Victorian Planning Authority

January 2025

Sodic/Dispersive Soils Testing and Assessment

Bannockburn South-East Precinct

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Sodic/Dispersive Soils Testing and Assessment
Bannockburn South-East Precinct

Victorian Planning Authority

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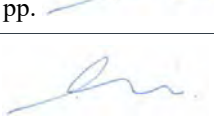
Approved by:	Shane Giliam	14 January 2025	

WSP acknowledges that every project we work on takes place on First Peoples lands.
We recognise Aboriginal and Torres Strait Islander Peoples as the first scientists and engineers and pay our respects to Elders past and present.

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EXECUTIVE SUMMARY

WSP Australia Pty Limited (WSP) was engaged by the Victorian Planning Authority (VPA) on March 2024 to undertake a sodic/dispersive soils assessment at the Bannockburn South-East Precinct, at Bannockburn, Victoria (precinct/site). The works were commissioned because it had been identified that soils in the precinct were likely to be sodic and that an erosion risk may exist. This assessment includes sensitivities and potential risks of sodic/dispersive soils for future development, and outlines the associated implications for land use planning and potential management recommendations.

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 Creek to the west. Currently the precinct comprises a mix of grazing/cropping land with minor rural residential.

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 Creek, which is incised by approximately 10 metres from the surrounding surface.

The scope of works undertaken to achieve the assessment objectives comprised: a site walkover and preparation of a Sampling Analysis and Quality Plan (SAQP) to identify areas of concern; stakeholder engagement prior to soil investigation works to allow input on the SAQP and to finalise borehole locations; soil investigation works to assess for sodic/dispersive soils from 20 soil boreholes; and analysis and interpretation of soil testing (including this report).

The drilling of bores was conducted with a 4WD-vehicle mounted drill rig on 22 and 23 May 2024. Mechanical drilling was undertaken from surface using solid-auger drilling. At five locations adjacent to Bruce Creek only surface samples were taken due to sensitivities regarding cultural heritage considerations.

Evidence of the presence of sodic/dispersive soils were observed primarily along Bruce Creek during the site walkover on 25 March 2024. This consisted of erosion along the steep escarpment leading down toward Bruce Creek.

Intrusive soil investigation works showed that the soil consisted predominantly of a sand layer overlying basaltic clay which at times was overlying a gravel layer, located approximately at depths between 1.0 and 2.0 m.

Laboratory testing indicated predominantly “sodic” to “very strongly sodic” soils are present across the precinct, with exchangeable sodium percentage ranging from <0.2% – 34.2%.

Emerson aggregate testing by the laboratory indicated that primarily the soils show slaking with some dispersion (“Class 2”) and slaking with complete dispersion (“Class 1”). Broadly the surface samples are less dispersive across all soil profiles with three samples showing no slaking with swelling (“Class 7”) and five samples showed slaking and dispersion only when remoulded (“Class 3”), whereas the subsurface samples predominantly showed either slaking with some dispersion (“Class 2”) or slaking with complete dispersion (“Class 1”).

Results for salinity are quite varied, ranging from “non-saline” to “moderately saline”. In general, the upper 0.1 m were classed as “non-saline”, with the salinity increasing with depth. The pH results were highly variable, ranging from “strongly acidic” to “very strongly alkaline”. The “very strongly alkaline” results were typically found at depths of 0.5 m or greater. These were associated with samples showing very high sodicity, and likely it is the very high sodium content of those subsoils that are leading to the very alkaline conditions at depth.

In summary, both published data and the intrusive assessment undertaken strongly indicate that sodic and dispersive soils are present at Bannockburn South-East Precinct. Therefore, the precinct is vulnerable to dispersion, which poses a soil erosion risk and subsequently may result in soil loss, damage potential future buildings and infrastructure and cause a reduction in water quality for nearby waterways including Bruce Creek if not managed appropriately. The steeper slopes along Bruce Creek are particularly vulnerable to soil erosion with the added risk of exposure of subsurface soils which have been shown to be more sodic and dispersive than the topsoil.

While there is variability in the level of sodicity in the surface soils, at a precinct scale, the erosion risk is considered to be predominantly driven by the slope, being consistently low to medium risk across the flatter area of the precinct, but high risk along the escarpment to Bruce Creek.

Due to the surface soils being relatively less dispersive and sodic than the subsurface soils, the main concern should be to minimise ground disturbance to minimise exposure of subsurface soils, and to maintain topsoil and vegetative cover as much as possible. This is particularly important along Bruce Creek due to the higher risk present along the steep escarpments and the potential exposure of subsurface soils.

Management recommendations presented in the report include:

1 **Precinct scale erosion controls:** The erosion control component of the precinct structure plan (PSP) should include the following precinct scale considerations:

   - **Waterway and gully management:** Ongoing control and maintenance steep slopes (particularly waterways/gullies and easement where infrastructure is built) along the escarpment of Bruce Creek, and outside of the precinct boundary may be implemented at the **statutory level** by applying an environmental overlay (or equivalent) to require/encourage particular management in these areas (e.g. enforce riparian land management controls, minimise disturbance to native vegetation, etc.). At the **strategic level**, this land could be incorporated into the precinct to enable developer control over greenspace development/establishment.
   - **Topsoil and urban run-off management:** To minimise the risks during and post construction, **strategic controls** may include implementing water sensitive urban design in the precinct, and **statutory controls** may include specifying conservative stormwater retention and discharge parameters to reduce impact to waterways to acceptable levels (as established by others).
   - **Greenspace and buffer zones:** The **strategic** implementation of a green corridor along the escarpment has the dual benefit of improving land management (e.g. vegetation, minimise disturbance of topsoils) along the highest risk part of the precinct, and preventing the construction of housing too close to the edge of the plateau (risk of future structural damage).

2 **Development or Lot scale erosion controls:** To control erosion risk during and post development, the Precinct Structure Plan (PSP) may specify strategic controls for development or require proponents to demonstrate appropriate controls are in place as part of the planning application process (statutory conditions). **Strategic** controls may include staging release of development and consideration of development that is sympathetic to the landform (as may be applicable in particular areas). **Statutory** conditions could include a requirement for 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). It is further recommended that intrusive (physical) soil investigations be required where constructions are deemed medium to high risk (e.g. along the escarpment, steep slopes, or where infrastructure is likely to be placed within the Sandringham Sandstone) to confirm soil conditions and erosion risk and allow for site specific recommendations to be made. A general condition for a minimum thickness of topsoil to be retained or placed in exposed soil areas (nature strips, yards, parks, etc.) would help to control erosion risk in the longer term, through providing a suitable depth of growing media to support vegetation growth and cover.

1 PURPOSE AND OBJECTIVES

WSP Australia Pty Limited (WSP) was engaged by the Victorian Planning Authority (VPA) in March 2024 to undertake a sodic/dispersive soils 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 works was to assist VPA in understanding the presence and extent of sodic/dispersive soils within the precinct to inform the precinct structure planning being undertaken and provide options for their management in a property development context.

1.2 OBJECTIVES

The objectives of the works were to:

- Investigate sodic/dispersive soils within the Bannockburn South-East Precinct, map their position, identify their severity and the associated implications for planned future development.
- Assist and inform the VPA precinct structure planning for the Bannockburn South-East Precinct.

2 BACKGROUND

2.1 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 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 2.1 below.

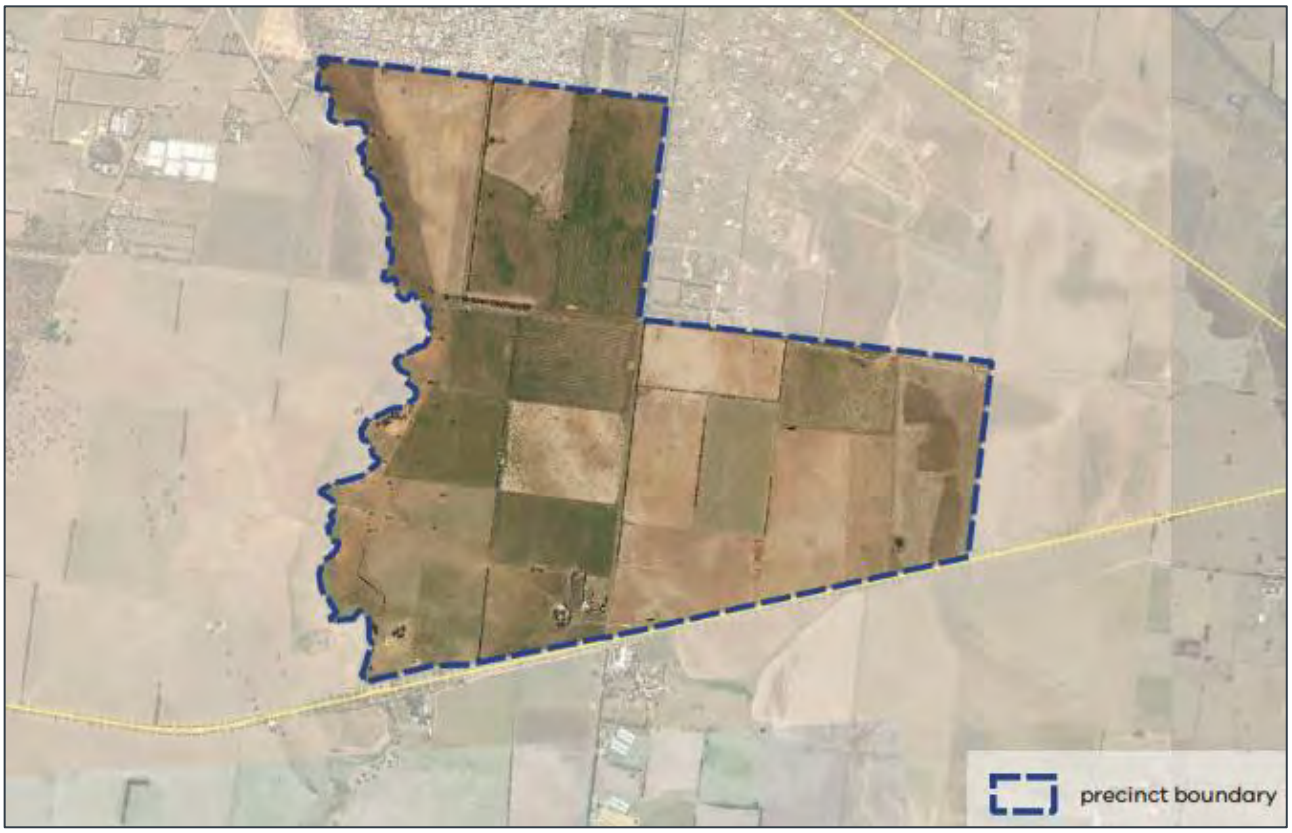

Figure 2.1 Precinct boundary – Bannockburn South-East precinct (source: VPA)

WSP understands the Bannockburn South-East precinct is proposed to provide for the anticipated 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 Creek, which is incised by approximately 10 metres from the surrounding surface.

The precinct location and layout are presented in further detail in Figure 1, Appendix A, while pertinent details are provided in Table 2.1 and Table 2.2 (following page).

Table 2.1 Pertinent Site Details

ASPECT	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 Creek (west).
Lot and Plan number	— Lot 1, TP134465 (part) — Crown land, SPI 2011\PP3225 (Bruce Creek) — Road reserve (unnamed), SPI 35A~21\PP3225 — Lots 1 and 2, TP134466 — 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 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.):	N: 5782520, E: 252690 Projection: MGA Zone 55 (GDA2020)
Site Zoning	Farming Zone (FZ).
Overlays	Environmental Significance Overlay – Schedule 2 (ESO) – protection of Bruce Creek, Land Subject to Inundation Overlay (LSIO) – Bruce Creek, Salinity Management Overlay (SMO) – small area of Bruce Creek.

Table 2.2 Surrounding land-use

ASPECT		DETAILS
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 Creek, followed by agricultural (predominantly cropping/grazing, and greenhouses, and including farmhouses), followed by bushland reserve.

2.2 SODIC AND DISPERSIVE SOILS IN VICTORIA

2.2.1 DEFINITION OF SODIC AND DISPERSIVE SOILS

Sodic soils are soils that containing a relatively high proportion of exchangeable sodium. Sodium is a cation (positive ion) that is held loosely to the surfaces of clay particles in the soil. Other cations in the soil include calcium, magnesium, potassium and hydrogen. However, when sodium makes up more than about 6% of all these loosely bound or "exchangeable" cations, soil structural problems begin to occur, and the soil is said to be sodic.

The amount of sodium as a proportion of all exchangeable cations is the main measure of sodicity, is termed the exchangeable sodium percentage (ESP) and can be calculated from chemical tests of the soils cation exchange capacity (CEC).

As the sodium is generally associated with clay particles sodic soils are often clay dominated but may also be sandy with some clay present in the matrix (clayey or gravelly sands).

Sodic soil may have the following problems (Hazelton and Murphy, 2007):

- Very severe surface crusting
- Very low infiltration and hydraulic conductivity
- Very hard, dense subsoils
- High susceptibility to severe gully erosion, and
- High susceptibility to tunnel erosion

The reason these soils are highly susceptible to erosion is that when a sodic soil encounters 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 2.2 Tunnel erosion of dispersive clay subsoil, https://vro.agriculture.vic.gov.au (accessed 2024) (Left), and construction of dam in dispersive soils leading to rill erosion, https://nre.tas.gov.au (accessed 2024) (Right)

2.2.2 SODICITY AND DISPERSION TESTING AND CLASSIFICATIONS

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) as shown below.

Table 2.3 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 according to the above definitions. Evidence of historical dispersion at a site may be identified in the field while dispersion potential can also be assessed using field and/or laboratory physical tests.

A common physical 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 based on their coherence in water. This empirical test was developed by Emerson in 1967, and updated in 2002 (Emerson, 2002). Figure 2.3 (following page) shows the Emerson classes. Emerson Class 1 and 2 are considered susceptible to tunnel erosion (DPIPWE, 2009).

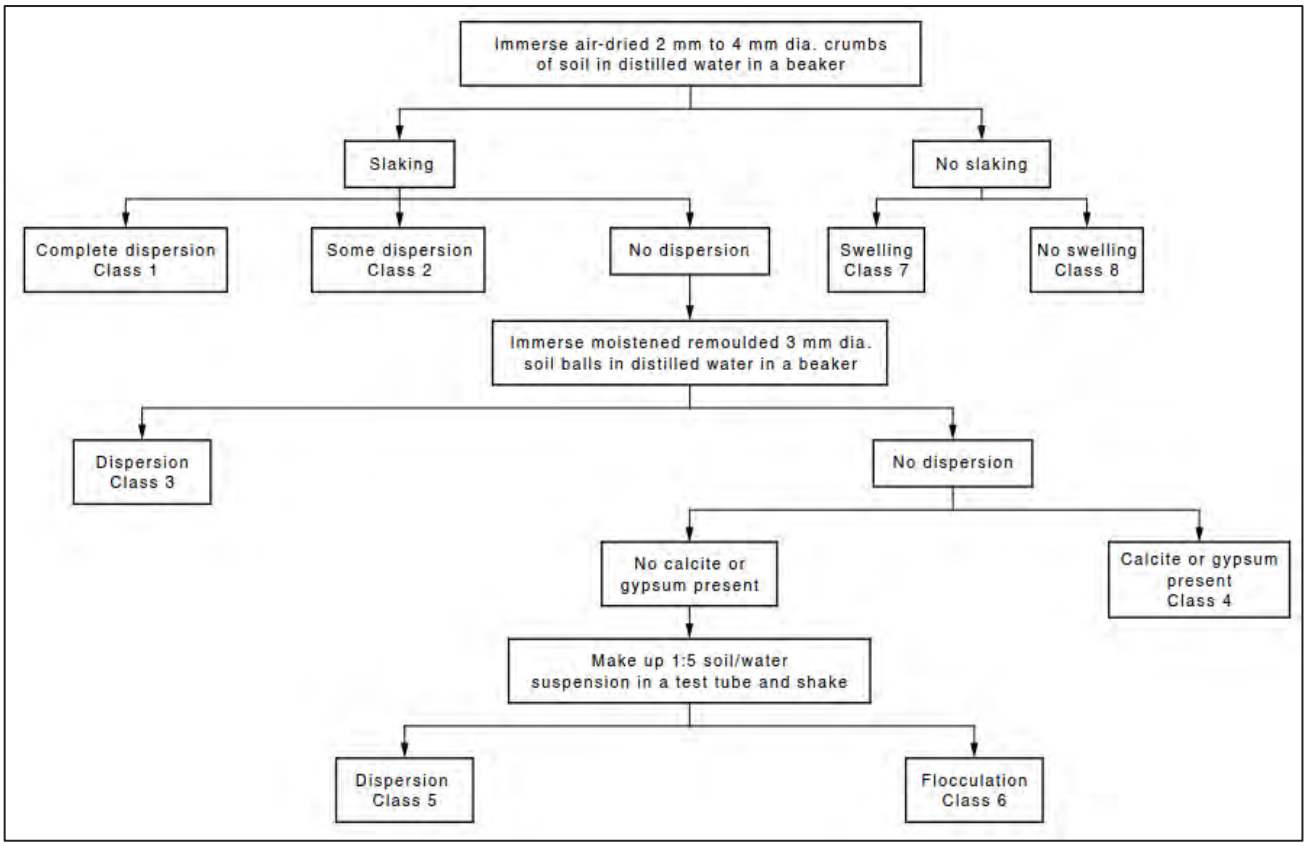

Figure 2.3 Emerson soil classes (extract from AS1289.3.8.9:2017)

2.2.3 SOIL pH AND ELECTRICAL CONDUCTIVITY (EC)

This study included limited soil pH and EC measurements. These two parameters, whilst not directly relating to the erosion potential (at least within the range likely to be present in this environment), do have a role in the soils ability to support plant growth. Soil pH relates to the acidity or alkalinity of the soil, while the EC is an indirect measure of the salinity of the soil.

Sodic or dispersive soils have an increased risk of erosion. This can be mitigated or reduced through vegetation physically stabilising the soil. Plant growth, however, is often limited when the pH is either acidic or alkaline, and plant growth is also increasingly limited as the salt content in the soil rises.

In this study we discuss the pH in relation to the risk to plant growth using the following categories.

Table 2.4 Soil pH ranges and limitations (adapted from Hazelton and Murphy, 2007 Table 5.1)

Rating	pH (1:5 in water) [1]	Notes
Very strongly alkaline	>9	At high pHs iron and zinc may become deficient.
Strongly alkaline	9.0-8.5	
Moderately alkaline	8.4-7.9	
Mildly alkaline	7.8-7.4	Range in which most crops can be grown.
Neutral	7.3-6.6	
Slightly acidic	6.5-6.1	
Moderately acidic	6.0-5.6	
Strongly acidic	5.5-5.1	

Rating	pH (1:5 in water) (1)	Notes
Very strongly acidic	5.0-4.2	At low pH heavy metals and aluminium become more mobile/toxic.

Salinity ranges based on saturated extract method (i.e., electrical conductivity at 25C) are presented in Table D1, Appendix D. The laboratory reports salinity in units of µS/cm by the 1:5 soil to water method. These values are converted to EC_E (dS/m) by multiplication of an empirical conversion factor, depending on the soil texture, as presented in Table 5.33 of Hazelton and Murphy, 2007. The applied conversion factors and resulting EC_E values for tested samples are provided in Table D1 in Appendix D.

Table 2.5 Soil assessment criteria – Salinity (from Table 5.32 of Hazelton and Murphy, 2007)

Rating	EC_E (ds/m)	Effect on Plants
Non saline	<2	Salinity effects are mostly negligible
Slightly saline	2-4	Yields of sensitive crops are affected
Moderately saline	4-8	Yields of many crops are affected
Highly saline	8-16	Only tolerant crops yield satisfactorily
Extremely saline	>16	Only very tolerant crops yield satisfactorily

2.3 MANAGEMENT OF SODIC AND DISPERSIVE SOILS

2.3.1 SODIC AND DISPERSIVE SOILS IN VICTORIA

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 mapping of sodic soils in Victoria (https://vro.agriculture.vic.gov.au, accessed 2024).

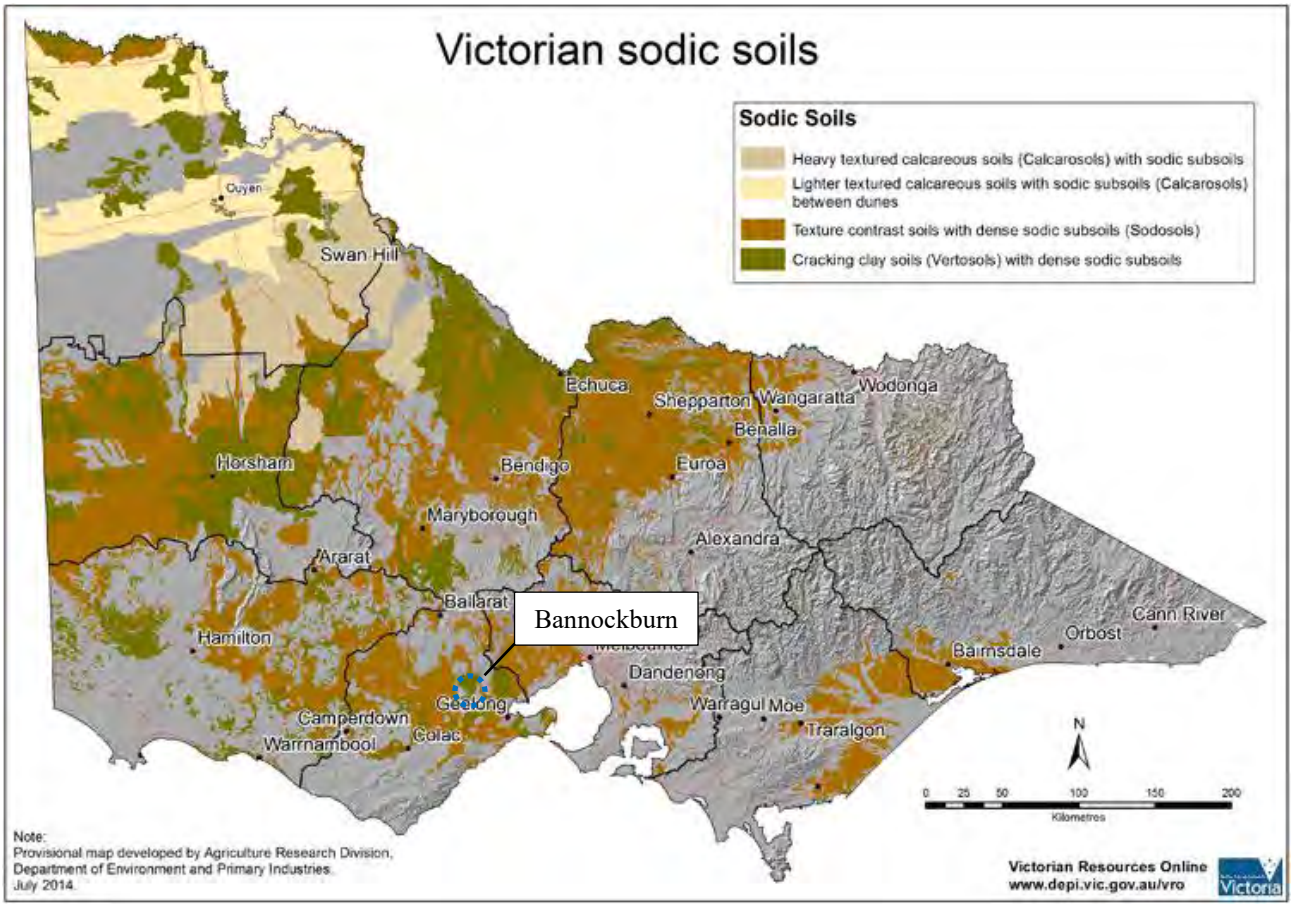

Figure 2.4 State of Victoria (Agriculture Victoria), 2014

As can be seen sodicity is particularly a problem in lower rainfall, alluvial deposits in the north-west of the state. However, localised sodic soils are also found across the state, predominantly also in alluvial deposits. In the vicinity of Bannockburn, the incidence of sodicity is sporadic and generally exists in texture contrast soils with dense sodic subsoils.

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. Port Phillip and Westernport 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. Moorabool Planning scheme, Clause 12.03-1S), and in particular, *"Limiting earthworks in proximity to waterway systems to minimise alterations to geomorphology, natural drainage, natural flows and water quality"*. One control that can be applied is an Erosion Management Overlay (EMO) to ensure this protection through the planning process.

2.3.2 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 because 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 encounter 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 and gully 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 impacts).

2.4 LITERATURE REVIEW

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

2.4.1 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 shown in Figure 2.5 (following page).

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 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).

Figure 2.5 Study Area included in the Meinhardt project (Meinhardt, 2020)

2.4.1.1 SOIL AND GEOLOGY

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

Meinhardt anticipated the underlying geology of the Study Area as consisting 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 Creek and Miocene to Holocene (0.01 million years old) aged Newer Volcanics basalt flows (overlying the BlackRock Sandstone) to the east of Bruce Creek. Areas of Miocene-aged Gellibrand Marl and Quaternary-aged (0 to 2.58 million years old) alluvium were interpreted to be present around Bruce Creek (incised) (Meinhardt, 2020).

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

2.4.1.2 HYDROLOGY AND HYDROGEOLOGY

The Study Area is located within the Corangamite Catchment. Meinhardt considered surface water runoff from the Study Area was likely to flow towards Bruce Creek which runs from north to south in the centre of the Study Area. Bruce 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 Creek (Meinhardt, 2020). It was 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 in Meinhardt (2020) at depth range 0 – 16 metres, and with a salinity range of 1,000 mg/L to 3,500 mg/L (approximately Segment B under the Environmental Reference Standard).

2.4.1.3 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 contained homesteads and associated equipment sheds.

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

Meinhardt 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 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 2.2.2.2.

2.4.1.4 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 Properties located at north-west (Property 11 and Property 20) (outside of the Bannockburn South-East Precinct) were rated as having 'Medium' potential for contamination. 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 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 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).

2.4.2 WSP (2022) SOIL DESKTOP ASSESSMENT – SODIC/DISPERSIVE SOILS AND CONTAMINATION RISK

WSP was engaged by the Victorian Planning Authority (VPA) in 2022 to undertake a preliminary, desk-based assessment of sodic/dispersive soils and contamination risk at the Bannockburn South-East Precinct, at Bannockburn, Victoria. The assessment of soil erosion and contamination risk was based on a literature review and a site visit.

2.4.2.1 GEOLOGY AND SOILS

WSP (2022) reported the Precinct being underlain by Newer Volcanics to the east of Bruce Creek, Sandringham Sandstone (formerly Black Rock Sandstone) to the west of the creek, and Gellibrand Marl (formerly Newport Silt and Fyansford Clay) along Bruce Creek. Inspection of the surface geology and cuttings at the Precinct during the site visit confirmed the published geology, with the order of deposition from most recent to oldest being Newer Volcanics, Sandringham Sandstone, and lastly the Gellibrand Marl.

The desktop study also described the distribution of soil groups using the Corangamite Land Resource Assessment (CLRA). The resource assessment show Soil Group 13 west of Bruce Creek, aligning with the underlying Sandringham Sandstone, and Soil Group 39 east of Bruce Creek, aligning with the underlying Newer Volcanics. The CLRA describes the 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.

2.4.2.2 SUMMARY OF SITE HISTORY

Historically, based on historical aerial photographic images the precinct was noted to comprise a mix grazing/cropping land with minor rural residential. A series of chicken breeder farms was identified immediately south of the precinct along Burnside Road.

Furthermore, the Bannockburn region was reported to comprise land predominantly used for agricultural uses (cropping and livestock) with the majority of region zoned for farming. Residential and commercial developments were present to the immediate north, northeast, and east of the Study Area, which make up the township of Bannockburn.

2.4.2.3 SOIL EROSION RISK

The topography was described across the Study Area as relatively flat, with areas around Bruce Creek having the lowest elevation with land sloping downwards from the west and east.

The soil erosion risk assessment was based on the potential impacts to soil stability and erosion associated with proposed development in both the short (i.e., during construction) and long term (i.e. topsoil conservation, channel instability) and impacts to buildings, infrastructure, and waterways. Within the context of soil erosion, buildings and infrastructure, and water quality the risks were all deemed Low – Medium risk under the adopted risk scheme. The level of risk was determined based on likelihood and the level of effort required to inform precinct planning activities and to mitigate the risk.

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

Particular mention was made regarding excavations and cuttings in the study area east and west of Bruce Creek which may encounter dispersive soils (nominally 500 m buffer) which was determined through the desktop study and site observations.

2.4.3 PRELIMINARY LANDFORM FOR DEVELOPMENT

Two Place Based Plans (PBP) currently inform future land use in Bannockburn South-East. Version 1 is from June 2023 and has been reviewed, and Version 2 from March 2024 which is a work in progress that is still subject to change regarding matters such as cultural heritage, biodiversity, transport, and drainage.

The plans outline preliminary locations for stormwater infrastructure such as retarding basins, drainage, and waterways, and buildings and structures including schools, parks, and government facilities.

2.5 STAKEHOLDER INPUT

A stakeholder engagement meeting was held on Monday 6 May 2024. This meeting comprised notification of planned assessment works so that stakeholders had an opportunity to provide comments/input.

Through discussions with Unearthed Heritage, the sampling approach and location of some boreholes were changed. The sampling approach was changed to surface level sampling along Bruce Creek due to sensitivities regarding cultural heritage considerations. Additionally, three boreholes were moved due to the locations being with a registered Aboriginal Artefact Scatter place.

2.6 SITE INSPECTION OBSERVATIONS

A site inspection was completed by WSP on 25 March 2024. Site observations were mainly focussed on evidence of sodic/dispersive soils (refer also to the attached photolog in Appendix B). In summary:

- Canola/cereal cropping was observed across the majority of the Precinct.
- Grazing land was present in the western, southwestern and eastern portions of the Precinct.
- Cleared grazing land was adjacent to Bruce Creek which was noted to be incised into the landscape.
- A sparse covering of basalt boulders and cobbles was observed across the majority of the site, increasing in frequency at flow margins.
- Various farm dams were located within the properties.
- The western boundary of the precinct adjoined Bruce Creek, with a steep escarpment leading down to the creek.
- Erosion along parts of the steep escarpment was observed, particularly along the northwestern and southwestern corners of the precinct.
- The southern boundary of the precinct was delineated by the freight railway.
- At the time of the inspection, Bruce Creek was observed to be generally clear, with low turbidity.

