treatment/settlement to minimise sedimentation

(1) Corangamite CMA's Waterway Strategy (2014-2022) details typical riparian land management strategies, including stock exclusion fencing, planting of riparian vegetation and pest management.

6.2 CONTAMINATION RISK SCHEME

The following methodology was adopted to assess contamination risk at the precinct and assess the need for further investigation to enable the planning authority to be satisfied that the land is unlikely to be contaminated, or otherwise ensure the planning authority meets the requirements of Ministerial Direction No.1.

The assessment of contamination risk has been based on the PPN30 framework, undertaking a desktop investigation alongside a site inspection which was undertaken on 14 June 2022 (accessible areas only).

Because the potential for contamination being associated with agricultural land and animal production land uses is recognised in PPN30 as more likely to have an isolated impact at a site, WSP has considered this risk further within the context of the Bannockburn South-East precinct. We consider that while the wider area of the precinct is not likely to be contaminated, there may be certain areas where more concentrated activities have occurred (e.g., farmyards, farm buildings and possibly residences). There may also be higher risk activities within these areas that should also be considered e.g. bulk fuel or chemical storage, slurry pits, slurry lagoons or sheep dips (high potential for contamination, therefore, likely to be contaminated). By contrast, areas such as native forest or bushland may be considered 'untouched' and unlikely to be contaminated.

Based on these considerations, and to support the identification of areas requiring further consideration, the recommended approach to assessing potentially contaminated land provided in PPN30 has been aligned to the following:

- **Potential for Contamination:** Land uses that have a "High" or "Medium" potential to contaminate land, or land not likely to be contaminated.
- **Example Land Uses:** Range of land uses with potential to contaminate land.
- **Contaminants of Concern:** Range of contaminant types or categories generally associated with activities.

Finally, the need for additional investigation has been identified, aligned with the requirements of PPN30, and in consideration of the GED and PRSA guidelines provided in EPA Publication 2021.1.

The resultant contamination risk scheme, as presented in **Table 6.2** below, has been used in this assessment.

Table 6.2 PSI Risk Scheme and PPN30 Context

RISK LEVEL	POTENTIAL FOR CONTAMINATION	PPN30 CONTEXT	EXAMPLE LAND USES	CONTAMINANTS OF CONCERN
High risk	**High potential** of contamination being present; situation more likely relevant to **point sources** within assessment subzones.	**Scenario A:** Proceeding directly to an audit is recommended	— Farmyards and farm buildings with bulk fuel or chemical storage e.g. USTs. — Slurry pits, slurry lagoons or cess pits with animal wastes (excreta). — Agricultural landfills, possibly including animal burial after culling. — Sheep treatment areas for external parasites (sheep dips).	Comprising contamination point sources from fuels, oils, pesticides, fertilisers, herbicides (bulk storage); faecal coliforms, hazardous gases (slurry pits); bio-hazards (landfills), arsenic and dieldrin (sheep dips).
Medium risk	**Medium potential** of contamination being present; situation more likely relevant to localised **diffuse sources** across assessment subzones.	**Scenario B:** PRSA to determine need for audit is recommended.	— More intensive farming such as market gardening, horticulture or cropping. — Applications of biosolids as fertiliser e.g. vineyards, pasture, arable land. — Stockpiles of soil, rubble, other wastes, laydown areas for old farm machinery. — Ancillary land uses in agricultural areas e.g. builders' yards, vehicle mechanics.	May include diffuse but more localised impacts from the application of fertilisers, pesticides or herbicides, possibly small quantities of fuels, oils, paints, solvents, metals or ACM from yards.

RISK LEVEL	POTENTIAL FOR CONTAMINATION	PPN30 CONTEXT	EXAMPLE LAND USES	CONTAMINANTS OF CONCERN
Low risk	**Not likely to be contaminated**; situation more likely relevant to regional **dispersed sources** across assessment subzones.	PPN30 makes no recommendation. Contamination risk to be met by GED.	— Expanses of agricultural fields used mainly for grazing of livestock. — Areas unlikely to have required extensive use of fertilisers, pesticides or herbicides. — Farmhouses and low density rural residences, possibly with septic tanks. — Horse training facilities, running tracks, paddocks and stables.	Likely limited to dispersed regional contaminants in groundwater or surface water e.g. faecal coliforms from residential septic tanks, or nitrates and other salts and heavy metals from application of fertilisers.
Very low risk	**Not likely to be contaminated**; situation more likely relevant to **absence of sources** across assessment subzones.	PPN30 makes no recommendation. Contamination risk to be met by GED.	— Land unaffected by European settlement in Victoria i.e. pre-European conditions. — Native forests or bushland subject to low-impact management measures.	Only naturally occurring contaminants associated with ambient local conditions and excluding impacts from controlled burns and possibly the use of firefighting foams containing PFAS.

7 SITE VISIT FINDINGS

7.1 SITE FEATURES

A site walkover was undertaken on 14 June 2022 by a Geotechnical Engineer and a Contaminated Land Scientist from WSP. It is noted that the rural residential property at 418 Burnside Road, Bannockburn, was not accessible; however, this property appeared to be in use as rural residential, with no agricultural equipment visible (beyond fencing).

For clarity, observations within the precinct were referenced to each property as identified by number shown in Figure 7.1 below.

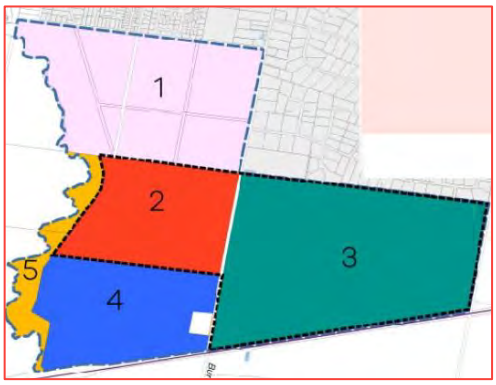


Figure 7.1 Property numbering – site visit to Bannockburn South-East Precinct

The following features were observed:

- Canola cropping across the majority of the Precinct,
- Grazing land in the southwestern and eastern portions of the Precinct,
- Vacant, cleared land adjacent to Bruce's Creek which is incised into the landscape,
- Property 1 had a sparse covering of basalt boulders and cobbles within short grasses,
- Large stockpiles of basalt rock were present within property 3 and 4, and are possibly present within other areas not accessed during the inspection,
- The properties, with the exception of property 4, were relatively flat, with short grasses, and livestock (excepting the slope to Bruce's Creek),
- The terrain in property 4 was undulating to hilly,
- Various farm dams were located in the properties,
- The southern boundary of the study area was bordered by a rail track and underlain by a fill embankment in the southwest of the study area,
- The western boundary of the study area was bounded by Bruce's Creek, with vegetation and trees, mostly accessible by foot,
- The northern boundary of the study area was bounded by various housing estates, and low grasses,
- The eastern boundary of the study area was bounded by fields with low grasses, and
- Dirt tracks were present within property 1 (from north to south), at the southern boundary of property 4, and the northern boundary of property 3.

On 25 March 2024, WSP conducted an additional site walkover assessing erosion features in the vicinity of Bruce's Creek in conjunction with precinct structure planning. Disturbed, raised soil with steel and plastic inclusions was observed in the south-western corner of the Netherby's property (referred to as PCL N1 and indicated on Figure 4, Appendix A). The site interview conducted on 2 April 2024 with Wesley Phillips revealed that the site is owned by his father, although has been under his operation for greater than 10 years. Wesley Phillips informed WSP that this material was excess spoil/ soil potentially containing inert waste originating from a nearby housing estate in Bannockburn to the north and was deposited around 2014.

7.2 SODIC/DISPERSIVE SOILS

7.2.1 SITE GEOLOGY

Figure 7.2 below presents an extract of the Geological Survey of Victoria 1:250,000 Queenscliff map sheet, 1997. It shows the Precinct is underlain by Newer Volcanics to the east of Bruce's Creek, Sandringham Sandstone (formerly Black Rock Sandstone) to the west of the creek, and Gellibrand Marl (formerly Newport Silt and Fyansford Clay) along Bruce's Creek. An overlay of the geological map and site is presented as Figure 2 in **Appendix A**.

Inspection of the surface geology and cuttings at the Precinct aligned with the published geology, with the order of deposition from most recent to oldest being Newer Volcanics, then Sandringham Sandstone and then Gellibrand Marl.

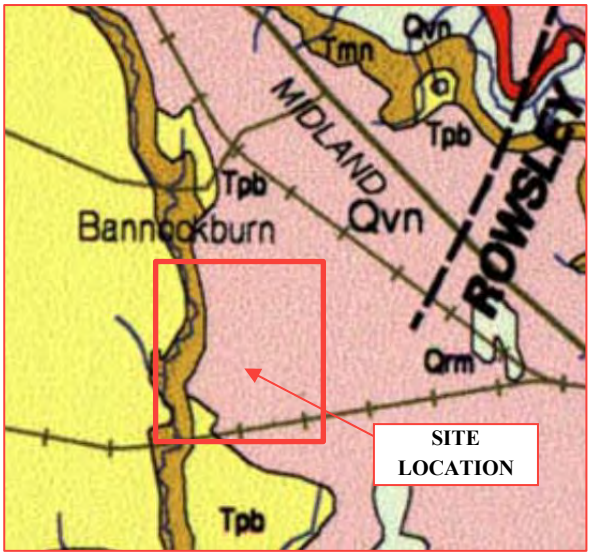


Figure 7.2: Site geology

7.2.2 SODIC SOILS DESKTOP STUDY

Soil properties in the Corangamite region are described in the Corangamite Land Resource Assessment (Robinson et al. 2003) which divides soils into 41 Soil Groups.

The distribution of the Soil Groups is shown on the Soil Health Knowledge Base website (www.ccmaknowledgebase.vic.gov.au). The website shows Soil Group 13 west of Bruce's Creek, aligning with the underlying Sandringham Sandstone, and Soil Group 39 east of Bruce's Creek, aligning with the underlying Newer Volcanics. The Corangamite Land Resource Assessment (CLRA) describes these Soil Groups as follows:

- Soil Group 13 - Grey and brown (occasionally black, yellow or red) mottled texture contrast soils.
  - Soil profile around 1.5 m thick.
  - Some sodicity of lower subsoil.

- Soil Group 39 - Black, grey, brown and red cracking calcareous clays
  - Soil profile around 0.6 to 0.7 m thick.
  - Soils often sodic, particularly at depth.

An overlay of the Soil Group distributions and the Precinct is presented as Figure 3 in **Appendix A**, and includes photographs of observed conditions.

7.2.3 SODIC SOIL SITE WALKOVER OBSERVATIONS

Observations were made during the site walkover of features which could be evidence of historical dispersion. Dispersion is often associated with sodic soils.

The following features were observed:

- Undisturbed and vegetated surfaces across the majority of the precinct (note large areas of cropping were present) did not display visible signs of erosion, except as mentioned below,
- Minor erosion was present on non-vegetated banks of Bruce's Creek, with minor dribble patterns (worminess) on the soil surface,
- Bruce's Creek appeared to have relatively clear water,
- Farm dams in property 1, 2, and in the northeast of property 4, appeared to have minor to no discoloration or noticeable turbidity in the dam water,
- Evidence of extensive erosion was present in cuttings and on the dam wall surface in the southwest of property 4,
- Farm dam water in the south and west of property 4 appeared to be highly discoloured/turbid with evidence of dispersion,
- Evidence of extensive erosion and discoloured/turbid dam water was present north-west of the study area in an existing development, and
- Evidence of extensive erosion was present approximately 3km south of the study area in a road cutting (limited to exposed soils/subsoils).

Photos of these features with descriptions are presented as a photolog within **Appendix B**.

Based on the desk study and site observations, excavations and cuttings in the study area east and west of Bruce's Creek may encounter dispersive soils, particularly within (but not limited to) the Sandringham Sandstone in the southwest corner of the precinct and where Bruce's Creek intersects this unit, or where the Newer Volcanics is thinner or absent.

7.3 POTENTIALLY CONTAMINATING ACTIVITIES

7.3.1 LAND USE FEATURES

Based on the site inspections (and incorporating the historical site aerial imagery review), the key built features of the Precinct included:

- An inferred former house yard in the northwest of the Precinct (Property 1),
- Farm sheds in the north and west of the Precinct (Property 1 and 2),
- An inferred former house and farmyard in the south of the Precinct (Property 4),
- Dams in various locations,
- Stockpiles of chicken manure and general waste in the south of the Precinct (Property 3), and

- Stockpiling of soil and inert waste in the south-western corner.

7.3.2 PROPERTY INSPECTIONS

Access approval was obtained by VPA and WSP for five properties within the Precinct, and excluding 418 Burnside Road, Bannockburn.

The following land uses were observed across the precinct:

- **Agriculture (grazing):** Land used for grazing i.e. livestock pastures, attached to farmyards and farm buildings.
- **Agriculture (cropping):** More intensive agricultural activities such as cropping for canola.
- **Vacant (grazing):** Portion of land adjacent to Bruce's Creek consisting of cleared land.

Eight focus areas identified during the desktop assessment as areas of interest were inspected in more detail. These areas are shown in Figure 4, **Appendix A** and with observations summarised in Table 7.1 below.

A photolog showing general Precinct layout and areas of interest are included in **Appendix B**.

Table 7.1 Summary of potentially contaminated areas based on the site inspection

AREA	ACTIVITIES & POTENTIAL CONTAMINATION SOURCES OBSERVED / EVIDENCED	POTENTIAL CONTAMINANTS
PCL 1	Stockpiling / area of basaltic rocks on site surface, presenting an aesthetic issue.	None (aesthetics only)
PCL 2	Stockpiling of hard waste (predominantly wood observed with some plastic and metal wastes included) and chicken manure (biosolids).	TRH, PAH, heavy metals, fertilisers (nitrate, nitrite), asbestos containing materials (ACM)
PCL 3	Inferred former house yard and farmyard. Fertilisers and pesticides (omethoate [insecticide] and MCPA [herbicide]) were observed. A jerry can and drums containing unknown products were observed in an inferred shed. A trailer inferred to be used for spraying was located in the vicinity.	TRH, PAH, metals, herbicides, OCP, OPP, fertilisers (nitrate, nitrite), ACM
PCL 4	Farm shed and former intended house. Empty plastic drums understood to have contained glucose were scattered throughout. A car wreck, empty IBC formerly containing unknown contents and a paint tin were also observed.	TRH, PAH, metals, cresols, solvents, phenols, ACM
PCL 5	Stockpiling / area of basaltic rocks on site surface, presenting an aesthetic issue.	None (aesthetics only)
PCL 6	Two sheds of unknown former use were observed. It is likely that farming equipment and products were formerly stored here.	TRH, PAH, metals, herbicides, OCP, OPP, fertilisers (nitrate, nitrite), ACM
PCL 7	A former house yard containing small stockpiles of metal and bricks, as well as four drums.	TRH, PAH, metals, herbicides, OCP, OPP, fertilisers (nitrate, nitrite), ACM
PCL N1	Stockpiling of soil and inert waste in the south-western corner of the property. Presents an aesthetic issue.	TRH, PAH, metals, herbicides, OCP, OPP, ACM

8 DISCUSSION

8.1 PRECINCT SOIL EROSION RISKS

An assessment of erosion risk was undertaken at a precinct planning level, on the basis of a literature review and site walkover.

