

## Appendix E

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## REPORT

# Delburn Wind Farm, Gippsland, Victoria

## *Desktop Assessment of Potential Geotechnical, Contaminated Land and Hydrogeological Impacts*

Submitted to:

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## Executive Summary

Golder Associates Pty Ltd has been engaged by Delburn Wind Farm Pty. Ltd. (an OSMI Australia Pty Ltd Company) (OSMI) to undertake an assessment of potential geotechnical, contaminated land and hydrogeological impacts associated with the proposed Delburn Wind Farm (DWF) located in the vicinity of Delburn, about 5 km to south east of Moe in Victoria.

Relevant clauses within the state and local government planning policy framework that relate to potential geotechnical, contaminated land and hydrogeological impacts have been identified. These clauses generally relate to impacts of the proposed development to groundwater and surface water, landslide, erosion, acid sulfate soils, salinity and impacts to stone and coal resources. Impacts associated with each of these have been assessed based on a desktop study and site walkover survey.

The proposed wind farm development involves relatively shallow temporary excavations for wind turbine footings and trenches. These excavations will be backfilled in the permanent condition. It also involves the upgrade of existing unsealed tracks (mostly former logging tracks), the construction of some new lengths of access track to wind turbine locations and hardstands to support cranes at wind turbine locations.

The site typically comprises areas that are currently used for forestry purposes. Most of the terrain is an incised plateau, with low angle slopes at higher elevations and relatively steep slopes in the vicinity of water courses. The proposed wind farm straddles a surface water divide, draining towards the north west and south east, although the site itself is not within a designated catchment area.

Published information indicates that the eastern part of the site is underlain by Pliocene to Miocene age dense sands and hard clays of the Latrobe Valley Group with the western (and majority) of the site underlain by weathered Eocene age basalt of the Thorpdale Volcanics. The Thorpdale Volcanics weather to a high plasticity clay, which is expected to be encountered near the ground surface and to be encountered by the relatively shallow excavations proposed. The soils of the Thorpdale Volcanics are susceptible to landslide on slopes steeper than about 20°. However, none of the proposed wind turbines are to be located on ground susceptible to landslide.

The soils have minor susceptibility to erosion. Furthermore, given the long flow paths between wind turbine locations and watercourses, the potential for eroded soil to reach watercourses is low. Notwithstanding this, it is expected that erosion through construction could be managed through normal construction practices including wetting of soil to suppress dust, temporary silt barriers and drains. In the permanent condition, natural soils are expected to be capped with crushed rock or revegetated which will provide protection against erosion.

None of the proposed development is expected to encounter or disturb soils that are prone to salinity or that are potential acid sulfate soils.

Overall, the potential geotechnical, hydrogeological and contaminated land impacts associated with the project are either negligible or are expected to be manageable within the requirements of the relevant planning schemes using typical wind farm construction and operation techniques.

Additional investigation will be required to provide information to inform detailed design of the proposed wind farm. This information should be reviewed to confirm the indications of the desktop study on which this conclusion is based. If information is obtained which is contrary to the expectations arising from the desktop study, there may be a requirement to introduce additional mitigation measures. However, we expect that any measures required would comprise design and construction which is typical for wind farm developments of this type.

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Figure 2 – Geological Plan

Figure 3 – Inferred Landslide Susceptibility

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## **APPENDICES**

### **APPENDIX A**

Results of Desktop Study

### **APPENDIX B**

Historical Aerial Photographs

### **APPENDIX C**

Important Information Relating to This Report

## 1.0 ENGAGEMENT

Delburn Wind Farm Pty. Ltd. (an OSMI Australia Pty. Ltd. Company) (OSMI) has engaged Golder Associates Pty Ltd (Golder) to undertake an assessment of potential geotechnical, contaminated land and hydrogeological impacts associated with the proposed Delburn Wind Farm (DWF) in the Gippsland region of Victoria. This report specifically addresses impacts relevant to state and local government planning policy frameworks in the areas of geotechnical, contaminated land and hydrogeology. Impacts considered in this report include those associated with erosion, landslip, changes to surface water runoff, groundwater impacts, salinity, natural hazards and impact to known resources.

## 2.0 BACKGROUND

### 2.1 Site description

The proposed Delburn Wind Farm project area is located about 5 km to the south of Moe, with the windfarm centred around Delburn as indicated in Figure 1. The site has maximum dimensions of about 16 km (north-south) and 6 km (east-west) with a total area of about 4,900 ha. Most of the terrain on which the wind farm development is proposed is an incised plateau, with low angle slopes at higher elevations and relatively steep slopes in the vicinity of water courses. The proposed wind farm straddles a surface water divide, draining towards the north west and south east.