Figure 2.6 Photo of erosion down the escarpment leading to Bruce Creek

3 SCOPE OF WORKS

3.1 GENERAL SCOPE OF WORKS

The scope proposed to achieve the assessment objectives identified in Section 1.2 included undertaking the following:

1. Literature review of relevant literature, including the Land Capability Assessment (Meinhardt, 2020) and the Soil Desktop Assessment – Sodic/Dispersive Soils and Contamination Risk (WSP, 2022).
2. Site visit of the precinct to observe potential areas of sodic/dispersive soils.
3. Preparation of a Sampling Analysis and Quality Plan (SAQP) to identify any additional areas of concern.
4. Stakeholder engagement prior to soil investigation works to allow input on the SAQP and borehole locations.
5. Soil investigation works to assess for sodic/dispersive soils from 20 boreholes.
6. Analysis and interpretation of soil testing and provision of a report detailing the findings.

Note: Due to sensitivities relating to cultural heritage considerations (i.e., the presence of mapped Aboriginal heritage artefacts along Bruce Creek), soil assessment was restricted along Bruce Creek (refer to Stakeholder Engagement – Section 2.5). This meant that the scope of works undertaken were outside of the mapped heritage area along Bruce Creek alignment at the site. This meant that some features of interest could not be physically sampled, and the assessment is limited to physical description of observed features.

3.2 SOIL ASSESSMENT

To assess the sodic/dispersive nature of the soils at the site the following works was completed:

- Drilling of 20 soil bores, with emphasis on sampling along Bruce Creek (within cultural heritage constraints), to maximum depth of 3.45 m.
- Placement of boreholes to allow for meaningful stratigraphic cross sections to be drawn, and including targeting where practicable:
  - Areas with potential for medium-high risk erosion risk (i.e., along Bruce Creek escarpment).
  - Areas where drainage assets and constructed waterways are proposed.
- Collection of representative soil samples from each borehole for laboratory analysis.

The soil sampling locations are shown in Figure 2, Appendix A.

Soil samples were submitted to NATA accredited laboratories for analysis. The number of soil samples submitted, and specific laboratory analysis are summarised in Table 3.1.

Table 3.1 Laboratory analysis

Matrix	No. of Primary Samples	Duplicates/Triplicates	Analysis
Soil	30	1	Emerson Class Dispersion Testing
	30	1	Exchangeable Sodium Percentage (ESP)
	30	-	Electrical Conductivity (EC)
	30	-	pH

4 METHODOLOGY

4.1 SOIL INVESTIGATION

The general soil sampling methodology for sodic/dispersive soil sampling is summarised in Table 4.1.

Table 4.1 Soil investigation methodology

Item	Description
Service location	Proposed soil borehole locations was cleared prior to commencement by an appropriately qualified service locator, where these locations were within 50 m of a mapped or suspected underground service. A WSP ground penetration permit was prepared for the precinct, noting that the majority of the precinct is greenfield (undeveloped).
Drilling of boreholes	The drilling of bores was conducted with a 4WD-mounted drill rig. The top 1.5 m of each borehole was cleared in accordance with WSP policy prior to the commencement of mechanical drilling, where a service was mapped or suspected to be present within 10 metres. Mechanical drilling was undertaken from surface using solid-auger drilling techniques at all other locations.
Logging	Stratigraphy and other relevant information observed during drilling (e.g. the soil texture, colour, inclusions and any other in situ testing, and any groundwater inflow or levels) was recorded by appropriately qualified personnel. Logging of soils was undertaken with reference to AS1726-1993 Geotechnical Site Investigations and the Unified Soil Classification System (USCS).
Soil sampling	An allowance was made for up to two soil samples per soil bore (or equivalent) to be analysed. Soil samples were generally collected at the following depth intervals: — 0.1 mBGL — 0.5 mBGL — 1.0 mBGL and every 1.0 m interval thereafter to the proposed maximum depth — where there was a change in lithology Samples were kept in laboratory supplied jars and resealable bags and kept in an ice cooled esky while on-site and when in transit to the laboratory.
Quality control	Duplicate and triplicate samples were collected in the field at the rate of 1 in 20 primary samples for analysis by the primary laboratories.

Item	Description
Laboratory analysis	**Assessment Rationale** — Soil sample locations were arranged in approximate east-west transects[1], with a GPS used to maximise accuracy and efficiency, The transects were designed to characterise initial soil risk across the precinct. — While soil types were inferred to change laterally across the precinct, vertical profiles were also anticipated. Laboratory analysis was conducted on select soil bores representative of encountered conditions in each soil type and undertaking detailed assessment at these locations, targeting typical soil horizons and changes/boundaries in soil types. Consideration was also given to topography and landform as identified in site walkover and SAQP. **Nominated Laboratory** Australian Laboratory Services (ALS) Group was the nominated primary laboratory, and Eurofins Pty Ltd and Ground Science Pty Ltd the nominated secondary laboratory (for QA/QC purposes). Both laboratories are accredited by the National Associated of Testing Authorities (NATA).

[1]Initially, the proposal dictated samples be arranged in a grid formation, however through the preparation of the SAQP this was changed to east-west transects to better inform soil erosion risk, based on outcome of the desktop assessment and precinct walkover.

4.2 SOIL EROSION RISK SCHEME

The following methodology, adopted in WSP (2022), and outlined below was used to assess the soil erosion risk to the precinct and to inform precinct planning activities.

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 risk level has been allocated based on likelihood of erosion, 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 main stormwater, sewer and potable water infrastructure, which is constructed as linear infrastructure, especially if this is built close to waterways and associated steeper landforms (banks) (e.g. entering the precinct along a hillside).

The risk level has also largely been allocated by considering slope, with the highest risk being observed on slopes greater than 15%. See Figure 7 and 8 in Appendix A for the terrain slope map and the high-risk slope map respectively. The high-risk slope map includes a 100 m buffer around the high-risk zone, which ensures the appropriate scrutiny is applied during construction for soil erosion risk. The focus of slope when considering soil erosion risk is partly due to the landscape and exposure of subsurface soils largely dictating the erosion vulnerability at Bannockburn South-East. (see Section 5.3).

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; and
- 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 4.2 below, has been used in this assessment.

Table 4.2 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) Likely to affect all aspects of development, including residential dwelling construction.	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) Likely to significantly affect stormwater management infrastructure design/maintenance.	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) Likely to affect some aspects of stormwater management infrastructure design/maintenance.	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) Unlikely to affect aspects of stormwater management infrastructure design.	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

5 RESULTS AND DISCUSSION

5.1 FIELD OBSERVATIONS

As noted in Section 2.6, evidence of the presence of sodic/dispersive soils was observed primarily along Bruce Creek during the site walkover on 25 March 2024. This consisted of erosion along the steep escarpment leading down toward Bruce Creek.

Intrusive soil investigation works showed that the soil consisted predominantly of a sand layer overlying basaltic clay which at times was overlying a gravel layer, located approximately at depths between 1.0 and 2.0 m.

The soil profiles were separated broadly by geological unit, and the potential for dispersivity and sodicity were investigated further by laboratory analysis.

Note due to heritage constraints, samples along Bruce Creek (BH01, BH02, BH05, BH08, BH11) comprised of only surface samples with limited interpretation of subsurface conditions (see Figure 2, Appendix A).

5.1.1 GEOLOGICAL OBSERVATIONS

Site observations of geological units onsite were predominantly consistent with published geology as reported in WSP (2022). The majority of the site comprises of Newer Volcanics with the underlying Gellibrand Marl being present along Bruce Creek.

5.1.2 SOIL PROFILES

Two soil profiles were identified in the desktop study by WSP (2022), which included the grey, brown mottled texture contrast soils, aligning with the underlying Sandringham Sandstone, west of Bruce Creek and the black, grey, brown, and red cracking calcareous clays, aligning with the Newer Volcanics, east of Bruce Creek. Field observations largely concurred with the reported soil profiles with differences along Bruce Creek, where the unit underlying the Newer Volcanics was observed which likely represents the Gellibrand Marl, and stoney basalt outcrops being observed along the eastern boundary of the site.

5.2 SUBSURFACE CONDITIONS

Intrusive soil sampling was undertaken between 22 and 23 May 2024 (refer to Section 4.1). A total of 20 boreholes were advanced across the precinct. Detailed logs of soil boreholes were recorded and are presented in Appendix C.

The following field observations were made during soil sampling:

- The soil bores were predominantly located within grassed areas, mostly within paddocks and among agricultural infrastructure.
- No (imported) fill soils were observed at any of the boreholes.
- Predominantly, the soil profile consisted of a sandy layer overlying basaltic clay which at times was overlying a calcareous gravel layer, located approximately at depths between 1.0 and 2.0 m.

The boreholes were grouped into three distinct soil profiles:

- Boreholes which had a soil profile comprising primarily of basaltic clay. These boreholes also included those which some calcareous gravels at depth.
- Boreholes which had a soil profile with no basaltic clay at depth. BH09 and BH10 were included in this group, but due to shallow refusal on basalt or similar, interpretations on deeper soil strata are unable to be made.

— Boreholes located along Bruce Creek which included the five locations where only surface samples were taken.

See Table 5.1 for a summary of soils profiles encountered at Bannockburn South-East.

Table 5.1 Soil profiles encountered in the Bannockburn South-East Precinct

Profile Code	Locations mapped to soil profile (n=20)
Basaltic clay	BH03, BH04, BH06, BH07, BH12, BH13, BH15, BH16, BH17, BH18, BH19, BH20
Basaltic clay absent at depth	BH14, BH09, BH10
Surface samples along Bruce Creek	BH01, BH02, BH05, BH08, BH11

The boreholes were arranged in approximate east-west transects to identify the distinct soil profiles and any lateral changes in soil type. Selection of soil samples submitted for laboratory analysis was prioritised with the aim of assessing in detail each distinct soil profile (including obtaining a vertical profile through the soil) instead of pursuing the analysis of soil samples from all boreholes advanced across the precinct.

Thirty-one samples were selected for laboratory analysis with results discussed in Section 5.3. Soil samples submitted for analysis were selected based on the following:

— Areas with potential for medium-high erosion risk (i.e., along Bruce Creek escarpment); and

— Areas where drainage assets and constructed waterways are proposed.

5.3 LABORATORY ANALYTICAL RESULTS

5.3.1 SODICITY AND DISPERSIVITY

Samples were taken from soil bore locations as shown in Figure 2, Appendix A, from a range of depths from 0.1 – 2.0 m, and selected samples were submitted from laboratory testing for ESP and Emerson Class testing. Where only surface samples were taken (i.e., along Bruce Creek) comments are unable to be made on deeper soil strata.

Table 5.2 below summarises samples submitted and results of Emerson Class and exchangeable sodium percentage (ESP).

Table 5.2 Summary of sample results – Emerson Class and Exchangeable Sodium Percentage (ESP)

Soil profile	Boreholes	No. of samples	Surface (<0.5 mBGL)[1]		Subsurface	
			Emerson Class	ESP (%)	Emerson Class	ESP (%)
Basaltic clay	BH04, BH07, BH12, BH15, BH16, BH17, BH20	22	2 (n=3), 3 (n=3), 7 (n=1)	5.7 – 12.8	1 (n=8), 2 (n=7)	11.3 – 34.2
Basaltic clay absent at depth	BH14	4	2 (n=1)	2.0	1 (n=2), 3 (n=1)	5.1 – 24.5

[1] Surface topsoils were generally <0.4 m thick across the precinct. It is expected that the soil profile may be as thin as <0.2 m in places. For the purposes of this assessment, samples from the upper 0.4 m of the soil profile are considered "surface soils".

Soil profile	Boreholes	No. of samples	Surface (<0.5 mBGL)[1]		Subsurface	
			Emerson Class	ESP (%)	Emerson Class	ESP (%)
Surface samples along Bruce Creek	BH01, BH02, BH05, BH08, BH11	5	3 (n=2), 7 (n=2)	<0.2 – 3.9	-	-

The laboratory testing shows predominantly sodic to very strongly sodic soils are present across the precinct, with exchangeable sodium percentage ranging from <0.2% – 34.2%.

In terms of Emerson Class the laboratory results indicate that primarily the soils show slaking with some dispersion (2) and slaking with complete dispersion (1). Broadly the surface samples are less dispersive across all soil profiles with three samples showing no slaking with swelling (7) and five samples showed slaking and dispersion only when remoulded (3), whereas the subsurface samples predominantly showed either slaking with some dispersion (2) or slaking with complete dispersion (1).

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. It is also important to understand that the risk of erosion relates to the soils dispersivity, and in addition to landscape features such as the slope, catchment, and vegetative cover.

At Bannockburn South-East, surface soils are less dispersive and sodic across the precinct than subsurface soils, which show relatively high dispersivity and sodicity levels. Therefore, the main concern should be to minimise ground disturbance to minimise exposure of the more sodic and dispersive subsurface soils, and to maintain topsoil and vegetative cover as much as possible. This is particularly important along Bruce Creek due to the higher risk present along the steep escarpments and the potential exposure of subsurface soils.

The heat map outlining erosion risk (Figure 9, Appendix A) was prepared based on slope, with the highest risk being observed on slopes greater than 15%, as the landscape and exposure of subsurface soils largely dictates the erosion vulnerability at Bannockburn South-East. The erosion risk is assessed to be the same for soil erosion, buildings and infrastructure, and water quality based on our understanding of the site and taking into account the limitations of the investigation (see Section 6.4).

In summary, while there is variability in the level of sodicity in the surface soils, at a precinct scale, the erosion risk is considered to be the consistent (i.e., low to medium) across areas of low relief (i.e. the flatter areas of the precinct), and controlled predominantly by slope (i.e., high risk along the escarpment/Bruce Creek).

5.3.2 SALINITY AND ELECTRICAL CONDUCTIVITY

Results for salinity are quite varied, ranging from non-saline to moderately saline. In general, the upper 0.1 m were classed as non-saline, with the salinity increasing with depth. The results for the topsoil indicate that salinity in that layer is unlikely to be a significant limitation to plant growth, however the higher salinity at depth could (among other soil factors) could be limiting. This result highlights that retention of topsoil is important for stabilisation of the sodic subsoils.

The pH results were highly variable, ranging from strongly acidic to very strongly alkaline. The very strongly alkaline results were typically found at depths of 0.5 m or greater. These were associated with samples showing very high sodicity, and likely it is the very high sodium content of those subsoils that are leading to the very alkaline conditions at depth. Generally, the topsoils, including those collected in proximity to Bruce Creek, showed near neutral pH, which would be favourable for plant growth.

Where removal of the topsoil is necessary during development, controls to prevent erosion will be imperative and the developer should ensure any unpaved areas in the completed development are provided non-saline, and near neutral pH topsoil to ensure good plant establishment to stabilise the underlying sodic subsoils.

5.4 QUALITY ASSURANCE AND QUALITY CONTROL TESTING

A summary of the quality assurance and quality control (QA/QC) protocols followed for the collection and analysis of soil and groundwater samples be obtained as part of the assessment program are presented in Table 5.3 below. A review of QA methods and QC data was undertaken and indicated appropriate data reliability for the purpose of this assessment.

Table 5.3 Summary of QA/QC Protocols

Item	Description	Comment
General	Work was undertaken following WSP's standard field procedures, which are based on industry accepted standard practice.	General protocols were considered compliant
Equipment decontamination	Sampling equipment was decontaminated after the collection of each soil sample by washing with Decon 90® detergent followed by water-only decontamination.	Cross-contamination risk was considered to be low based on soil sampling technique and analytes (non-contamination related). Given that the assessment did not consider analytes indicative of contamination, the analysis of rinsate blanks and trip blanks as indicators of cross contamination was not considered warranted.
Sample handling	All soil samples was stored in chilled eskies after collection and during transport by courier to the laboratory. Prior to delivery to the laboratory, a chain of custody form (COC) was completed. The COC was signed and accompanied the samples. Upon receipt by the laboratory, COC and/or samples receipt notices was returned to confirm the receipt, condition of samples and specified analysis.	Protocols for handling samples were considered compliant
Transport	Samples was stored in a cooled esky and transported to the laboratory. To ensure the integrity of the samples from collection to receipt by the analytical laboratory, soil samples were sent by courier to the laboratories under a 'chain of custody', describing sample preservation, and transport duration.	Protocols for sample transportation were considered compliant
QC samples	Field QC samples was analysed as follows: — intra-laboratory duplicate samples at a rate of 1 in 20 primary samples — inter-laboratory duplicate samples at a rate of 1 in 20 primary samples. Laboratory QC sample analysis primarily included duplicate analysis and method blanks. No surrogate spike recovery analysis was required due to absence of contaminant analysis.	A summary of field duplicate sample RPD results is presented as Table D2 in Appendix D. A summary of laboratory QC data is presented in laboratory reports in Appendix E. Both field and laboratory QC data quality was considered acceptable for the purpose of this assessment.

Item	Description	Comment
Laboratory analysis	The laboratories selected met WSP in-house compliance requirements under the respective ISO 9001 QA programs. They performed their own internal QA/QC programs and used appropriate detection limits for the analyses to be undertaken.	NATA accredited laboratory analytical certificates are presented in Appendix E. Laboratory QA/QC was considered acceptable for this assessment.
Holding times	Holding times are the maximum permissible elapsed time in days from the collection of the sample to its extraction and/or analysis. All extraction and analyses should be completed within standard guidelines.	No holding time exceedances were reported.
QA/QC conclusion	The QA/QC indicators should either all comply with the required standards or show no variations that would have a significant effect on the quality of the data.	Natural sample heterogeneity was considered to account for any variations observed (i.e. elevated RPD results). Field QC indicated no variations considered to have an impact on the findings of the investigation were detected. Laboratory QC data was considered acceptable for the purpose of this assessment. A review of QA methods and QC data was undertaken and indicated appropriate data reliability for the purpose of this assessment.

6 CONCLUSIONS AND RECOMMENDATIONS

6.1 EXTENT OF SODIC/DISPERSIVE SOILS AT THE PRECINCT

Based on the range of exchangeable sodium percentage (predominantly strongly to very strongly sodic) and dispersivity results (predominantly Emerson Class 1 and 2) reported across the depth profile (up to 2.0 mBGL) and across the precinct, it should be assumed that all soils within the precinct are potentially dispersive and strongly (to very strongly) sodic.

Laboratory testing suggests that surface soils are less dispersive and sodic than subsurface soils and within the context of precinct planning activities, any management measure should aim to minimise surface disturbance and maintain topsoil and vegetation cover across the precinct as far as practicable, to minimise exposure of the higher risk subsurface soils.

The measures should also recognise the higher risk of soil erosion present along the steep escarpments at Bruce Creek.

In summary, while there is variability in the level of sodicity in the surface soils, at a precinct scale, the erosion risk is considered to be the consistently low to medium across the flatter area of the precinct, increasing to high risk along the steep escarpment of Bruce Creek.

6.2 VULNERABILITY ASSESSMENT

Both published data and this intrusive assessment strongly suggests that sodic and dispersive soils are present at Bannockburn South-East Precinct. Therefore, the precinct is vulnerable to dispersion, which poses a significant soil erosion risk if not managed appropriately. Erosion, in addition to the loss of soil, has the potential to damage future buildings and infrastructure through undermining these structures, and to cause a reduction in water quality for downstream waterways including Bruce Creek.

The steeper slopes along Bruce Creek are particularly vulnerable to soil erosion as overland flows of water will have increased energy (faster flows) and with the added risk of exposure of subsurface soils on the scarp which have been shown to be more sodic and dispersive.

Figure 9, Appendix A, present a precinct scale indication of soil erosion vulnerability and risk for soil erosion, buildings and infrastructure, and water quality, based largely on slope, with highest risk being observed on slopes greater than 15%. The heat maps are subject to the limitations of the investigation (see Section 6.4) but indicate areas across the precinct of higher vulnerability to soil erosion.

Therefore, precinct planning should incorporate management and mitigation measures for sodic/dispersive soils as outlined in Section 6.3.

6.3 MANAGEMENT RECOMMENDATIONS

6.3.1 PRECINCT SCALE

Waterway and gully management: Ongoing control and maintenance of steep slopes (particularly waterways/gullies and easements where infrastructure is built) along the escarpment of Bruce Creek, and outside of the precinct boundary may be implemented at the **statutory level** by applying an environmental overlay (or equivalent) to require/encourage particular management in these areas (e.g. enforce riparian land management controls, minimise disturbance to native

vegetation, etc.). At the **strategic level**, this land could be incorporated into the precinct to enable developer control over greenspace development/establishment.

Topsoil and urban run-off management: To minimise the risks during and post construction, **strategic controls** may include implementing water sensitive urban design in the precinct, and **statutory controls** may include specifying conservative stormwater retention and discharge parameters to reduce impact to waterways to acceptable levels (as established by others).

Greenspace and buffer zones: The **strategic** implementation of a green corridor along the escarpment has the dual benefit of improving land management (e.g. vegetation, minimise disturbance of topsoils) along the highest risk part of the precinct, and preventing the construction of housing too close to the edge of the plateau (risk of future structural damage).

6.3.2 DEVELOPMENT OR LOT SCALE

Erosion risk is highest in steeply sloping areas adjacent to Bruce Creek and maintaining topsoil and vegetative cover should be a priority.

Planning permit conditions may be considered for stages/tranches of the development to ensure appropriate consideration of soil erosion risk management, protection of topsoil and water quality, and appropriate design of engineered structures that take into consideration erosion risks and impact on future maintenance requirements.

Strategic controls may include:

- Staging release of development to reduce compounding risks arising from multiple development fronts across the precinct resulting in large areas of exposed soils and disturbed vegetation. This may be mitigated by careful construction controls informed by intrusive testing and appropriate runoff and sedimentation control.
- Consideration of development that is sympathetic to the landform – avoiding terracing, minimising cut-and-fill, selection of less intrusive foundation systems – particularly directly adjacent to Bruce Creek, on steep slopes, and within the Sandringham Sandstone, the unit underlying the Newer Volcanics.

Statutory conditions may include:

- Requirement for 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).
- Requirement for intrusive (physical) soil investigations where constructions are deemed medium to high risk (e.g. along Bruce Creek, steep slopes, or where infrastructure is likely to be placed within the Sandringham Sandstone) to confirm soil conditions and erosion risk (driven by dispersivity).
- A general condition for a minimum thickness of topsoil to be retained or placed in exposed soil areas (nature strips, yards, parks, etc.) to provide a suitable depth of growing media to support vegetation growth and cover.

6.4 ASSUMPTIONS AND LIMITATIONS OF THE ASSESSMENT

The sodic soils assessment has been conducted at a Precinct scale and due to sensitivities relating to cultural heritage considerations (i.e., the presence of mapped Aboriginal heritage artefacts along Bruce Creek), soil assessment was restricted along Bruce Creek. Additionally, the following assumption and limitations apply to this assessment.

- **Variability:** It should be noted that the presence and severity of dispersive soils can vary over short distances and so the testing represents the information at the sampling location and depth only – care should be taken if inferring dispersive potential of soils in between sampling locations.

- **Limited investigation depth:** No testing has been done below 2 metres. Additional testing may be required if excavation is proposed at a depth greater than 2.0 m.
- **Subsurface conditions are time dependent:** Subsurface conditions may be modified by changing natural forces or man-made influences. Our investigation report is based on conditions which existed at the time of subsurface exploration.
- **Limited number of investigation locations:** In making an assessment of a site from a limited number of boreholes or test pits there is the possibility that variations may occur between test locations. Site exploration identifies specific subsurface conditions only at those points from which samples have been taken. The risk that variations will not be detected can be reduced by increasing the frequency of test locations. The investigation program undertaken is a professional estimate of the scope of investigation required to provide a general profile of the subsurface conditions. The data derived from the site investigation program and subsequent laboratory testing has been extrapolated across the site to form an inferred geological model and an opinion is rendered about overall subsurface conditions and their likely behaviour with regard to the proposed development. The actual conditions at the site might differ from those inferred to exist, however no subsurface exploration program, no matter how comprehensive, can reveal all subsurface details and anomalies.

6.5 RECOMMENDATIONS FOR FURTHER ASSESSMENT

WSP has undertaken an assessment to support VPA's Strategic Planning for the Bannockburn South-East Precinct. It was considered that the assessment undertaken regarding sodic and dispersive soils was sufficient to support Strategic Planning Requirements. Further, the assessment is considered sufficient to assist the Statutory Planning Authority's decision making regarding future Statutory Planning approvals, including the conditions attached to the issuance of Planning Permits to manage sodic and dispersive soils.

Further assessments may be warranted, during future development phases, by the proponent, for advising on specific risks where certain activities have the potential to disturb deeper soils or are required in identified higher risk areas of the site (e.g., construction of sediment basins, installation of sewage or stormwater infrastructure, etc.), as outlined as part of Management Recommendations (Section 6.3 above).

7 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 26 April 2022 and written agreement with the Client (Agreement) dated 7 November 2022 (Ref No: COR\22\5961).

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.

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Appendix A
FIGURES

PS211655
Bannockburn Sodic Soils Assessment

Figure 1
Site Location Plan

Legend

- Road
- Watercourse
- Precinct Boundary
- Waterbody
- Parcel Boundary

0 250 500
Meters

Coordinate system: GDA2020 MGA Zone 55

Scale ratio correct when printed at A3

1:11,000 Date: 3/07/2024

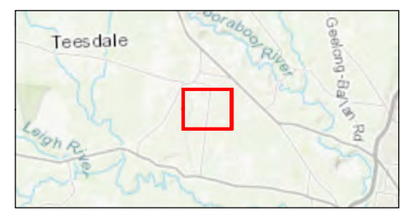
Data sources: DELWP, Geoscience Australia

PS211655
Bannockburn Sodic Soils Assessment

Figure 2
Borehole location plan

Legend

- Road
- Watercourse
- Precinct Boundary
- Waterbody
- Parcel Boundary
- Borehole location



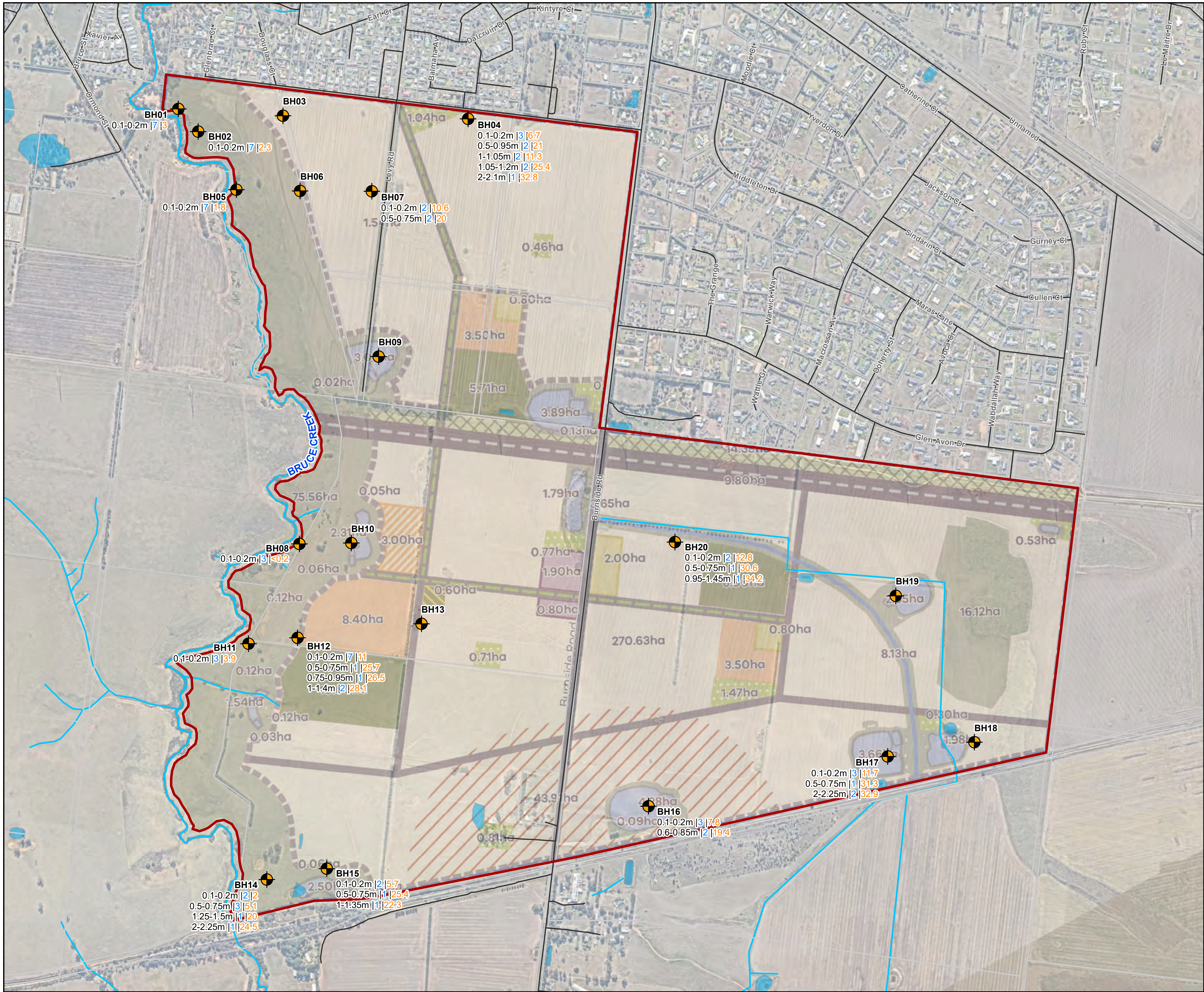
0 250 500
Meters

Coordinate system: GDA2020 MGA Zone 55

Scale ratio correct when printed at A3

1:11,000 Date: 3/07/2024

Data sources: DELWP, Geoscience Australia



BRUCE CREEK
Burnside Rd
BH01
0.1-0.2m |7 |3
BH02
0.1-0.2m |7 |2.3
BH03
BH04
0.1-0.2m |3 |6.7
0.5-0.95m |2 |21
1-1.05m |2 |11.3
1.05-1.2m |2 |25.4
2-2.1m |1 |32.8
BH05
0.1-0.2m |7 |1.8
BH06
BH07
0.1-0.2m |2 |10.6
0.5-0.75m |2 |20
BH08
0.1-0.2m |3 |<0.2
BH09
BH10
BH11
0.1-0.2m |3 |3.9
BH12
0.1-0.2m |7 |11
0.5-0.75m |1 |25.7
0.75-0.95m |1 |26.5
1-1.4m |2 |28.1
BH13
BH14
0.1-0.2m |2 |2
0.5-0.75m |3 |5.1
1.25-1.5m |1 |20
2-2.25m |1 |24.5
BH15
0.1-0.2m |2 |5.7
0.5-0.75m |1 |25.4
1-1.35m |1 |22.3
BH16
0.1-0.2m |3 |7.8
0.6-0.85m |2 |19.4
BH17
0.1-0.2m |3 |11.7
0.5-0.75m |1 |31.3
2-2.25m |2 |32.9
BH18
BH19
BH20
0.1-0.2m |2 |12.8
0.5-0.75m |1 |30.6
0.95-1.45m |1 |34.2
270.63ha
16.12ha
8.40ha