Previous assessments of erosion risk, mapping of erosion/landslide events have identified that while there is a low-medium risk of erosion on the plateau, there is an elevated risk along the embankments of the incised valley of Bruce's Creek, particularly on the upper slope.

The site walkover identified generally clear water in Bruce's Creek, cloudy water in some farm dams, extensive erosion in the southwest corner (corresponding to the geological unit Sandringham Sandstone), and minor erosion within Bruce's Creek.

8.1.1 EROSION RISK (SOIL)

Based on the findings of the literature review and site walkover, in accordance with the adopted soil erosion risk scheme (Section 6.1), the Precinct soil erosion risk (surface soil) was assessed as **Low – Medium Risk**.

Undisturbed (and cropped land) on the plateau generally showed minimal evidence of surface erosion. Extensive erosion was observed in un-vegetated areas in the southwest corner of the precinct (Sandringham Sandstone).

The inherent soil risk appears relatively low on the Newer Volcanics, although the thickness of this unit is likely to decrease towards the west, and may be absent in the southwestern corner. In general, the soil erosion risk presented by the development is likely to be most prevalent during the construction phase while soil surfaces are exposed, but once development is complete the risk across the developed portions is likely to be negligible with the surfaces covered by houses, roads and maintained gardens. Furthermore, the risk to the riparian zone, which is inherently higher than the plateau area due to the presence of more erodible soils coupled with increased slope steepness, should reduce as a result of the development because the escarpment will be fenced, destocked and allowed to revegetate.

In addition to better informing the risk profile by undertaking intrusive investigations, controls during development may include protection of topsoil, placement of topsoil in scalped areas, and placement of matting to minimise erosion, in addition to maintaining vegetative cover and ensuring revegetation and stabilisation occur in a timely manner throughout the development works.

8.1.2 EROSION RISK (BUILDINGS AND INFRASTRUCTURE)

Based on the findings of the literature review and site walkover, in accordance with the adopted soil erosion risk scheme (Section 6.1), the Precinct soil erosion risk (buildings and infrastructure) was assessed as **Low – Medium Risk**.

Broadly, undisturbed, vegetated surfaces displayed minimal evidence of erosion, except in the south-west corner (Sandringham Sandstone unit) and along Bruce's Creek where this unit was intersected.

While soils on the plateau are reported as less dispersive, the thickness of the soil profile is less than 1 metre. Therefore, it is possible that deep excavations may intersect underlying strata, which may be more reactive. Further assessment to understand the vertical soil profile may better inform the risk profile.

Infrastructure on the valley slopes of Bruce's Creek may intersect more erodible soils or subsoils, and detailed design of retention structures and discharge works into Bruce's Creek should consider these risks.

In addition to better informing the risk profile by undertaking intrusive investigations, controls may include backfill of linear infrastructure to prevent tunnel erosion, avoidance (where possible) of installation of linear infrastructure, and minimisation of disturbance to topsoil.

8.1.3 EROSION RISK (WATER QUALITY)

Based on the findings of the literature review and site walkover, in accordance with the adopted soil erosion risk scheme (Section 6.1), the Precinct soil erosion risk (surface soil) was assessed as **Low – Medium Risk**.

Observations of Bruce's Creek indicated that while the local area has erosion risks, the water quality was relatively good, with effective vegetation cover and minor evidence of erosion on unvegetated surfaces. Provided maintenance of water quality on the site during the development is a focus it is not anticipated that the development works would result in significant degradation of the water quality in the creek. Furthermore, with effective adoption of integrated water management principles to protect environmental and landscape values associated with Bruce's Creek, it is not anticipated that the development would lead to long-term degradation of the waterway downstream of the precinct (e.g. through additional scouring from increased flows etc).

In addition to better informing the risk profile by undertaking intrusive investigations, controls may include typical riparian land management (exclusion of stock, establishment and protection of riparian vegetation, weed and pest control), stormwater treatment/settlement to minimise sedimentation, and stormwater retarding to manage peak and total flows within waterways.

8.1.4 FURTHER ASSESSMENT WORK (EROSION RISK)

Based on the desk study and site observations, excavations and cuttings in the precinct east of Bruce's Creek may encounter dispersive soils and this potential should be confirmed with an intrusive investigation including collection and analysis of soil samples. Intrusive investigation is also recommended in the vicinity of Bruce's Creek (500 m buffer) to confirm the soil type(s) and soil properties in this area. The 500 m buffer encompasses the escarpment slope, Sandringham Sandstone and Gellibrand Marl within the precinct, and Newer Volcanics closest to Bruce's Creek where the thickness may be reduced.

8.1.4.1 PRECINCT SCALE EROSION RISK PLAN

As part of the **precinct structure plan (**PSP) process, VPA prepare a precinct scale plan/map which highlights areas of high risk, medium risk and low risk in relation to erosion potential, which will inform strategic and statutory controls.

The resolution of this plan may be improved (if deemed necessary by stakeholders) though intrusive investigations; however, the cost of such improvements may outweigh the benefits, and it is considered that such investigation may be better deferred to the proponent as this enables scoping to be suited to the proposed development (e.g. deep vs shallow, structural vs vegetation, etc.).

The map should be developed based on:

- Agreed buffers from Bruce's Creek
- Existing gullies
- Known/inferred mapping of Sandringham Sandstone and Gellibrand Marl formation geology, and
- Slope.

8.1.4.2 INTRUSIVE INVESTIGATION

Intrusive investigations should be undertaken based on the erosion risk plan/map:

- Intrusive investigation is recommended to allow for visual appraisal of the soil type, structure and thickness, and to allow for retrieval of soil samples for laboratory testing.
- Samples should be taken from investigation locations distributed across the site to provide coverage of different landscapes, and at different depths to identify more susceptible layers.

- Laboratory testing should be undertaken on retrieved samples. Testing should include testing for sodium content as a proportion of cation exchange capacity and dispersion potential.
- Findings of the intrusive investigation should inform preparation of an erosion control management plan (ECMP) addressing risks and providing best-practice mitigations and which has been endorsed by a suitably qualified professional (e.g. a certified professional in erosion and sediment control or soil science).
- Target for intrusive investigations should include land within 500 m of Bruce's Creek, including where mapping indicates presence of Sandringham Sandstone and/or Gellibrand Marl units which were observed to be more prone to erosion.
- A subsequent phase of more closely spaced investigations may be required in some areas if sodic and potentially dispersive soils are encountered to enable the site to be more closely zoned, because the presence and severity of sodic and dispersive soils can vary over relatively short distances. The proponent would undertake this to further develop the ECMP and input into the planning approval process.

8.2 PRECINCT CONTAMINATION RISKS

An assessment of contamination risk was undertaken at a precinct planning level, on the basis of a literature review and site walkover.

The literature review identified predominantly agricultural use in the Precinct, comprising cropping and livestock grazing, with some rural residential use. The site walkover identified some areas of interest where ancillary land uses may be considered to increase the potential for contamination to have occurred.

8.2.1 PPN30 CONSIDERATIONS

As detailed in Section 4.3 above, PPN30 details the framework by which a planning or responsible authority must ensure that the effects of the environment on a planning proposal are considered, and that land that is potentially contaminated is suitable for its proposed use.

In consideration of the Contamination Risk Scheme detailed in Section 6.2 above, the following register of planning considerations in Table 8.1 may be provided for the various areas within the Precinct as identified during this assessment, including notable land uses and activities, and associated contaminants of concern:

Table 8.1 Register of Planning Considerations for Contamination Risk

Areas of interest	Potential for Contamination	Confirmed Land Uses / Activities	Contaminants of Concern[1]	PPN30 Context (in the absence of additional information)
Majority of site	**Unlikely to be contaminated**	**Agriculture (cropping)** Canola	Herbicides, OCP, OPP, fertilisers (nitrates, phosphates)	PPN30 makes no recommendation. Contamination risk to be met by GED.
Southwest and east (property 2, 3, 4, and 5 – refer Figure 1)	**Medium**	**Agriculture (grazing)** Livestock pastures e.g. sheep	Fertilisers (nitrate, nitrite) and possibly herbicides, potential stock dipping/drenching	PRSA potentially required (if stock dips may have been present) to determine need for Environmental Audit recommended (2).

Areas of interest	Potential for Contamination	Confirmed Land Uses / Activities	Contaminants of Concern[1]	PPN30 Context (in the absence of additional information)
PCLs 2, 3, 4 & 6	**Medium**	**Agriculture (infrastructure)** Farmyards and buildings, farm waste storage areas, stockpiles of biosolids	TPH, CHC, PAH, herbicides, fertilisers (nitrate, nitrite), ACM	PRSA to determine need for Environmental Audit recommended.
PCL 7	**Medium**	**Waste storage** Stockpiled metal, bricks and drums of unknown former use	TPH, CHC, PAH, ACM	PRSA to determine need for Environmental Audit recommended.
PCL N1	**Medium**	**Waste storage** Stockpiled soil and inert waste	TRH, PAH, metals, herbicides, OCP, OPP, ACM	PRSA to determine need for Environmental Audit recommended.

Notes:

(1) ACM is asbestos containing material, TPH is total petroleum hydrocarbons, CHC is chlorinated hydrocarbons, PAH is polycyclic aromatic hydrocarbons, OCP is organochlorine pesticides, OPP is organophosphorus pesticides.

(2) While no stock dipping sites were observed during the walkover, a PRSA may be appropriate to document the site history review.

8.2.2 AESTHETIC CONSIDERATIONS

In addition to the areas identified in Section 8.2.1, two areas were identified at site containing stockpiled basaltic rocks (1 and 5 in Figure 4), and one site containing soil potentially containing inert waste (N1 in Figure 4). Although not included in the PPN30 planning considerations, these areas will require consideration due to aesthetics of soil as a protected Environmental Value (a consideration of any Environmental Audit – see Section 4.2) in the context of precinct planning for residential development.

It is understood that in areas of Stony Rises, a cultural heritage management plan (CHMP) is being developed, which may limit development and may prevent importation of covering soil. This report does not address cultural heritage.

8.2.3 FURTHER ASSESSMENT WORK (CONTAMINATION RISK)

Areas of interest which have been determined to have "Medium" potential for contamination following the PPN30-based contamination potential assessment (see Table 8.1 above) will require a PRSA to be completed in accordance with the requirements of PPN30 and EPA Publication 2021 (see Section 4.3 above). The PRSA will assess the need for an Environmental Audit.

In areas (majority of the precinct) where land is not likely to be contaminated, PPN30 does not include any recommendations for further assessment. In this case, the General Environment Duty (GED) applies to for any suspected risk to human health or the environment.

VPA may consider two pathways to meeting the requirements of PPN30:

1 **Meet the PRSA and/or Environmental Audit requirements prior to the amendment:**

- Preferred option under PPN30 and may avoid unnecessary encumbrances on the land.
- Landowners participating in the precinct planning process may be encouraged to undertake the PRSA for the existing properties/lots within the Precinct, noting restrictions around the PRSA process can result in an Audit requirement if insufficient supporting information is available to close out contamination risk.

- Landowners participating in the precinct planning process may be approached to undertake site investigations to demonstrate consideration of the GED (e.g., by undertaking clean up of surface stockpiles, completing a PSI and/or DSI to address contamination concerns arising from desktop reviews and seeking to demonstrate absence of contamination.
- Undertaking the GED compliance work ahead of the PRSA may provide the Environmental Auditor with sufficient confidence to conclude that the likelihood of the presence of contaminated land is low under the PRSA guidelines (refer Section 4.3.3.2 above), thus reducing the potential that an Environmental Audit is recommended , but subsequently shown to have been unnecessary based on a limited volume of further information.
- This **Strategic Planning Control** can enable VPA to demonstrate compliance with the requirements of Ministerial Direction No.1 (MD No.1).

2 **Defer meeting the PRSA and/or Environmental Audit requirements until after the amendment via application of an Environmental Audit Overlay or inclusion of PRSA requirement within the schedule of the new land zoning (e.g. Urban Growth Zone [UGZ]):**

- Supported by MD No.1 where it is difficult or inappropriate to meet requirements prior to the amendment.
- VPA must determine that it is difficult or inappropriate to complete PRSA's at the time of the amendment, noting that PPN30 states that time and cost are not necessarily sufficient reasons to defer assessment.
- May delay development of the Precinct.
- May result in rework due to loss of local knowledge, and therefore additional effort.
- The application of the EAO or inclusion of PRSA requirements within the Schedule to the UGZ will require the completion of the PRSA for any land included in the overlay or within the schedule regardless of the findings of a PPN30-based contamination potential assessment (i.e. regardless of whether potential for contamination was found to be Low or Medium).
- This **Statutory Planning Control** can enable VPA to ensure controls are in place to enable the planning authority to meet the requirements of MD No.1 (refer Section 4.3.3.1).

WSP recommends Option 1 as the preferred approach, as it maximises potential to tap into local knowledge, ensures that persons in management or control of land meet their obligations under the GED, and may reduce the time and cost of required environmental investigations at the Precinct.

To support the effective completion of the PRSAs, and subject to Precinct planning considerations, it may be prudent to undertake some limited soil investigations (sampling) in medium risk areas. This could take the form of the collection and analysis of surface / shallow soil samples targeted on higher risk areas within these diffuse source areas e.g. chemical stores within farmyards, or on a wide grid basis across cropping land e.g. in areas of expected fertiliser application. This sampling could inform the need for any further soil, groundwater, surface water, sediment or soil vapour investigations, providing increased confidence to the Environmental Auditor completing the PRSA.