The project area is mostly used for forestry and comprises a mixture of vegetated and recently cleared forestry areas with some adjacent open paddocks. There is an existing quarry (Kennedy Haulage Quarry) located near the centre of the project area from which basalt materials are mined to produce crushed rock and select fill products. The Strzelecki Highway passes through the site and access within the site is provided by unsealed logging tracks off the Strzelecki Highway. There are several minor water courses within the area, including Silver Creek and Stony Creek which are tributaries to the Morwell River which runs to the east of the site.

### 2.2 Proposed Delburn Wind Farm

Based on information provided to us via OSMI, 33 wind turbine generators (WTGs) are currently proposed (Version 3.4) at the site along with associated infrastructure including access roads, hardstand areas, batching and laydown areas, monitoring masts, transmission infrastructure and a substation. Access to the site is expected to be via tracks branching off the Strzelecki Highway. The approximate locations of the proposed WTGs and associated infrastructure, based on the information provided to us by OSMI, are shown on Figure 1.

Elements of the construction and operation of the proposed DWF relevant to this assessment are expected to include:

- Wind turbine generator (WTG) foundations, which typically involve excavation to a depth of 2.0 m to 5.0 m below ground level, construction of the WTG footing and backfilling of material over the constructed WTG footing. WTG footing diameters can be up to 25 m in diameter for large turbines. Upon backfilling above the footing, topsoil is typically reinstated.
- The construction of hardstands to allow cranes to be set up for turbine construction. These are typically constructed from compacted crushed rock and remain in place after construction to allow cranes to be set up for undertaking future maintenance.

- The construction of access roads. These are typically unsealed access roads capped with crushed rock and remain in place to allow all weather access to turbine locations. Most of the proposed WTG access roads will be constructed by upgrading existing logging tracks. However, some new sections of track will also be constructed.
- The construction of buried power cables to connect the turbines to the substations. These involve the excavation of trenches, placement of the power cables and backfilling of the trenches.
- The construction of a substation and an operations and maintenance facility which are typically low rise structures supported on shallow foundations.

### 3.0 PLANNING POLICY FRAMEWORK

We have been provided with a memorandum prepared by Debra Butcher Consulting (DBC) (dated April 28, 2020) which sets out planning controls that are expected to apply to the proposed Wind Farm. The following extracts from the DBC report summarise planning controls relevant to geotechnical, hydrogeological and contaminated land aspects of the proposed development at both state and local government level.

#### 3.1 State level

The following policies within the state level planning policy framework are relevant to geotechnical, hydrogeological and contaminated land aspects:

- Clause 12.03-1S River corridors, waterways, lakes and wetlands. The need to protect the environmental, cultural and landscape values of all water bodies and wetlands is recognised by this clause.
- Clause 13.01-1S Natural hazards and climate change. Seeks to identify at risk areas and consider those risks in planning and management decision making processes.
- Clause 13.04-2S Erosion and landslip. Seeks to prevent inappropriate development in unstable areas or areas prone to erosion.
- Clause 13.04-3S Salinity. Seeks to minimise the impact of salinity and rising water tables on land uses, buildings and infrastructure in rural and urban areas and areas of environmental significance.
- Clause 14.02-1S Catchment planning and management. Seeks to assist the protection and restoration of catchments, water bodies, groundwater and the marine environment including ensuring that development at or near waterways protects the environmental qualities of waterways and their instream uses. This includes the provision of appropriate setbacks to waterways.
- Clause 14.02-2S Water Quality. Seeks to ensure that land use activities are sited and designed to minimise discharge to waterways and to protect the quality of surface water and groundwater.
- Clause 14.03-1S Resource exploration and extraction. Amongst a range of strategies this clause seeks to protect the brown coal resource in Central Gippsland by ensuring that changes in use and development of land overlying coal resources do not compromise the winning or processing of coal.
- Clause 14.03-1R Resource exploration and extraction. This clause seeks to protect the Gippsland brown coal resource and associated buffer areas via a range of strategies including ensuring that development in coal resource areas does not compromise the existing or future use of the resource.