PS211655
Bannockburn Sodic Soils Assessment

Figure 3
Borehole Location Plan with Draft PBP and Analytical Results

Legend

- Precinct Boundary
- Parcel Boundary
- Waterbody
- Road
- Watercourse
- Borehole

Location ID
Sample Depth | Emerson Class (Class #) | ESP (%)

Coordinate system: GDA2020 MGA Zone 55
Scale ratio correct when printed at A3
1:12,500 Date: 11/11/2024
Data sources: DELWP, Geoscience Australia

PS211655
Bannockburn Sodic Soils Assessment

Figure 4
DTM map

Legend

- Road
- Watercourse
- Precinct Boundary
- Waterbody
- Parcel Boundary
- Borehole location

DEM

Elevation (m)

- 0 - 10
- 10 - 20
- 20 - 30
- 30 - 40
- 40 - 50
- 50 - 60
- 60 - 70
- 70 - 80
- 80 - 90
- 90 - 100
- >100

Coordinate system: GDA2020 MGA Zone 55

Scale ratio correct when printed at A3

1:11,200 Date: 3/07/2024

Data sources: DELWP, Geoscience Australia

PS211655
Bannockburn Sodic Soils Assessment

Figure 5
Geology

Legend

- Road
- Watercourse
- Precinct Boundary
- Waterbody
- Parcel Boundary
- Borehole location

Gelogical Unit

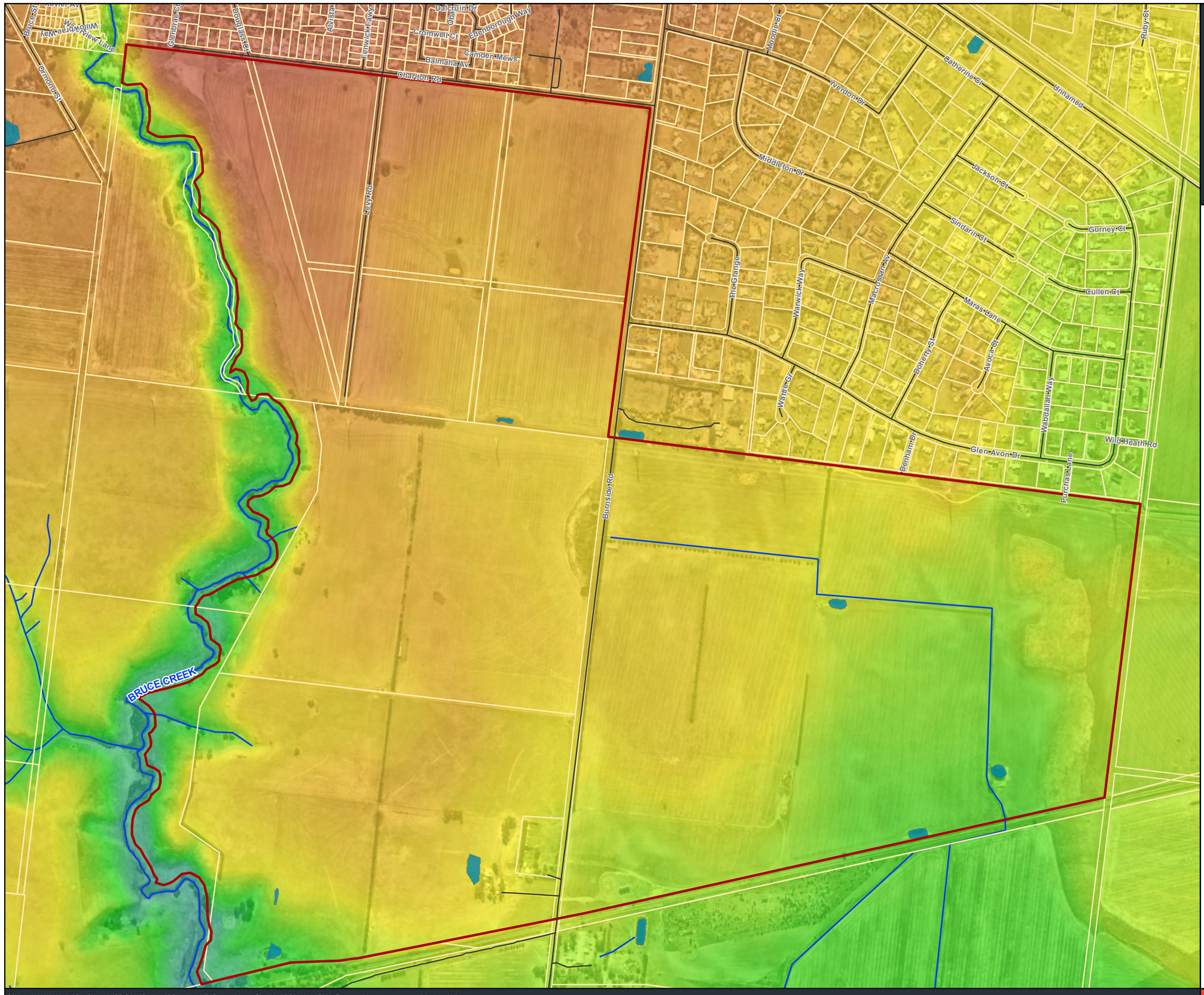
- Black Rock Sandstone (Nbb): generic
- Gellibrand Marl (Ntg): Gellibrand Marl in Torquay Group
- Newer Volcanic Group - basalt flows (Neo): generic
- alluvium(Qa1): generic

Coordinate system: GDA2020 MGA Zone 55

Scale ratio correct when printed at A3

1:11,200 Date: 3/07/2024

Data sources: DELWP, Geoscience Australia



PS211655
Bannockburn Sodic Soils Assessment

Figure 6
Topographic Map

Legend

- Road
- Watercourse
- Precinct Boundary
- Waterbodies
- Parcel Boundary

Topographic surface elevation

Value

High : 114.201

Low : 36.111

0 250 500
Meters

Coordinate system: GDA2020 MGA Zone 55

Scale ratio correct when printed at A3

1:11,200 Date: 3/07/2024

Data sources: DELWP, Geoscience Australia

PS211655
Bannockburn Sodic Soils Assessment

Figure 7
Terrain Slope Map

Legend

- Topographic Contours (1m)
- Watercourse
- Precinct Boundary
- Waterbodies
- Parcel Boundary

Slope

- 0 - 5 %
- 5 - 10 %
- 10 - 15 %
- >15 %

Coordinate system: GDA2020 MGA Zone 55

Scale ratio correct when printed at A3

1:11,200 Date: 3/07/2024

GDA 2020

Data sources: DELWP, Geoscience Australia

PS211655
Bannockburn Sodic Soils Assessment

Figure 7
High Risk Slope Map

Legend

- Topographic Contours (1m)
- Watercourse
- Precinct Boundary
- Waterbodies
- Parcel Boundary

Slope

- 0 - 5 %
- 5 - 10 %
- 10 - 15 %
- >15 %
- High risk slopes, escarpment, and steep banks (slope > 15%, plus 100 meter buffer)

Coordinate system: GDA2020 MGA Zone 55

Scale ratio correct when printed at A3

1:11,200 Date: 3/07/2024

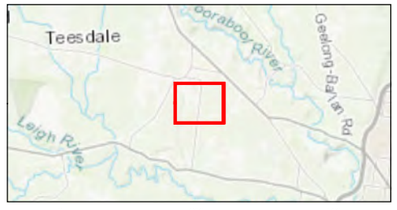
Data sources: DELWP, Geoscience Australia

PS211655
Bannockburn Sodic Soils Assessment

Figure 9
Erosion RIsk Map

Legend

- Topographic Contours (1m)
- Watercourse
- Precinct Boundary
- Waterbodies
- Low to medium risk
- High risk



0 250 500
Meters

Coordinate system: GDA2020 MGA Zone 55

Scale ratio correct when printed at A3

1:11,200 Date: 8/07/2024

Data sources: DELWP, Geoscience Australia

Appendix B
PHOTOGRAPHS

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

Client Name	**Site Location**	**Project No.**
Victorian Planning Authority	Bannockburn South-East Precinct	PS211655

Photo No.	**Date**
1	25 March 2024

Description

Bruce Creek:

Along Bruce Creek in the northwestern corner of the Precinct near Charlton Road.

Photo No.	**Date**
2	25 March 2024

Description

Bruce Creek:

Southward view of Bruce Creek from northwestern corner of the precinct near Charlton Road.

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

Client Name	**Site Location**	**Project No.**
Victorian Planning Authority	Bannockburn South-East Precinct	PS211655

Photo No.	**Date**
3	25 March 2024

Description

Bruce Creek:

Bruce Creek observed in the northwestern corner of the precinct near Charlton Road.

Photo No.	**Date**
4	25 March 2024

Description

Bruce Creek

Geological contact between the Newer Volcanic and the underlying unit (likely Sandringham Sandstone) observed along the central western boundary of the precinct leading down to Bruce Creek.

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

Client Name	**Site Location**	**Project No.**
Victorian Planning Authority	Bannockburn South-East Precinct	PS211655

Photo No.	**Date**
5	25 March 2024

Description

South of Charlton Road near Bruce Creek:

Cracking of basaltic soils close to Bruce Creek, south of Charlton Road, before the escarpment.

Photo No.	**Date**
6	25 March 2024

Description

Bruce Creek:

Rill erosion across Bruce Creek outside the project boundary. Observed along the central western boundary of the precinct.

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

Client Name	**Site Location**	**Project No.**
Victorian Planning Authority	Bannockburn South-East Precinct	PS211655

Photo No.	**Date**
7	25 March 2024

Description

Bruce Creek:

Minor erosion along escarpment down to Bruce's Creek. Observed along the central western boundary of the precinct.

Photo No.	**Date**
8	25 March 2024

Description

Bruce Creek:

Minor erosion along escarpment down to Bruce's Creek. Observed along the central western boundary of the precinct.

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

Client Name	**Site Location**	**Project No.**
Victorian Planning Authority	Bannockburn South-East Precinct	PS211655

Photo No.	**Date**
9	25 March 2024

Description

Erosion on farm dam surface in southwest corner of the site close to Bruce Creek.

Photo No.	**Date**
10	25 March 2024

Description

Erosion on cutting in ephemeral creek leading from the farm dam in Photo 9 down to Bruce Creek.

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

Client Name	**Site Location**	**Project No.**
Victorian Planning Authority	Bannockburn South-East Precinct	PS211655

Photo No.	**Date**
11	25 March 2024

Description

Farm dam located in the southwest corner of the site.

Photo No.	**Date**
12	25 March 2024

Description

Drainage pipes located in the southeast corner of the site running underneath the railway line.

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

Client Name	**Site Location**	**Project No.**
Victorian Planning Authority	Bannockburn South-East Precinct	PS211655

Photo No.	**Date**
13	25 March 2024

Description

Farm dam located in the southeast corner of the site just west of the drainage pipes.

Appendix C

BOREHOLE LOGS

BOREHOLE: BH01

Sheet 1 of 1

Project:	Bannockburn SE Sodic Soils Assessment				
Location:	Bannockburn	Coords:	251122.4 m E 5784021.9 m N MGA2020-56	Date Started:	23/5/2024
Client:	Victorian Planning Authority	Contractor:	Aquasearch Driling Drill Rig: Edson 260	Date Completed:	23/5/2024
Job No.:	PS211655	Inclination:	-90°	Logged:	HJ

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T		Not Encountered	0.0					SW	SAND: fine to medium grained, pale brown, trace low to medium plasticity silt; no odour, no staining.	D	L - MD	RESIDUAL SOIL
					0.10-0.20 m BH01							
				0.20					Hole Terminated at 0.20 m Target depth			
			0.5									
			1.0									
			1.5									
			2.0									
			2.5									
			3.0									
			3.5									

Comments

Checked

Date

BOREHOLE: BH02

Sheet 1 of 1

Project:	Bannockburn SE Sodic Soils Assessment				
Location:	Bannockburn	Coords:	251256.0 m E 5784024.5 m N MGA2020-56	Date Started:	23/5/2024
Client:	Victorian Planning Authority	Contractor:	Aquasearch Driling Drill Rig: Edson 260	Date Completed:	23/5/2024
Job No.:	PS211655	Inclination:	-90°	Logged:	HJ

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T		Not Encountered	0.0		0.10-0.20 m BH02			SW	SAND: fine to medium grained, red brown, trace low to medium plasticity clay; no odour, no staining, trace organics.	D	L - MD	RESIDUAL SOIL
				0.25					Hole Terminated at 0.25 m Refusal			
			0.5									
			1.0									
			1.5									
			2.0									
			2.5									
			3.0									
			3.5									

Comments

Checked

Date

BOREHOLE: BH03

Sheet 1 of 1

Project:	Bannockburn SE Sodic Soils Assessment				
Location:	Bannockburn	Coords:	251251.6 m E 5784182.6 m N MGA2020-56	Date Started:	22/5/2024
Client:	Victorian Planning Authority	Contractor:	Aquasearch Driling Drill Rig: Edson 260	Date Completed:	22/5/2024
Job No.:	PS211655	Inclination:	-90°	Logged:	HJ

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T		Not Encountered	0.0		0.00-0.10 m BH03			SP	Gravelly SAND: fine grained, brown, gravel is medium grained; no odour, no staining, with organics.	M		RESIDUAL SOIL
			0.5		0.50-0.70 m BH03							
				0.65				Cl	Sandy CLAY: medium plasticity, brown mottled orange, sand is fine grained; trace fine grained gravel; no odour, no staining, with organics.		L - MD	
				0.95				Cl	Gravelly CLAY: medium plasticity, brown mottled orange and black, gravel is fine grained; no odour, no staining, with organics.	w≈PL	VSt	
			1.0									
			1.5									
			2.0		2.20-2.45 m BH03							
				2.47					Hole Terminated at 2.47 m Refusal			
			2.5									
			3.0									
			3.5									

Comments

Checked

Date

REPORT OF CORE PHOTOGRAPHS: BH03

		SHEET: 1 OF 2	
CLIENT:	Victorian Planning Authority	DRILL RIG: Edson 260	
PROJECT:	Bannockburn SE Sodic Soils Assessment	COORDS: 251251.6 m E 5784182.6 m N MGA2020-56	CONTRACTOR: Aquasearch Driling
LOCATION:	Bannockburn	INCLINATION: -90°	LOGGED: HJ DATE: 22/5/24
JOB NO:	PS211655	HOLE DEPTH: 2.47 m	CHECKED: DATE:

PointID : BH03 Depth Range: 0.50 - 0.70 m

PointID : BH03 Depth Range: 1.20 - 1.65 m

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REPORT OF CORE PHOTOGRAPHS: BH03

SHEET: 2 OF 2

CLIENT:	Victorian Planning Authority		DRILL RIG: Edson 260		
PROJECT:	Bannockburn SE Sodic Soils Assessment	COORDS: 251251.6 m E 5784182.6 m N MGA2020-56	CONTRACTOR: Aquasearch Driling		
LOCATION:	Bannockburn	INCLINATION: -90°	LOGGED: HJ	DATE:	22/5/24
JOB NO:	PS211655	HOLE DEPTH: 2.47 m	CHECKED:	DATE:	

PointID : BH03 Depth Range: 2.20 - 2.65 m

BOREHOLE: BH04

Sheet 1 of 1

Project:	Bannockburn SE Sodic Soils Assessment				
Location:	Bannockburn	Coords:	252173.1 m E 5784057.0 m N MGA2020-56	Date Started:	22/5/2024
Client:	Victorian Planning Authority	Contractor:	Aquasearch Driling Drill Rig: Edson 260	Date Completed:	22/5/2024
Job No.:	PS211655	Inclination:	-90°	Logged:	HJ

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T		Not Encountered	0.0		0.10-0.20 m BH04			SP	SAND: fine grained, brown, trace fine grained gravel; no odour, no staining, trace organics.	M - D	L - MD	RESIDUAL SOIL
				0.30				CL-CI	Sandy CLAY: low to medium plasticity, brown mottled grey, sand is fine grained; trace fine grained gravel; no odour, no staining.		S - F	
			0.5		0.50-0.95 m BH04			CL-CI	Gravelly CLAY: low to medium plasticity, pale grey mottled pale brown, gravel is fine grained; no odour, no staining.	w≈PL	St - VSt	
				0.95				CL-CI	Gravelly CLAY: low to medium plasticity, grey brown mottled red brown, pale yellow and dark grey, gravel is fine grained; no odour, no staining.			
			1.0	1.05	1.00-1.05 m BH04			CL	Gravelly CLAY: low plasticity, yellow brown mottled pale grey, gravel is fine grained; trace fine grained sand; no odour, no staining.			
					1.05-1.20 m BH04							
			1.5							w<PL	F - St	
			2.0	2.10	2.00-2.10 m BH04							
									Hole Terminated at 2.10 m Refusal			
			2.5									
			3.0									
			3.5									

Comments

Checked

Date

REPORT OF CORE PHOTOGRAPHS: BH04

SHEET: 1 OF 1

CLIENT:	Victorian Planning Authority		DRILL RIG:	Edson 260	
PROJECT:	Bannockburn SE Sodic Soils Assessment	COORDS: 252173.1 m E 5784057.0 m N MGA2020-56	CONTRACTOR:	Aquasearch Driling	
LOCATION:	Bannockburn	INCLINATION: -90°	LOGGED: HJ	DATE:	22/5/24
JOB NO:	PS211655	HOLE DEPTH: 2.10 m	CHECKED:	DATE:	

PointID : BH04 Depth Range: 0.50 - 0.95 m

PointID : BH04 Depth Range: 1.00 - 1.20 m

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BOREHOLE: BH05

Sheet 1 of 1

Project:	Bannockburn SE Sodic Soils Assessment				
Location:	Bannockburn	Coords:	251357.9 m E 5783748.3 m N MGA2020-56	Date Started:	23/5/2024
Client:	Victorian Planning Authority	Contractor:	Aquasearch Driling Drill Rig: Edson 260	Date Completed:	23/5/2024
Job No.:	PS211655	Inclination:	-90°	Logged:	HJ

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T		Not Encountered	0.0					SP	SAND: fine grained, pale red brown, with low to medium plasticity silt; no odour, no staining.	D	MD	RESIDUAL SOIL
				0.20	0.10-0.20 m BH05							
									Hole Terminated at 0.20 m Target depth			
			0.5									
			1.0									
			1.5									
			2.0									
			2.5									
			3.0									
			3.5									

Comments

Checked

Date

BOREHOLE: BH06

Sheet 1 of 1

Project:	Bannockburn SE Sodic Soils Assessment				
Location:	Bannockburn	Coords:	251251.6 m E 5784175.7 m N MGA2020-56	Date Started:	22/5/2024
Client:	Victorian Planning Authority	Contractor:	Aquasearch Driling Drill Rig: Edson 260	Date Completed:	22/5/2024
Job No.:	PS211655	Inclination:	-90°	Logged:	HJ

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T		Not Encountered	0.0		0.10-0.20 m BH06			SC	Clayey SAND: fine grained, brown, clay is low to medium plasticity; trace organics.	D	L	RESIDUAL SOIL
				0.20				CL-CI	Sandy CLAY: low to medium plasticity, brown mottled orange and grey, sand is fine grained; trace fine grained gravel; no odour, no staining.		St - VSt	
			0.5		0.50-0.80 m BH06					w<PL		
				0.75				CL-CI	CLAY: low to medium plasticity, grey mottled pale brown, trace fine grained gravel; trace fine grained sand; no odour, no staining.		VSt - H	
				0.85				CL-CI	Gravelly CLAY: low to medium plasticity, brown grey, gravel is fine grained; no odour, no staining.			
			1.0	1.00	0.95-1.15 m BH06			CL	Gravelly CLAY: low plasticity, pale grey mottled pale brown, gravel is fine grained; trace fine grained sand; no odour, no staining.		VSt	
				1.15					Hole Terminated at 1.15 m Refusal			
			1.5									
			2.0									
			2.5									
			3.0									
			3.5									

Comments

Checked

Date

REPORT OF CORE PHOTOGRAPHS: BH06

SHEET: 1 OF 1

CLIENT:	Victorian Planning Authority		DRILL RIG: Edson 260		
PROJECT:	Bannockburn SE Sodic Soils Assessment	COORDS: 251251.6 m E 5784175.7 m N MGA2020-56	CONTRACTOR: Aquasearch Driling		
LOCATION:	Bannockburn	INCLINATION: -90°	LOGGED: HJ	DATE:	22/5/24
JOB NO:	PS211655	HOLE DEPTH: 1.15 m	CHECKED:	DATE:	

PointID : BH06 Depth Range: 1.00 - 1.45 m

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BOREHOLE: BH07

Sheet 1 of 1

Project:	Bannockburn SE Sodic Soils Assessment				
Location:	Bannockburn	Coords:	251763.2 m E 5784122.1 m N MGA2020-56	Date Started:	22/5/2024
Client:	Victorian Planning Authority	Contractor:	Aquasearch Driling Drill Rig: Edson 260	Date Completed:	22/5/2024
Job No.:	PS211655	Inclination:	-90°	Logged:	HJ

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T		Not Encountered	0.0		0.10-0.20 m BH07			SC	Clayey SAND: fine grained, brown, clay is low to medium plasticity; trace fine grained gravel; no odour, no staining.	D	L	RESIDUAL SOIL
			0.5		0.50-0.75 m BH07							
				0.60				CL-Cl	Gravelly CLAY: low to medium plasticity, grey brown mottled orange and black, gravel is fine to medium grained; no odour, no staining, black basalt.	w<PL	St - VSt	
				0.85					Hole Terminated at 0.85 m Target depth			
			1.0									
			1.5									
			2.0									
			2.5									
			3.0									
			3.5									

Comments

Checked

Date

REPORT OF CORE PHOTOGRAPHS: BH07

SHEET: 1 OF 1

CLIENT:	Victorian Planning Authority		DRILL RIG: Edson 260	
PROJECT:	Bannockburn SE Sodic Soils Assessment	COORDS: 251763.2 m E 5784122.1 m N MGA2020-56	CONTRACTOR: Aquasearch Driling	
LOCATION:	Bannockburn	INCLINATION: -90°	LOGGED: HJ	DATE: 22/5/24
JOB NO:	PS211655	HOLE DEPTH: 0.85 m	CHECKED:	DATE:

PointID : BH07 Depth Range: 0.50 - 0.75 m

BOREHOLE: BH08

Sheet 1 of 1

Project:	Bannockburn SE Sodic Soils Assessment				
Location:	Bannockburn	Coords:	251650.3 m E 5782882.2 m N MGA2020-56	Date Started:	23/5/2024
Client:	Victorian Planning Authority	Contractor:	Aquasearch Driling Drill Rig: Edson 260	Date Completed:	23/5/2024
Job No.:	PS211655	Inclination:	-90°	Logged:	HJ

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
		Not Encountered	0.0					SC	Clayey SAND: fine grained, pale brown, clay is medium plasticity; no odour, no staining, trace organics.	D	MD	RESIDUAL SOIL
					0.10-0.25 m BH08							
AD/T				0.25					Hole Terminated at 0.25 m Target depth			
			0.5									
			1.0									
			1.5									
			2.0									
			2.5									
			3.0									
			3.5									

Comments

Checked

Date

BOREHOLE: BH09

Sheet 1 of 1

Project:	Bannockburn SE Sodic Soils Assessment				
Location:	Bannockburn	Coords:	251654.0 m E 5786012.8 m N MGA2020-56	Date Started:	22/5/2024
Client:	Victorian Planning Authority	Contractor:	Aquasearch Driling Drill Rig: Edson 260	Date Completed:	22/5/2024
Job No.:	PS211655	Inclination:	-90°	Logged:	HJ

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T		Not Encountered	0.0		0.10-0.20 m BH09			SP	SAND: fine grained, brown, trace fine grained gravel; no odour, no staining, with organics (roots).			RESIDUAL SOIL
			0.5		0.50-0.75 m BH09					M	L	
			1.0	*1.00*					Hole Terminated at 1.00 m Refusal			
			1.5									
			2.0									
			2.5									
			3.0									
			3.5									

Comments

Checked

Date

REPORT OF CORE PHOTOGRAPHS: BH09

SHEET: 1 OF 1

CLIENT:	Victorian Planning Authority		DRILL RIG: Edson 260	
PROJECT:	Bannockburn SE Sodic Soils Assessment	COORDS: 251654.0 m E 5786012.8 m N MGA2020-56	CONTRACTOR: Aquasearch Driling	
LOCATION:	Bannockburn	INCLINATION: -90°	LOGGED: HJ	DATE: 22/5/24
JOB NO:	PS211655	HOLE DEPTH: 1.00 m	CHECKED:	DATE:

PointID : BH09 Depth Range: 0.50 - 0.95 m

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BOREHOLE: BH10

Sheet 1 of 1

Project:	Bannockburn SE Sodic Soils Assessment				
Location:	Bannockburn	Coords:	252610.1 m E 5783258.1 m N MGA2020-56	Date Started:	23/5/2024
Client:	Victorian Planning Authority	Contractor:	Aquasearch Driling Drill Rig: Edson 260	Date Completed:	23/5/2024
Job No.:	PS211655	Inclination:	-90°	Logged:	HJ

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T		Not Encountered	0.0		0.10-0.20 m BH10			SP	SAND: fine grained, brown, trace medium grained gravel; no odour, no staining, with organics.	M	L - MD	RESIDUAL SOIL
			0.5	*0.50*	0.50-0.65 m BH10			GW	Sandy GRAVEL: fine to medium, sub-angular, dark grey and brown, sand is fine grained; with medium plasticity clay; no odour, no staining, basalt gravels.	M - D	MD	
				0.60				GP	GRAVEL: medium, sub-angular, pale brown and dark grey, trace medium plasticity clay; no odour, no staining, basalt gravels.	D	D	
				0.65					Hole Terminated at 0.65 m Refusal			
			1.0									
			1.5									
			2.0									
			2.5									
			3.0									
			3.5									

Comments

Checked

Date

REPORT OF CORE PHOTOGRAPHS: BH10

SHEET: 1 OF 1

CLIENT:	Victorian Planning Authority		DRILL RIG: Edson 260		
PROJECT:	Bannockburn SE Sodic Soils Assessment	COORDS: 252610.1 m E 5783258.1 m N MGA2020-56	CONTRACTOR: Aquasearch Driling		
LOCATION:	Bannockburn	INCLINATION: -90°	LOGGED: HJ	DATE:	23/5/24
JOB NO:	PS211655	HOLE DEPTH: 0.65 m	CHECKED:	DATE:	

PointID : BH10 Depth Range: 0.50 - 0.65 m

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BOREHOLE: BH11

Sheet 1 of 1

Project:	Bannockburn SE Sodic Soils Assessment				
Location:	Bannockburn	Coords:	251360.5 m E 5784021.9 m N MGA2020-56	Date Started:	23/5/2024
Client:	Victorian Planning Authority	Contractor:	Aquasearch Driling Drill Rig: Edson 260	Date Completed:	23/5/2024
Job No.:	PS211655	Inclination:	-90°	Logged:	HJ

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T		Not Encountered	0.0					SC	Clayey SAND: fine to medium grained, red brown, trace fine grained gravel; no odour, no staining, trace organics.	D	L - MD	RESIDUAL SOIL
				0.20	0.10-0.20 m BH11							
									Hole Terminated at 0.20 m Target depth			
			0.5									
			1.0									
			1.5									
			2.0									
			2.5									
			3.0									
			3.5									

Comments

Checked

Date

BOREHOLE: BH12

Sheet 1 of 1

Project:	Bannockburn SE Sodic Soils Assessment				
Location:	Bannockburn	Coords:	251654.0 m E 5786012.8 m N MGA2020-56	Date Started:	22/5/2024
Client:	Victorian Planning Authority	Contractor:	Aquasearch Driling Drill Rig: Edson 260	Date Completed:	22/5/2024
Job No.:	PS211655	Inclination:	-90°	Logged:	HJ

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T		Not Encountered	0.0		0.10-0.20 m BH12			SP	SAND: fine grained, brown, no odour, no staining, with organics (roots).	M - D	L	RESIDUAL SOIL
			0.5	0.50	0.50-0.75 m BH12			Cl	CLAY: medium plasticity, brown mottled red brown and pale orange, trace fine grained gravel; no odour, no staining, black basalt gravel.			
				0.75	0.75-0.95 m BH12			Cl	CLAY: medium plasticity, orange pale brown mottled red brown, trace fine grained gravel; no odour, no staining, black basalt gravel.	w≈PL	St	
			1.0		1.00-1.40 m BH12							
				1.20				GC	Clayey GRAVEL: medium to coarse, sub-angular, black mottled red brown and brown, clay is medium plasticity; no odour, no staining, basalt gravels.	D	MD - D	
			1.5	1.50					Hole Terminated at 1.50 m Refusal			
			2.0									
			2.5									
			3.0									
			3.5									