The sampling could also indicate whether any remediation might be required to render these subzones suitable for a residential end use before the PRSA process. With respect to the potential future requirement for remediation at the Precinct, it is anticipated that this may be limited to farmyard and farm building areas that are to be redeveloped, and where more intensive activities have been carried out. In these places, localised areas of diffuse contamination may exist in surface / shallow soils, which may require removal prior to residential development.

Similarly, if soils in cropping areas are to be re-used, further assessment would be required to demonstrate they are suitable for future residential areas e.g. as topsoil in gardens or within communal landscaping.

8.3 ASSUMPTIONS AND LIMITATIONS OF THE ASSESSMENT

This soil erosion risk and contamination risk assessment has been based upon a literature review and site visit and walkover (accessible areas). The risk ranking is general in nature and has been assessed at a Precinct scale.

Further works have been recommended based on the findings of this assessment, which will further inform the risk profile at the Precinct and enable appropriate planning/design of infrastructure to meet the objectives of the Precinct Planning process underway.

9 CONCLUSIONS

9.1 PRECINCT CONTEXT

The Bannockburn South-East precinct is located southeast of Bannockburn approximately 14 km northwest of Geelong and covers an area of approximately 524 hectares. The precinct is bounded by the existing Bannockburn township to the north, farmland to the east, the Gheringhap-Maroona freight railway to the south, and Bruce's Creek to the west. Currently the precinct comprises a mix of grazing/cropping land with minor rural residential.

A site inspection/walkover was undertaken on 14 June 2022 and an additional site walkover was undertaken on 25 March 2024 identifying an additional area of concern.

This soil erosion risk and contamination risk assessment has been based upon a literature review and site visits and walkover (accessible areas). The risk ranking is general in nature and has been assessed at a Precinct scale.

9.2 PREVIOUS STUDIES

Previous Land Capability Assessments were completed for the Bannockburn area by Meinhardt (2020) and SCA (1981). Soil mapping, erosion studies and master planning for Bruce's Creek have also been completed.

- In general, the erosion risk in previous studies was assessed as Low – Medium.
- In general, the contamination risk in the Meinhardt LCA was assessed as Low (assessed under the previous iteration of PPN30, now superseded).

9.3 SOIL EROSION RISK

Soil erosion risk in the context of **soil erosion** was assessed as Low – Medium risk under the adopted risk scheme.

Soil erosion risk in the context of **buildings and infrastructure** was assessed as Low – Medium risk under the adopted risk scheme.

Soil erosion risk in the context of **water quality** was assessed as Low – Medium under the adopted risk scheme.

In addition to better informing the risk profile by undertaking intrusive investigations, controls may include protection of topsoil, limiting earthworks to the extent practicable, stormwater retention and treatment, elimination of linear infrastructure (or management of backfill to limit risk of tunnel erosion).

Based on the desk study and site observations, excavations and cuttings in the study area east and west of Bruce's Creek may encounter dispersive soils (nominally 500 m buffer).

9.4 CONTAMINATION RISK

Areas of interest which have been determined to have a "Medium" potential for contamination will require a PRSA to be completed in accordance with the requirements of PPN30. The PRSA will assess the need for an Environmental Audit.

In areas (majority of the precinct) where land is not likely to be contaminated, PPN30 does not include any recommendations for further assessment. In this case, the General Environment Duty (GED) applies to for any suspected risk to human health or the environment.

It was noted that one property within the precinct was not accessible, located at 418 Burnside Road, Bannockburn. Based on a review of aerial imagery, the Meinhardt (2020) report, and observations over boundary fences, the contamination risk at 418 Burnside Road, Bannockburn did not appear to be elevated above surrounding properties.

VPA may consider two pathways to meeting the requirements of PPN30:

- Meet the PRSA and/or Environmental Audit requirements prior to the amendment, or
- Defer meeting the PRSA and/or Environmental Audit requirements until after the amendment via application of an Environmental Audit Overlay or within the schedule of the new land zoning (e.g. Urban Growth Zone [UGZ] – see Section 8.2.3).

WSP recommends Option 1 as the preferred approach, as it maximises potential to tap into local knowledge, ensures that persons in management or control of land meet their obligations under the GED, and may reduce the time and cost of required environmental investigations at the Precinct.

9.5 FURTHER ASSESSMENT

9.5.1 EROSION RISK

Based on the desk study and site observations, excavations and cuttings in the precinct east of Bruce's Creek may encounter dispersive soils and this potential should be confirmed with an intrusive investigation including collection and analysis of soil samples. Intrusive investigation is also recommended within 500 m of Bruce's Creek to confirm the soil type(s) and soil properties in this area:

- **Prepare a precinct scale plan/map as part of the PSP process**, which highlights areas of high risk, medium risk and low risk in relation to erosion potential, which will inform strategic and statutory controls. This

  The resolution of this plan may be improved (if deemed necessary by stakeholders) though intrusive investigations; however, the cost of such improvements may outweigh the benefits, and **it is considered that such investigation may be better deferred to the proponent** as this enables scoping to be suited to the proposed development (e.g. deep vs shallow, structural vs vegetation, etc.).

Intrusive investigations should be undertaken based on the erosion risk plan/map:

- **Intrusive investigation** is recommended to allow for visual appraisal of the soil type, structure and thickness, and to allow for retrieval of soil samples for laboratory testing. Samples should be taken from investigation locations distributed across the site to provide coverage of different landscapes, and at different depths to identify more susceptible layers. Laboratory testing should be undertaken on retrieved samples. Testing should include testing for sodium content as a proportion of cation exchange capacity and dispersion potential.

  The findings of the intrusive investigation should inform **preparation of an erosion control management plan** addressing risks and providing best-practice mitigations and which has been endorsed by a suitably qualified professional (e.g. a certified professional in erosion and sediment control or soil science).

  Target for intrusive investigations should include land within 500 m of Bruce's Creek, including where mapping indicates presence of Sandringham Sandstone and/or Gellibrand Marl units which were observed to be more prone to erosion. A subsequent phase of more closely spaced investigations may be required in some areas if sodic and potentially dispersive soils are encountered to enable the site to be more closely zoned, because the presence and severity of sodic and dispersive soils can vary over relatively short distances. The proponent would undertake this to further develop the ECMP and input into the planning approval process.

9.5.2 CONTAMINATION RISK

To meet the requirements of Ministerial Direction No.1, further site assessment is required where a "Medium" potential for contamination has been determined.

- Landowners participating in the precinct planning process may be encouraged to undertake the PRSA for the existing properties/lots within the Precinct, noting restrictions around the PRSA process.

- Landowners participating in the precinct planning process may be approached to undertake site investigations to demonstrate consideration of the GED (e.g., by undertaking clean up of surface stockpiles, completing a PSI and/or DSI to address contamination concerns arising from desktop reviews and seeking to demonstrate absence of contamination.
- Undertaking the GED compliance work ahead of the PRSA may provide the Environmental Auditor with sufficient confidence to conclude that there is low likelihood of contamination under the PRSA guidelines, thus reducing the potential that an Environmental Audit is recommended.

Alternatively,

- VPA may elect to defer meeting the PRSA and/or Environmental Audit requirements until after the amendment via application of an Environmental Audit Overlay or within the schedule of the new land zoning (e.g. Urban Growth Zone [UGZ]). This approach has potential to impose encumbrances on land unlikely to be contaminated.

10 LIMITATIONS

This Report is provided by WSP Australia Pty Limited (WSP) for the Victorian Planning Authority (VPA) (Client) in response to specific instructions from the Client and in accordance with WSP's communicated scope of works dated 13 May 2022 and written agreement with the Client (Agreement).

10.1 PERMITTED PURPOSE

This Report is provided by WSP for the purpose described in the Agreement and no responsibility is accepted by WSP for the use of the Report in whole or in part, for any other purpose (Permitted Purpose).

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The services undertaken by WSP in preparing this Report were limited to those specifically detailed in the Report and are subject to the scope, qualifications, assumptions and limitations set out in the Report or otherwise communicated to the Client.

Except as otherwise stated in the Report and to the extent that statements, opinions, facts, conclusion and / or recommendations in the Report (Conclusions) are based in whole or in part on information provided by the Client and other parties identified in the report (Information), those Conclusions are based on assumptions by WSP of the reliability, adequacy, accuracy and completeness of the Information and have not been verified. WSP accepts no responsibility for the Information.

The Conclusions are reflective of the current Site conditions and cannot be regarded as absolute without further extensive intrusive investigations, outside the scope of the services set out in the Agreement and are indicative of the environmental condition of the Site at the time of preparing the Report. As a general principle, vertical and horizontal soil or groundwater conditions are not uniform. No monitoring, common or intrusive testing or sampling technique can eliminate the possibility that monitoring or testing results or samples taken, are not totally representative of soil and / or groundwater conditions encountered at the Site. It should also be recognised that Site conditions, including subsurface conditions can change with time due to the presence and concentration of contaminants, changing natural forces and man-made influences.

Within the limitations imposed by the scope of the services undertaken by WSP, the monitoring, testing (intrusive or otherwise), sampling for the preparation of this Report has been undertaken and performed in a professional manner in accordance with generally accepted practices, using a degree of skill and care ordinarily exercised by reputable environmental consultants under similar circumstances. No other warranty, expressed or implied, is made.

WSP has prepared the Report without regard to any special interest of any person other than the Client when undertaking the services described in the Agreement or in preparing the Report.

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WSP is not (and will not be) obliged to provide an update of this Report to include any event, circumstance, revised Information or any matter coming to WSP's attention after the date of this Report. Data reported and conclusions drawn are based solely on the information made available to WSP at the time of preparing the Report. The passage of time; unexpected variations in ground conditions; manifestations of latent conditions; or the impact of future events (including

(without limitation) changes in policy, legislation, guidelines, scientific knowledge; and changes in interpretation of policy by statutory authorities); may require further investigation or subsequent re-evaluation of the Conclusions.

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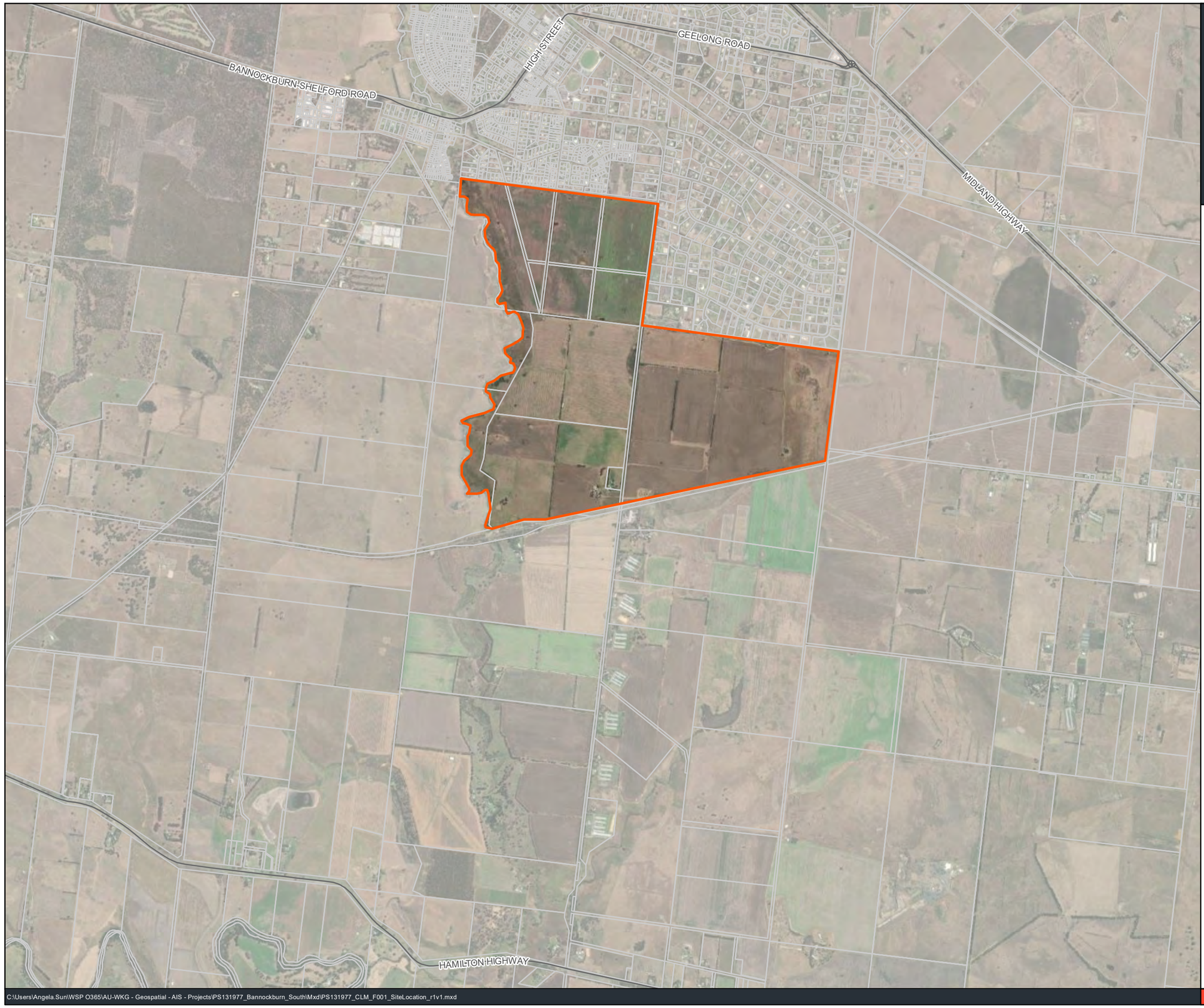
APPENDIX A