The Department of Environment, Land, Water and Planning (DELWP) has developed policy and planning guidelines for the development of wind energy facilities in Victoria: *Policy and Planning Guidelines for Development of Wind Energy Facilities in Victoria*, (March 2019). These guidelines have little to say regarding the geotechnical, hydrogeological and contaminated land requirements for a wind energy facility but provide that a permit application must be accompanied by a site and context analysis which accurately describes the site and surrounding area including 'any notable features, constraints and characteristics'. The guidelines note some examples of possible constraints 'e.g. acid sulphate soil, highly erodible soils and land instability'.

## 3.2 Local level

The proposed Delburn Wind Farm covers three local municipalities, Latrobe City, Baw Baw Shire and South Gippsland Shire. Relevant clauses from the local planning policy frameworks which are applicable to geotechnical, hydrogeological and contaminated land issues are set out below.

### 3.2.1 Latrobe planning scheme

Clause 21.05-17 Stone resources. Seeks to protect significant stone resources to ensure adequate future supplies. The clause refers to protecting areas as required by the Latrobe Area Extractive Industry Interest Areas Strategy 1999 and seeks to protect extractive industry sites by separating incompatible land uses.

### 3.2.2 Baw Baw planning scheme

Clause 21.06-4 Natural Resource Base. Seeks to ensure development proposals make a positive contribution to the environment in terms of soil stability, erosion, flood and drainage management and the retention of native vegetation.

### 3.2.3 South Gippsland planning scheme

Clause 21.01-2 Key issues. Amongst a range of key issues, this Clause identifies the need to manage development and land use to ensure that environmental and landscape values are maintained; the incidence of landslip and erosion (particularly within steep areas of the Strzelecki Ranges) flooding and drainage problems affecting parts of the Shire; the need to protect the character and significance of the coast line, and the need to promote and protect the strong agricultural base of the Shire.

### 3.2.4 Summary of planning provisions assessed in this report

Based on the planning provisions set out above, this report discusses the potential impacts of the proposed DWF and impacts to the proposed DWF from:

- Erosion and landslip.
- Surface water including catchments, rivers and waterways.
- Groundwater.
- Stone resources.
- Natural hazards.
- Dry land salinity.
- Soil and groundwater contamination.
- Acid sulfate soils.

## 4.0 AIMS OF THE ASSESSMENT

In accordance with our understanding of the state and local level planning provisions, the aims of the assessment are to provide information relevant to the requirements of the applicable planning schemes as follows:

- Assess the surface topography, surrounding land use and likely subsurface conditions at the site, relevant to the proposed DWF.
- Identify potential impacts on erosion and landslip and where appropriate indicate means by which potential impacts could be mitigated.
- Identify potential impacts on surface water, including catchments, rivers and water ways and where appropriate indicate means by which potential impacts could be mitigated.
- Identify potential impacts on groundwater, and where appropriate indicate means by which potential impacts could be mitigated.
- Identify the potential for the project to impact or be impacted by contaminated land, salinity and acid sulfate soils.
- Identify the potential for the project to impact or be impacted by natural hazards, including earthquake and landslide.
- Identify potential impacts on stone resources.

Please note that consideration of cultural heritage and biodiversity protection are outside the scope of this assessment.

## 5.0 METHODOLOGY

### 5.1 General

The assessment comprised a desktop study together with a site walkover undertaken by a principal engineering geologist. The results of the desktop study are set out in Appendix A. The information gathered in the desk study is called upon to inform the impact assessments described in Section 6.0.

### 5.2 Documents reviewed

As part of the desktop study relevant aspects of the following documents were reviewed.

#### 5.2.1 Historical information

- Historical aerial photographs of the site from 1945, 1965 and the 1980s. The historical photographs reviewed are presented in Appendix B.

#### 5.2.2 Environmental Protection Authority database

- EPA Environmental Audit database.
- EPA Priority Sites Register.
- Post Closure Pollution Abatement Notices.
- Victorian Landfill Register.

#### 5.2.3 Published geological information

- Geological Survey of Victoria (GSV) 1:63,360 scale 'Mirboo North' mapsheet.



- CSIRO – ASRIS Acid Sulfate Soils Probability Maps.
- Victorian Salinity Provinces, Victorian Department of Environment and Primary Industries.

We also reviewed information on the Department of Economic Development, Jobs, Transport and Resources (DEDJTR) 'Geovic' and the Visualising Victoria's Groundwater (VVG) websites, and the results of investigations undertaken by the Kennedy Haulage quarry located near the centre of the site.