Comments

Checked

Date

REPORT OF CORE PHOTOGRAPHS: BH12

SHEET: 1 OF 1

CLIENT:	Victorian Planning Authority		DRILL RIG:	Edson 260	
PROJECT:	Bannockburn SE Sodic Soils Assessment	COORDS: 251654.0 m E 5786012.8 m N MGA2020-56	CONTRACTOR:	Aquasearch Driling	
LOCATION:	Bannockburn	INCLINATION: -90°	LOGGED: HJ	DATE: 22/5/24	
JOB NO:	PS211655	HOLE DEPTH: 1.50 m	CHECKED:	DATE:	

PointID : BH12 Depth Range: 0.50 - 0.95 m

PointID : BH12 Depth Range: 1.00 - 1.40 m

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BOREHOLE: BH13

Sheet 1 of 1

Project:	Bannockburn SE Sodic Soils Assessment				
Location:	Bannockburn	Coords:	253349.0 m E 5784435.0 m N MGA2020-56	Date Started:	22/5/2024
Client:	Victorian Planning Authority	Contractor:	Aquasearch Driling Drill Rig: Edson 260	Date Completed:	22/5/2024
Job No.:	PS211655	Inclination:	-90°	Logged:	HJ

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T		Not Encountered	0.0		0.10-0.20 m BH13			SW	SAND: fine to medium grained, pale brown, trace low to medium plasticity clay; no odour, no staining.	M - D	L	RESIDUAL SOIL
			0.5	0.60	0.60-0.75 m BH13			CL-CI	CLAY: low to medium plasticity, brown mottled dark grey and orange, trace fine grained sand; no odour, no staining.			
			1.0		1.00-1.30 m BH13							
				1.20				CL-CI	CLAY: low to medium plasticity, brown mottled dark grey and orange, with fine grained gravel; trace fine grained sand; no odour, no staining, black basalt gravel.	w≈PL	F - St	
			1.5	1.80				GP	BASALT: medium grained, pale grey and dark grey pale-brown, indistinct.	D	MD	
			2.0	2.10	2.10-2.20 m BH13			CL-CI	CLAY: low to medium plasticity, mottled and yellow dark grey pale brown pale orange, with fine to medium grained gravel; trace fine grained sand; no odour, no staining, black basalt gravel.	w≈PL	F - St	
				2.40					Hole Terminated at 2.40 m Refusal			
			2.5									
			3.0									
			3.5									

Comments

Checked

Date

REPORT OF CORE PHOTOGRAPHS: BH13

CLIENT:	Victorian Planning Authority	DRILL RIG:	Edson 260
PROJECT:	Bannockburn SE Sodic Soils Assessment	COORDS:	253349.0 m E 5784435.0 m N MGA2020-56
CONTRACTOR:	Aquasearch Driling		
LOCATION:	Bannockburn	INCLINATION:	-90°
LOGGED:	HJ	DATE:	22/5/24
JOB NO:	PS211655	HOLE DEPTH:	2.40 m
CHECKED:		DATE:	

PointID : BH13 Depth Range: 0.50 - 0.95 m

PointID : BH13 Depth Range: 1.00 - 1.40 m

REPORT OF CORE PHOTOGRAPHS: BH13

SHEET: 2 OF 2

CLIENT:	Victorian Planning Authority		DRILL RIG: Edson 260	
PROJECT:	Bannockburn SE Sodic Soils Assessment	COORDS: 253349.0 m E 5784435.0 m N MGA2020-56	CONTRACTOR: Aquasearch Driling	
LOCATION:	Bannockburn	INCLINATION: -90°	LOGGED: HJ	DATE: 22/5/24
JOB NO:	PS211655	HOLE DEPTH: 2.40 m	CHECKED:	DATE:

PointID : BH13 Depth Range: 2.20 - 2.40 m

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GAP gINT FN. F28
RL1

BOREHOLE: BH14

Sheet 1 of 1

Project:	Bannockburn SE Sodic Soils Assessment				
Location:	Bannockburn	Coords:	251030.8 m E 5777996.8 m N MGA2020-56	Date Started:	23/5/2024
Client:	Victorian Planning Authority	Contractor:	Aquasearch Driling Drill Rig: Edson 260	Date Completed:	23/5/2024
Job No.:	PS211655	Inclination:	-90°	Logged:	HJ

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T		Not Encountered	0.0		0.10-0.20 m BH14			SM	Silty SAND: fine grained, brown, no odour, no staining, trace organics.	D	L	RESIDUAL SOIL
			0.5		0.50-0.75 m BH14							
				0.75				GW	Sandy GRAVEL: fine to medium, sub-rounded, orange brown mottled dark grey, sand is fine grained; with low to medium plasticity clay; no odour, no staining.		L - MD	
			1.0									
				1.25	1.25-1.50 m BH14			GC	Clayey GRAVEL: fine, rounded to sub-rounded, orange brown and pale grey, clay is low to medium plasticity; trace fine grained sand; no odour, no staining. white grey rounded gravels.	M - D	L - MD	
			1.5									
			2.0		2.00-2.25 m BH14							
				2.25					Hole Terminated at 2.25 m Refusal			
			2.5									
			3.0									
			3.5									

Comments

Checked

Date

REPORT OF CORE PHOTOGRAPHS: BH14

SHEET: 1 OF 1

CLIENT:	Victorian Planning Authority		DRILL RIG:	Edson 260	
PROJECT:	Bannockburn SE Sodic Soils Assessment	COORDS: 251030.8 m E 5777996.8 m N MGA2020-56	CONTRACTOR:	Aquasearch Driling	
LOCATION:	Bannockburn	INCLINATION: -90°	LOGGED: HJ	DATE:	23/5/24
JOB NO:	PS211655	HOLE DEPTH: 2.25 m	CHECKED:	DATE:	

PointID : BH14 Depth Range: 0.50 - 0.80 m

PointID : BH14 Depth Range: 1.00 - 1.50 m

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GAP gINT FN. F28
RL1

BOREHOLE: BH15

Sheet 1 of 1

Project:	Bannockburn SE Sodic Soils Assessment				
Location:	Bannockburn	Coords:	252338.6 m E 5780687.0 m N MGA2020-56	Date Started:	23/5/2024
Client:	Victorian Planning Authority	Contractor:	Aquasearch Driling Drill Rig: Edson 260	Date Completed:	23/5/2024
Job No.:	PS211655	Inclination:	-90°	Logged:	HJ

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T		Not Encountered	0.0		0.10-0.20 m BH15			SM	Silty SAND: fine grained, pale brown, no odour, no staining, trace organics.	D	L - MD	RESIDUAL SOIL
				0.25				CL	CLAY: low plasticity, yellow brown mottled orange and dark grey, trace fine grained gravel; no odour, no staining, basalt gravels.			
			0.5		0.50-0.75 m BH15					w≈PL	F - St	
			1.0		1.00-1.35 m BH15							
				1.35				GC	Clayey GRAVEL: medium to coarse, sub-rounded, orange with brown, clay is low to medium plasticity; no odour, no staining.	M - D	MD - D	
				1.45					Hole Terminated at 1.45 m Refusal			
			1.5									
			2.0									
			2.5									
			3.0									
			3.5									

Comments

Checked

Date

REPORT OF CORE PHOTOGRAPHS: BH15

SHEET: 1 OF 1

CLIENT:	Victorian Planning Authority		DRILL RIG:	Edson 260	
PROJECT:	Bannockburn SE Sodic Soils Assessment	COORDS: 252338.6 m E 5780687.0 m N MGA2020-56	CONTRACTOR:	Aquasearch Driling	
LOCATION:	Bannockburn	INCLINATION: -90°	LOGGED: HJ	DATE: 23/5/24	
JOB NO:	PS211655	HOLE DEPTH: 1.45 m	CHECKED:	DATE:	

PointID : BH15 Depth Range: 0.50 - 0.95 m

PointID : BH15 Depth Range: 1.00 - 1.45 m

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GAP gINT FN. F28
RL1

BOREHOLE: BH16

Sheet 1 of 1

Project:	Bannockburn SE Sodic Soils Assessment				
Location:	Bannockburn	Coords:	253349.0 m E 5784435.0 m N MGA2020-56	Date Started:	23/5/2024
Client:	Victorian Planning Authority	Contractor:	Aquasearch Driling Drill Rig: Edson 260	Date Completed:	23/5/2024
Job No.:	PS211655	Inclination:	-90°	Logged:	HJ

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T		Not Encountered	0.0		0.10-0.20 m BH16			SW	SAND: fine to medium grained, brown, trace fine grained gravel; no odour, no staining, trace organics seed and roots.	D	L - MD	RESIDUAL SOIL
			0.5	0.60	0.60-0.85 m BH16			CI-CH	CLAY: medium to high plasticity, brown and pale brown mottled red brown with dark grey, no odour, no staining.		St	
			1.0	1.20	1.20-1.40 m BH16			CI	CLAY: medium plasticity, brown mottled dark grey and white, with fine grained gravel; no odour, no staining, basalt gravels throughout.	w≈PL	VSt	
			1.5									
			2.0	2.10				GW	GRAVEL: fine to medium, sub-rounded, pale brown mottled white, with medium plasticity clay; no odour, no staining.	D	MD	
				2.35	2.35-2.45 m BH16			CI	CLAY: medium plasticity, dark grey and brown mottled black, trace fine grained gravel; no odour, no staining, beige gravels.			
			2.5							w≈PL	VSt	
			3.0	3.30	3.30-3.45 m BH16			CI-CH	CLAY: medium to high plasticity, brown mottled pale orange, trace fine grained gravel; no odour, no staining, basalt gravels.		F	
			3.5	3.45					Hole Terminated at 3.45 m Target depth			

Comments

Checked

Date

REPORT OF CORE PHOTOGRAPHS: BH16

CLIENT:	Victorian Planning Authority	DRILL RIG:	Edson 260
PROJECT:	Bannockburn SE Sodic Soils Assessment	CONTRACTOR:	Aquasearch Driling
LOCATION:	Bannockburn	COORDS:	253349.0 m E 5784435.0 m N MGA2020-56
JOB NO:	PS211655	INCLINATION:	-90°
LOGGED:	HJ	DATE:	23/5/24
CHECKED:		HOLE DEPTH:	3.45 m
DATE:			

PointID : BH16 Depth Range: 0.50 - 0.85 m

PointID : BH16 Depth Range: 1.10 - 1.40 m

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GAP gINT FN. F28
RL1

REPORT OF CORE PHOTOGRAPHS: BH16

SHEET: 2 OF 2

CLIENT:	Victorian Planning Authority		DRILL RIG: Edson 260		
PROJECT:	Bannockburn SE Sodic Soils Assessment	COORDS: 253349.0 m E 5784435.0 m N MGA2020-56	CONTRACTOR: Aquasearch Driling		
LOCATION:	Bannockburn	INCLINATION: -90°	LOGGED: HJ	DATE:	23/5/24
JOB NO:	PS211655	HOLE DEPTH: 3.45 m	CHECKED:	DATE:	

PointID : BH16 Depth Range: 2.00 - 2.45 m

PointID : BH16 Depth Range: 3.00 - 3.45 m

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GAP gINT FN. F28
RL1

BOREHOLE: BH17

Sheet 1 of 1

Project:	Bannockburn SE Sodic Soils Assessment				
Location:	Bannockburn	Coords:	250485.6 m E 5778219.1 m N MGA2020-56	Date Started:	23/5/2024
Client:	Victorian Planning Authority	Contractor:	Aquasearch Driling Drill Rig: Edson 260	Date Completed:	23/5/2024
Job No.:	PS211655	Inclination:	-90°	Logged:	HJ

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T		Not Encountered	0.0		0.10-0.20 m BH17			SW	SAND: fine to medium grained, brown, no odour, no staining, trace organics.	D	L - MD	RESIDUAL SOIL
			0.5	0.50	0.50-0.75 m BH17			CI-CH	CLAY: medium to high plasticity, brown and grey, trace medium grained gravel; no odour, no staining.	w≈PL	St - VSt	
			1.0									
			1.5	1.50				CI-CH	CLAY: medium to high plasticity, and grey brown mottled pale pale orange, with fine to medium grained gravel; no odour, no staining, pale beige gravel.			
			2.0	2.10	2.00-2.25 m BH17			GW	GRAVEL: fine to medium, sub-rounded, pale yellow with white, trace medium plasticity clay; no odour, no staining, white gravels.	D	D	
				2.25					Hole Terminated at 2.25 m Refusal			
			2.5									
			3.0									
			3.5									

Comments

Checked

Date

REPORT OF CORE PHOTOGRAPHS: BH17

CLIENT:	Victorian Planning Authority		DRILL RIG:	Edson 260	
PROJECT:	Bannockburn SE Sodic Soils Assessment	COORDS: 250485.6 m E 5778219.1 m N MGA2020-56	CONTRACTOR:	Aquasearch Driling	
LOCATION:	Bannockburn	INCLINATION: -90°	LOGGED: HJ	DATE: 23/5/24	
JOB NO:	PS211655	HOLE DEPTH: 2.25 m	CHECKED:	DATE:	

PointID : BH17 Depth Range: 0.50 - 0.85 m

PointID : BH17 Depth Range: 1.10 - 1.50 m

REPORT OF CORE PHOTOGRAPHS: BH17

SHEET: 2 OF 2

CLIENT:	Victorian Planning Authority		DRILL RIG:	Edson 260	
PROJECT:	Bannockburn SE Sodic Soils Assessment	COORDS: 250485.6 m E 5778219.1 m N MGA2020-56	CONTRACTOR:	Aquasearch Driling	
LOCATION:	Bannockburn	INCLINATION: -90°	LOGGED: HJ	DATE: 23/5/24	
JOB NO:	PS211655	HOLE DEPTH: 2.25 m	CHECKED:	DATE:	

PointID : BH17 Depth Range: 2.00 - 2.50 m

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GAP gINT FN. F28
RL1

BOREHOLE: BH18

Sheet 1 of 1

Project:	Bannockburn SE Sodic Soils Assessment				
Location:	Bannockburn	Coords:	251717.6 m E 5785891.8 m N MGA2020-56	Date Started:	23/5/2024
Client:	Victorian Planning Authority	Contractor:	Aquasearch Driling Drill Rig: Edson 260	Date Completed:	23/5/2024
Job No.:	PS211655	Inclination:	-90°	Logged:	HJ

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T		Not Encountered	0.0		0.10-0.20 m BH18			SW	SAND: fine to medium grained, brown, trace fine grained gravel; no odour, no staining, trace organics.	M	L - MD	RESIDUAL SOIL
			0.5	0.50				CL-CI	CLAY: low to medium plasticity, brown mottled dark grey, no odour, no staining.	w>PL		
				0.60				CL-CI	Gravelly CLAY: low to medium plasticity, brown mottled white, gravel is fine grained; no odour, no staining, white gravels.	w≈PL		
				0.70				CL-CI	CLAY: low to medium plasticity, brown mottled dark grey, no odour, no staining.	w>PL		
				0.75				CL-CI	Gravelly CLAY: low to medium plasticity, brown mottled white, gravel is fine grained; no odour, no staining, white gravels.	w≈PL		
				0.95				CL-CI	CLAY: low to medium plasticity, brown mottled dark grey, no odour, no staining.			
			1.0		1.00-1.25 m BH18							
			1.5									
			2.0		2.00-2.25 m BH18					w>PL	F	
			2.5									
				2.80				CL-CI	Gravelly CLAY: low to medium plasticity, brown mottled white, gravel is fine grained; no odour, no staining, white gravels.	w≈PL		
			3.0	3.00	3.00-3.25 m BH18			CL-CI	CLAY: low to medium plasticity, brown mottled dark grey, no odour, no staining.	w>PL		
				3.45					Hole Terminated at 3.45 m Target depth			
			3.5									

Comments

Checked

Date

REPORT OF CORE PHOTOGRAPHS: BH18

CLIENT:	Victorian Planning Authority	DRILL RIG: Edson 260	
PROJECT:	Bannockburn SE Sodic Soils Assessment	COORDS: 251717.6 m E 5785891.8 m N MGA2020-56	CONTRACTOR: Aquasearch Driling
LOCATION:	Bannockburn	INCLINATION: -90°	LOGGED: HJ DATE: 23/5/24
JOB NO:	PS211655	HOLE DEPTH: 3.45 m	CHECKED: DATE:

PointID : BH18 Depth Range: 1.00 - 1.40 m

PointID : BH18 Depth Range: 2.00 - 2.45 m

REPORT OF CORE PHOTOGRAPHS: BH18

SHEET: 2 OF 2

CLIENT:	Victorian Planning Authority		DRILL RIG: Edson 260		
PROJECT:	Bannockburn SE Sodic Soils Assessment	COORDS: 251717.6 m E 5785891.8 m N MGA2020-56	CONTRACTOR: Aquasearch Driling		
LOCATION:	Bannockburn	INCLINATION: -90°	LOGGED: HJ	DATE:	23/5/24
JOB NO:	PS211655	HOLE DEPTH: 3.45 m	CHECKED:	DATE:	

PointID : BH18 Depth Range: 3.00 - 3.45 m

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GAP gINT FN. F28
RL1

BOREHOLE: BH19

Sheet 1 of 1

Project:	Bannockburn SE Sodic Soils Assessment				
Location:	Bannockburn	Coords:	252954.9 m E 5777687.3 m N MGA2020-56	Date Started:	23/5/2024
Client:	Victorian Planning Authority	Contractor:	Aquasearch Driling Drill Rig: Edson 260	Date Completed:	23/5/2024
Job No.:	PS211655	Inclination:	-90°	Logged:	HJ

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T		Not Encountered	0.0		0.10-0.20 m BH19			SW	Gravelly SAND: fine to medium grained, brown, gravel is fine grained; no odour, no staining, trace organics.	M - D	L - MD	RESIDUAL SOIL
			0.5	0.50				CI	CLAY: medium plasticity, brown mottled red brown and white, trace fine grained gravel; no odour, no staining.	w≈PL	F	
				0.60	0.60-0.75 m BH19			SC	Clayey SAND: fine to medium grained, yellow brown, clay is medium plasticity; trace fine grained gravel; no odour, no staining.	M	MD - D	
			1.0	1.20	1.20-1.35 m BH19			GC	Clayey GRAVEL: fine, sub-angular, pale brown yellow mottled white, clay is medium plasticity; trace fine grained sand; no odour, no staining.	D	L - MD	
				1.35					Hole Terminated at 1.35 m Refusal			
			1.5									
			2.0									
			2.5									
			3.0									
			3.5									

Comments

Checked

Date

REPORT OF CORE PHOTOGRAPHS: BH19

SHEET: 1 OF 1

CLIENT:	Victorian Planning Authority		DRILL RIG:	Edson 260	
PROJECT:	Bannockburn SE Sodic Soils Assessment	COORDS: 252954.9 m E 5777687.3 m N MGA2020-56	CONTRACTOR:	Aquasearch Driling	
LOCATION:	Bannockburn	INCLINATION: -90°	LOGGED: HJ	DATE: 23/5/24	
JOB NO:	PS211655	HOLE DEPTH: 1.35 m	CHECKED:	DATE:	

PointID : BH19 Depth Range: 0.50 - 0.95 m

PointID : BH19 Depth Range: 1.00 - 1.35 m

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GAP gINT FN. F28
RL1

BOREHOLE: BH20

Sheet 1 of 1

Project:	Bannockburn SE Sodic Soils Assessment				
Location:	Bannockburn	Coords:	257709.9 m E 5781834.8 m N MGA2020-56	Date Started:	23/5/2024
Client:	Victorian Planning Authority	Contractor:	Aquasearch Driling Drill Rig: Edson 260	Date Completed:	23/5/2024
Job No.:	PS211655	Inclination:	-90°	Logged:	HJ

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T		Not Encountered	0.0		0.10-0.20 m BH20			SP	SAND: fine grained, brown, trace low to medium plasticity clay; no odour, no staining, trace organics.	D	L - MD	RESIDUAL SOIL
			0.5	0.50	0.50-0.75 m BH20			CL-CI	CLAY: low to medium plasticity, brown mottled red brown and pale grey, with fine grained gravel; no odour, no staining.		F	
				0.75				CL-CI	CLAY: low to medium plasticity, pale brown mottled orange and white with dark grey, trace fine grained gravel; no odour, no staining, trace white rock and basalt gravel.	w≈PL	F - St	
			1.0		0.95-1.45 m BH20							
				1.40				GP	GRAVEL: medium, sub-rounded, white and pale orange mottled dark grey, trace low to medium plasticity clay.	D	L - MD	
			1.5									
			2.0									
				2.20					Hole Terminated at 2.20 m Refusal			
			2.5									
			3.0									
			3.5									

Comments

Checked

Date

REPORT OF CORE PHOTOGRAPHS: BH20

SHEET: 1 OF 1

CLIENT:	Victorian Planning Authority		DRILL RIG:	Edson 260	
PROJECT:	Bannockburn SE Sodic Soils Assessment	COORDS: 257709.9 m E 5781834.8 m N MGA2020-56	CONTRACTOR:	Aquasearch Driling	
LOCATION:	Bannockburn	INCLINATION: -90°	LOGGED: HJ	DATE:	23/5/24
JOB NO:	PS211655	HOLE DEPTH: 2.20 m	CHECKED:	DATE:	

PointID : BH20 Depth Range: 0.50 - 0.95 m

PointID : BH20 Depth Range: 0.95 - 1.45 m

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GAP gINT FN. F28
RL1

Appendix D

RESULTS TABLES

							Particle Size	Field Parameters	Physical	Inorganics				Exch						
							Emerson Class Number	Texture	Color (Munsell)	pH (Lab)	Electrical Conductivity @ 25°C	EC Conversion factor	Electrical Conductivity (as EC_E)	Calcium/Magnesium Ratio	Exchangeable Calcium	Exchangeable Calcium Percent	Exchangeable Magnesium	Exchangeable Magnesium Percent		
							-	-	-	pH	uS/cm		dSm	-	cmol (+)/k	%	cmol (+)/k	%		
EQL										0.1	1			0.2	0.1	0.2	0.1	0.2		
Site ID	**Location Cod**	**Depth Avg**	**Field ID**	**Sample Code**	**Date**	**Geological Unit**														
Bannockbu	BH01	0.1	BH01 0.1-0.2	EM2408749001	23 Apr 2024	Topsoil	7	Sandy Loam	Brown (7.5YR 4/3)	6.3	137	14	1.92		4.4		2.4			
	BH02	0.1	BH02 0.1-0.2	EM2408749002	23 Apr 2024	Topsoil	7	Light Medium Clay	Dark Reddish Gray (2.5YR 4/1)	6.3	115	8.6	0.99		13.5		8.0			
	BH04	0.1	BH04 0.1-0.2	EM2408749006	22 May 2024	Basalt	3	Silty Loam	Very Dark Gray (7.5YR 3/1)	6.1	108	9.5	1.03		7.6		4.7			
		0.5	BH04 0.5-0.95	EM2408749007	22 May 2024		2	Medium Heavy Clay	Light Brown (7.5YR 6/3)	9.4	651	6.7	4.36	0.3	5.6	19.9	16.1	57.3		
		1	BH04 1.00-1.05	EM2408749008	22 May 2024		2	Medium Clay	Dark Reddish Gray (2.5YR 4/1)	7.6	486	7.5	3.65	1.2	7.2	45.7	6.1	38.4		
		1	BH04 1.05-1.20	EM2408749009	22 May 2024		2	Light Clay	Brown (10YR 5/3)	9.6	648	8.6	5.57	0.3	4.2	16.7	14.2	56.0		
		2	BH04 2.00-2.10	EM2408749010	22 May 2024		1	Light Clay	Brown (7.5YR 5/2)	9.7	577	8.6	4.96	<0.2	2.7	10.0	14.7	54.7		
	BH05	0.1	BH05 0.1-0.2	EM2408749011	23 Apr 2024	Topsoil	7	Medium Clay	Dark Reddish Brown (5YR 3/3)	6.2	180	7.5	1.35		11.1		9.4			
	BH07	0.1	BH07 0.1-0.2	EM2408749015	22 May 2024	Basalt	2	Medium Clay	Dark Gray (5YR 4/1)	6.3	191	7.5	1.43		6.4		6.8			
		0.5	BH07 0.5-0.75	EM2408749016	22 May 2024		2	Medium Heavy Clay	Pinkish Gray (7.5YR 6/2)	9.3	657	6.7	4.40	0.5	8.2	27.3	15.3	51.0		
	BH08	0.1	BH08 0.1-0.2	EM2408749059	23 May 2024	Topsoil	3	Silty Clay Loam	Yellowish Red (5 YR 4/6)	8.6	96	8.6	0.83	1.6	3.1	51.4	1.9	31.8		
	BH11	0.1	BH11 0.1-0 .2	EM2408749062	22 May 2024	Topsoil	3	Sandy Loam	Dark Reddish Brown (5YR 3/4)	6.5	79	14	1.11		2.0		1.0			
	BH12	0.1	BH12 0.1-0.2	EM2408749023	22 May 2024	Basalt w/calcareous unit	7	Sandy Loam	Dark Reddish Gray (5YR 4/2)	6.1	300	14	4.20		3.3		1.1			
		0.5	BH12 0.5-0.75	EM2408749024	22 May 2024		1	Medium Heavy Clay	Brown (7.5YR 5/3)	9.2	599	6.7	4.01	0.4	3.8	19.7	10.1	51.7		
		0.75	BH12 0.75-0.95	EM2408749025	22 May 2024		1	Medium Heavy Clay	Pale Brown (10YR 6/3)	9.5	589	6.7	3.95	0.4	4.4	18.6	12.3	52.2		
		1	BH12 1.00-1.4	EM2408749026	22 May 2024		2	Medium Heavy Clay	Light Brownish Gray (10YR 6/2)	9.4	698	6.7	4.68	0.3	4.1	16.9	12.7	52.3		
	BH14	0.1	BH14 0.1-0.2	EM2408749031	23 May 2024	Marl / Sandstone	2	Loamy Sand	Brown (7.5YR 5/3)	6.3	66	9.5	0.63		2.3		0.4			
		0.5	BH14 0.5-0.75	EM2408749032	23 May 2024		3	Sandy Loam	Brown (7.5YR 4/4)	6.1	29	14	0.41		1.3		0.2			
		1.25	BH14 1.25-1.5	EM2408749033	23 May 2024		1	Sandy Clay Loam	Strong Brown (7.5YR 5/6)	6.8	165	9.5	1.57		2.8		8.5			
		2	BH14 2.00-2.25	EM2408749034	23 May 2024		1	Sandy Loam	Strong Brown (7.5YR 5/6)	7.6	128	14	1.79	0.3	1.1	17.6	3.4	54.8		
	BH15	0.1	BH15 0.1-0.2	EM2408749035	23 May 2024	Basalt w/calcareous unit	2	Sandy Clay Loam	Dark Gray (5YR 4/1)	6.3	63	9.5	0.60		3.4		1.0			
		0.5	BH15 0.5-0.75	EM2408749036	23 May 2024		1	Medium Heavy Clay	Light Brownish Gray (10YR 6/2)	7.1	293	6.7	1.96		4.8		14.7			
		1	BH15 1.00-1.35	EM2408749037	23 May 2024		1	Medium Heavy Clay	Pale Brown (10YR 6/3)	7.5	338	6.7	2.26	0.4	3.4	20.4	9.2	54.4		
	BH16	0.1	BH16 0.1-0.2	EM2408749038	23 May 2024	Basalt w/calcareous unit	3	Silty Loam	Dark Gray (7.5YR 4/1)	6.1	268	9.5	2.55		7.3		5.0			
		0.5	BH16 0.6-0.85	EM2408749039	23 May 2024		2	Heavy Clay	Dark Gray (10YR 4/1)	8.7	886	5.8	5.14	0.4	5.2	22.9	12.5	55.2		
			QA-01	EM2408749040	23 May 2024		2	Heavy Clay	Gray (7.5YR 5/1)	8.5	560	5.8	3.25	0.5	5.8	22.4	11.7	45.5		
			QA-02	M24-My0070542	23 May 2024		2	-	-	-	190	-	-	-	-	-	-	-		
	BH17	0.1	BH17 0.1-0.2	EM2408749044	23 May 2024	Basalt w/calcareous unit	3	Silty Clay Loam	Grayish Brown (10YR 5/2)	5.8	204	8.6	1.75		6.4		3.8			
		0.5	BH17 0.5-0.75	EM2408749045	23 May 2024		1	Heavy Clay	Light Brownish Gray (10YR 6/2)	8.9	747	5.8	4.33	0.4	4.0	19.2	9.6	46.4		
		2	BH17 2.00-2.25	EM2408749046	23 May 2024		2	Medium Heavy Clay	Light Brownish Gray (10YR 6/2)	9.2	836	6.7	5.60	0.5	4.7	20.3	10.3	44.0		
	BH20	0.1	BH20 0.1-0.2	EM2408749054	23 May 2024	Basalt w/calcareous unit	2	Light Medium Clay	Dark Gray (5YR 4/1)	6.2	200	8.6	1.72		6.9		4.2			
		0.5	BH20 0.5-0.75	EM2408749055	23 May 2024		1	Medium Heavy Clay	Light Gray (10YR 7/1)	9.4	674	6.7	4.52	0.4	3.2	18.7	8.2	47.8		
		1	BH20 0.95-1.45	EM2408749056	23 May 2024		1	Medium Heavy Clay	Light Brownish Gray (10YR 6/2)	9.4	890	6.7	5.96	0.4	4.1	17.0	11.0	46.3		
			QA-03	EM2408749067	23 May 2024		1	Medium Heavy Clay	Light Gray (10YR 7/2)	9.0	942	6.7	6.31	0.3	4.8	16.2	13.9	47.2		
			QA-04	M24-My0070543	23 May 2024		1	-	-	-	580	-	-	-	-	-	-	-		

						angeable Cations					
						Exchangeable Potassium	Exchangeable Potassium Percent	Exchangeable Sodium	Exchangeable Sodium Percent	Magnesium/Potassium Ratio	CEC
						cmol (+)/k	%	cmol (+)/k	%	-	meq/kg
EQL						0.1	0.2	0.1	0.1	0.2	1
Site ID	**Location Cod**	**Depth Avg**	**Field ID**	**Sample Code**	**Date**						
Bannockbu	BH01	0.1	BH01 0.1-0.2	EM2408749001	23 Apr 2024	0.4		0.2	3.0		74
	BH02	0.1	BH02 0.1-0.2	EM2408749002	23 Apr 2024	0.4		0.5	2.3		224
	BH04	0.1	BH04 0.1-0.2	EM2408749006	22 May 2024	0.9		0.9	6.7		141
		0.5	BH04 0.5-0.95	EM2408749007	22 May 2024	0.5	1.8	5.9	21.0	32.1	282
		1	BH04 1.00-1.05	EM2408749008	22 May 2024	0.7	4.5	1.8	11.3	8.5	158
		1	BH04 1.05-1.20	EM2408749009	22 May 2024	0.5	1.9	6.5	25.4	30.1	255
		2	BH04 2.00-2.10	EM2408749010	22 May 2024	0.7	2.5	8.8	32.8	22.2	269
	BH05	0.1	BH05 0.1-0.2	EM2408749011	23 Apr 2024	0.7		0.4	1.8		216
	BH07	0.1	BH07 0.1-0.2	EM2408749015	22 May 2024	1.0		1.7	10.6		158
		0.5	BH07 0.5-0.75	EM2408749016	22 May 2024	0.5	1.7	6.0	20.0	29.7	299
	BH08	0.1	BH08 0.1-0.2	EM2408749059	23 May 2024	1.0	16.8	<0.2	<0.2	1.9	60
	BH11	0.1	BH11 0.1-0 .2	EM2408749062	22 May 2024	1.0		0.2	3.9		41
	BH12	0.1	BH12 0.1-0.2	EM2408749023	22 May 2024	0.3		0.6	11.0		53
		0.5	BH12 0.5-0.75	EM2408749024	22 May 2024	0.6	2.9	5.0	25.7	17.8	196
		0.75	BH12 0.75-0.95	EM2408749025	22 May 2024	0.6	2.7	6.2	26.5	19.1	236
		1	BH12 1.00-1.4	EM2408749026	22 May 2024	0.6	2.7	6.8	28.1	19.4	242
	BH14	0.1	BH14 0.1-0.2	EM2408749031	23 May 2024	<0.1		<0.1	2.0		29
		0.5	BH14 0.5-0.75	EM2408749032	23 May 2024	<0.1		<0.1	5.1		17
		1.25	BH14 1.25-1.5	EM2408749033	23 May 2024	0.3		2.9	20.0		144
		2	BH14 2.00-2.25	EM2408749034	23 May 2024	<0.2	3.1	1.5	24.5	<0.2	62
	BH15	0.1	BH15 0.1-0.2	EM2408749035	23 May 2024	0.2		0.3	5.7		48
		0.5	BH15 0.5-0.75	EM2408749036	23 May 2024	0.7		6.9	25.4		271
		1	BH15 1.00-1.35	EM2408749037	23 May 2024	0.5	2.9	3.8	22.3	18.8	169
	BH16	0.1	BH16 0.1-0.2	EM2408749038	23 May 2024	0.8		1.1	7.8		142
		0.5	BH16 0.6-0.85	EM2408749039	23 May 2024	0.6	2.5	4.4	19.4	22.1	226
			QA-01	EM2408749040	23 May 2024	0.7	2.8	7.6	29.4	16.3	258
			QA-02	M24-My0070542	23 May 2024	-	-	-	36.0	-	-
	BH17	0.1	BH17 0.1-0.2	EM2408749044	23 May 2024	0.5		1.4	11.7		122
		0.5	BH17 0.5-0.75	EM2408749045	23 May 2024	0.6	3.1	6.5	31.3	14.8	208
		2	BH17 2.00-2.25	EM2408749046	23 May 2024	0.6	2.8	7.7	32.9	16.0	233
	BH20	0.1	BH20 0.1-0.2	EM2408749054	23 May 2024	0.7		1.7	12.8		134
		0.5	BH20 0.5-0.75	EM2408749055	23 May 2024	0.5	2.9	5.2	30.6	16.3	171
		1	BH20 0.95-1.45	EM2408749056	23 May 2024	0.6	2.4	8.2	34.2	19.3	238
			QA-03	EM2408749067	23 May 2024	0.6	2.1	10.2	34.5	22.3	295
			QA-04	M24-My0070543	23 May 2024	-	-	-	29.0	-	-