FIGURES



Bannockburn Southeast PSP
Sodic Soil and Contamination Risk Desktop Assessment

Figure 1
Site Location

Legend

- Road
- Cadastre
- Precinct Boundary

0 340 680
Meters

Coordinate system: GDA2020 MGA Zone 55

Scale ratio correct when printed at A3

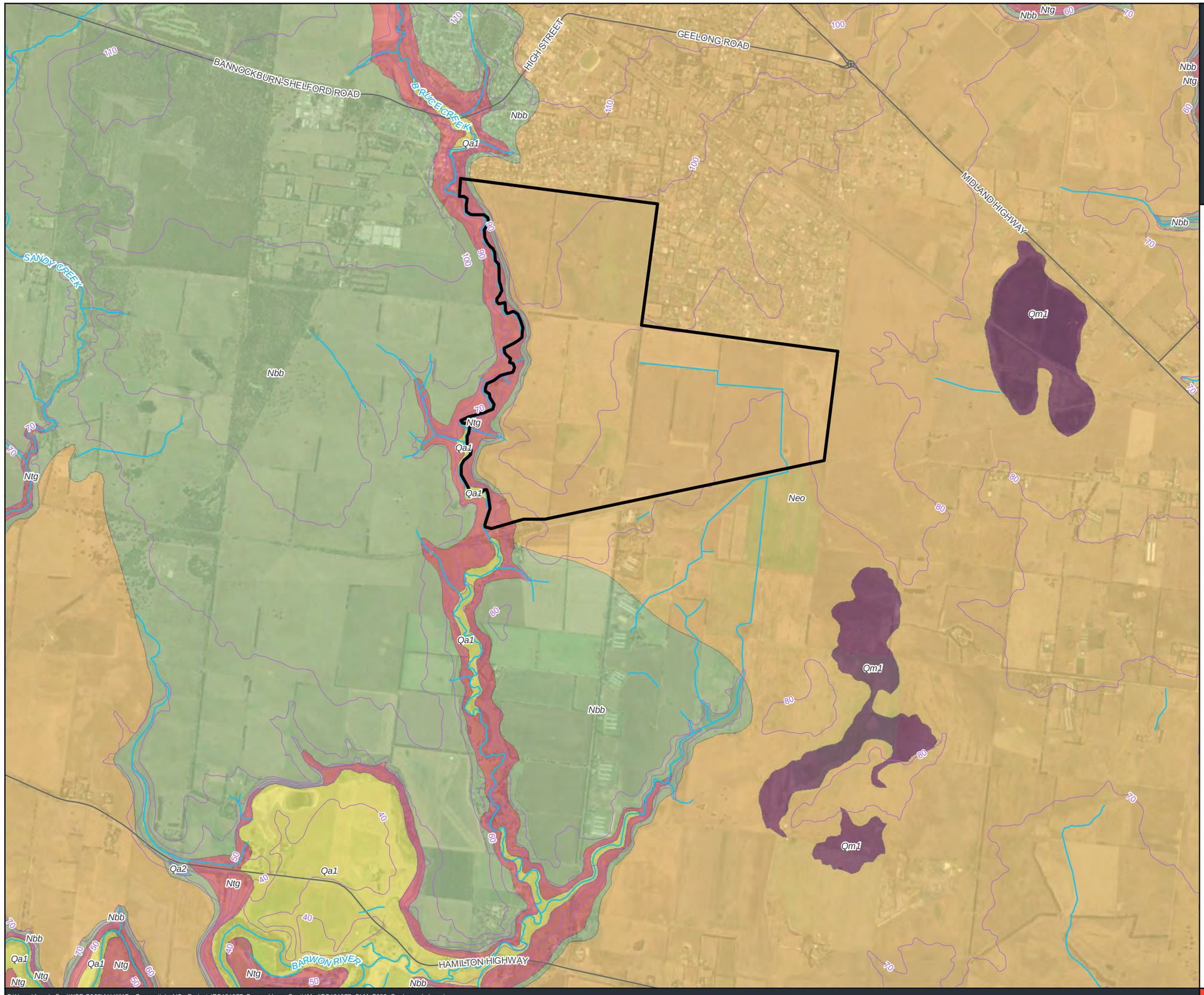
1:30,000 Date: 25/05/2022

Data sources: DELWP 2022, WSP 2022

C:\Users\Angela.Sun\WSP O365\AU-WKG - Geospatial - AIS - Projects\PS131977_Bannockburn_South\Mxd\PS131977_CLM_F001_SiteLocation_r1v1.mxd

Bannockburn Southeast PSP
Sodic Soil and Contamination Risk Desktop Assessment

Figure 2
Geology



Legend

- Contour 10m
- Road
- Watercourse
- Precinct Boundary

Gelogical Unit

- Sandringham Sandstone (Nbb): generic
- Gellibrand Marl (Ntg): Gellibrand Marl in Torquay Group
- Newer Volcanic Group - basalt flows (Neo): generic
- alluvial terrace deposits(Qa2): generic
- alluvium(Qa1): generic
- swamp and lake deposits (Qm1): generic

0 340 680
Meters

Coordinate system: GDA2020 MGA Zone 55

Scale ratio correct when printed at A3

1:30,000 Date: 25/05/2022

Data sources: DELWP 2022, WSP 2022

Bannockburn Southeast PSP
Sodic Soil and Contamination Risk Desktop Assessment

Figure 1
Site Location

Legend

- Road
- Cadastre
- Precinct Boundary
- 1 Property Number

Soil group ID

13 Grey and brown (occasionally black, yellow or red) mottled texture contrast soils comprising:

39 Black, grey, brown and red cracking calcareous clays

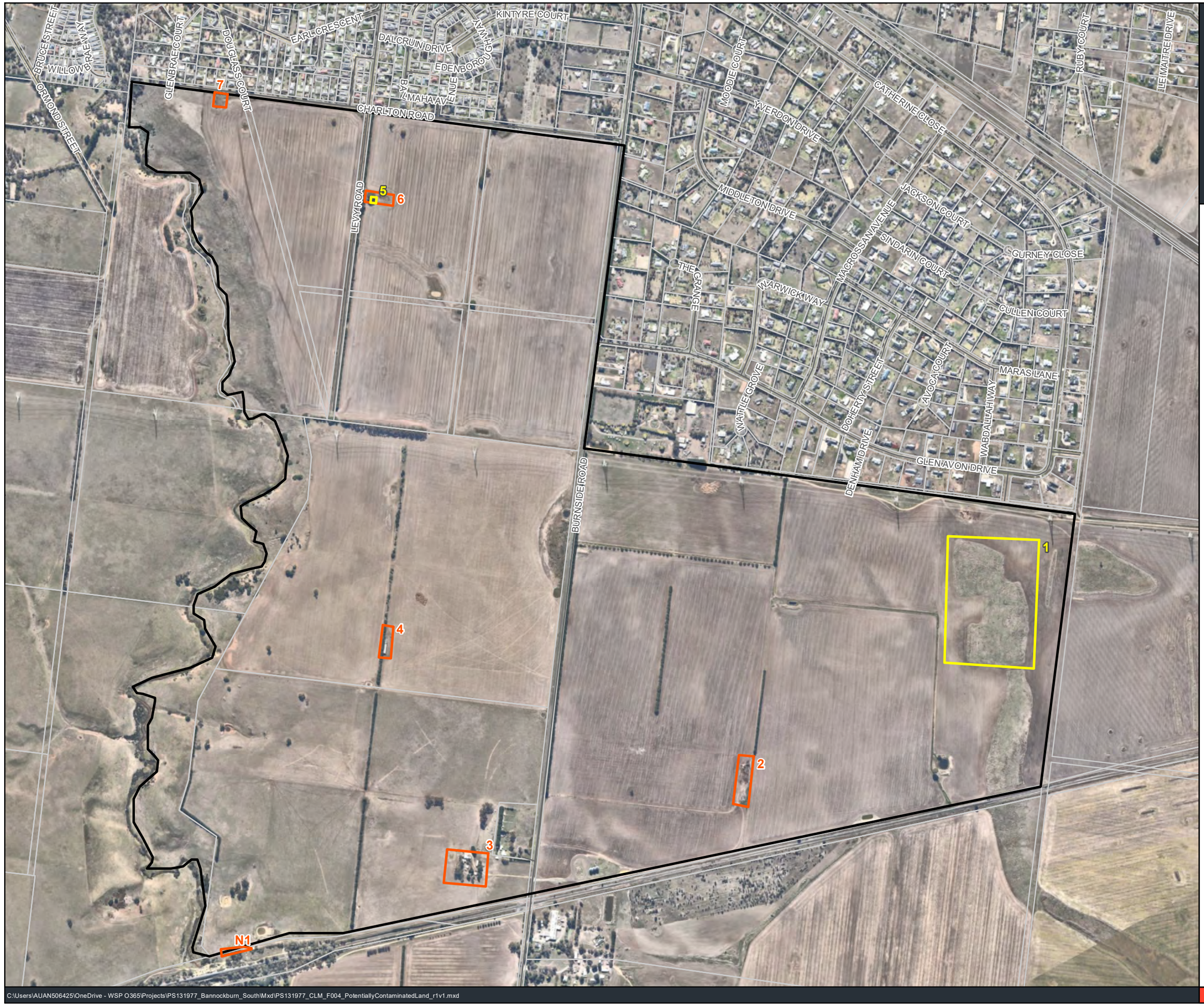
Robinson et al. (2003) Corangamite Land Resource Assessment

Coordinate system: GDA2020 MGA Zone 55

Scale ratio correct when printed at A3

1:30,000 Date: 25/05/2022

Data sources: DELWP 2022, WSP 2022



Bannockburn Southeast PSP
Sodic Soil and Contamination Risk Desktop Assessment

Figure 4
Potentially Contaminated Land

Legend

- Road
- Cadastre
- Potentially contaminated land: contamination status to be confirmed
- Basaltic rock stockpile/area: potential aesthetic impact (residential use)
- Precinct Boundary

0 120 240
Meters

Coordinate system: GDA2020 MGA Zone 55

Scale ratio correct when printed at A3

1:12,000 Date: 24/07/2024

Data sources: DELWP 2022, WSP 2022

APPENDIX B

PHOTOLOGS

wsp	**PHOTOGRAPHIC LOG – Potentially Contaminating Activities (Appendix B)**

Client Name	**Site Location**	**Project No.**
Victorian Planning Authority	Bannockburn South-East Precinct	PS131977

Photo No.	**Date**
1	14 June 2022

Description

Looking south from Charlton Road towards an inferred former house yard in PCL Area 7.

Shrubs and small trees are visible in a small area.

Photo No.	**Date**
2	14 June 2022

Description

Pile of metal and timber observed in the south of the former house yard in PCL Area 7.

wsp	**PHOTOGRAPHIC LOG – Potentially Contaminating Activities (Appendix B)**

Client Name	**Site Location**	**Project No.**
Victorian Planning Authority	Bannockburn South-East Precinct	PS131977

Photo No.	**Date**
3	14 June 2022

Description

Drums observed in the former house yard in PCL Area 7.

Photo No.	**Date**
4	14 June 2022

Description

Looking west towards Levy Road. A shed of unknown use was present adjacent to the road (PCL Area 6).

wsp	**PHOTOGRAPHIC LOG – Potentially Contaminating Activities (Appendix B)**

Client Name	**Site Location**	**Project No.**
Victorian Planning Authority	Bannockburn South-East Precinct	PS131977

Photo No.	**Date**
5	14 June 2022

Description

Looking west towards Levy Road. A second shed of unknown use was present in PCL Area 7.

Photo No.	**Date**
6	14 June 2022

Description

A metal cylinder of unknown origin present at the end of Levy Road. Potential contamination risk of low concern.

Photo No.	Date
7	14 June 2022

Description

Shed present to the west of Burnside Road in PCL 4, looking from the east.

Photo No.	Date
8	14 June 2022

Description

Empty plastic drums present to the north of the shed in Photo 7, understood to have been formerly used for the storage of glucose.

wsp	**PHOTOGRAPHIC LOG – Potentially Contaminating Activities (Appendix B)**

Client Name	**Site Location**	**Project No.**
Victorian Planning Authority	Bannockburn South-East Precinct	PS131977

Photo No.	**Date**
9	14 June 2022

Description

Paint tin observed to the south of the shed in Photo 7.

Photo No.	**Date**
10	14 June 2022

Description

View of the inside of the shed in Photo 7. Drums, an IBC and a car wreck are visible.

wsp	**PHOTOGRAPHIC LOG – Potentially Contaminating Activities (Appendix B)**	
Client Name Victorian Planning Authority	**Site Location** Bannockburn South-East Precinct	**Project No.** PS131977

Photo No.	**Date**
11	14 June 2022

Description

A trailer inferred to be used for spraying located in a former house yard in PCL 3 in the southeast of Property 4.

Photo No.	**Date**
12	14 June 2022

Description

Insecticide and herbicide containers visible adjacent to a shed containing omethoate (insecticide) and MCPA (herbicide) in PCL 3.

wsp	**PHOTOGRAPHIC LOG – Potentially Contaminating Activities (Appendix B)**

Client Name	**Site Location**	**Project No.**
Victorian Planning Authority	Bannockburn South-East Precinct	PS131977

Photo No.	**Date**
13	14 June 2022

Description

Bags of fertilizer observed in storage in a shed in PCL 3.

Photo No.	**Date**
14	14 June 2022

Description

Jerry can observed in a shed in PCL 3.

wsp	**PHOTOGRAPHIC LOG – Potentially Contaminating Activities (Appendix B)**

Client Name	**Site Location**	**Project No.**
Victorian Planning Authority	Bannockburn South-East Precinct	PS131977

Photo No.	**Date**
15	14 June 2022

Description

Inside the shed located in PCL 4. Drums of unknown contents visible in the background.

Photo No.	**Date**
16	14 June 2022

Description

Waste pile observed to the east of Burnside Road in PCL 2. Observed waste consisted predominantly of timber, with some plastics and metal observed.

wsp	**PHOTOGRAPHIC LOG – Potentially Contaminating Activities (Appendix B)**

Client Name	**Site Location**	**Project No.**
Victorian Planning Authority	Bannockburn South-East Precinct	PS131977

Photo No.	**Date**
17	14 June 2022

Description

Burnside Road:

Stockpiles of chicken manure observed to the north of PCL 2.

wsp	**PHOTOGRAPHIC LOG – SODIC SOIL POTENTIAL - SITE WALKOVER OBSERVATIONS (Appendix B)**

Client Name	**Site Location**	**Project No.**
Victorian Planning Authority	Bannockburn South-East Precinct	PS131977

Photo No.	**Date**
1	14 June 2022

Description

Manifold Street:

Development north west of property 1 (outside study area) showing erosion on dam wall and discolored water within dam.