				Particle Size	Field Parameters	Physical	Inorganics		Exchangeable Cations									
				Emerson Class Number	Texture	Color (Munsell)	pH (Lab)	Electrical Conductivity @ 25°C	Calcium/Magnesium Ratio	Exchangeable Calcium	Exchangeable Calcium Percent	Exchangeable Magnesium	Exchangeable Magnesium Percent	Exchangeable Potassium	Exchangeable Potassium Percent	Exchangeable Sodium	Exchangeable Sodium Percent	Magnesium/Potassium Ratio
				-	-	-	pH	uS/cm	-	cmol (+)/k	%	cmol (+)/k	%	cmol (+)/k	%	cmol (+)/k	%	-
EQL							0.1	1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.2
Field ID	**Matrix Type**	**Date**	**Lab Report Number**															
BH16 0.6-0.85	**Soil**	**23 May 2024**	**EM2408749**	2	Heavy Clay	Dark Gray (10YR 4/1)	8.7	886	0.4	5.2	22.9	12.5	55.2	0.6	2.5	4.4	19.4	22.1
QA-01	**Soil**	**23 May 2024**	**EM2408749**	2	Heavy Clay	Gray (7.5YR 5/1)	8.5	560	0.5	5.8	22.4	11.7	45.5	0.7	2.8	7.6	29.4	16.3
RPD				0	0	0	2	45	22	11	2	7	19	15	11	53	41	30
BH16 0.6-0.85	**Soil**	**23 May 2024**	**EM2408749**	2	Heavy Clay	Dark Gray (10YR 4/1)	8.7	886	0.4	5.2	22.9	12.5	55.2	0.6	2.5	4.4	19.4	22.1
QA-02	**Soil**	**23 May 2024**	**1100992**	2	-	-	-	-	-	-	-	-	-	-	-	-	36	-
RPD				0	-	-	-	-	-	-	-	-	-	-	-	-	60	-
BH20 0.95-1.45	**Soil**	**23 May 2024**	**EM2408749**	1	Medium Heavy Clay	Light Brownish Gray (10YR 6/2)	9.4	890	0.4	4.1	17.0	11.0	46.3	0.6	2.4	8.2	34.2	19.3
QA-03	**Soil**	**23 May 2024**	**EM2408749**	1	Medium Heavy Clay	Light Gray (10YR 7/2)	9.0	942	0.3	4.8	16.2	13.9	47.2	0.6	2.1	10.2	34.5	22.3
RPD				0	0	0	4	6	29	16	5	23	2	0	13	22	1	14
BH20 0.95-1.45	**Soil**	**23 May 2024**	**EM2408749**	1	Medium Heavy Clay	Light Brownish Gray (10YR 6/2)	9.4	890	0.4	4.1	17.0	11.0	46.3	0.6	2.4	8.2	34.2	19.3
QA-04	**Soil**	**23 May 2024**	**1100992**	1	-	-	-	-	-	-	-	-	-	-	-	-	29	-
RPD				0	-	-	-	-	-	-	-	-	-	-	-	-	16	-

***RPDs have only been considered where a concentration is greater than 1 times the EQL.**

****Elevated RPDs are highlighted as per QAQC Profile settings (Acceptable RPDs for each EQL multiplier range are: 50 (1 - 10 x EQL); 50 (10 - 30 x EQL); 50 (> 30 x EQL))**

*****Interlab Duplicates are matched on a per compound basis as methods vary between laboratories. Any methods in the row header relate to those used in the primary laboratory**

					Sample Quality Parameters	
				CEC	Conductivity of Extract (1:5 as received)	Moisture Content (dried @ 103°C)
				meq/kg	µS/cm	%
EQL				2	10	1
Field ID	**Matrix Type**	**Date**	**Lab Report Number**			
BH16 0.6-0.85	**Soil**	**23 May 2024**	**EM2408749**	226	-	-
QA-01	**Soil**	**23 May 2024**	**EM2408749**	258	-	-
RPD				13	-	-
BH16 0.6-0.85	**Soil**	**23 May 2024**	**EM2408749**	226	-	-
QA-02	**Soil**	**23 May 2024**	**1100992**	-	190	14
RPD				-	-	-
BH20 0.95-1.45	**Soil**	**23 May 2024**	**EM2408749**	238	-	-
QA-03	**Soil**	**23 May 2024**	**EM2408749**	295	-	-
RPD				21	-	-
BH20 0.95-1.45	**Soil**	**23 May 2024**	**EM2408749**	238	-	-
QA-04	**Soil**	**23 May 2024**	**1100992**	-	580	22
RPD				-	-	-

***RPDs have only been considered where a concentration is greater than 1 times the EQL.**
****Elevated RPDs are highlighted as per QAQC Profile settings (Acceptable RPDs for each EQL multiplier rang**
*****Interlab Duplicates are matched on a per compound basis as methods vary between laboratories. Any r**

Appendix E

LABORATORY CERTIFICATES

SAMPLE RECEIPT NOTIFICATION (SRN)

Work Order : **EM2408749**

Client	: **WSP Australia Pty Ltd**	Laboratory	: Environmental Division Melbourne
Contact	: JIN-SOL LEE	Contact	: Josh Alexander
Address	: Level 11 567 Collins Street Melbourne VIC, AUSTRALIA 3000	Address	: 4 Westall Rd Springvale VIC Australia 3171
E-mail	: jin-sol.lee@wsp.com	E-mail	: Josh.Alexander@alsglobal.com
Telephone	: ----	Telephone	: +61-3-8549 9600
Facsimile	: ----	Facsimile	: +61-3-8549 9626
Project	: PS211655 VPA Bannockburn South East	Page	: 1 of 4
Order number	: PS211655	Quote number	: EM2023PARBRIVIC0019 (EN/000)
C-O-C number	: ----	QC Level	: NEPM 2013 B3 & ALS QC Standard
Site	: ----		
Sampler	: Hannah James		

Dates

Date Samples Received	: 24-May-2024 16:40	Issue Date	: 28-May-2024
Client Requested Due Date	: 05-Jun-2024	Scheduled Reporting Date	: **05-Jun-2024**

Delivery Details

Mode of Delivery	: Carrier	Security Seal	: Intact.
No. of coolers/boxes	: 5	Temperature	: 4.7°C - Ice present
Receipt Detail	:	No. of samples received / analysed	: 63 / 33

General Comments

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Proactive Holding Time Report
  - Requested Deliverables
- **Please direct any queries related to sample condition / numbering / breakages to Client Services.**
- Sample Disposal - Aqueous (3 weeks), Solid (2 months) from receipt of samples.
- **Analytical work for this work order will be conducted at ALS Springvale & ALS Brisbane.**
- **Please refer to the Proactive Holding Time Report table below which summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory. The laboratory will process these samples unless instructions are received from you indicating you do not wish to proceed. The absence of this summary table indicates that all samples have been received within the recommended holding times for the analysis requested.**
- Please be aware that APHA/NEPM recommends water and soil samples be chilled to less than or equal to 6°C for chemical analysis, and less than or equal to 10°C but unfrozen for Microbiological analysis. Where samples are received above this temperature, it should be taken into consideration when interpreting results. Refer to ALS EnviroMail 85 for ALS recommendations of the best practice for chilling samples after sampling and for maintaining a cool temperature during transit.

Sample Container(s)/Preservation Non-Compliances

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

- **No sample container / preservation non-compliance exists.**

Any sample identifications that cannot be displayed entirely in the analysis summary table will be listed below.

EM2408749-066 : [22-May-2024] : No sample ID or date

Summary of Sample(s) and Requested Analysis

Some items described below may be part of a laboratory process necessary for the execution of client requested tasks. Packages may contain additional analyses, such as the determination of moisture content and preparation tasks, that are included in the package.
If no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory and displayed in brackets without a time component

Matrix: **SOIL**

Laboratory sample ID	*Sampling date / time*	*Sample ID*	(On Hold) SOIL No analysis requested	SOIL - AG-1 EM Only Agricultural (CEC) Soil Suite 1 (pretest air dried)	SOIL - EA058 Emerson Aggregate Test
EM2408749-001	23-Apr-2024 00:00	BH01 0.1-0.2		✓	✓
EM2408749-002	23-Apr-2024 00:00	BH02 0.1-0.2		✓	✓
EM2408749-003	22-May-2024 00:00	BH03 0.0-0.1	✓		
EM2408749-004	22-May-2024 00:00	BH03 0.5-0.7	✓		
EM2408749-005	22-May-2024 00:00	BH03 2.2-2.45	✓		
EM2408749-006	22-May-2024 00:00	BH04 0.1-0.2		✓	✓
EM2408749-007	22-May-2024 00:00	BH04 0.5-0.95		✓	✓
EM2408749-008	22-May-2024 00:00	BH04 1.00-1.05		✓	✓
EM2408749-009	22-May-2024 00:00	BH04 1.05-1.20		✓	✓
EM2408749-010	22-May-2024 00:00	BH04 2.00-2.10		✓	✓
EM2408749-011	23-Apr-2024 00:00	BH05 0.1-0.2		✓	✓
EM2408749-012	22-May-2024 00:00	BH06 0.1-0.2	✓		
EM2408749-013	22-May-2024 00:00	BH06 0.5-0.8	✓		
EM2408749-014	22-May-2024 00:00	BH06 0.95-1.15	✓		
EM2408749-015	22-May-2024 00:00	BH07 0.1-0.2		✓	✓
EM2408749-016	22-May-2024 00:00	BH07 0.5-0.75		✓	✓
EM2408749-018	22-May-2024 00:00	BH09 0.1-0.2	✓		
EM2408749-019	22-May-2024 00:00	BH09 0.5-0.75	✓		
EM2408749-021	22-May-2024 00:00	BH10 0.5-0.65	✓		
EM2408749-023	22-May-2024 00:00	BH12 0.1-0.2		✓	✓
EM2408749-024	22-May-2024 00:00	BH12 0.5-0.75		✓	✓
EM2408749-025	22-May-2024 00:00	BH12 0.75-0.95		✓	✓
EM2408749-026	22-May-2024 00:00	BH12 1.00-1.4		✓	✓
EM2408749-027	22-May-2024 00:00	BH13 0.1-0.2	✓		
EM2408749-028	22-May-2024 00:00	BH13 0.6-0.75	✓		
EM2408749-029	22-May-2024 00:00	BH13 1.00-1.30	✓		
EM2408749-030	22-May-2024 00:00	BH13 2.10-2.20	✓		
EM2408749-031	23-May-2024 00:00	BH14 0.1-0.2		✓	✓
EM2408749-032	23-May-2024 00:00	BH14 0.5-0.75		✓	✓
EM2408749-033	23-May-2024 00:00	BH14 1.25-1.5		✓	✓
EM2408749-034	23-May-2024 00:00	BH14 2.00-2.25		✓	✓
EM2408749-035	23-May-2024 00:00	BH15 0.1-0.2		✓	✓
EM2408749-036	23-May-2024 00:00	BH15 0.5-0.75		✓	✓

			(On Hold) SOIL No analysis requested	SOIL - AG-1 EM Only Agricultural (CEC) Soil Suite 1 (pretest air dried)	SOIL - EA058 Emerson Aggregate Test
EM2408749-037	23-May-2024 00:00	BH15 1.00-1.35		✓	✓
EM2408749-038	23-May-2024 00:00	BH16 0.1-0.2		✓	✓
EM2408749-039	23-May-2024 00:00	BH16 0.6-0.85		✓	✓
EM2408749-040	23-May-2024 00:00	QA-01		✓	✓
EM2408749-041	23-May-2024 00:00	BH16 1.2-1.4	✓		
EM2408749-042	23-May-2024 00:00	BH16 2.35-2.45	✓		
EM2408749-043	23-May-2024 00:00	BH16 3.3-3.45	✓		
EM2408749-044	23-May-2024 00:00	BH17 0.1-0.2		✓	✓
EM2408749-045	23-May-2024 00:00	BH17 0.5-0.75		✓	✓
EM2408749-046	23-May-2024 00:00	BH17 2.00-2.25		✓	✓
EM2408749-047	23-May-2024 00:00	BH18 0.1-0.2	✓		
EM2408749-048	23-May-2024 00:00	BH18 1.00-1.25	✓		
EM2408749-049	23-May-2024 00:00	BH18 2.00-2.25	✓		
EM2408749-050	23-May-2024 00:00	BH18 3.00-3.25	✓		
EM2408749-051	23-May-2024 00:00	BH19 0.1-0.2	✓		
EM2408749-052	23-May-2024 00:00	BH19 0.6-0.75	✓		
EM2408749-053	23-May-2024 00:00	BH19 1.2-1.35	✓		
EM2408749-054	23-May-2024 00:00	BH20 0.1-0.2		✓	✓
EM2408749-055	23-May-2024 00:00	BH20 0.5-0.75		✓	✓
EM2408749-056	23-May-2024 00:00	BH20 0.95-1.45		✓	✓
EM2408749-058	22-May-2024 00:00	BH03 1.2-1.65	✓		
EM2408749-059	23-May-2024 00:00	BH08 0.1-0.2		✓	✓
EM2408749-060	22-May-2024 00:00	BH09 0.95-1.00	✓		
EM2408749-061	23-May-2024 00:00	BH10 0.5-0.65	✓		
EM2408749-062	22-May-2024 00:00	BH11 0.1-0 .2		✓	✓
EM2408749-063	22-May-2024 00:00	BH13 2.3-2.4	✓		
EM2408749-064	23-May-2024 00:00	BH17 1.1-1.25	✓		
EM2408749-065	23-May-2024 00:00	BH18 0.5-0.75	✓		
EM2408749-066	22-May-2024 00:00	No sample ID or date	✓		
EM2408749-067	23-May-2024 00:00	QA-03		✓	✓

Proactive Holding Time Report

The following table summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Client Sample ID(s)	Container	Due for extraction	Due for analysis	Samples Received		Instructions Received	
				Date	Evaluation	Date	Evaluation
EA002-AD: pH (1:5) on 40°C dried soil							
BH01 0.1-0.2	Soil Glass Jar - Unpreserved	30-Apr-2024	30-Apr-2024	24-May-2024	✘	----	----
BH02 0.1-0.2	Soil Glass Jar - Unpreserved	30-Apr-2024	30-Apr-2024	24-May-2024	✘	----	----
BH05 0.1-0.2	Soil Glass Jar - Unpreserved	30-Apr-2024	30-Apr-2024	24-May-2024	✘	----	----
EA010-AD: Electrical Conductivity (1:5) on 40°C dried soil							

BH01 0.1-0.2	Soil Glass Jar - Unpreserved	30-Apr-2024	28-May-2024	24-May-2024	✘	----	----
BH02 0.1-0.2	Soil Glass Jar - Unpreserved	30-Apr-2024	28-May-2024	24-May-2024	✘	----	----
BH05 0.1-0.2	Soil Glass Jar - Unpreserved	30-Apr-2024	28-May-2024	24-May-2024	✘	----	----
ED006: Exchangeable Cations on Alkaline Soils							
BH01 0.1-0.2	Soil Glass Jar - Unpreserved	21-May-2024	21-May-2024	24-May-2024	✘	----	----
BH02 0.1-0.2	Soil Glass Jar - Unpreserved	21-May-2024	21-May-2024	24-May-2024	✘	----	----
BH05 0.1-0.2	Soil Glass Jar - Unpreserved	21-May-2024	21-May-2024	24-May-2024	✘	----	----
ED007: Exchangeable Cations							
BH01 0.1-0.2	Soil Glass Jar - Unpreserved	21-May-2024	21-May-2024	24-May-2024	✘	----	----
BH02 0.1-0.2	Soil Glass Jar - Unpreserved	21-May-2024	21-May-2024	24-May-2024	✘	----	----
BH05 0.1-0.2	Soil Glass Jar - Unpreserved	21-May-2024	21-May-2024	24-May-2024	✘	----	----
ED008: Exchangeable Cations with pre-treatment							
BH01 0.1-0.2	Soil Glass Jar - Unpreserved	21-May-2024	21-May-2024	24-May-2024	✘	----	----
BH02 0.1-0.2	Soil Glass Jar - Unpreserved	21-May-2024	21-May-2024	24-May-2024	✘	----	----
BH05 0.1-0.2	Soil Glass Jar - Unpreserved	21-May-2024	21-May-2024	24-May-2024	✘	----	----

Requested Deliverables

ACCOUNT

- *AU Certificate of Analysis - NATA (COA)	Email	gld._dbd4e@wsp.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	gld._dbd4e@wsp.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	gld._dbd4e@wsp.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	gld._dbd4e@wsp.com
- Chain of Custody (CoC) (COC)	Email	gld._dbd4e@wsp.com
- EDI Format - ESDAT (ESDAT)	Email	gld._dbd4e@wsp.com

INVOICES

- A4 - AU Tax Invoice (INV)	Email	au.accountspayable@wsp.com

JIN-SOL LEE

- *AU Certificate of Analysis - NATA (COA)	Email	jin-sol.lee@wsp.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	jin-sol.lee@wsp.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	jin-sol.lee@wsp.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	jin-sol.lee@wsp.com
- Chain of Custody (CoC) (COC)	Email	jin-sol.lee@wsp.com
- EDI Format - ESDAT (ESDAT)	Email	jin-sol.lee@wsp.com

Inter-Laboratory Testing

Analysis conducted by ALS Brisbane, NATA accreditation no. 825, site no. 818 (Chemistry) 18958 (Biology).

(SOIL) EA058: Emerson Aggregate Test

CHAIN OF CUSTODY

ALS Environmental

ALS Laboratory: please tick →

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☐SYDNEY 277-289 Woodpark Road Smithfield NSW 2164 Ph: 02 8784 8555 E: samples.sydney@alsglobal.com
☐NOWRA 4/13 Geary Place North Nowra NSW 2541 Ph: 02 4423 2063 E: nowra@alsglobal.com
☐TOWNSVILLE 14-15 Desma Court Bohle QLD 4818 Ph: 07 4796 0600 E: townsville.environmental@alsglobal.com
☐PERTH 10 Hod Way Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsglobal.com
☐WOLLONGONG 99 Kenny Street Wollongong NSW 2500 Ph: 02 4225 3125 E: portkembla@alsglobal.com

CLIENT: WSP	TURNAROUND REQUIREMENTS : ✣ Standard TAT (List due date):	FOR LABORATORY USE ONLY (Circle)
OFFICE: Level 11, 567 Collins Street, Melbourne, 3000	(Standard TAT may be longer for some tests e.g., Ultra Trace Organics) ☐ Non Standard or urgent TAT (List due date):	Custody Seal Intact? Yes No N/A
PROJECT: PS211655 VPA Bannockburn South East	ALS QUOTE NO.:	Free Ice / frozen ice bricks present upon receipt? Yes No N/A
ORDER NUMBER:	COC SEQUENCE NUMBER (Circle) COC 1 2 3 4 5 6 7	Random Sample Temperature on Receipt: °C
PROJECT MANAGER: Jin-Sol Lee CONTACT PH: 0451058636	OF: 1 2 3 4 5 6 7	Other comment:
SAMPLER: Hannah James SAMPLER MOBILE: 0434394277	RELINQUISHED BY:	RECEIVED BY: CAITLIN (ALS)
COC emailed to ALS? YES EDD FORMAT (or default):	Jin-Sol Lee	DATE/TIME: 24/5/24 16:40
Email Reports to (will default to PM if no other addresses are listed): jin-sol.lee@wsp.com	DATE/TIME: 24/05/24	RELINQUISHED BY: DATE/TIME:
Email Invoice to (will default to PM if no other addresses are listed): accounts		

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

Environmental Division Melbourne
Work Order Reference
EM2408749

Telephone : + 61-3-8549 9600

ALS USE	SAMPLE DETAILS MATRIX: SOLID (S) WATER (W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suit price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).								
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE *(refer to codes below)*	TOTAL CONTAINERS	Emerson Dispersion Test (EA058)	AG-1 (pH, EC, Cations incl. ESP)	Hold						
1	BH01 0.1-0.2	22/05/2024	S		2	X	X							
2	BH02 0.1-0.2	22/05/2024	S		2	X	X							
3	BH03 0.0-0.1	22/05/2024	S		2			X						
4	BH03 0.5-0.7	22/05/2024	S		2			X						
5	BH03 2.2-2.45	22/05/2024	S		1			X						
6	BH04 0.1-0.2	22/05/2024	S		2	X	X							
7	BH04 0.5-0.95	22/05/2024	S		2	X	X							
8	BH04 1.00-1.05	22/05/2024	S		1	X	X							
9	BH04 1.05-1.20	22/05/2024	S		2	X	X							
10	BH04 2.00-2.10	22/05/2024	S		2	X	X							
11	BH05 0.1-0.2	22/05/2024	S		2	X	X							
12	BH06 0.1-0.2	22/05/2024	S		2			X						
13	BH06 0.5-0.8	22/05/2024	S		2			X						
14	BH06 0.95-1.15	22/05/2024	S		2			X						
15	BH07 0.1-0.2	22/05/2024	S		2	X	X							
16	BH07 0.5-0.75	22/05/2024	S		2	X	X							
				TOTAL										

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserve
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

CHAIN OF CUSTODY

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☐MELBOURNE 2-4 Westall Road Springvale VIC 3171 Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com
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☐NEWCASTLE 5/585 Maitland Rd Mayfield West NSW 2304 Ph: 02 4014 2500 E: samples.newcastle@alsglobal.com
☐NOWRA 4/19 Geary Place North Nowra NSW 2541 Ph: 024423 2063 E: nowra@alsglobal.com
☐PERTH 10 Hod Way Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsglobal.com
☐SYDNEY 277-289 Woodpark Road Smithfield NSW 2164 Ph: 02 8784 8555 E: samples.sydney@alsglobal.com
☐TOWNSVILLE 14-16 Desma Court Bohle QLD 4818 Ph: 07 4796 0600 E: townsville.environmental@alsglobal.com
☐WOLLONGONG 99 Kenny Street Wollongong NSW 2500 Ph: 02 4225 3125 E: portkembla@alsglobal.com

CLIENT: WSP	**TURNAROUND REQUIREMENTS :** (Standard TAT may be longer for some tests e.g., Ultra Trace Organics)	✠ Standard TAT (List due date):	**FOR LABORATORY USE ONLY (Circle)**
OFFICE: Level 11, 567 Collins Street, Melbourne, 3000		☐ Non Standard or urgent TAT (List due date):	Custody Seal Intact? Yes No N/A
PROJECT: PS211655 VPA Bannockburn South East	**ALS QUOTE NO.:**	**COC SEQUENCE NUMBER (Circle)**	Free ice / frozen ice bricks present upon receipt? Yes No N/A
ORDER NUMBER:		COC 1 2 3 4 5 6 7	Random Sample Temperature on Receipt: °C
PROJECT MANAGER: Jin-Sol Lee	**CONTACT PH:** 0451058636	OF: 1 2 3 4 5 6 7	Other comment:
SAMPLER: Hannah James	**SAMPLER MOBILE:** 0434394277	**RELINQUISHED BY:**	**RECEIVED BY:** CAITLIN (ALS)
COC emailed to ALS? YES	**EDD FORMAT (or default):**	Jin-Sol Lee	
Email Reports to (will default to PM if no other addresses are listed): jin-sol.lee@wsp.com		DATE/TIME: 24/05/24	DATE/TIME: 24/5/24 16:40
Email Invoice to (will default to PM if no other addresses are listed): accounts			

RELINQUISHED BY:	**RECEIVED BY:**
DATE/TIME:	DATE/TIME:

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE	SAMPLE DETAILS MATRIX: SOLID (S) WATER (W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where **Metals** are required, specify **Total** (unfiltered bottle required) or **Dissolved** (field filtered bottle required).								Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE *(refer to codes below)*	TOTAL CONTAINERS	Emerson Dispersion Test (EA058)	AG-1 (pH, EC, Cations incl. ESP)	Hold						Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
17	BH08 0.1-0.2	22/05/2024	S		2	X	X							
18	BH09 0.1-0.2	22/05/2024	S		2			X						
19	BH09 0.5-0.75	22/05/2024	S		2			X						
20	BH10 0.1-0.2	22/05/2024	S		2			X						
21	BH10 0.5-0.65	22/05/2024	S		2			X						
22	BH11 0.1-0.2	22/05/2024	S		2	X	X							
23	BH12 0.1-0.2	22/05/2024	S		2	X	X							
24	BH12 0.5-0.75	22/05/2024	S		1	X	X							
25	BH12 0.75-0.95	22/05/2024	S		2	X	X							
26	BH12 1.00-1.4	22/05/2024	S		2	X	X							
27	BH13 0.1-0.2	22/05/2024	S		2			X						
28	BH13 0.6-0.75	22/05/2024	S		2			X						
29	BH13 1.00-1.30	22/05/2024	S		2			X						
30	BH13 2.10-2.20	22/05/2024	S		1			X						
31	BH14 0.1-0.2	23/05/2024	S		2	X	X							
32	BH14 0.5-0.75	23/05/2024	S		2	X	X							
				TOTAL										

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

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☐PERTH 10 Hod Way Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsglobal.com
☐WOLLONGONG 99 Kenny Street Wollongong NSW 2500 Ph: 02 4225 3125 E: portkembla@alsglobal.com

CLIENT: WSP	TURNAROUND REQUIREMENTS : (Standard TAT may be longer for some tests e.g. Ultra Trace Organics)	✠ Standard TAT (List due date):
OFFICE: Level 11, 567 Collins Street, Melbourne, 3000		☐ Non Standard or urgent TAT (List due date):
PROJECT: PS211655 VPA Bannockburn South East	ALS QUOTE NO.:	COC SEQUENCE NUMBER (Circle): COC 1 2 3 4 5 6 7; OF: 1 2 3 4 5 6 7
ORDER NUMBER:		
PROJECT MANAGER: Jin-Sol Lee	CONTACT PH: 0451058636	
SAMPLER: Hannah James	SAMPLER MOBILE: 0434394277	
COC emailed to ALS? YES	EDD FORMAT (or default):	
Email Reports to (will default to PM if no other addresses are listed): jin-sol.lee@wsp.com		
Email Invoice to (will default to PM if no other addresses are listed): accounts		

FOR LABORATORY USE ONLY (Circle)

Custody Seal Intact?	Yes	No	N/A
Free ice / frozen ice bricks present upon receipt?	Yes	No	N/A
Random Sample Temperature on Receipt:		°C	
Other comment:			

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Jin-Sol Lee	CAITLIN (ALS)		
DATE/TIME: 24/05/24	DATE/TIME: 24/5/24 16:40	DATE/TIME:	DATE/TIME:

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE	SAMPLE DETAILS MATRIX: SOLID (S) WATER (W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).								Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE *(refer to codes below)*	TOTAL CONTAINERS	Emerson Dispersion Test (EA058)	AG-1 (pH, EC, Cations incl. ESP)	Hold						Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
33	BH14 1.25-1.5	23/05/2024	S		2	X	X							
34	BH14 2.00-2.25	23/05/2024	S		2	X	X							
35	BH15 0.1-0.2	23/05/2024	S		2	X	X							
36	BH15 0.5-0.75	23/05/2024	S		2	X	X							
37	BH15 1.00-1.35	23/05/2024	S		2	X	X							
38	BH16 0.1-0.2	23/05/2024	S		2	X	X							
39	BH16 0.6-0.85	23/05/2024	S		2	X	X							
40	QA-01	23/05/2024	S		2	X	X							
41	BH16 1.2-1.4	23/05/2024	S		2			X						
42	BH16 2.35-2.45	23/05/2024	S		2			X						
43	BH16 3.3-3.45	23/05/2024	S		2			X						
44	BH17 0.1-0.2	23/05/2024	S		2	X	X							
45	BH17 0.5-0.75	23/05/2024	S		2	X	X							
46	BH17 2.00-2.25	23/05/2024	S		2	X	X							
47	BH18 0.1-0.2	23/05/2024	S		2			X						
48	BH18 1.00-1.25	23/05/2024	S		2			X						
				TOTAL										

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserve
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

CHAIN OF CUSTODY

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ALS Laboratory: please tick →

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☐MELBOURNE 2-4 Westall Road Springvale VIC 3171 Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com
☐MUDGEE 27 Sydney Road Mudgee NSW 2850 Ph: 02 6372 6735 E: mudgee.mail@alsglobal.com
☐NEWCASTLE 5/585 Maitland Rd Mayfield West NSW 2304 Ph: 02 4014 2500 E: samples.newcastle@alsglobal.com
☐NOWRA 4/13 Geary Place North Nowra NSW 2541 Ph: 024423 2063 E: nowra@alsglobal.com
☐PERTH 10 Hod Way Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsglobal.com
☐SYDNEY 277-289 Woodpark Road Smithfield NSW 2164 Ph: 02 8784 8555 E: samples.sydney@alsglobal.com
☐TOWNSVILLE 14-15 Desma Court Bohle QLD 4818 Ph: 07 4796 0600 E: townsville.environmental@alsglobal.com
☐WOLLONGONG 99 Kenny Street Wollongong NSW 2500 Ph: 02 4225 3125 E: portkembla@alsglobal.com

CLIENT: WSP	**TURNAROUND REQUIREMENTS :** ✠ Standard TAT (List due date):	**FOR LABORATORY USE ONLY (Circle)**	
OFFICE: Level 11, 567 Collins Street, Melbourne, 3000	(Standard TAT may be longer for some tests e.g. Ultra Trace Organics) ☐ Non Standard or urgent TAT (List due date):	Custody Seal Intact?	Yes / No / N/A
PROJECT: PS211655 VPA Bannockburn South East	**ALS QUOTE NO.:**	Free ice / frozen ice bricks present upon receipt?	Yes / No / N/A
ORDER NUMBER:	COC SEQUENCE NUMBER (Circle) COC 1 2 3 4 5 6 7	Random Sample Temperature on Receipt:	°C
PROJECT MANAGER: Jin-Sol Lee	**CONTACT PH:** 0451058636 OF: 1 2 3 4 5 6 7	Other comment:	
SAMPLER: Hannah James	**SAMPLER MOBILE:** 0434394277	**RELINQUISHED BY:**	**RECEIVED BY:** CAITLIN (ALS)
COC emailed to ALS? YES	**EDD FORMAT (or default):**	*Jin-Sol Lee*	
Email Reports to (will default to PM if no other addresses are listed): **jin-sol.lee@wsp.com**		DATE/TIME: 24/05/24	DATE/TIME: 24/5/24 16:40
Email Invoice to (will default to PM if no other addresses are listed): accounts		**RELINQUISHED BY:** DATE/TIME:	**RECEIVED BY:** DATE/TIME:

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE	SAMPLE DETAILS MATRIX: SOLID (S) WATER (W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where **Metals** are required, specify **Total** (unfiltered bottle required) or **Dissolved** (field filtered bottle required).								Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE *(refer to codes below)*	TOTAL CONTAINERS	Emerson Dispersion Test (EA058)	AG-1 (pH, EC, Cations incl. ESP)	Hold						Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
49	BH18 2.00-2.25	23/05/2024	S		2			X						
50	BH18 3.00-3.25	23/05/2024	S		2			X						
51	BH19 0.1-0.2	23/05/2024	S		2			X						
52	BH19 0.6-0.75	23/05/2024	S		2			X						
53	BH19 1.2-1.35	23/05/2024	S		2			X						
54	BH20 0.1-0.2	23/05/2024	S		2	X	X							
55	BH20 0.5-0.75	23/05/2024	S		2	X	X							
56	BH20 0.95-1.45	23/05/2024	S		2	X	X							
57	QA-04	23/05/2024	S		2	X	X							
				TOTAL										

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

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☐MACKAY 78 Harbour Road Mackay QLD 4740 Ph: 07 4944 0177 E: mackay@alsglobal.com
☐MELBOURNE 2-4 Westall Road Springvale VIC 3171 Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com
☐MUDGEE 27 Sydney Road Mudgee NSW 2850 Ph: 02 6372 6735 E: mudgee.mail@alsglobal.com
☐NEWCASTLE 5/585 Maitland Rd Mayfield West NSW 2304 Ph: 02 4014 2500 E: samples.newcastle@alsglobal.com
☐NOWRA 4/13 Geary Place North Nowra NSW 2541 Ph: 024423 2063 E: nowra@alsglobal.com
☐PERTH 10 Hod Way Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsglobal.com
☐SYDNEY 277-289 Woodpark Road Smithfield NSW 2164 Ph: 02 8784 8555 E: samples.sydney@alsglobal.com
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☐WOLLONGONG 99 Kenny Street Wollongong NSW 2500 Ph: 02 4225 3125 E: portkembla@alsglobal.com

CLIENT: WSP	**TURNAROUND REQUIREMENTS :** ✠ Standard TAT (List due date):	**FOR LABORATORY USE ONLY (Circle)**	
OFFICE: Level 11, 567 Collins Street, Melbourne, 3000	(Standard TAT may be longer for some tests e.g. Ultra Trace Organics) ☐ Non Standard or urgent TAT (List due date):	Custody Seal Intact?	Yes / No / N/A
PROJECT: PS211655 VPA Bannockburn South East	**ALS QUOTE NO.:**	Free ice / frozen ice bricks present upon receipt?	Yes / No / N/A
ORDER NUMBER:	COC SEQUENCE NUMBER (Circle) COC: 1 2 3 4 5 6 7	Random Sample Temperature on Receipt:	°C
PROJECT MANAGER: Jin-Sol Lee — **CONTACT PH:** 0451058636	OF: 1 2 3 4 5 6 7	Other comment:	
SAMPLER: Hannah James — **SAMPLER MOBILE:** 0434394277	**RELINQUISHED BY:**	**RECEIVED BY:**	**RELINQUISHED BY:**
COC emailed to ALS? YES — **EDD FORMAT (or default):**	Jin-Sol Lee	CAITLIN (ALS)	
Email Reports to (will default to PM if no other addresses are listed): jin-sol.lee@wsp.com	DATE/TIME:	DATE/TIME:	DATE/TIME:
Email Invoice to (will default to PM if no other addresses are listed): accounts	24/05/24	24/5/24 16:40	

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

Environmental Division Melbourne
Work Order Reference
EM2408749

Telephone : +61-3-8549 9600

ALS USE	SAMPLE DETAILS MATRIX: SOLID (S) WATER (W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suit price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).								
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE *(refer to codes below)*	TOTAL CONTAINERS	Emerson Dispersion Test (EA058)	AG-1 (pH, EC, Cations incl. ESP)	Hold						
1	BH01 0.1-0.2	23/5 22/05/2024	S		2	X	X							
2	BH02 0.1-0.2	23/5 22/05/2024	S		2	X	X							
3	BH03 0.0-0.1	22/05/2024	S		2			X						
4	BH03 0.5-0.7	22/05/2024	S		2			X						
5	BH03 2.2-2.45 2.2-2.47	22/05/2024	S		1			X						
6	BH04 0.1-0.2	22/05/2024	S		2	X	X							
7	BH04 0.5-0.95 0.5-0.75	22/05/2024	S		2	X	X							
8	BH04 1.00-1.05	22/05/2024	S		1	X	X							
9	BH04 1.05-1.20	22/05/2024	S		2	X	X							
10	BH04 2.00-2.10	22/05/2024	S		2	X	X							
11	BH05 0.1-0.2	23/5 22/05/2024	S		2	X	X							
12	BH06 0.1-0.2	22/05/2024	S		2			X						
13	BH06 0.5-0.8	22/05/2024	S		2			X						
14	BH06 0.95-1.15 0.95-1.00	22/05/2024	S		2			X						
15	BH07 0.1-0.2	22/05/2024	S		2	X	X							
16	BH07 0.5-0.75	22/05/2024	S		2	X	X							
				TOTAL										

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserve
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

CHAIN OF CUSTODY

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ALS Laboratory: please tick →

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BRISBANE 32 Shand Street Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com
GLADSTONE 46 Callemondah Drive Clinton QLD 4680 Ph: 07 7471 5600 E: gladstone@alsglobal.com
MACKAY 78 Harbour Road Mackay QLD 4740 Ph: 07 4944 0177 E: mackay@alsglobal.com
MELBOURNE 2-4 Westall Road Springvale VIC 3171 Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com
MUDGEE 27 Sydney Road Mudgee NSW 2850 Ph: 02 6372 6735 E: mudgee mail@alsglobal.com
NEWCASTLE 5/585 Maitland Rd Mayfield West NSW 2304 Ph: 02 4014 2500 E: samples.newcastle@alsglobal.com
NOWRA 4/13 Geary Place North Nowra NSW 2541 Ph: 024425 2063 E: nowra@alsglobal.com
PERTH 10 Hod Way Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsglobal.com
SYDNEY 277-289 Woodpark Road Smithfield NSW 2164 Ph: 02 8784 8555 E: samples.sydney@alsglobal.com
TOWNSVILLE 14-15 Desma Court Bohle QLD 4818 Ph: 07 4796 0600 E: townsville environmental@alsglobal.com
WOLLONGONG 99 Kenny Street Wollongong NSW 2500 Ph: 02 4225 3125 E: portkembla@alsglobal.com

CLIENT: WSP	TURNAROUND REQUIREMENTS : ✠ Standard TAT (List due date):	FOR LABORATORY USE ONLY (Circle)	
OFFICE: Level 11, 567 Collins Street, Melbourne, 3000	(Standard TAT may be longer for some tests e.g. Ultra Trace Organics) ☐ Non Standard or urgent TAT (List due date):	Custody Seal Intact?	Yes No N/A
PROJECT: PS211655 VPA Bannockburn South East	ALS QUOTE NO.:	Free ice / frozen ice bricks present upon receipt?	Yes No N/A
ORDER NUMBER:	COC SEQUENCE NUMBER (Circle) COC 1 2 3 4 5 6 7	Random Sample Temperature on Receipt:	°C
PROJECT MANAGER: Jin-Sol Lee CONTACT PH: 0451058636	OF: 1 2 3 4 5 6 7	Other comment:	
SAMPLER: Hannah James SAMPLER MOBILE: 0434394277	RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY: / RECEIVED BY:
COC emailed to ALS? YES EDD FORMAT (or default):	Jin-Sol Lee	CAITLIN (ALS)	
Email Reports to (will default to PM if no other addresses are listed): jin-sol.lee@wsp.com	DATE/TIME: 24/05/24	DATE/TIME: 24/5/24 16:40	DATE/TIME: / DATE/TIME:
Email Invoice to (will default to PM if no other addresses are listed): accounts			

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE	SAMPLE DETAILS MATRIX: SOLID (S) WATER (W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).								Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE *(refer to codes below)*	TOTAL CONTAINERS	Emerson Dispersion Test (EA058)	AG-1 (pH, EC, Cations incl. ESP)	Hold						Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
17	BH08 0.1-0.2 NR	22/05/2024	S		2	X	X							
18	BH09 0.1-0.2	22/05/2024	S		2			X						
19	BH09 0.5-0.75 0.5 -	22/05/2024	S		2			X						
20	BH10 0.1-0.2 NR	22/05/2024	S		2			X						
21	BH10 0.5-0.65	22/05/2024	S		1 2			X						
22	BH11 0.1-0.2 NR	22/05/2024	S		2	X	X							
23	BH12 0.1-0.2	22/05/2024	S		2	X	X							
24	BH12 0.5-0.75	22/05/2024	S		2 1	X	X							
25	BH12 0.75-0.95	22/05/2024	S		1 2	X	X							
26	BH12 1.00-1.4	22/05/2024	S		2	X	X							
27	BH13 0.1-0.2	22/05/2024	S		2			X						
28	BH13 0.6-0.75	22/05/2024	S		2			X						
29	BH13 1.00-1.30	22/05/2024	S		2			X						
30	BH13 2.10-2.20	22/05/2024	S		1			X						
31	BH14 0.1-0.2	23/05/2024	S		2	X	X							
32	BH14 0.5-0.75	23/05/2024	S		2	X	X							
				TOTAL										

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

CHAIN OF CUSTODY

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MACKAY 78 Harbour Road Mackay QLD 4740 Ph: 07 4944 0177 E: mackay@alsglobal.com
MELBOURNE 24 Westall Road Springvale VIC 3171 Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com
MUDGEE 27 Sydney Road Mudgee NSW 2850 Ph: 02 6370 6735 E: mudgee.mail@alsglobal.com
NEWCASTLE 5585 Maitland Rd Mayfield West NSW 2304 Ph: 02 4014 2500 E: samples.newcastle@alsglobal.com
NOWRA 4/15 Geary Place North Nowra NSW 2541 Ph: 02 4423 2063 E: nowra@alsglobal.com
PERTH 10 Hod Way Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsglobal.com
SYDNEY 277-289 Woodpark Road Smithfield NSW 2164 Ph: 02 8784 8555 E: samples.sydney@alsglobal.com
TOWNSVILLE 14-15 Desma Court Bohle QLD 4818 Ph: 07 4796 0600 E: townsville.environmental@alsglobal.com
WOLLONGONG 99 Kenny Street Wollongong NSW 2500 Ph: 02 4225 3125 E: wollongong@alsglobal.com

CLIENT: WSP	**TURNAROUND REQUIREMENTS :** (Standard TAT may be longer for some tests e.g. Ultra Trace Organics)	✻ Standard TAT (List due date):	**FOR LABORATORY USE ONLY (Circle)**
OFFICE: Level 11, 567 Collins Street, Melbourne, 3000		☐ Non Standard or urgent TAT (List due date):	Custody Seal Intact? Yes No N/A
PROJECT: PS211655 VPA Bannockburn South East	**ALS QUOTE NO.:**	**COC SEQUENCE NUMBER (Circle)**	Free ice / frozen ice bricks present upon receipt? Yes No N/A
ORDER NUMBER:		COC 1 2 3 4 5 6 7	Random Sample Temperature on Receipt: °C
PROJECT MANAGER: Jin-Sol Lee	**CONTACT PH:** 0451058636	OF: 1 2 3 4 5 6 7	Other comment:
SAMPLER: Hannah James	**SAMPLER MOBILE:** 0434394277	**RELINQUISHED BY:**	**RECEIVED BY:** CAITLIN (ALS)
COC emailed to ALS? YES	**EDD FORMAT (or default):**	*Jin-Sol Lee*	
Email Reports to (will default to PM if no other addresses are listed): jin-sol.lee@wsp.com		DATE/TIME: 24/05/24	DATE/TIME: 24/5/24 16:40
Email Invoice to (will default to PM if no other addresses are listed): accounts			

RELINQUISHED BY:	**RECEIVED BY:**
DATE/TIME:	DATE/TIME:

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE	SAMPLE DETAILS MATRIX: SOLID (S) WATER (W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).								Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE *(refer to codes below)*	TOTAL CONTAINERS	Emerson Dispersion Test (EA058)	AG-1 (pH, EC, Cations incl. ESP)	Hold						Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
33	BH14 1.25-1.5	23/05/2024	S		2	X	X							
34	BH14 2.00-2.25	23/05/2024	S		2	X	X							
35	BH15 0.1-0.2	23/05/2024	S		2	X	X							
36	BH15 0.5-0.75	23/05/2024	S		2	X	X							
37	BH15 1.00-1.35	23/05/2024	S		2	X	X							
38	BH16 0.1-0.2	23/05/2024	S		2	X	X							
39	BH16 0.6-0.85	23/05/2024	S		2	X	X							
40	QA-01	23/05/2024	S		2	X	X							
41	BH16 1.2-1.4	23/05/2024	S		2			X						
42	BH16 2.35-2.45	23/05/2024	S		2			X						
43	BH16 3.3-3.45	23/05/2024	S		2			X						
44	BH17 0.1-0.2	23/05/2024	S		2	X	X							
45	BH17 0.5-0.75	23/05/2024	S		2	X	X							
46	BH17 2.00-2.25	23/05/2024	S		2	X	X							
47	BH18 0.1-0.2	23/05/2024	S		2			X						
48	BH18 1.00-1.25	23/05/2024	S		2			X						
				TOTAL										

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved
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ALS Environmental

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ALS Laboratory: please tick →

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☐SYDNEY 277-289 Woodpark Road Smithfield NSW 2164 Ph: 02 8784 8555 E: samples.sydney@alsglobal.com
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ORDER NUMBER:		OF: 1 2 3 4 5 6 7	Random Sample Temperature on Receipt: °C
PROJECT MANAGER: Jin-Sol Lee	CONTACT PH: 0451058636		Other comment:
SAMPLER: Hannah James	SAMPLER MOBILE: 0434394277	RELINQUISHED BY: Jin-Sol Lee	RECEIVED BY: CAITLIN (ALS)
COC emailed to ALS? YES	EDD FORMAT (or default):	DATE/TIME: 24/05/24	DATE/TIME: 24/5/24 16:40
Email Reports to (will default to PM if no other addresses are listed): jin-sol.lee@wsp.com		RELINQUISHED BY:	RECEIVED BY:
Email Invoice to (will default to PM if no other addresses are listed): accounts		DATE/TIME:	DATE/TIME:

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE	SAMPLE DETAILS MATRIX: SOLID (S) WATER (W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).								Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL CONTAINERS	Emerson Dispersion Test (EA038)	AG-1 (pH, EC, Cations incl. ESP)	Hold						Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
49	BH18 2.00-2.25	23/05/2024	S		2			X						
50	BH18 3.00-3.25	23/05/2024	S		2			X						
51	BH19 0.1-0.2	23/05/2024	S		2			X						
52	BH19 0.6-0.75	23/05/2024	S		2			X						
53	BH19 1.2-1.35	23/05/2024	S		2			X						
54	BH20 0.1-0.2	23/05/2024	S		2	X	X							
55	BH20 0.5-0.75	23/05/2024	S		2	X	X							
56	BH20 0.95-1.45	23/05/2024	S		2	X	X							
57	QA-04 NR	23/05/2024	S		2	X	X							
58	BH03 1.2-1.65	22/5/24	S											
59	BH08 0.25-0.35	23/5/24	S											
60	BH09 0.95-1.00	22/5/24	S											
61	BH10 0.5-0.65	23/5/24	S											
62	BH11 0.25-0.5	22/5/24	S											
63	BH13 2.3-2.4	22/5/24	S											
64	BH17 1.1-1.25	23/5/24	S											
				TOTAL										

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
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65 BH18 0.5-0.75 23/5/24 S 66 No sample ID or date. 67 QA-03 23/5/24

CERTIFICATE OF ANALYSIS

Work Order	: **EM2408749**	Page	: 1 of 10
Client	: **WSP Australia Pty Ltd**	Laboratory	: Environmental Division Melbourne
Contact	: JIN-SOL LEE	Contact	: Josh Alexander
Address	: Level 11 567 Collins Street Melbourne VIC, AUSTRALIA 3000	Address	: 4 Westall Rd Springvale VIC Australia 3171
Telephone	: ----	Telephone	: +61-3-8549 9600
Project	: PS211655 VPA Bannockburn South East	Date Samples Received	: 24-May-2024 16:40
Order number	: PS211655	Date Analysis Commenced	: 29-May-2024
C-O-C number	: ----	Issue Date	: 11-Jun-2024 15:17
Sampler	: Hannah James		
Site	: ----		
Quote number	: EN/000		
No. of samples received	: 63		
No. of samples analysed	: 33		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Eric Chau	Metals Team Leader	Melbourne Inorganics, Springvale, VIC
Layla Hafner	Acid Sulphate Soils - Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- Sample 017, 020, 022, 057 - NR
- Sample 021 only received one sample
- ALS is not NATA accredited for the analysis of Exchangeable Cations on Alkaline Soils when performed under ALS Method ED006.
- EA058 Emerson: V. = Very, D. = Dark, L. = Light, VD. = Very Dark
- ED007 and ED008: When Exchangeable Al is reported from these methods, it should be noted that Rayment & Lyons (2011) suggests Exchange Acidity by 1M KCl - Method 15G1 (ED005) is a more suitable method for the determination of exchange acidity (H+ + Al3+).

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH01 0.1-0.2	BH02 0.1-0.2	BH04 0.1-0.2	BH04 0.5-0.95	BH04 1.00-1.05
			Sampling date / time	23-Apr-2024 00:00	23-Apr-2024 00:00	22-May-2024 00:00	22-May-2024 00:00	22-May-2024 00:00
Compound	CAS Number	LOR	Unit	EM2408749-001	EM2408749-002	EM2408749-006	EM2408749-007	EM2408749-008
				Result	Result	Result	Result	Result
EA002-AD: pH (Soils) dried at 40°C								
pH Value	----	0.1	pH Unit	6.3	6.3	6.1	9.4	7.6
EA010-AD: Conductivity (Soils) dried at 40°C								
Electrical Conductivity @ 25°C	----	1	µS/cm	137	115	108	651	486
EA058: Emerson Aggregate Test								
Color (Munsell)	----	-	-	Brown (7.5YR 4/3)	Dark Reddish Gray (2.5YR 4/1)	Very Dark Gray (7.5YR 3/1)	Light Brown (7.5YR 6/3)	Dark Reddish Gray (2.5YR 4/1)
Texture	----	-	-	Sandy Loam	Light Medium Clay	Silty Loam	Medium Heavy Clay	Medium Clay
Emerson Class Number	EC/TC	-	-	7	7	3	2	2
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	----	----	----	5.6	7.2
ø Exchangeable Magnesium	----	0.2	meq/100g	----	----	----	16.1	6.1
ø Exchangeable Potassium	----	0.2	meq/100g	----	----	----	0.5	0.7
ø Exchangeable Sodium	----	0.2	meq/100g	----	----	----	5.9	1.8
ø Cation Exchange Capacity	----	0.2	meq/100g	----	----	----	28.2	15.8
ø Exchangeable Calcium Percent	----	0.2	%	----	----	----	19.9	45.7
ø Exchangeable Magnesium Percent	----	0.2	%	----	----	----	57.3	38.4
ø Exchangeable Potassium Percent	----	0.2	%	----	----	----	1.8	4.5
ø Exchangeable Sodium Percent	----	0.2	%	----	----	----	21.0	11.3
ø Calcium/Magnesium Ratio	----	0.2	-	----	----	----	0.3	1.2
ø Magnesium/Potassium Ratio	----	0.2	-	----	----	----	32.1	8.5
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	4.4	13.5	7.6	----	----
Exchangeable Magnesium	----	0.1	meq/100g	2.4	8.0	4.7	----	----
Exchangeable Potassium	----	0.1	meq/100g	0.4	0.4	0.9	----	----
Exchangeable Sodium	----	0.1	meq/100g	0.2	0.5	0.9	----	----
Cation Exchange Capacity	----	0.1	meq/100g	7.4	22.4	14.1	----	----
Exchangeable Sodium Percent	----	0.1	%	3.0	2.3	6.7	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH04 1.05-1.20	BH04 2.00-2.10	BH05 0.1-0.2	BH07 0.1-0.2	BH07 0.5-0.75
			Sampling date / time	22-May-2024 00:00	22-May-2024 00:00	23-Apr-2024 00:00	22-May-2024 00:00	22-May-2024 00:00
Compound	CAS Number	LOR	Unit	EM2408749-009	EM2408749-010	EM2408749-011	EM2408749-015	EM2408749-016
				Result	Result	Result	Result	Result
EA002-AD: pH (Soils) dried at 40°C								
pH Value	----	0.1	pH Unit	9.6	9.7	6.2	6.3	9.3
EA010-AD: Conductivity (Soils) dried at 40°C								
Electrical Conductivity @ 25°C	----	1	µS/cm	648	577	180	191	657
EA058: Emerson Aggregate Test								
Color (Munsell)	----	-	-	Brown (10YR 5/3)	Brown (7.5YR 5/2)	Dark Reddish Brown (5YR 3/3)	Dark Gray (5YR 4/1)	Pinkish Gray (7.5YR 6/2)
Texture	----	-	-	Light Clay	Light Clay	Medium Clay	Medium Clay	Medium Heavy Clay
Emerson Class Number	EC/TC	-	-	2	1	7	2	2
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	4.2	2.7	----	----	8.2
ø Exchangeable Magnesium	----	0.2	meq/100g	14.2	14.7	----	----	15.3
ø Exchangeable Potassium	----	0.2	meq/100g	0.5	0.7	----	----	0.5
ø Exchangeable Sodium	----	0.2	meq/100g	6.5	8.8	----	----	6.0
ø Cation Exchange Capacity	----	0.2	meq/100g	25.5	26.9	----	----	29.9
ø Exchangeable Calcium Percent	----	0.2	%	16.7	10.0	----	----	27.3
ø Exchangeable Magnesium Percent	----	0.2	%	56.0	54.7	----	----	51.0
ø Exchangeable Potassium Percent	----	0.2	%	1.9	2.5	----	----	1.7
ø Exchangeable Sodium Percent	----	0.2	%	25.4	32.8	----	----	20.0
ø Calcium/Magnesium Ratio	----	0.2	-	0.3	<0.2	----	----	0.5
ø Magnesium/Potassium Ratio	----	0.2	-	30.1	22.2	----	----	29.7
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	----	----	11.1	6.4	----
Exchangeable Magnesium	----	0.1	meq/100g	----	----	9.4	6.8	----
Exchangeable Potassium	----	0.1	meq/100g	----	----	0.7	1.0	----
Exchangeable Sodium	----	0.1	meq/100g	----	----	0.4	1.7	----
Cation Exchange Capacity	----	0.1	meq/100g	----	----	21.6	15.8	----
Exchangeable Sodium Percent	----	0.1	%	----	----	1.8	10.6	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH12 0.1-0.2	BH12 0.5-0.75	BH12 0.75-0.95	BH12 1.00-1.4	BH14 0.1-0.2
			Sampling date / time	22-May-2024 00:00	22-May-2024 00:00	22-May-2024 00:00	22-May-2024 00:00	23-May-2024 00:00
Compound	CAS Number	LOR	Unit	EM2408749-023	EM2408749-024	EM2408749-025	EM2408749-026	EM2408749-031
				Result	Result	Result	Result	Result
EA002-AD: pH (Soils) dried at 40°C								
pH Value	----	0.1	pH Unit	6.1	9.2	9.5	9.4	6.3
EA010-AD: Conductivity (Soils) dried at 40°C								
Electrical Conductivity @ 25°C	----	1	µS/cm	300	599	589	698	66
EA058: Emerson Aggregate Test								
Color (Munsell)	----	-	-	Dark Reddish Gray (5YR 4/2)	Brown (7.5YR 5/3)	Pale Brown (10YR 6/3)	Light Brownish Gray (10YR 6/2)	Brown (7.5YR 5/3)
Texture	----	-	-	Sandy Loam	Medium Heavy Clay	Medium Heavy Clay	Medium Heavy Clay	Loamy Sand
Emerson Class Number	EC/TC	-	-	7	1	1	2	2
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	----	3.8	4.4	4.1	----
ø Exchangeable Magnesium	----	0.2	meq/100g	----	10.1	12.3	12.7	----
ø Exchangeable Potassium	----	0.2	meq/100g	----	0.6	0.6	0.6	----
ø Exchangeable Sodium	----	0.2	meq/100g	----	5.0	6.2	6.8	----
ø Cation Exchange Capacity	----	0.2	meq/100g	----	19.6	23.6	24.2	----
ø Exchangeable Calcium Percent	----	0.2	%	----	19.7	18.6	16.9	----
ø Exchangeable Magnesium Percent	----	0.2	%	----	51.7	52.2	52.3	----
ø Exchangeable Potassium Percent	----	0.2	%	----	2.9	2.7	2.7	----
ø Exchangeable Sodium Percent	----	0.2	%	----	25.7	26.5	28.1	----
ø Calcium/Magnesium Ratio	----	0.2	-	----	0.4	0.4	0.3	----
ø Magnesium/Potassium Ratio	----	0.2	-	----	17.8	19.1	19.4	----
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	3.3	----	----	----	2.3
Exchangeable Magnesium	----	0.1	meq/100g	1.1	----	----	----	0.4
Exchangeable Potassium	----	0.1	meq/100g	0.3	----	----	----	<0.1
Exchangeable Sodium	----	0.1	meq/100g	0.6	----	----	----	<0.1
Cation Exchange Capacity	----	0.1	meq/100g	5.3	----	----	----	2.9
Exchangeable Sodium Percent	----	0.1	%	11.0	----	----	----	2.0