Photo No.	**Date**
2	14 June 2022

Description

Bruce Creek:

In north west of property 1 on Bruce Creek, with minor erosion on creek side.

wsp	**PHOTOGRAPHIC LOG – SODIC SOIL POTENTIAL - SITE WALKOVER OBSERVATIONS (Appendix B)**

Client Name	**Site Location**	**Project No.**
Victorian Planning Authority	Bannockburn South-East Precinct	PS131977

Photo No.	**Date**
3	14 June 2022

Description

Bruce Creek:

In north west of property 1 on Bruce Creek, with minor dribble pattern on ground.

Photo No.	**Date**
4	14 June 2022

Description

Charlton Road:

Farm dam in north east of Property 1 with minor discoloration.

wsp	**PHOTOGRAPHIC LOG – SODIC SOIL POTENTIAL - SITE WALKOVER OBSERVATIONS (Appendix B)**

Client Name	**Site Location**	**Project No.**
Victorian Planning Authority	Bannockburn South-East Precinct	PS131977

Photo No.	**Date**
5	14 June 2022

Description

Burnside Road:

Farm Dam north west of Property 3 (outside study area) with minor discoloration.

Photo No.	**Date**
6	14 June 2022

Description

Burnside Road:

Farm Dam in north east of property 2 with minor discoloration.

wsp	**PHOTOGRAPHIC LOG – SODIC SOIL POTENTIAL - SITE WALKOVER OBSERVATIONS (Appendix B)**

Client Name	**Site Location**	**Project No.**
Victorian Planning Authority	Bannockburn South-East Precinct	PS131977

Photo No.	**Date**
7	14 June 2022

Description

Burnside Road:

Farm dam in north east of property 4 with no discoloration.

Photo No.	**Date**
10	14 June 2022

Description

Farm dam in south west of property 4 with discolored water.

wsp	**PHOTOGRAPHIC LOG – SODIC SOIL POTENTIAL - SITE WALKOVER OBSERVATIONS (Appendix B)**

Client Name	**Site Location**	**Project No.**
Victorian Planning Authority	Bannockburn South-East Precinct	PS131977

Photo No.	**Date**
11	14 June 2022

Description

Erosion on farm dam surface in south west of property 4.

Photo No.	**Date**
12	14 June 2022

Description

Erosion on cutting in north west of property 4.

wsp	**PHOTOGRAPHIC LOG – SODIC SOIL POTENTIAL - SITE WALKOVER OBSERVATIONS (Appendix B)**

Client Name	**Site Location**	**Project No.**
Victorian Planning Authority	Bannockburn South-East Precinct	PS131977

Photo No.	**Date**
13	14 June 2022

Description

Dribble pattern and erosion in north west of property 4 on cutting.

Photo No.	**Date**
14	14 June 2022

Description

Farm dam in north west of property 4 with discolored water.

wsp	**PHOTOGRAPHIC LOG – SODIC SOIL POTENTIAL - SITE WALKOVER OBSERVATIONS (Appendix B)**

Client Name	**Site Location**	**Project No.**
Victorian Planning Authority	Bannockburn South-East Precinct	PS131977

Photo No.	**Date**
15	14 June 2022

Description

Farm dam in south centre of property 2 with no discoloration.

APPENDIX C

LOTSEARCH AERIAL IMAGERY REPORTS

Date: 31 May 2022

Reference: LS032769 EA

Address: Bannockburn South-East Precinct, Bannockburn, VIC 3331 (Part 1)

Aerial Imagery 2021

Bannockburn South-East Precinct, Bannockburn, VIC 3331 (Part 1)

Aerial Imagery 2016

Bannockburn South-East Precinct, Bannockburn, VIC 3331 (Part 1)

Scale:	Data Source Aerial Imagery: © 2022 Google Inc, used with permission. Google and the Google logo are registered trademarks of Google Inc.	Coordinate System: GDA 1994 MGA Zone 55	Date: 30 May, 2022

0 130 260 390 520 Meters

Aerial Imagery 2011

Bannockburn South-East Precinct, Bannockburn, VIC 3331 (Part 1)

Scale: 0 130 260 390 520 Meters	Data Source Aerial Imagery: © 2022 Google Inc, used with permission. Google and the Google logo are registered trademarks of Google Inc.	Coordinate System: GDA 1994 MGA Zone 55	Date: 30 May, 2022

Aerial Imagery 2005

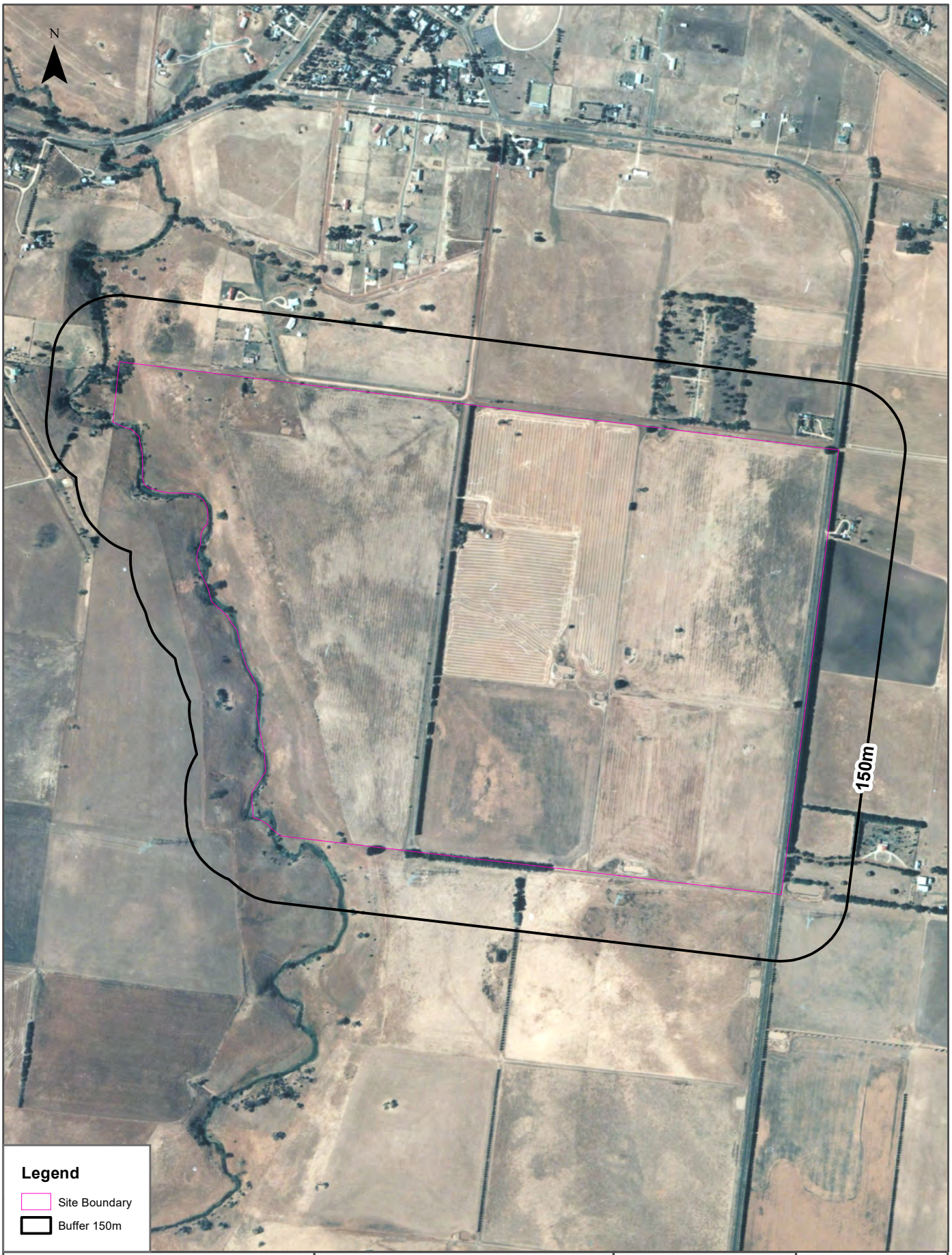
Bannockburn South-East Precinct, Bannockburn, VIC 3331 (Part 1)

Scale:	Data Source Aerial Imagery: © 2022 Google Inc, used with permission. Google and the Google logo are registered trademarks of Google Inc.	Coordinate System: GDA 1994 MGA Zone 55	Date: 30 May, 2022

0 130 260 390 520 Meters

Aerial Imagery 1990

Bannockburn South-East Precinct, Bannockburn, VIC 3331 (Part 1)



Data Source Aerial Imagery:
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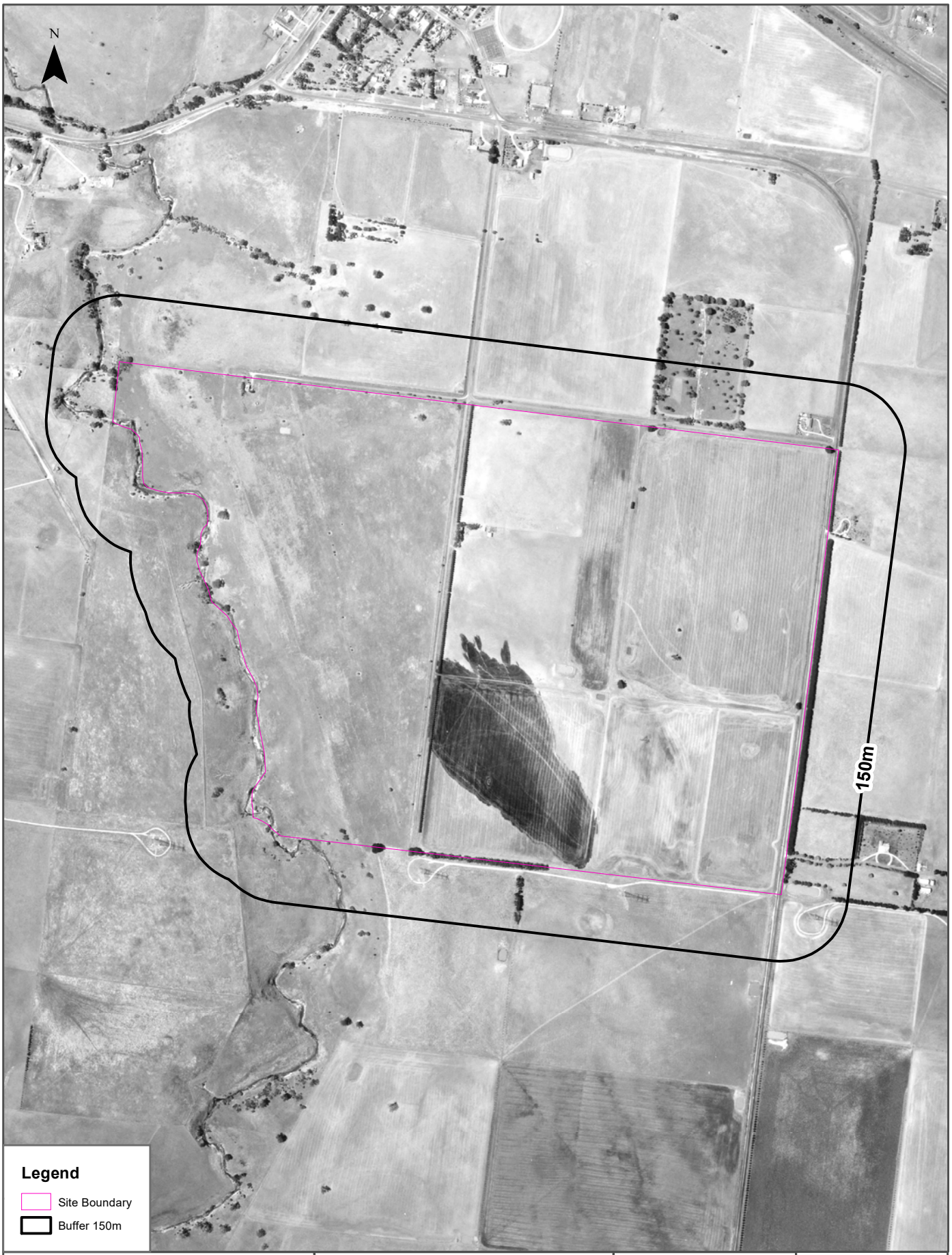
(Vicmap Topographic Mapping Program)

Coordinate System:
GDA 1994 MGA Zone 55

Date: 30 May, 2022

Aerial Imagery 1984

Bannockburn South-East Precinct, Bannockburn, VIC 3331 (Part 1)