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH14 0.5-0.75	BH14 1.25-1.5	BH14 2.00-2.25	BH15 0.1-0.2	BH15 0.5-0.75
			Sampling date / time	23-May-2024 00:00	23-May-2024 00:00	23-May-2024 00:00	23-May-2024 00:00	23-May-2024 00:00
Compound	CAS Number	LOR	Unit	EM2408749-032	EM2408749-033	EM2408749-034	EM2408749-035	EM2408749-036
				Result	Result	Result	Result	Result
EA002-AD: pH (Soils) dried at 40°C								
pH Value	----	0.1	pH Unit	6.1	6.8	7.6	6.3	7.1
EA010-AD: Conductivity (Soils) dried at 40°C								
Electrical Conductivity @ 25°C	----	1	µS/cm	29	165	128	63	293
EA058: Emerson Aggregate Test								
Color (Munsell)	----	-	-	Brown (7.5YR 4/4)	Strong Brown (7.5YR 5/6)	Strong Brown (7.5YR 5/6)	Dark Gray (5YR 4/1)	Light Brownish Gray (10YR 6/2)
Texture	----	-	-	Sandy Loam	Sandy Clay Loam	Sandy Loam	Sandy Clay Loam	Medium Heavy Clay
Emerson Class Number	EC/TC	-	-	3	1	1	2	1
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	----	----	1.1	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	----	----	3.4	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	----	----	<0.2	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	----	----	1.5	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	----	----	6.2	----	----
ø Exchangeable Calcium Percent	----	0.2	%	----	----	17.6	----	----
ø Exchangeable Magnesium Percent	----	0.2	%	----	----	54.8	----	----
ø Exchangeable Potassium Percent	----	0.2	%	----	----	3.1	----	----
ø Exchangeable Sodium Percent	----	0.2	%	----	----	24.5	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	----	----	0.3	----	----
ø Magnesium/Potassium Ratio	----	0.2	-	----	----	<0.2	----	----
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	1.3	2.8	----	3.4	4.8
Exchangeable Magnesium	----	0.1	meq/100g	0.2	8.5	----	1.0	14.7
Exchangeable Potassium	----	0.1	meq/100g	<0.1	0.3	----	0.2	0.7
Exchangeable Sodium	----	0.1	meq/100g	<0.1	2.9	----	0.3	6.9
Cation Exchange Capacity	----	0.1	meq/100g	1.7	14.4	----	4.8	27.1
Exchangeable Sodium Percent	----	0.1	%	5.1	20.0	----	5.7	25.4

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH15 1.00-1.35	BH16 0.1-0.2	BH16 0.6-0.85	QA-01	BH17 0.1-0.2
			Sampling date / time	23-May-2024 00:00	23-May-2024 00:00	23-May-2024 00:00	23-May-2024 00:00	23-May-2024 00:00
Compound	CAS Number	LOR	Unit	EM2408749-037	EM2408749-038	EM2408749-039	EM2408749-040	EM2408749-044
				Result	Result	Result	Result	Result
EA002-AD: pH (Soils) dried at 40°C								
pH Value	----	0.1	pH Unit	7.5	6.1	8.7	8.5	5.8
EA010-AD: Conductivity (Soils) dried at 40°C								
Electrical Conductivity @ 25°C	----	1	µS/cm	338	268	886	560	204
EA058: Emerson Aggregate Test								
Color (Munsell)	----	-	-	Pale Brown (10YR 6/3)	Dark Gray (7.5YR 4/1)	Dark Gray (10YR 4/1)	Gray (7.5YR 5/1)	Grayish Brown (10YR 5/2)
Texture	----	-	-	Medium Heavy Clay	Silty Loam	Heavy Clay	Heavy Clay	Silty Clay Loam
Emerson Class Number	EC/TC	-	-	1	3	2	2	3
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	3.4	----	5.2	5.8	----
ø Exchangeable Magnesium	----	0.2	meq/100g	9.2	----	12.5	11.7	----
ø Exchangeable Potassium	----	0.2	meq/100g	0.5	----	0.6	0.7	----
ø Exchangeable Sodium	----	0.2	meq/100g	3.8	----	4.4	7.6	----
ø Cation Exchange Capacity	----	0.2	meq/100g	16.9	----	22.6	25.8	----
ø Exchangeable Calcium Percent	----	0.2	%	20.4	----	22.9	22.4	----
ø Exchangeable Magnesium Percent	----	0.2	%	54.4	----	55.2	45.5	----
ø Exchangeable Potassium Percent	----	0.2	%	2.9	----	2.5	2.8	----
ø Exchangeable Sodium Percent	----	0.2	%	22.3	----	19.4	29.4	----
ø Calcium/Magnesium Ratio	----	0.2	-	0.4	----	0.4	0.5	----
ø Magnesium/Potassium Ratio	----	0.2	-	18.8	----	22.1	16.3	----
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	----	7.3	----	----	6.4
Exchangeable Magnesium	----	0.1	meq/100g	----	5.0	----	----	3.8
Exchangeable Potassium	----	0.1	meq/100g	----	0.8	----	----	0.5
Exchangeable Sodium	----	0.1	meq/100g	----	1.1	----	----	1.4
Cation Exchange Capacity	----	0.1	meq/100g	----	14.2	----	----	12.2
Exchangeable Sodium Percent	----	0.1	%	----	7.8	----	----	11.7

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH17 0.5-0.75	BH17 2.00-2.25	BH20 0.1-0.2	BH20 0.5-0.75	BH20 0.95-1.45
			Sampling date / time	23-May-2024 00:00	23-May-2024 00:00	23-May-2024 00:00	23-May-2024 00:00	23-May-2024 00:00
Compound	CAS Number	LOR	Unit	EM2408749-045	EM2408749-046	EM2408749-054	EM2408749-055	EM2408749-056
				Result	Result	Result	Result	Result
EA002-AD: pH (Soils) dried at 40°C								
pH Value	----	0.1	pH Unit	8.9	9.2	6.2	9.4	9.4
EA010-AD: Conductivity (Soils) dried at 40°C								
Electrical Conductivity @ 25°C	----	1	µS/cm	747	836	200	674	890
EA058: Emerson Aggregate Test								
Color (Munsell)	----	-	-	Light Brownish Gray (10YR 6/2)	Light Brownish Gray (10YR 6/2)	Dark Gray (5YR 4/1)	Light Gray (10YR 7/1)	Light Brownish Gray (10YR 6/2)
Texture	----	-	-	Heavy Clay	Medium Heavy Clay	Light Medium Clay	Medium Heavy Clay	Medium Heavy Clay
Emerson Class Number	EC/TC	-	-	1	2	2	1	1
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	4.0	4.7	----	3.2	4.1
ø Exchangeable Magnesium	----	0.2	meq/100g	9.6	10.3	----	8.2	11.0
ø Exchangeable Potassium	----	0.2	meq/100g	0.6	0.6	----	0.5	0.6
ø Exchangeable Sodium	----	0.2	meq/100g	6.5	7.7	----	5.2	8.2
ø Cation Exchange Capacity	----	0.2	meq/100g	20.8	23.3	----	17.1	23.8
ø Exchangeable Calcium Percent	----	0.2	%	19.2	20.3	----	18.7	17.0
ø Exchangeable Magnesium Percent	----	0.2	%	46.4	44.0	----	47.8	46.3
ø Exchangeable Potassium Percent	----	0.2	%	3.1	2.8	----	2.9	2.4
ø Exchangeable Sodium Percent	----	0.2	%	31.3	32.9	----	30.6	34.2
ø Calcium/Magnesium Ratio	----	0.2	-	0.4	0.5	----	0.4	0.4
ø Magnesium/Potassium Ratio	----	0.2	-	14.8	16.0	----	16.3	19.3
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	----	----	6.9	----	----
Exchangeable Magnesium	----	0.1	meq/100g	----	----	4.2	----	----
Exchangeable Potassium	----	0.1	meq/100g	----	----	0.7	----	----
Exchangeable Sodium	----	0.1	meq/100g	----	----	1.7	----	----
Cation Exchange Capacity	----	0.1	meq/100g	----	----	13.4	----	----
Exchangeable Sodium Percent	----	0.1	%	----	----	12.8	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH08 0.1-0.2	BH11 0.1-0 .2	QA-03	----	----
			Sampling date / time	23-May-2024 00:00	22-May-2024 00:00	23-May-2024 00:00	----	----
Compound	CAS Number	LOR	Unit	EM2408749-059	EM2408749-062	EM2408749-067	--------	--------
				Result	Result	Result	----	----
EA002-AD: pH (Soils) dried at 40°C								
pH Value	----	0.1	pH Unit	8.6	6.5	9.0	----	----
EA010-AD: Conductivity (Soils) dried at 40°C								
Electrical Conductivity @ 25°C	----	1	µS/cm	96	79	942	----	----
EA058: Emerson Aggregate Test								
Color (Munsell)	----	-	-	Yellowish Red (5YR 4/6)	Dark Reddish Brown (5YR 3/4)	Light Gray (10YR 7/2)	----	----
Texture	----	-	-	Silty Clay Loam	Sandy Loam	Medium Heavy Clay	----	----
Emerson Class Number	EC/TC	-	-	3	3	1	----	----
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	3.1	----	4.8	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	1.9	----	13.9	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	1.0	----	0.6	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2	----	10.2	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	6.0	----	29.5	----	----
ø Exchangeable Calcium Percent	----	0.2	%	51.4	----	16.2	----	----
ø Exchangeable Magnesium Percent	----	0.2	%	31.8	----	47.2	----	----
ø Exchangeable Potassium Percent	----	0.2	%	16.8	----	2.1	----	----
ø Exchangeable Sodium Percent	----	0.2	%	<0.2	----	34.5	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	1.6	----	0.3	----	----
ø Magnesium/Potassium Ratio	----	0.2	-	1.9	----	22.3	----	----
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	----	2.0	----	----	----
Exchangeable Magnesium	----	0.1	meq/100g	----	1.0	----	----	----
Exchangeable Potassium	----	0.1	meq/100g	----	1.0	----	----	----
Exchangeable Sodium	----	0.1	meq/100g	----	0.2	----	----	----
Cation Exchange Capacity	----	0.1	meq/100g	----	4.1	----	----	----
Exchangeable Sodium Percent	----	0.1	%	----	3.9	----	----	----

Inter-Laboratory Testing

Analysis conducted by ALS Brisbane, NATA accreditation no. 825, site no. 818 (Chemistry) 18958 (Biology).

(SOIL) EA058: Emerson Aggregate Test

QUALITY CONTROL REPORT

Work Order	: **EM2408749**	Page	: 1 of 6
Client	: **WSP Australia Pty Ltd**	Laboratory	: Environmental Division Melbourne
Contact	: JIN-SOL LEE	Contact	: Josh Alexander
Address	: Level 11 567 Collins Street Melbourne VIC, AUSTRALIA 3000	Address	: 4 Westall Rd Springvale VIC Australia 3171
Telephone	: ----	Telephone	: +61-3-8549 9600
Project	: PS211655 VPA Bannockburn South East	Date Samples Received	: 24-May-2024
Order number	: PS211655	Date Analysis Commenced	: 29-May-2024
C-O-C number	: ----	Issue Date	: 11-Jun-2024
Sampler	: Hannah James		
Site	: ----		
Quote number	: EN/000		
No. of samples received	: 63		
No. of samples analysed	: 33		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Eric Chau	Metals Team Leader	Melbourne Inorganics, Springvale, VIC
Layla Hafner	Acid Sulphate Soils - Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC
* = The final LOR has been raised due to dilution or other sample specific cause; adjusted LOR is shown in brackets. The duplicate ranges for Acceptable RPD% are applied to the final LOR where applicable.

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Acceptable RPD (%)*
EA002-AD: pH (Soils) dried at 40°C (QC Lot: 5823293)									
EM2408749-001	BH01 0.1-0.2	EA002-AD: pH Value	----	0.1	pH Unit	6.3	6.0	4.2	0% - 20%
EM2408749-023	BH12 0.1-0.2	EA002-AD: pH Value	----	0.1	pH Unit	6.1	6.1	0.0	0% - 20%
EA002-AD: pH (Soils) dried at 40°C (QC Lot: 5823296)									
EM2408749-037	BH15 1.00-1.35	EA002-AD: pH Value	----	0.1	pH Unit	7.5	7.5	0.0	0% - 20%
EM2408749-059	BH08 0.1-0.2	EA002-AD: pH Value	----	0.1	pH Unit	8.6	8.6	0.0	0% - 20%
EA010-AD: Conductivity (Soils) dried at 40°C (QC Lot: 5823294)									
EM2408749-001	BH01 0.1-0.2	EA010-AD: Electrical Conductivity @ 25°C	----	1	µS/cm	137	137	0.0	0% - 20%
EM2408749-023	BH12 0.1-0.2	EA010-AD: Electrical Conductivity @ 25°C	----	1	µS/cm	300	300	0.0	0% - 20%
EA010-AD: Conductivity (Soils) dried at 40°C (QC Lot: 5823295)									
EM2408749-037	BH15 1.00-1.35	EA010-AD: Electrical Conductivity @ 25°C	----	1	µS/cm	338	338	0.0	0% - 20%
EM2408749-059	BH08 0.1-0.2	EA010-AD: Electrical Conductivity @ 25°C	----	1	µS/cm	96	96	0.0	0% - 20%
ED006: Exchangeable Cations on Alkaline Soils (QC Lot: 5823288)									
EM2408749-037	BH15 1.00-1.35	ED006: Calcium/Magnesium Ratio	----	0.1 (0.2)*	-	0.4	0.3	0.0	No Limit
		ED006: Magnesium/Potassium Ratio	----	0.1 (0.2)*	-	18.8	18.8	0.0	0% - 20%
		ED006: Exchangeable Calcium Percent	----	0.2	%	20.4	17.9	13.1	0% - 20%
		ED006: Exchangeable Magnesium Percent	----	0.2	%	54.4	53.1	2.6	0% - 20%
		ED006: Exchangeable Potassium Percent	----	0.2	%	2.9	2.8	0.0	0% - 50%
		ED006: Exchangeable Sodium Percent	----	0.2	%	22.3	26.2	16.3	0% - 20%
		ED006: Exchangeable Calcium	----	0.2	meq/100g	3.4	2.9	16.2	0% - 50%
		ED006: Exchangeable Magnesium	----	0.2	meq/100g	9.2	8.7	5.7	0% - 20%

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Acceptable RPD (%)*
ED006: Exchangeable Cations on Alkaline Soils (QC Lot: 5823288) - continued									
EM2408749-037	BH15 1.00-1.35	ED006: Exchangeable Potassium	----	0.2	meq/100g	0.5	0.5	0.0	No Limit
		ED006: Exchangeable Sodium	----	0.2	meq/100g	3.8	4.3	13.2	0% - 20%
		ED006: Cation Exchange Capacity	----	0.2	meq/100g	16.9	16.3	3.1	0% - 20%
EM2408749-059	BH08 0.1-0.2	ED006: Calcium/Magnesium Ratio	----	0.1 (0.2)*	-	1.6	1.6	0.0	No Limit
		ED006: Magnesium/Potassium Ratio	----	0.1 (0.2)*	-	1.9	2.3	18.7	0% - 50%
		ED006: Exchangeable Calcium Percent	----	0.2	%	51.4	52.3	1.8	0% - 20%
		ED006: Exchangeable Magnesium Percent	----	0.2	%	31.8	33.2	4.2	0% - 20%
		ED006: Exchangeable Potassium Percent	----	0.2	%	16.8	14.5	14.5	0% - 20%
		ED006: Exchangeable Sodium Percent	----	0.2	%	<0.2	<0.2	0.0	No Limit
		ED006: Exchangeable Calcium	----	0.2	meq/100g	3.1	2.8	10.6	0% - 50%
		ED006: Exchangeable Magnesium	----	0.2	meq/100g	1.9	1.8	8.2	No Limit
		ED006: Exchangeable Potassium	----	0.2	meq/100g	1.0	0.8	26.8	No Limit
		ED006: Exchangeable Sodium	----	0.2	meq/100g	<0.2	<0.2	0.0	No Limit
		ED006: Cation Exchange Capacity	----	0.2	meq/100g	6.0	5.3	12.4	0% - 20%
ED006: Exchangeable Cations on Alkaline Soils (QC Lot: 5844078)									
EM2408749-007	BH04 0.5-0.95	ED006: Calcium/Magnesium Ratio	----	0.1 (0.2)*	-	0.3	0.3	0.0	No Limit
		ED006: Magnesium/Potassium Ratio	----	0.1 (0.2)*	-	32.1	28.2	12.9	0% - 20%
		ED006: Exchangeable Calcium Percent	----	0.2	%	19.9	20.4	2.2	0% - 20%
		ED006: Exchangeable Magnesium Percent	----	0.2	%	57.3	59.4	3.6	0% - 20%
		ED006: Exchangeable Potassium Percent	----	0.2	%	1.8	2.1	16.5	0% - 50%
		ED006: Exchangeable Sodium Percent	----	0.2	%	21.0	18.2	14.7	0% - 20%
		ED006: Exchangeable Calcium	----	0.2	meq/100g	5.6	5.9	4.4	0% - 20%
		ED006: Exchangeable Magnesium	----	0.2	meq/100g	16.1	17.1	5.9	0% - 20%
		ED006: Exchangeable Potassium	----	0.2	meq/100g	0.5	0.6	18.7	No Limit
		ED006: Exchangeable Sodium	----	0.2	meq/100g	5.9	5.2	12.4	0% - 20%
		ED006: Cation Exchange Capacity	----	0.2	meq/100g	28.2	28.8	2.2	0% - 20%
EM2408749-039	BH16 0.6-0.85	ED006: Calcium/Magnesium Ratio	----	0.1 (0.2)*	-	0.4	0.4	0.0	No Limit
		ED006: Magnesium/Potassium Ratio	----	0.1 (0.2)*	-	22.1	22.3	0.7	0% - 20%
		ED006: Exchangeable Calcium Percent	----	0.2	%	22.9	23.7	3.6	0% - 20%
		ED006: Exchangeable Magnesium Percent	----	0.2	%	55.2	54.5	1.3	0% - 20%
		ED006: Exchangeable Potassium Percent	----	0.2	%	2.5	2.4	0.0	0% - 50%
		ED006: Exchangeable Sodium Percent	----	0.2	%	19.4	19.3	0.0	0% - 20%
		ED006: Exchangeable Calcium	----	0.2	meq/100g	5.2	4.8	8.4	0% - 20%
		ED006: Exchangeable Magnesium	----	0.2	meq/100g	12.5	11.0	13.3	0% - 20%
		ED006: Exchangeable Potassium	----	0.2	meq/100g	0.6	0.5	0.0	No Limit
		ED006: Exchangeable Sodium	----	0.2	meq/100g	4.4	3.9	12.4	0% - 20%
		ED006: Cation Exchange Capacity	----	0.2	meq/100g	22.6	20.1	12.0	0% - 20%

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Acceptable RPD (%)*
ED007: Exchangeable Cations (QC Lot: 5823275)									
EM2408749-001	BH01 0.1-0.2	ED007: Exchangeable Sodium Percent	----	0.1	%	3.0	2.9	0.0	0% - 20%
		ED007: Exchangeable Calcium	----	0.1	meq/100g	4.4	4.9	11.7	0% - 20%
		ED007: Exchangeable Magnesium	----	0.1	meq/100g	2.4	2.5	0.0	0% - 20%
		ED007: Exchangeable Potassium	----	0.1	meq/100g	0.4	0.4	0.0	No Limit
		ED007: Exchangeable Sodium	----	0.1	meq/100g	0.2	0.2	0.0	No Limit
		ED007: Cation Exchange Capacity	----	0.1	meq/100g	7.4	8.0	8.2	0% - 20%
EM2408749-016	BH07 0.5-0.75	ED007: Exchangeable Sodium Percent	----	0.1	%	16.0	16.1	0.8	0% - 20%
		ED007: Exchangeable Calcium	----	0.1	meq/100g	22.2	22.8	2.5	0% - 20%
		ED007: Exchangeable Magnesium	----	0.1	meq/100g	21.2	22.1	4.1	0% - 20%
		ED007: Exchangeable Potassium	----	0.1	meq/100g	0.6	0.6	0.0	No Limit
		ED007: Exchangeable Sodium	----	0.1	meq/100g	8.4	8.8	4.2	0% - 20%
		ED007: Cation Exchange Capacity	----	0.1	meq/100g	52.4	54.2	3.5	0% - 20%
ED007: Exchangeable Cations (QC Lot: 5823276)									
EM2408749-037	BH15 1.00-1.35	ED007: Exchangeable Sodium Percent	----	0.1	%	27.4	27.5	0.0	0% - 20%
		ED007: Exchangeable Calcium	----	0.1	meq/100g	4.3	3.9	9.3	0% - 20%
		ED007: Exchangeable Magnesium	----	0.1	meq/100g	14.1	13.0	8.7	0% - 20%
		ED007: Exchangeable Potassium	----	0.1	meq/100g	0.6	0.6	0.0	No Limit
		ED007: Exchangeable Sodium	----	0.1	meq/100g	7.2	6.6	8.5	0% - 20%
		ED007: Cation Exchange Capacity	----	0.1	meq/100g	26.2	24.0	8.7	0% - 20%
EM2408749-056	BH20 0.95-1.45	ED007: Exchangeable Sodium Percent	----	0.1	%	33.3	33.8	1.6	0% - 20%
		ED007: Exchangeable Calcium	----	0.1	meq/100g	8.2	8.8	6.7	0% - 20%
		ED007: Exchangeable Magnesium	----	0.1	meq/100g	15.6	17.6	12.1	0% - 20%
		ED007: Exchangeable Potassium	----	0.1	meq/100g	0.7	0.8	0.0	No Limit
		ED007: Exchangeable Sodium	----	0.1	meq/100g	12.2	13.9	12.7	0% - 20%
		ED007: Cation Exchange Capacity	----	0.1	meq/100g	36.7	41.0	11.1	0% - 20%

Method Blank (MB) and Laboratory Control Sample (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Acceptable Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EA002-AD: pH (Soils) dried at 40°C (QCLot: 5823293)								
EA002-AD: pH Value	----	----	pH Unit	----	4 pH Unit	100	98.8	101
				----	7 pH Unit	100	99.3	101
EA002-AD: pH (Soils) dried at 40°C (QCLot: 5823296)								
EA002-AD: pH Value	----	----	pH Unit	----	4 pH Unit	100	98.8	101
				----	7 pH Unit	100	99.3	101
EA010-AD: Conductivity (Soils) dried at 40°C (QCLot: 5823294)								
EA010-AD: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	1413 µS/cm	100	90.0	110
EA010-AD: Conductivity (Soils) dried at 40°C (QCLot: 5823295)								
EA010-AD: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	1413 µS/cm	100	90.0	110
ED006: Exchangeable Cations on Alkaline Soils (QCLot: 5844078)								
ED006: Exchangeable Calcium	----	0.2	meq/100g	<0.2	33 meq/100g	76.5	66.6	101
ED006: Exchangeable Magnesium	----	0.2	meq/100g	<0.2	32 meq/100g	72.9	66.9	120
ED006: Exchangeable Potassium	----	0.2	meq/100g	<0.2	2.2 meq/100g	78.7	72.8	119
ED006: Exchangeable Sodium	----	0.2	meq/100g	<0.2	5.6 meq/100g	74.1	67.5	112
ED006: Cation Exchange Capacity	----	0.2	meq/100g	<0.2	----	----	----	----
ED006: Exchangeable Calcium Percent	----	0.2	%	<0.2	----	----	----	----
ED006: Exchangeable Magnesium Percent	----	0.2	%	<0.2	----	----	----	----
ED006: Exchangeable Potassium Percent	----	0.2	%	<0.2	----	----	----	----
ED006: Exchangeable Sodium Percent	----	0.2	%	<0.2	----	----	----	----
ED006: Calcium/Magnesium Ratio	----	0.1	-	<0.1	----	----	----	----
ED006: Magnesium/Potassium Ratio	----	0.1	-	<0.1	----	----	----	----
ED007: Exchangeable Cations (QCLot: 5823275)								
ED007: Exchangeable Calcium	----	0.1	meq/100g	<0.1	24.13 meq/100g	91.2	80.0	130
ED007: Exchangeable Magnesium	----	0.1	meq/100g	<0.1	1.96 meq/100g	109	72.2	130
ED007: Exchangeable Potassium	----	0.1	meq/100g	<0.1	1.01 meq/100g	120	77.4	130
ED007: Exchangeable Sodium	----	0.1	meq/100g	<0.1	0.86 meq/100g	130	89.2	130
ED007: Cation Exchange Capacity	----	0.1	meq/100g	<0.1	----	----	----	----
ED007: Exchangeable Cations (QCLot: 5823276)								
ED007: Exchangeable Calcium	----	0.1	meq/100g	<0.1	24.13 meq/100g	82.0	80.0	130
ED007: Exchangeable Magnesium	----	0.1	meq/100g	<0.1	1.96 meq/100g	78.2	72.2	130

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Acceptable Limits (%)	
				Result	Concentration	LCS	Low	High
ED007: Exchangeable Cations (QCLot: 5823276) - continued								
ED007: Exchangeable Potassium	----	0.1	meq/100g	<0.1	1.01 meq/100g	78.6	77.4	130
ED007: Exchangeable Sodium	----	0.1	meq/100g	<0.1	0.86 meq/100g	91.5	89.2	130
ED007: Cation Exchange Capacity	----	0.1	meq/100g	<0.1	----	----	----	----

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

- **No Matrix Spike (MS) or Matrix Spike Duplicate (MSD) Results are required to be reported.**

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EM2408749**	Page	: 1 of 8
Client	: **WSP Australia Pty Ltd**	Laboratory	: Environmental Division Melbourne
Contact	: JIN-SOL LEE	Telephone	: +61-3-8549 9600
Project	: PS211655 VPA Bannockburn South East	Date Samples Received	: 24-May-2024
Site	: ----	Issue Date	: 11-Jun-2024
Sampler	: Hannah James	No. of samples received	: 63
Order number	: PS211655	No. of samples analysed	: 33

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, where applicable to the methodology, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **Analysis Holding Time Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**

Outliers : Analysis Holding Time Compliance

Matrix: **SOIL**

Method / Container / Client Sample ID(s)		Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EA002-AD: pH (Soils) dried at 40°C							
Soil Glass Jar - Unpreserved							
BH04 0.1-0.2,	BH04 0.5-0.95,	06-Jun-2024	29-May-2024	**8**	----	----	----
BH04 1.00-1.05,	BH04 1.05-1.20,						
BH04 2.00-2.10,	BH07 0.1-0.2,						
BH07 0.5-0.75,	BH12 0.1-0.2,						
BH12 0.5-0.75,	BH12 0.75-0.95,						
BH12 1.00-1.4,	BH11 0.1-0 .2						
Soil Glass Jar - Unpreserved							
BH01 0.1-0.2,	BH02 0.1-0.2,	06-Jun-2024	30-Apr-2024	**37**	----	----	----
BH05 0.1-0.2							
Soil Glass Jar - Unpreserved							
BH14 0.1-0.2,	BH14 0.5-0.75,	06-Jun-2024	30-May-2024	**7**	----	----	----
BH14 1.25-1.5,	BH14 2.00-2.25,						
BH15 0.1-0.2,	BH15 0.5-0.75,						
BH15 1.00-1.35,	BH16 0.1-0.2,						
BH16 0.6-0.85,	QA-01,						
BH17 0.1-0.2,	BH17 0.5-0.75,						
BH17 2.00-2.25,	BH20 0.1-0.2,						
BH20 0.5-0.75,	BH20 0.95-1.45,						
BH08 0.1-0.2,	QA-03						
EA010-AD: Conductivity (Soils) dried at 40°C							
Soil Glass Jar - Unpreserved							
BH04 0.1-0.2,	BH04 0.5-0.95,	06-Jun-2024	29-May-2024	**8**	----	----	----
BH04 1.00-1.05,	BH04 1.05-1.20,						
BH04 2.00-2.10,	BH07 0.1-0.2,						
BH07 0.5-0.75,	BH12 0.1-0.2,						
BH12 0.5-0.75,	BH12 0.75-0.95,						
BH12 1.00-1.4,	BH11 0.1-0 .2						
Soil Glass Jar - Unpreserved							
BH01 0.1-0.2,	BH02 0.1-0.2,	06-Jun-2024	30-Apr-2024	**37**	----	----	----
BH05 0.1-0.2							

Matrix: **SOIL**

Method / Container / Client Sample ID(s)		Extraction / Preparation: Date extracted	Extraction / Preparation: Due for extraction	Extraction / Preparation: Days overdue	Analysis: Date analysed	Analysis: Due for analysis	Analysis: Days overdue
EA010-AD: Conductivity (Soils) dried at 40°C - Analysis Holding Time Compliance							
Soil Glass Jar - Unpreserved							
BH14 0.1-0.2,	BH14 0.5-0.75,	06-Jun-2024	30-May-2024	**7**	----	----	----
BH14 1.25-1.5,	BH14 2.00-2.25,						
BH15 0.1-0.2,	BH15 0.5-0.75,						
BH15 1.00-1.35,	BH16 0.1-0.2,						
BH16 0.6-0.85,	QA-01,						
BH17 0.1-0.2,	BH17 0.5-0.75,						
BH17 2.00-2.25,	BH20 0.1-0.2,						
BH20 0.5-0.75,	BH20 0.95-1.45,						
BH08 0.1-0.2,	QA-03						
ED006: Exchangeable Cations on Alkaline Soils							
Soil Glass Jar - Unpreserved							
BH01 0.1-0.2,	BH02 0.1-0.2,	29-May-2024	21-May-2024	**8**	06-Jun-2024	21-May-2024	**16**
BH05 0.1-0.2							
ED007: Exchangeable Cations							
Soil Glass Jar - Unpreserved							
BH01 0.1-0.2,	BH02 0.1-0.2,	29-May-2024	21-May-2024	**8**	06-Jun-2024	21-May-2024	**16**
BH05 0.1-0.2							
ED008: Exchangeable Cations							
Soil Glass Jar - Unpreserved							
BH01 0.1-0.2,	BH02 0.1-0.2,	29-May-2024	21-May-2024	**8**	06-Jun-2024	21-May-2024	**16**
BH05 0.1-0.2							

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation: Date extracted	Extraction / Preparation: Due for extraction	Extraction / Preparation: Evaluation	Analysis: Date analysed	Analysis: Due for analysis	Analysis: Evaluation

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA002-AD: pH (Soils) dried at 40°C							
Soil Glass Jar - Unpreserved (EA002-AD)							
BH04 0.1-0.2, BH04 0.5-0.95, BH04 1.00-1.05, BH04 1.05-1.20, BH04 2.00-2.10, BH07 0.1-0.2, BH07 0.5-0.75, BH12 0.1-0.2, BH12 0.5-0.75, BH12 0.75-0.95, BH12 1.00-1.4, BH11 0.1-0 .2	**22-May-2024**	**06-Jun-2024**	29-May-2024	×	**06-Jun-2024**	06-Jun-2024	✓
Soil Glass Jar - Unpreserved (EA002-AD)							
BH01 0.1-0.2, BH02 0.1-0.2, BH05 0.1-0.2	**23-Apr-2024**	**06-Jun-2024**	30-Apr-2024	×	**06-Jun-2024**	06-Jun-2024	✓
Soil Glass Jar - Unpreserved (EA002-AD)							
BH14 0.1-0.2, BH14 0.5-0.75, BH14 1.25-1.5, BH14 2.00-2.25, BH15 0.1-0.2, BH15 0.5-0.75, BH15 1.00-1.35, BH16 0.1-0.2, BH16 0.6-0.85, QA-01, BH17 0.1-0.2, BH17 0.5-0.75, BH17 2.00-2.25, BH20 0.1-0.2, BH20 0.5-0.75, BH20 0.95-1.45, BH08 0.1-0.2, QA-03	**23-May-2024**	**06-Jun-2024**	30-May-2024	×	**06-Jun-2024**	06-Jun-2024	✓
EA010-AD: Conductivity (Soils) dried at 40°C							
Soil Glass Jar - Unpreserved (EA010-AD)							
BH04 0.1-0.2, BH04 0.5-0.95, BH04 1.00-1.05, BH04 1.05-1.20, BH04 2.00-2.10, BH07 0.1-0.2, BH07 0.5-0.75, BH12 0.1-0.2, BH12 0.5-0.75, BH12 0.75-0.95, BH12 1.00-1.4, BH11 0.1-0 .2	**22-May-2024**	**06-Jun-2024**	29-May-2024	×	**06-Jun-2024**	04-Jul-2024	✓
Soil Glass Jar - Unpreserved (EA010-AD)							
BH01 0.1-0.2, BH02 0.1-0.2, BH05 0.1-0.2	**23-Apr-2024**	**06-Jun-2024**	30-Apr-2024	×	**06-Jun-2024**	04-Jul-2024	✓
Soil Glass Jar - Unpreserved (EA010-AD)							
BH14 0.1-0.2, BH14 0.5-0.75, BH14 1.25-1.5, BH14 2.00-2.25, BH15 0.1-0.2, BH15 0.5-0.75, BH15 1.00-1.35, BH16 0.1-0.2, BH16 0.6-0.85, QA-01, BH17 0.1-0.2, BH17 0.5-0.75, BH17 2.00-2.25, BH20 0.1-0.2, BH20 0.5-0.75, BH20 0.95-1.45, BH08 0.1-0.2, QA-03	**23-May-2024**	**06-Jun-2024**	30-May-2024	×	**06-Jun-2024**	04-Jul-2024	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA058: Emerson Aggregate Test								
Soil Glass Jar - Unpreserved (EA058)								
BH04 0.1-0.2,	BH04 0.5-0.95,	**22-May-2024**	**----**	----	**----**	**05-Jun-2024**	18-Nov-2024	✓
BH04 1.00-1.05,	BH04 1.05-1.20,							
BH04 2.00-2.10,	BH07 0.1-0.2,							
BH07 0.5-0.75,	BH12 0.1-0.2,							
BH12 0.5-0.75,	BH12 0.75-0.95,							
BH12 1.00-1.4,	BH11 0.1-0 .2							
Soil Glass Jar - Unpreserved (EA058)								
BH01 0.1-0.2,	BH02 0.1-0.2,	**23-Apr-2024**	**----**	----	**----**	**05-Jun-2024**	20-Oct-2024	✓
BH05 0.1-0.2								
Soil Glass Jar - Unpreserved (EA058)								
BH14 0.1-0.2,	BH14 0.5-0.75,	**23-May-2024**	**----**	----	**----**	**05-Jun-2024**	19-Nov-2024	✓
BH14 1.25-1.5,	BH14 2.00-2.25,							
BH15 0.1-0.2,	BH15 0.5-0.75,							
BH15 1.00-1.35,	BH16 0.1-0.2,							
BH16 0.6-0.85,	QA-01,							
BH17 0.1-0.2,	BH17 0.5-0.75,							
BH17 2.00-2.25,	BH20 0.1-0.2,							
BH20 0.5-0.75,	BH20 0.95-1.45,							
BH08 0.1-0.2,	QA-03							
ED006: Exchangeable Cations on Alkaline Soils								
Soil Glass Jar - Unpreserved (ED006)								
BH04 0.1-0.2,	BH04 0.5-0.95,	**22-May-2024**	**29-May-2024**	19-Jun-2024	✓	**06-Jun-2024**	19-Jun-2024	✓
BH04 1.00-1.05,	BH04 1.05-1.20,							
BH04 2.00-2.10,	BH07 0.1-0.2,							
BH07 0.5-0.75,	BH12 0.1-0.2,							
BH12 0.5-0.75,	BH12 0.75-0.95,							
BH12 1.00-1.4,	BH11 0.1-0 .2							
Soil Glass Jar - Unpreserved (ED006)								
BH01 0.1-0.2,	BH02 0.1-0.2,	**23-Apr-2024**	**29-May-2024**	21-May-2024	×	**06-Jun-2024**	21-May-2024	×
BH05 0.1-0.2								
Soil Glass Jar - Unpreserved (ED006)								
BH14 0.1-0.2,	BH14 0.5-0.75,	**23-May-2024**	**29-May-2024**	20-Jun-2024	✓	**06-Jun-2024**	20-Jun-2024	✓
BH14 1.25-1.5,	BH14 2.00-2.25,							
BH15 0.1-0.2,	BH15 0.5-0.75,							
BH15 1.00-1.35,	BH16 0.1-0.2,							
BH16 0.6-0.85,	QA-01,							
BH17 0.1-0.2,	BH17 0.5-0.75,							
BH17 2.00-2.25,	BH20 0.1-0.2,							
BH20 0.5-0.75,	BH20 0.95-1.45,							
BH08 0.1-0.2,	QA-03							

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
ED007: Exchangeable Cations							
Soil Glass Jar - Unpreserved (ED007)							
BH04 0.1-0.2, BH07 0.1-0.2, BH12 0.1-0.2, BH11 0.1-0 .2	**22-May-2024**	**29-May-2024**	19-Jun-2024	✓	**06-Jun-2024**	19-Jun-2024	✓
Soil Glass Jar - Unpreserved (ED007)							
BH01 0.1-0.2, BH02 0.1-0.2, BH05 0.1-0.2	**23-Apr-2024**	**29-May-2024**	21-May-2024	×	**06-Jun-2024**	21-May-2024	×
Soil Glass Jar - Unpreserved (ED007)							
BH14 0.1-0.2, BH14 0.5-0.75, BH14 1.25-1.5, BH15 0.1-0.2, BH15 0.5-0.75, BH16 0.1-0.2, BH17 0.1-0.2, BH20 0.1-0.2	**23-May-2024**	**29-May-2024**	20-Jun-2024	✓	**06-Jun-2024**	20-Jun-2024	✓
ED008: Exchangeable Cations							
Soil Glass Jar - Unpreserved (ED008)							
BH04 0.1-0.2, BH04 0.5-0.95, BH04 1.00-1.05, BH04 1.05-1.20, BH04 2.00-2.10, BH07 0.1-0.2, BH07 0.5-0.75, BH12 0.1-0.2, BH12 0.5-0.75, BH12 0.75-0.95, BH12 1.00-1.4, BH11 0.1-0 .2	**22-May-2024**	**29-May-2024**	19-Jun-2024	✓	**06-Jun-2024**	19-Jun-2024	✓
Soil Glass Jar - Unpreserved (ED008)							
BH01 0.1-0.2, BH02 0.1-0.2, BH05 0.1-0.2	**23-Apr-2024**	**29-May-2024**	21-May-2024	×	**06-Jun-2024**	21-May-2024	×
Soil Glass Jar - Unpreserved (ED008)							
BH14 0.1-0.2, BH14 0.5-0.75, BH14 1.25-1.5, BH14 2.00-2.25, BH15 0.1-0.2, BH15 0.5-0.75, BH15 1.00-1.35, BH16 0.1-0.2, BH16 0.6-0.85, QA-01, BH17 0.1-0.2, BH17 0.5-0.75, BH17 2.00-2.25, BH20 0.1-0.2, BH20 0.5-0.75, BH20 0.95-1.45, BH08 0.1-0.2, QA-03	**23-May-2024**	**29-May-2024**	20-Jun-2024	✓	**06-Jun-2024**	20-Jun-2024	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Electrical Conductivity (1:5) on 40°C dried soil	EA010-AD	4	33	**12.12**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations	ED007	4	15	**26.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations on Alkaline Soils	ED006	4	18	**22.22**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH (1:5) on 40°C dried soil	EA002-AD	4	33	**12.12**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Electrical Conductivity (1:5) on 40°C dried soil	EA010-AD	2	33	**6.06**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations	ED007	2	15	**13.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations on Alkaline Soils	ED006	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH (1:5) on 40°C dried soil	EA002-AD	4	33	**12.12**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Electrical Conductivity (1:5) on 40°C dried soil	EA010-AD	2	33	**6.06**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations	ED007	2	15	**13.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations on Alkaline Soils	ED006	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
pH (1:5) on 40°C dried soil	EA002-AD	SOIL	In house: Referenced to Rayment and Lyons 4A1 and APHA 4500H+. pH is determined on 40°C dried soil after a 1:5 soil/water leach. This method is compliant with NEPM Schedule B(3)
Electrical Conductivity (1:5) on 40°C dried soil	EA010-AD	SOIL	In house: Referenced to Rayment and Lyons 3A1 and APHA 2510. Conductivity is determined on soil samples dried at 40°C using a 1:5 soil/water leach. This method is compliant with NEPM Schedule B(3).
Emerson Aggregate Test	EA058	SOIL	In house: Referenced to AS1289.3.8.1. Testing is performed only on soils with suitable aggregates; sands and gravels are usually unsuitable for this test. The test classifies the behaviour of soil aggregates, when immersed, on their coherence in water.
Exchangeable Cations on Alkaline Soils	* ED006	SOIL	In house: Referenced to Soil Survey Test Method C5. Soluble salts are removed from the sample prior to analysis. Cations are exchanged from the sample by contact with alcoholic ammonium chloride at pH 8.5. They are then quantitated in the final solution by ICPAES and reported as meq/100g of original soil.
Exchangeable Cations	ED007	SOIL	In house: Referenced to Rayment & Lyons Method 15A1. Cations are exchanged from the sample by contact with Ammonium Chloride. They are then quantitated in the final solution by ICPAES and reported as meq/100g of original soil. This method is compliant with NEPM Schedule B(3).
Exchangeable Cations with pre-treatment	ED008	SOIL	In house: Referenced to Rayment & Lyons Method 15A2. Soluble salts are removed from the sample prior to analysis. Cations are exchanged from the sample by contact with Ammonium Chloride. They are then quantitated in the final solution by ICPAES and reported as meq/100g of original soil. This method is compliant with NEPM Schedule B(3).

Preparation Methods	Method	Matrix	Method Descriptions
Exchangeable Cations Preparation Method (Alkaline Soils)	* ED006PR	SOIL	In house: Referenced to Rayment and Lyons method 15C1.
Exchangeable Cations Preparation Method	ED007PR	SOIL	In house: Referenced to Rayment & Lyons method 15A1. A 1M NH4Cl extraction by end over end tumbling at a ratio of 1:20. There is no pretreatment for soluble salts. Extracts can be run by ICP for cations.
1:5 solid / water leach following drying at 40°C	EN34-AD	SOIL	10 g of 40°C dried soil is mixed with 50 mL of reagent grade water and tumbled end over end for 1 hour. Water soluble salts are leached from the soil by the continuous suspension. Samples are settled and the water filtered off for analysis.

CHAIN OF CUSTODY RECORD

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☐ **Perth Laboratory**
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☑ **Melbourne Laboratory**
6 Monterey Road Dandenong South VIC 3175
+61 3 8564 5000 EnviroSampleVic@eurofins.com

Company	WSP	Project №	PS211655	Project Manager	Jin-Sol Lee
Address	Level 11, 567 Collins Street Melbourne, 3000	Project Name	Bannockburn South East	EDD Format ESdat, EQuIS etc	Esdat
Contact Name	Hannah James				
Phone №	434394277				
Special Directions					
Purchase Order	PS211655				
Quote ID №					

Sampler(s)	Hannah James	
Handed over by	Hannah James	
Email for Invoice	jin-sol.lee@wsp.com	
Email for Results	jin-sol.lee@wsp.com	

Analyses Where metals are requested please specify "Total" or "Filtered". SUITE code must be used to attract SUITE pricing

Containers Change container type & size if necessary.

Required Turnaround Time (TAT) Default will be 5 days if not ticked

♦Surcharge will apply
☐ Overnight (reporting by 9am)♦
☐ Same day ♦ ☐ 1 day ♦
☐ 2 days ♦ ☐ 3
☐ 5 days (Standard)
☑ Other(**24 hr**)

№	Client Sample ID	Sampled Date/Time dd/mm/yy hh:mm	Matrix Solid (S) Water (W)	Emerson dipursion test	ESP	500mL Plastic	250mL Plastic	125mL Plastic	200mL Amber Glass	40mL VOA vial	500mL PFAS Bottle	Jar (Glass or HDPE)	Other (Asbestos AS4964, WA Guidelines)	Sample Comments / Dangerous Goods Hazard Warning
1	QA-02	23/05/24	Soil	X	X									
2	QA-04	23/5/24	Soil	X	X									
3														
4														
5														
6														
7														
8														
9														
10														
		Total Counts		2	2									

23/5/24 #100492

Method of Shipment: ☑ Courier (#) ☐ Hand Delivered ☐ Postal Name Signature Date Time

Laboratory Use Only							
Received By		SYD | BNE | MEL | PER | ADL | NTL | DRW	Signature		Date	Time 17:29	Temperature 6.7 c
Received By	Angelic	SYD | BNE | MEL | PER | ADL | NTL | DRW	Signature	AL	Date 24-5-24	Time	Report № 166

Eurofins Environment Testing Australia Pty Ltd EnviroSales@eurofins.com

Submission of samples to the laboratory will be deemed as acceptance of Eurofins | Environment Testing Standard Terms and Conditions unless agreed otherwise. A copy is available on request.

eastwest
geo ag enviro

82 Plain Street Tamworth NSW 2340
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abn 82 125 442 382

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ANALYSIS REPORT SOIL

PROJECT NO: EW241140		**Date of Issue:**	**05/06/2024**
Customer:	EUROFINS MELBOURNE	Report No:	1
Address:	6 Monterey Road DANDENONG SOUTH VIC 3175	Date Received:	29/05/2024
		Matrix:	Soil
Attention:	Savini Suduweli	Location:	1100992
Phone:	03 8564 5000	Sampler ID:	Client
Fax:		Date of Sampling:	23/05/2024
Email:	Savini.SuduweliKondage@eurofinsan	Sample Condition:	Acceptable

Results apply to the samples as submitted. All pages of this report have been checked and approved for release.

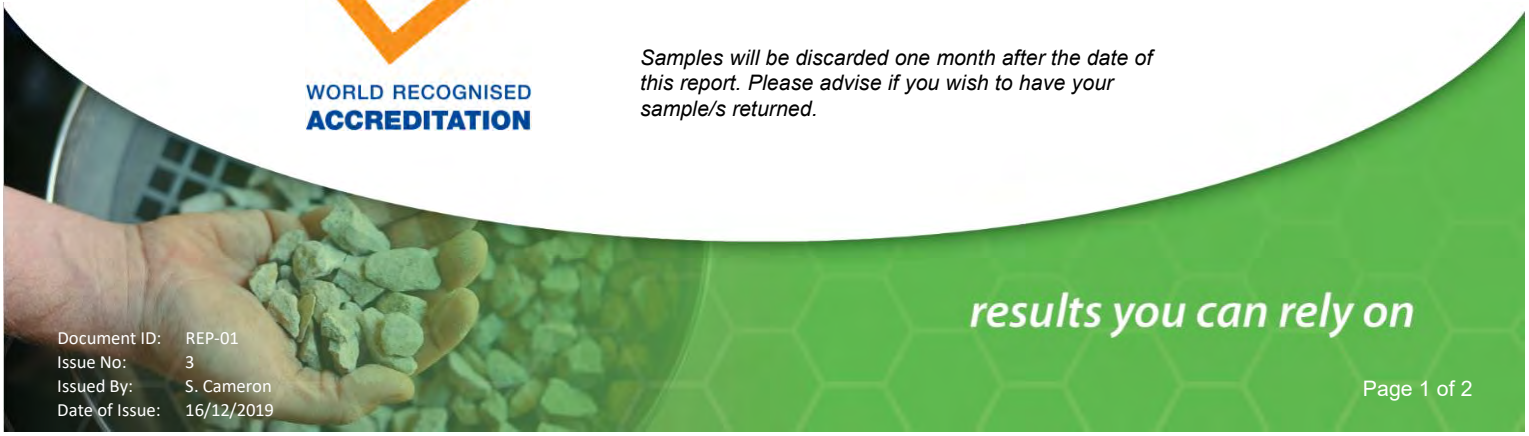
Signed:

Stephanie Cameron
Laboratory Operations Manager

NATA Accredited Laboratory 12360
Accredited for compliance with ISO/IEC 17025 - Testing

This analysis relates to the sample submitted and it is the client's responsibility to make certain the sample is representative of the matrix to be tested.

Samples will be discarded one month after the date of this report. Please advise if you wish to have your sample/s returned.



ANALYSIS REPORT

PROJECT NO: EW241140 **Location: 1100992**

					CLIENT SAMPLE ID	**24-My0070542**	**24-My0070543**	
					DEPTH	**Qa-02**	**Qa-04**	
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**		**241140-1**	**241140-2**	
Emerson Aggregate Test	Class	PMS-21	Number	na		2	1	

This Analysis Report shall not be reproduced except in full without the written approval of the laboratory.

Soils are air dried at 40°C and ground <2mm.

NB: LOR is the Lowest Obtainable Reading.

DOCUMENT END

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www.eurofins.com.au EnviroSales@eurofins.com

Eurofins Environment Testing Australia Pty Ltd

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Dandenong South	Grovedale	Girraween	Mitchell	Murarrie	Mayfield West
VIC 3175	VIC 3216	NSW 2145	ACT 2911	QLD 4172	NSW 2304
+61 3 8564 5000	+61 3 8564 5000	+61 2 9900 8400	+61 2 6113 8091	T: +61 7 3902 4600	+61 2 4968 8448
NATA# 1261	NATA# 1261	NATA# 1261	NATA# 1261	NATA# 1261	NATA# 1261
Site# 1254	Site# 25403	Site# 18217	Site# 25466	Site# 20794	Site# 25079 & 25289

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Site# 2554

Eurofins Environment Testing NZ Ltd

NZBN: 9429046024954

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IANZ# 1327	IANZ# 1308	IANZ# 1290	IANZ# 1402

Sample Receipt Advice

Company name:	WSP Australia P/L MELB
Contact name:	Jin-Sol Lee
Project name:	BANNOCKBURN SOUTH EAST
Project ID:	PS211655
Turnaround time:	1 Day
Date/Time received	May 24, 2024 5:29 PM
Eurofins reference	1100992

Sample Information

✓	A detailed list of analytes logged into our LIMS, is included in the attached summary table.
✓	All samples have been received as described on the above COC.
✓	COC has been completed correctly.
✓	Attempt to chill was evident.
✓	Appropriately preserved sample containers have been used.
✓	All samples were received in good condition.
✓	Samples have been provided with adequate time to commence analysis in accordance with the relevant holding times.
✓	Appropriate sample containers have been used.
✓	Sample containers for volatile analysis received with zero headspace.
X	Split sample sent to requested external lab.
X	Some samples have been subcontracted.
N/A	Custody Seals intact (if used).

Notes

PLEASE CLARIFY EMERSON TEST, THANKS!

Contact

If you have any questions with respect to these samples, please contact your Analytical Services Manager:

Onur Mehmet on phone : (+61) (3) 8564 5026 or by email: OnurMehmet@eurofins.com

Results will be delivered electronically via email to Jin-Sol Lee - jin-sol.lee@wsp.com.

Note: A copy of these results will also be delivered to the general WSP Australia P/L MELB email address.

eurofins

web: www.eurofins.com.au
email: EnviroSales@eurofins.com

Eurofins Environment Testing Australia Pty Ltd
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Melbourne	Geelong	Sydney	Canberra	Brisbane	Newcastle
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NATA# 1261	NATA# 1261	NATA# 1261	NATA# 1261	NATA# 1261	NATA# 1261
Site# 1254	Site# 25403	Site# 18217	Site# 25466	Site# 20794	Site# 25079 & 25289

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+64 9 526 4551	+64 9 525 0568	+64 3 343 5201	+64 9 525 0568
IANZ# 1327	IANZ# 1308	IANZ# 1290	IANZ# 1402

Company Name: WSP Australia P/L MELB
Address: Level 11, 567 Collins Street
Melbourne
VIC 3000

Project Name: BANNOCKBURN SOUTH EAST
Project ID: PS211655

Order No.: PS211655
Report #: 1100992
Phone: 9861 1111
Fax: 9861 1144

Received: May 24, 2024 5:29 PM
Due: May 27, 2024
Priority: 1 Day
Contact Name: Jin-Sol Lee

Eurofins Analytical Services Manager : Onur Mehmet

Sample Detail						Moisture Set	Exchangeable Sodium Percentage (ESP)
Melbourne Laboratory - NATA # 1261 Site # 1254						X	X
External Laboratory							
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**		
1	QA-02	May 23, 2024		Soil	M24-My0070542	X	X
2	QA-04	May 23, 2024		Soil	M24-My0070543	X	X
Test Counts						2	2

WSP Australia P/L MELB
Level 11, 567 Collins Street
Melbourne
VIC 3000

Attention: **Jin-Sol Lee**

Report **1100992-S**
Project name BANNOCKBURN SOUTH EAST
Project ID PS211655
Received Date May 24, 2024

Client Sample ID			**QA-02**	**QA-04**
Sample Matrix			**Soil**	**Soil**
Eurofins Sample No.			**M24-My0070542**	**M24-My0070543**
Date Sampled			**May 23, 2024**	**May 23, 2024**
Test/Reference	LOR	Unit		
Conductivity (1:5 aqueous extract at 25 °C as rec.)	10	uS/cm	190	580
Exchangeable Sodium Percentage (ESP)	0.1	%	36	29
Emerson Class Number	1	units	See attached	See attached
Sample Properties				
% Moisture	1	%	14	22

Sample History

Where samples are submitted/analysed over several days, the last date of extraction is reported.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Conductivity (1:5 aqueous extract at 25 °C as rec.)	Melbourne	May 25, 2024	7 Days
- Method: LTM-INO-4030 Conductivity			
Exchangeable Sodium Percentage (ESP)	Melbourne	May 27, 2024	28 Days
- Method: LTM-MET-3060 - Cation Exchange Capacity (CEC) & Exchangeable Sodium Percentage (ESP)			
% Moisture	Melbourne	May 24, 2024	14 Days
- Method: LTM-GEN-7080 Moisture			

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Eurofins Environment Testing Australia Pty Ltd
ABN: 50 005 085 521

Melbourne	Geelong	Sydney	Canberra	Brisbane	Newcastle
6 Monterey Road	19/8 Lewalan Street	179 Magowar Road	Unit 1,2 Dacre Street	1/21 Smallwood Place	1/2 Frost Drive
Dandenong South	Grovedale	Girraween	Mitchell	Murarrie	Mayfield West
VIC 3175	VIC 3216	NSW 2145	ACT 2911	QLD 4172	NSW 2304
+61 3 8564 5000	+61 3 8564 5000	+61 2 9900 8400	+61 2 6113 8091	T: +61 7 3902 4600	+61 2 4968 8448
NATA# 1261	NATA# 1261	NATA# 1261	NATA# 1261	NATA# 1261	NATA# 1261
Site# 1254	Site# 25403	Site# 18217	Site# 25466	Site# 20794	Site# 25079 & 25289

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Company Name: WSP Australia P/L MELB
Address: Level 11, 567 Collins Street
Melbourne
VIC 3000

Project Name: BANNOCKBURN SOUTH EAST
Project ID: PS211655

Order No.: PS211655
Report #: 1100992
Phone: 9861 1111
Fax: 9861 1144

Received: May 24, 2024 5:29 PM
Due: May 31, 2024
Priority: 5 Day
Contact Name: Jin-Sol Lee

Eurofins Analytical Services Manager : Onur Mehmet

Sample Detail						Emerson Class Number	Moisture Set	Exchangeable Sodium Percentage (ESP)
Melbourne Laboratory - NATA # 1261 Site # 1254							X	X
External Laboratory						X		
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**			
1	QA-02	May 23, 2024		Soil	M24-My0070542	X	X	X
2	QA-04	May 23, 2024		Soil	M24-My0070543	X	X	X
Test Counts						2	2	2

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Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples follow guidelines delineated in the National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended May 2013. They are included in this QC report where applicable. Additional QC data may be available on request.
2. Unless otherwise stated, all soil/sediment/solid results are reported on a dry weight basis.
3. Unless otherwise stated, all biota/food results are reported on a wet weight basis on the edible portion.
4. For CEC results where the sample's origin is unknown or environmentally contaminated, the results should be used advisedly.
5. Actual LORs are matrix dependent. Quoted LORs may be raised where sample extracts are diluted due to interferences.
6. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds where annotated.
7. SVOC analysis on waters is performed on homogenised, unfiltered samples unless noted otherwise.
8. Samples were analysed on an 'as received' basis.
9. Information identified in this report with **blue** colour indicates data provided by customers that may have an impact on the results.
10. This report replaces any interim results previously issued.

Holding Times

Please refer to the 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours before sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and despite any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the sampling date; therefore, compliance with these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether, the holding time is seven days; however, for all other VOCs, such as BTEX or C6-10 TRH, the holding time is 14 days.

Units

mg/kg: milligrams per kilogram
mg/L: milligrams per litre
ppm: parts per million
µg/L: micrograms per litre
ppb: parts per billion
%: Percentage
org/100 mL: Organisms per 100 millilitres
NTU: Nephelometric Turbidity Units
MPN/100 mL: Most Probable Number of organisms per 100 millilitres
CFU: Colony Forming Unit
Colour: Pt-Co Units (CU)

Terms

APHA	American Public Health Association
CEC	Cation Exchange Capacity
COC	Chain of Custody
CP	Client Parent - QC was performed on samples pertaining to this report
CRM	Certified Reference Material (ISO17034) - reported as percent recovery.
Dry	Where moisture has been determined on a solid sample, the result is expressed on a dry weight basis.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
LOR	Limit of Reporting.
LCS	Laboratory Control Sample - reported as percent recovery.
Method Blank	In the case of solid samples, these are performed on laboratory-certified clean sands and in the case of water samples, these are performed on de-ionised water.
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC represents the sequence or batch that client samples were analysed within.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
SRA	Sample Receipt Advice
Surr - Surrogate	The addition of a similar compound to the analyte target is reported as percentage recovery. See below for acceptance criteria.
TBTO	Tributyltin oxide (*bis*-tributyltin oxide) - individual tributyltin compounds cannot be identified separately in the environment; however, free tributyltin was measured, and its values were converted stoichiometrically into tributyltin oxide for comparison with regulatory limits.
TCLP	Toxicity Characteristic Leaching Procedure
TEQ	Toxic Equivalency Quotient or Total Equivalence
QSM	US Department of Defense Quality Systems Manual Version 6.0
US EPA	United States Environmental Protection Agency
WA DWER	Sum of PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC - Acceptance Criteria

The acceptance criteria should only be used as a guide and may be different when site-specific Sampling Analysis and Quality Plan (SAQP) have been implemented.

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is ≤30%; however, the following acceptance guidelines are equally applicable:

Results <10 times the LOR:	No Limit
Results between 10-20 times the LOR:	RPD must lie between 0-50%
Results >20 times the LOR:	RPD must lie between 0-30%

NOTE: pH duplicates are reported as a range, not as RPD

Surrogate Recoveries: Recoveries must lie between 20-130% for Speciated Phenols & 50-150% for PFAS. SVOCs recoveries 20 – 150%, VOC recoveries 50 – 150%

PFAS field samples containing surrogate recoveries above the QC limit designated in QSM 6.0, where no positive PFAS results have been reported or reviewed, and no data was affected.

QC Data General Comments

1. Where a result is reported as less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown are not data from your samples.
3. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling. Therefore, laboratory analysis is unlikely to be completed within holding time.Analysis will begin as soon as possible after sample receipt.
4. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of recovery, the term "INT" appears against that analyte.
5. For Matrix Spikes and LCS results, a dash "-" in the report means that the specific analyte was not added to the QC sample.
6. Duplicate RPDs are calculated from raw analytical data; thus, it is possible to have two sets of data.

Comments

Emerson Aggregate Test analytsed by East West report reference EWReport241140-01-050624-1

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Authorised by:

Onur Mehmet	Analytical Services Manager
Emily Rosenberg	Senior Analyst-Metal
Mary Makarios	Senior Analyst-Inorganic
Mary Makarios	Senior Analyst-Sample Properties

Glenn Jackson
Managing Director

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

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