Data Source Aerial Imagery:
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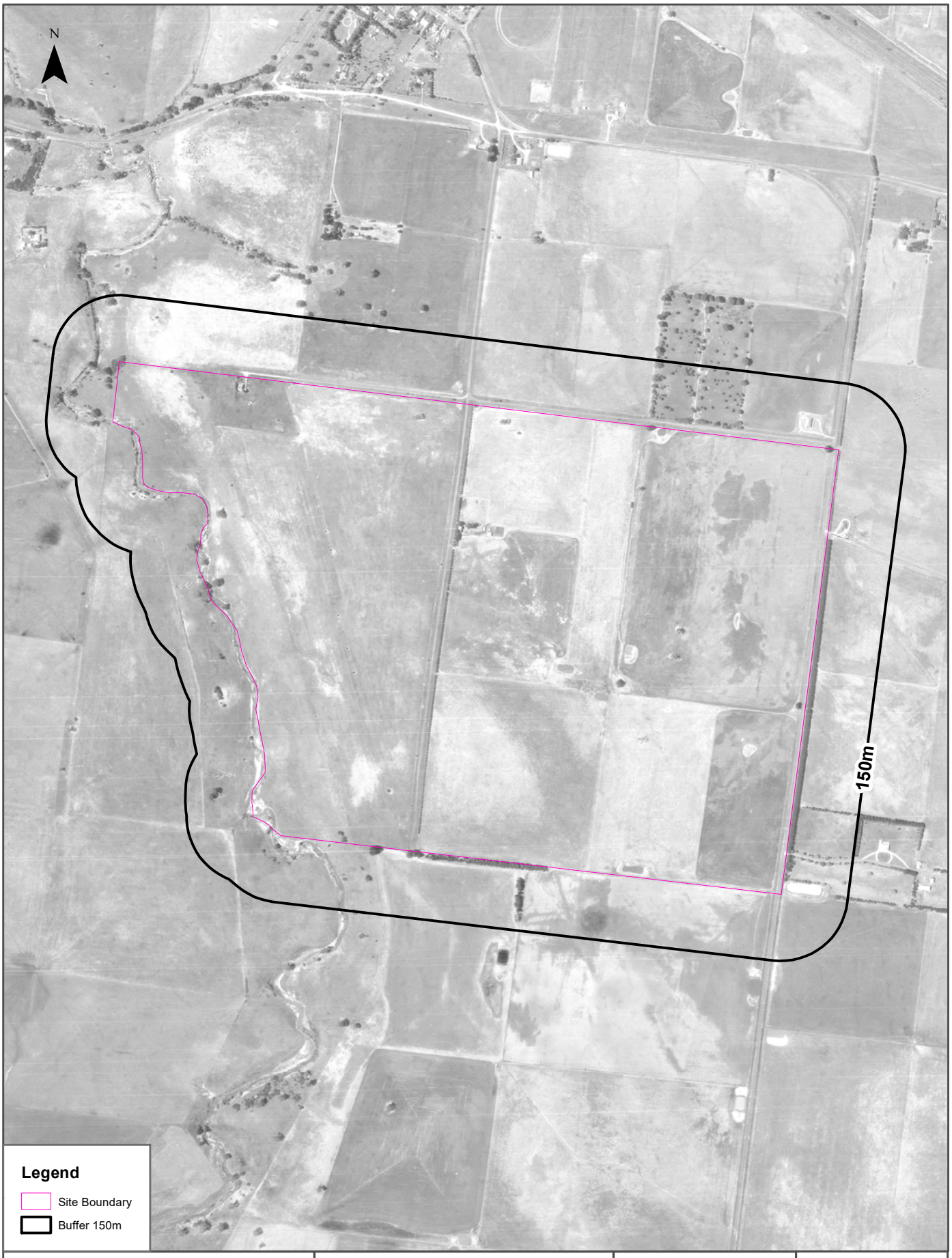
Coordinate System:
GDA 1994 MGA Zone 55

Date: 30 May, 2022

Aerial Imagery 1978

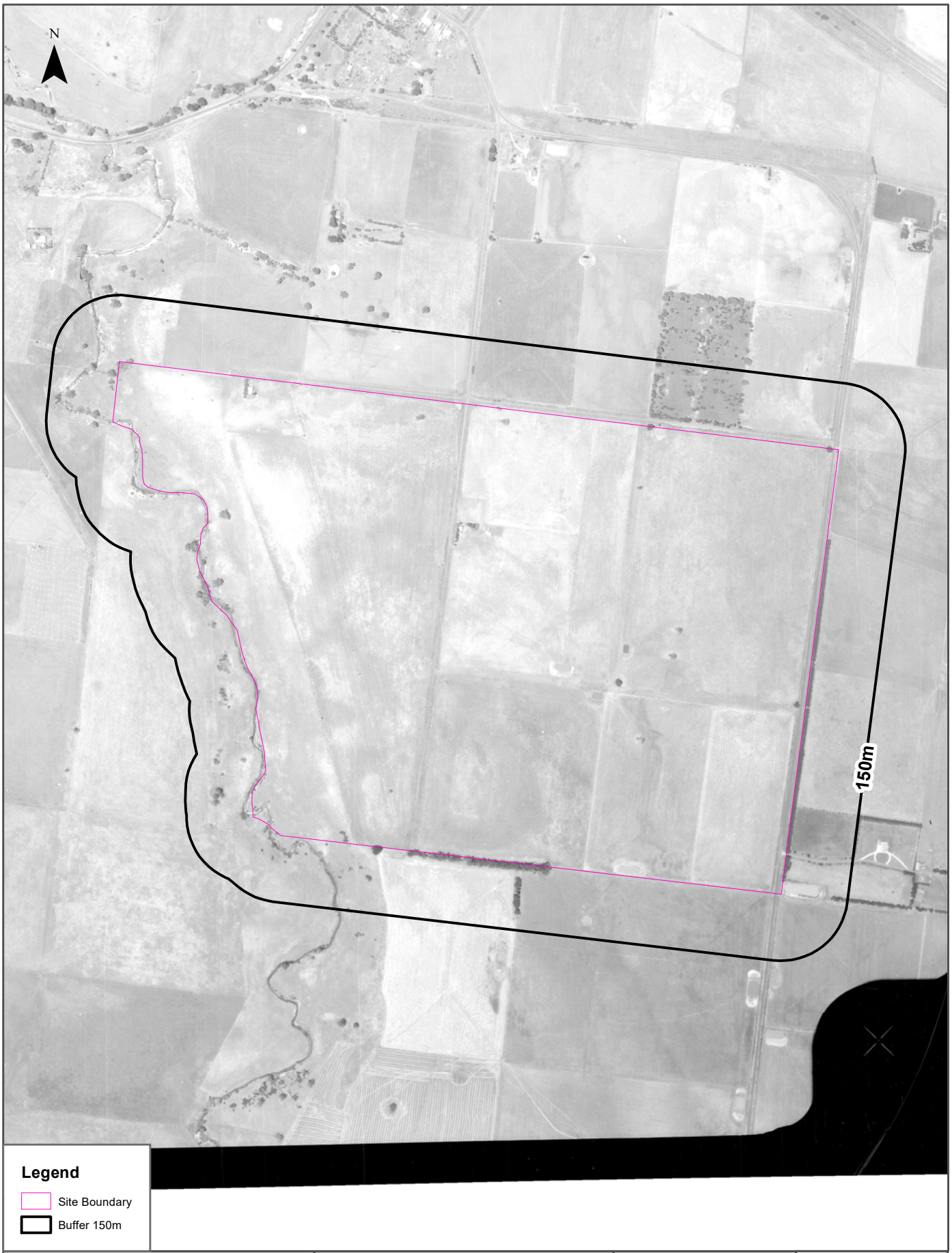
Bannockburn South-East Precinct, Bannockburn, VIC 3331 (Part 1)



Scale: 0 130 260 390 520 Meters	Data Source Aerial Imagery: © Department of Environment, Land, Water and Planning (Vicmap Topographic Mapping Program)	Coordinate System: GDA 1994 MGA Zone 55	Date: 30 May, 2022

Aerial Imagery 1970

Bannockburn South-East Precinct, Bannockburn, VIC 3331 (Part 1)



Data Source Aerial Imagery:
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Coordinate System:
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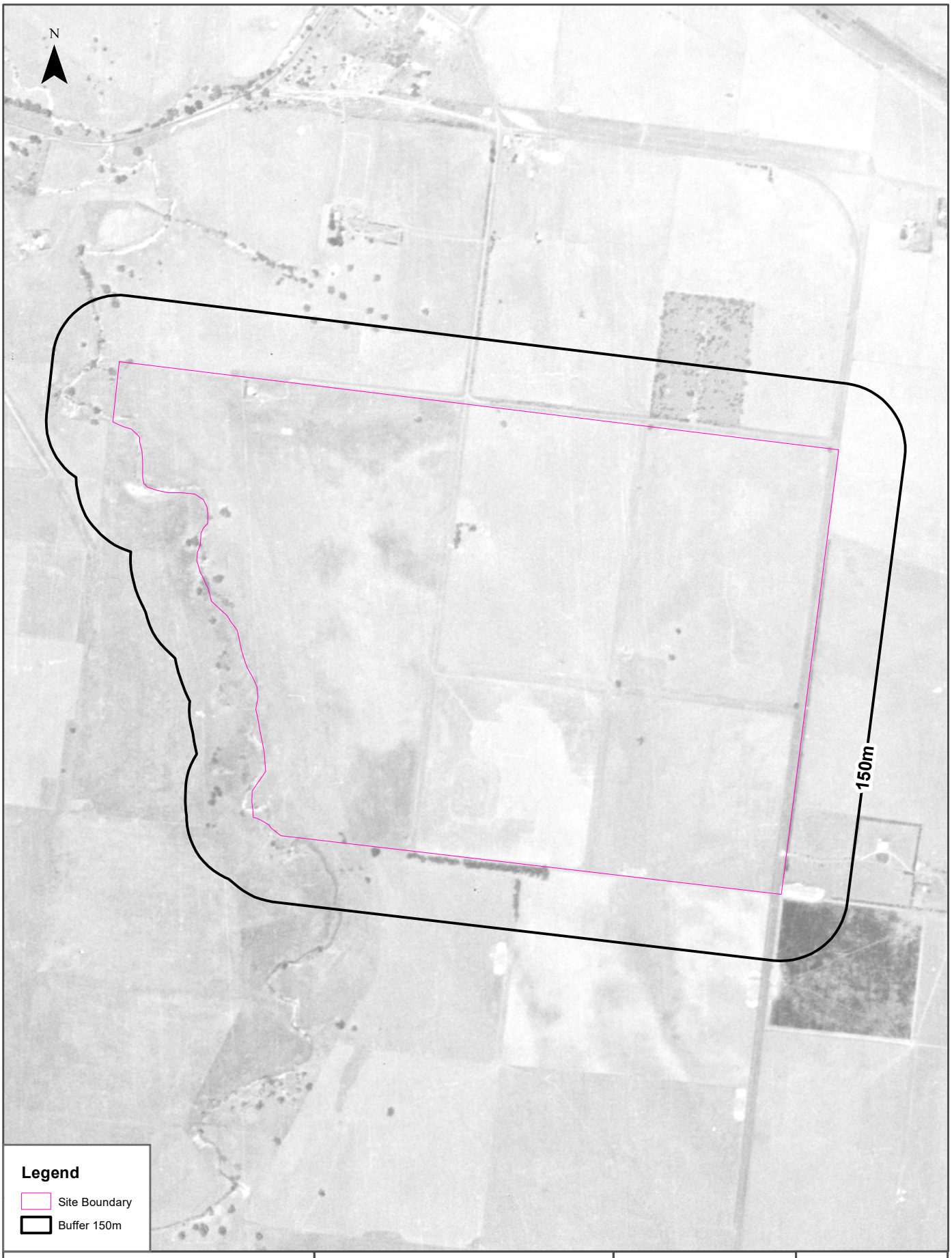
Date: 30 May, 2022

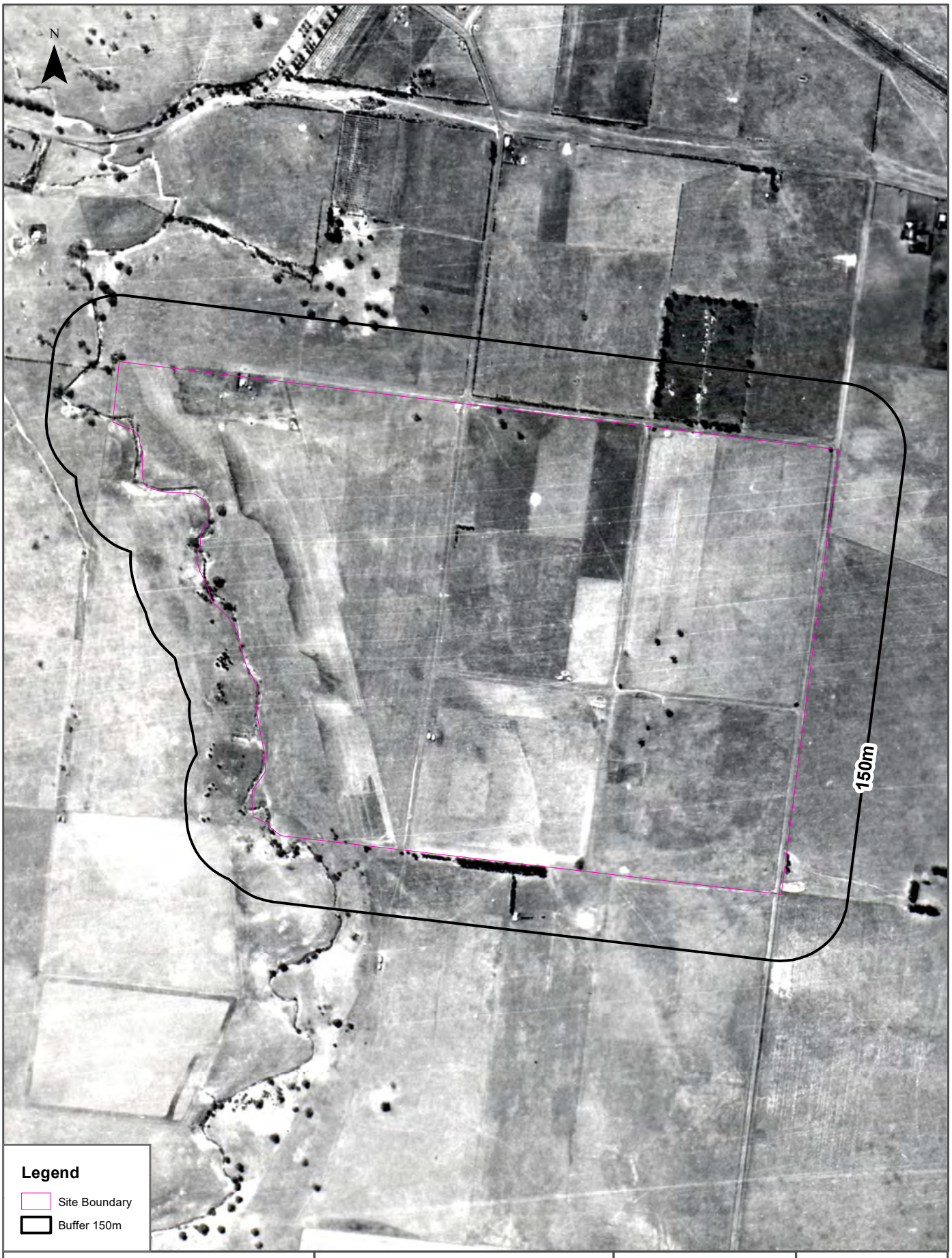
Aerial Imagery 1966

Bannockburn South-East Precinct, Bannockburn, VIC 3331 (Part 1)



Aerial Imagery 1947

Bannockburn South-East Precinct, Bannockburn, VIC 3331 (Part 1)



Scale: 0 130 260 390 520 Meters	Data Source Aerial Imagery: National Library of Australia	Coordinate System: GDA 1994 MGA Zone 55	Date: 30 May, 2022

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LOTSEARCH

LOTSEARCH AERIALS

Date: 31 May 2022

Reference: LS032833 EA

Address: Bannockburn South-East Precinct, Bannockburn, VIC 3331 (Part 2)

Aerial Imagery 2021

Bannockburn South-East Precinct, Bannockburn, VIC 3331 (Part 2)

Aerial Photo Coverage Not Available

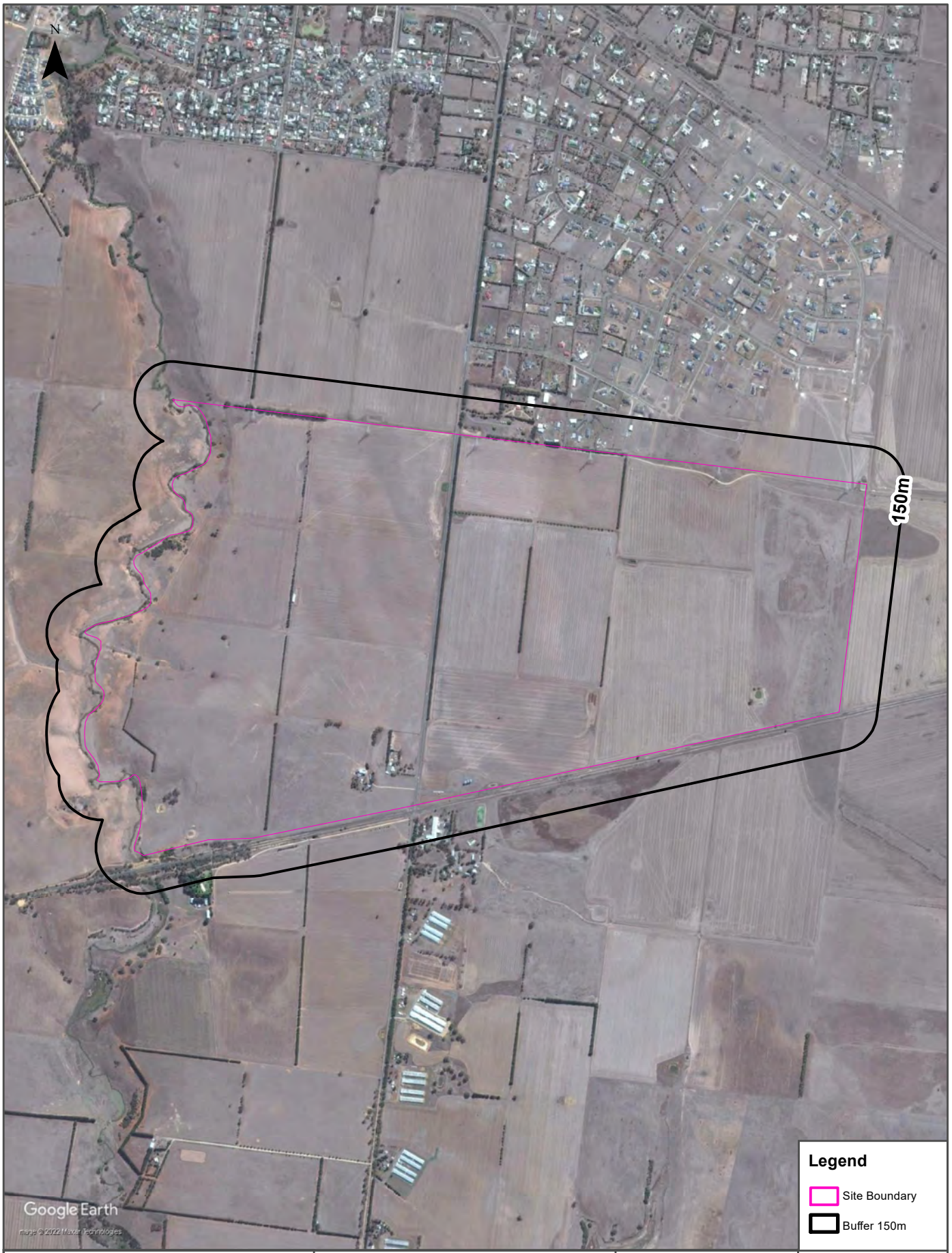
Legend

- Site Boundary
- Buffer 150m

Scale:	Data Source Aerial Imagery:	Coordinate System:	Date: 31 May 2022
0 240 480 960 720 Meters	© Aerometrex Pty Ltd	GDA 1994 MGA Zone 55	

Aerial Imagery 2016

Bannockburn South-East Precinct, Bannockburn, VIC 3331 (Part 2)



Scale: 0 240 480 720 960 Meters

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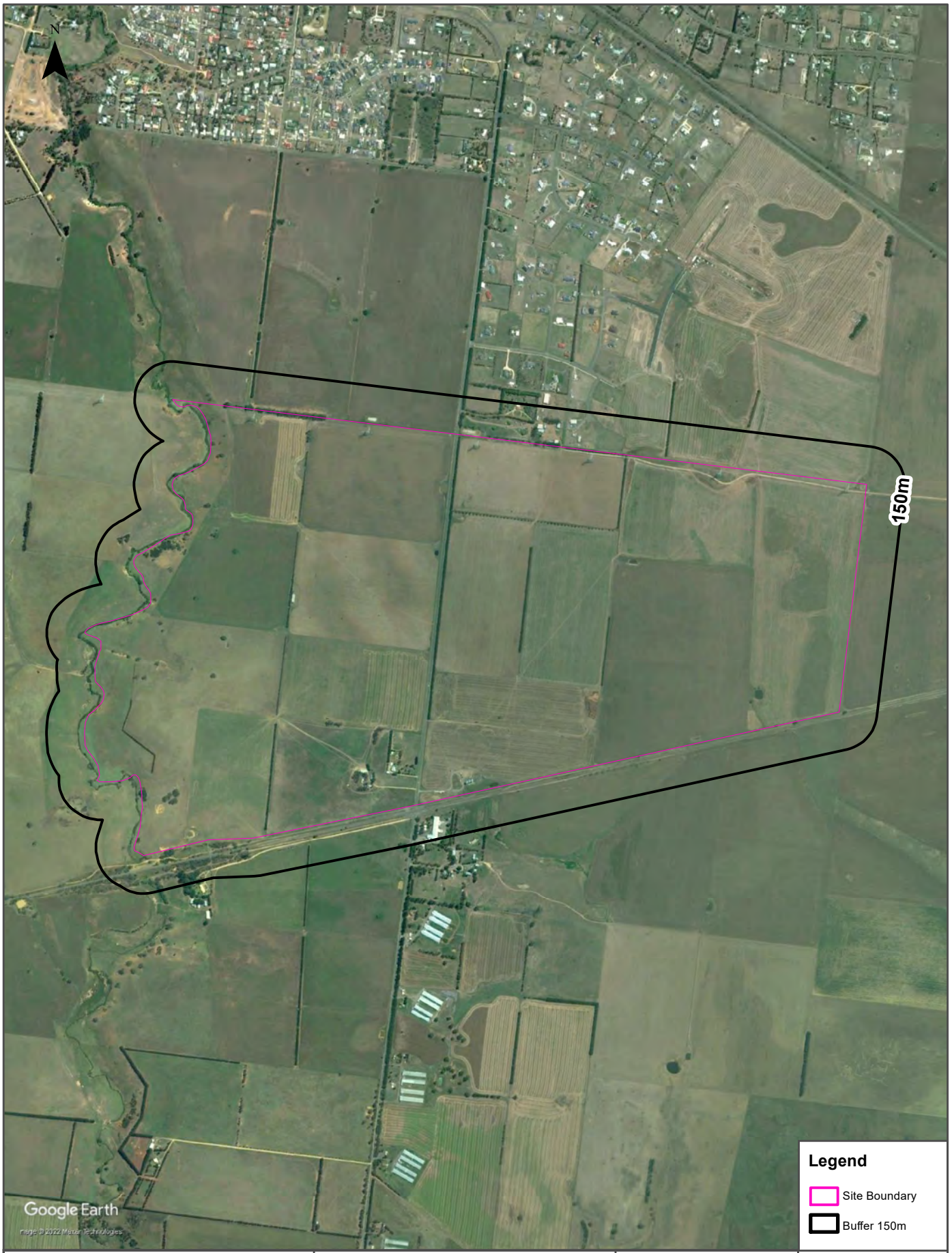
Coordinate System: GDA 1994 MGA Zone 55

Date: 30 May, 2022

Aerial Imagery 2011

Bannockburn South-East Precinct, Bannockburn, VIC 3331 (Part 2)



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Meters

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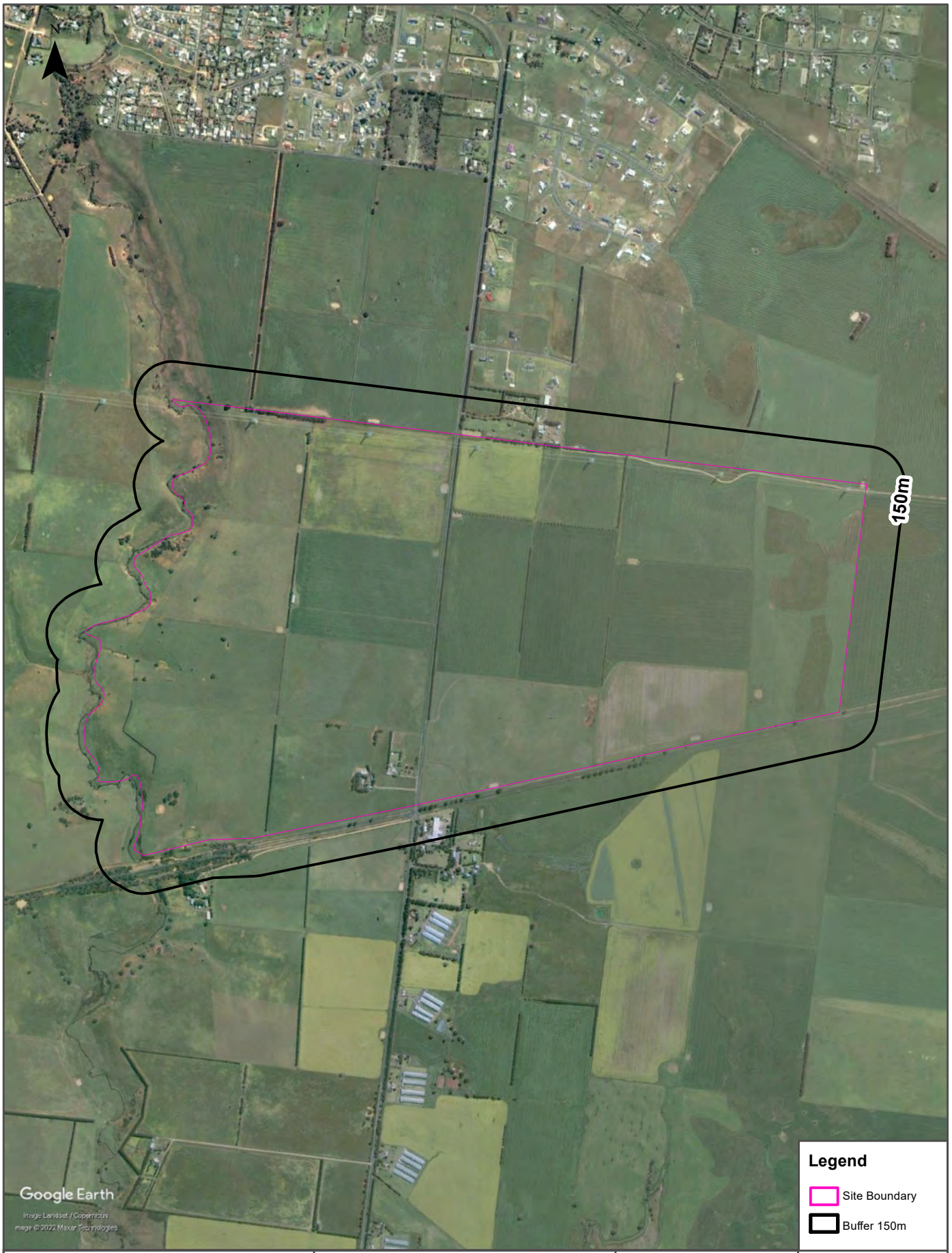
Aerial Imagery 2005

Bannockburn South-East Precinct, Bannockburn, VIC 3331 (Part 2)



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Coordinate System:
GDA 1994 MGA Zone 55

Date: 30 May, 2022

Aerial Imagery 1990

Bannockburn South-East Precinct, Bannockburn, VIC 3331 (Part 2)

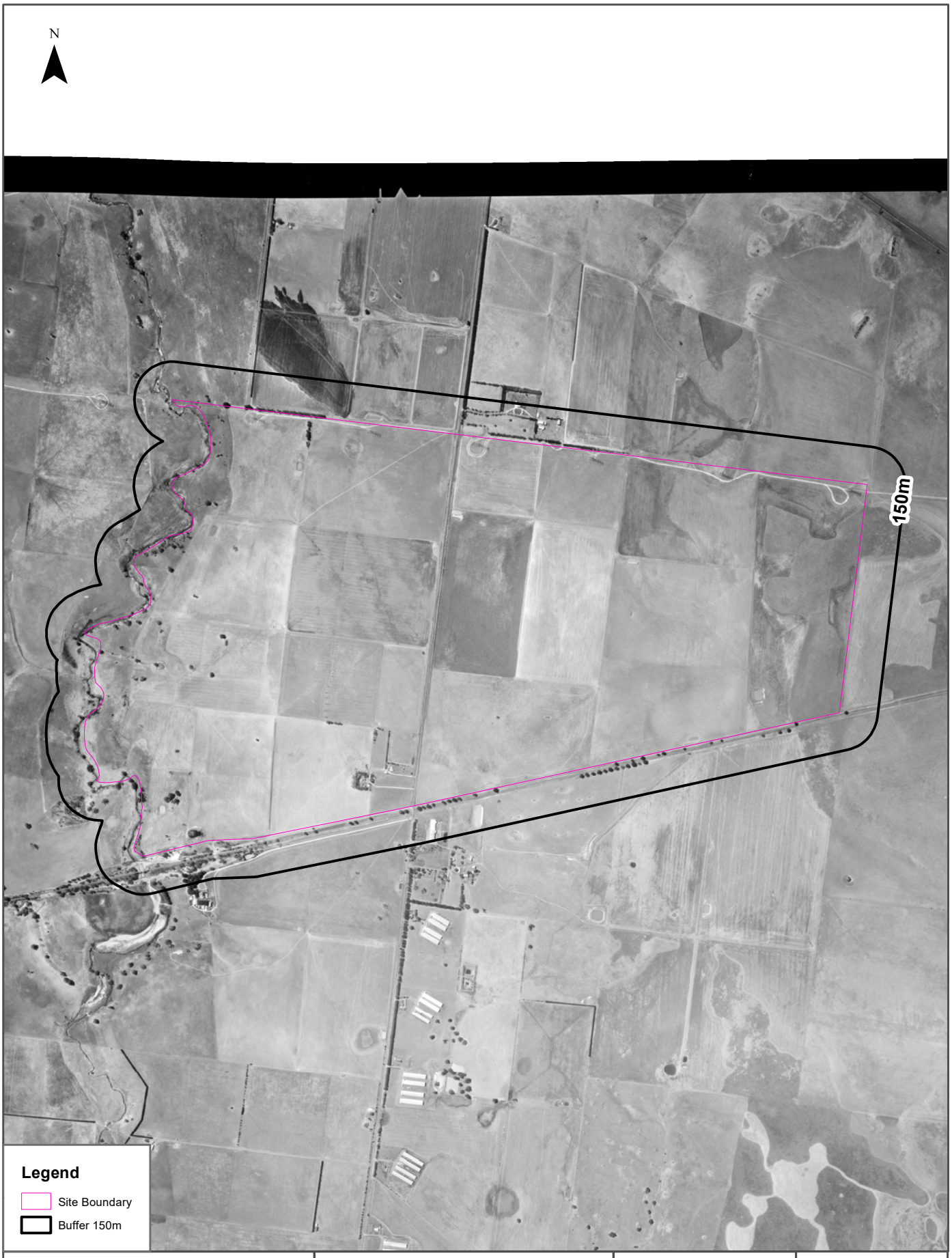
Legend

- Site Boundary
- Buffer 150m

Scale:	Data Source Aerial Imagery:	Coordinate System:	Date: 30 May, 2022
0 240 480 720 960 Meters	© Department of Environment, Land, Water and Planning (Vicmap Topographic Mapping Program)	GDA 1994 MGA Zone 55	

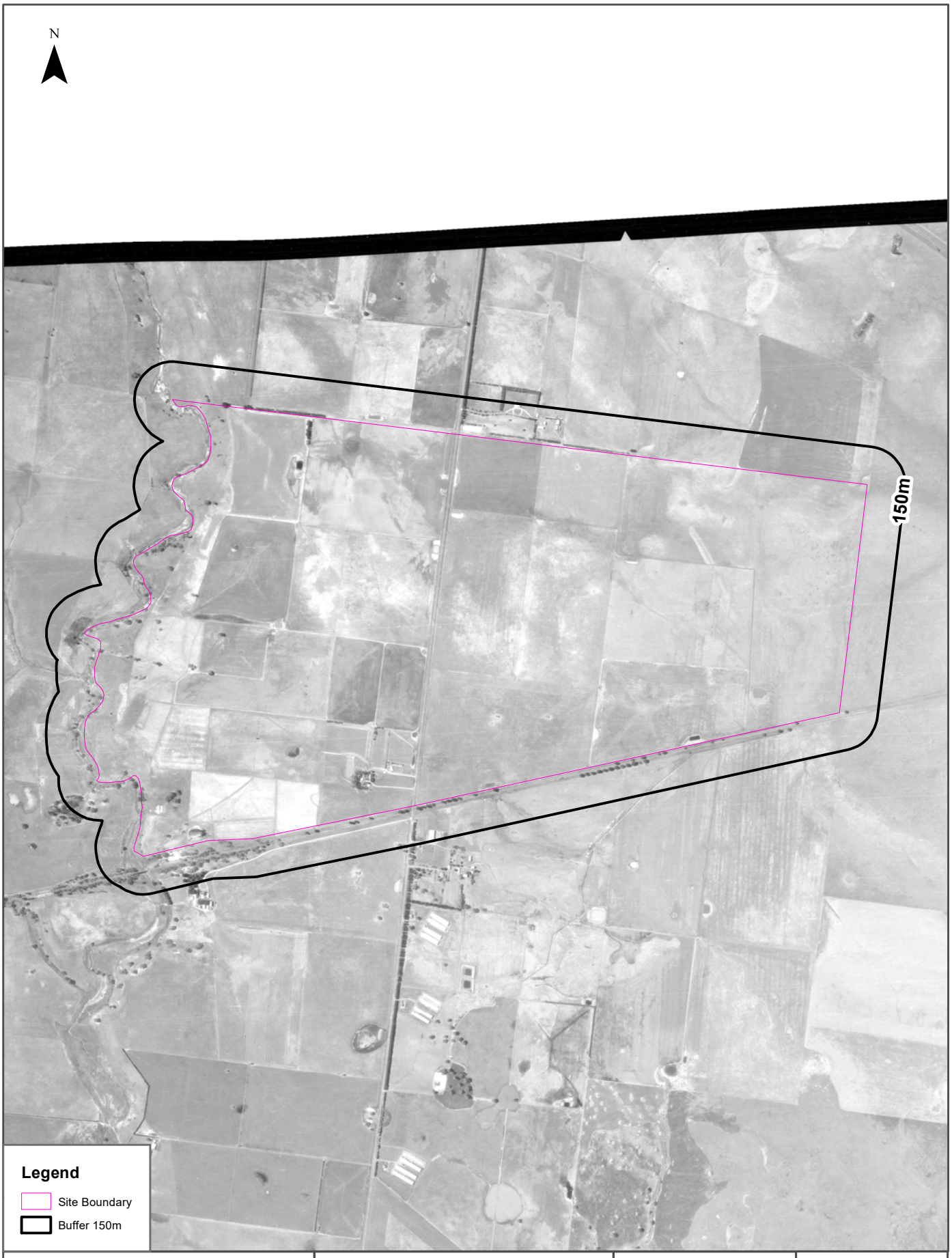
Aerial Imagery 1984

Bannockburn South-East Precinct, Bannockburn, VIC 3331 (Part 2)



Aerial Imagery 1978

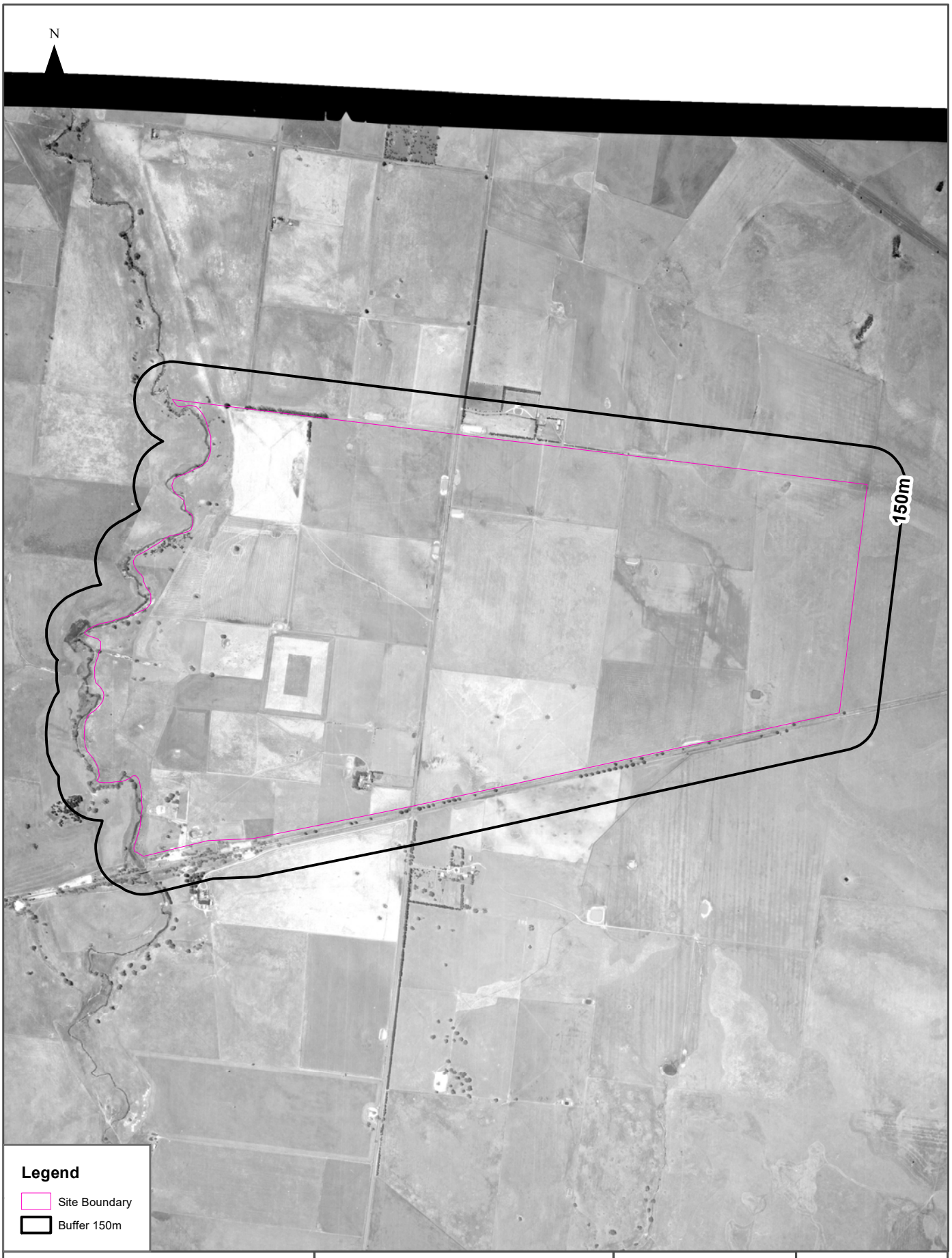
Bannockburn South-East Precinct, Bannockburn, VIC 3331 (Part 2)



Scale: 0 240 480 Meters 720 960	Data Source Aerial Imagery: © Department of Environment, Land, Water and Planning (Vicmap Topographic Mapping Program)	Coordinate System: GDA 1994 MGA Zone 55	Date: 30 May, 2022

Aerial Imagery 1970

Bannockburn South-East Precinct, Bannockburn, VIC 3331 (Part 2)

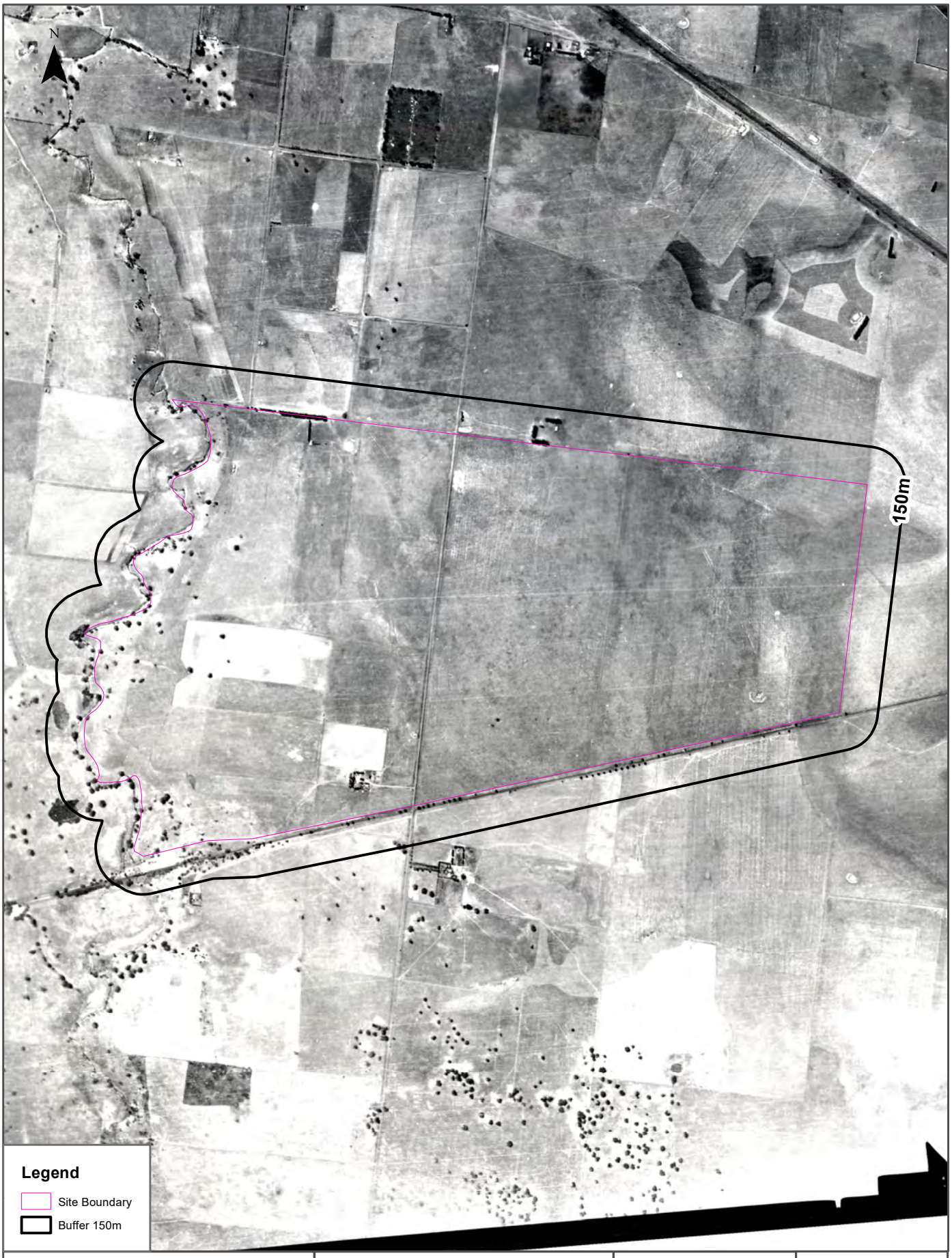


Aerial Imagery 1966

Bannockburn South-East Precinct, Bannockburn, VIC 3331 (Part 2)

Aerial Imagery 1947

Bannockburn South-East Precinct, Bannockburn, VIC 3331 (Part 2)



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