As part of the desktop study and site visit we spoke to Ross Kennedy of Kennedy Haulage quarries and were taken on a site visit to view rock and soil exposures within existing quarries. We were also provided with the results of boreholes drilled as part of resource exploration for the quarry.

### 5.3 Site walkover

The site walkover was performed on 22 October 2019 by a principal engineering geologist from Golder accompanied by Mr Peter Marriott of OSMI. During the walkover proposed WTG locations were visited and photographs taken of site features. Proposed WTG locations T02, T07, T21, T19, T27, T29, T30, T32 were visited. In addition, the Kennedy Haulage quarry was visited and a tour provided around the quarry site by the quarry management.

A description of observations made during the site walkover are presented in Appendix A.

## 6.0 IMPACT ASSESSMENT

Based on the information compiled from the desk study and site walkover (Appendix A), the following discusses the potential impacts associated with the proposed DWF along with measures that may be required to manage impacts and further investigation that is expected to be required to better understand the potential impacts.

### 6.1 Erosion and landslip

#### 6.1.1 Summary of findings

Figure 2 presents the geological map for the site. Most of the proposed WTG locations are underlain by the Thorpdale Volcanics geological unit. The upper portions of the Thorpdale Volcanics are typically deeply weathered to a red-brown high plasticity clay (residual soils), which is characteristic of the Thorpdale area. This clay is susceptible to volume changes in response to moisture changes. The clay is expected to be underlain by basalt rock, however the depth to basalt can be highly variable.

The residual soils of the Unit 3 Thorpdale Volcanics are prone to landslides. Landslides can occur at relatively shallow slope angles, in some cases as low as 11°, however observations made during the site visit indicate recent landslide activity only on slopes steeper than about 20°, which generally occur in the vicinity of water courses. The Baw Baw Shire erosion management overlay (EMO) does not trigger a permit requirement where the natural slope is less than 1 in 5. One WTG, T24 is within the area subject to the EMO and given it is located on a slope of less than 1 in 5, does not trigger a permit application under the EMO. Figure 3 presents a map indicating areas susceptible to slope instability based on the identification of slopes that have an angle steeper than about 20° and assessment of where landslides have previously occurred.

The landslides identified appear to be relatively subdued and are interpreted not to have been active for hundreds, or perhaps thousands of years. Notwithstanding this, where a landslide has occurred in the past, there is potential for remobilisation if initiated through inappropriate earthworks or drainage management.

The site walkover identified minor evidence of erosion, similar to that indicated in Plate 1. However, this appeared to be an isolated example. The southern part of the area proposed for development (south of WTG T21) is affected by the South Gippsland Shire environmental significance overlay (ESO) which includes provisions to protect areas prone to erosion.



**Plate 1: Example of minor surface erosion, near proposed location of WTG T27, view towards east.**

### 6.1.2 Project implications

Based on the WTG layout, Version 3.4, none of the WTG locations currently proposed are within areas that we have identified as susceptible to landslide and there is no evidence to suggest that the proposed layout will change or impact upon the landslide risk in the vicinity of the project.

We recommend that any future revisions of the WTG layout continue to avoid the placement of WTG in landslide susceptible areas. If this cannot be avoided, a site specific study and landslide risk assessment will be required during detailed design of the wind farm to assess landslide risk and to inform the development of risk mitigation measures if appropriate.

Based on the low prevalence of erosion observed across the site, the susceptibility of the Thorpdale Volcanics to erosion is assessed to be low. Furthermore, most of the area is vegetated which significantly reduces the susceptibility to erosion. Where vegetation clearance is required as part of WTG construction, we expect that

erosion can be managed through normal construction and slope maintenance processes implemented in accordance with the following guidelines, noting that implementation of these guidelines is a requirement of the schedule to the South Gippsland environmental significance overlay:

- EPA Victoria Publication – Construction Techniques for Sediment Pollution Control, May 1991.
- Environment Guidelines for Major Construction Sites (EPA Victoria, February 1996).
- Control of Erosion on Construction sites, Soil Conservation Authority)

Relevant measures to manage erosion are likely to include including sheeting of unsealed roads with material of low dispersivity (crushed rock), temporary and permanent drainage temporary and silt barriers where there is a risk of erosion and sediment runoff from exposed soils, mulching and revegetation of areas temporarily cleared for construction purposes.

## 6.2 Surface water including catchments, rivers and waterways

### 6.2.1 Summary of findings

The GeoVic website indicates that the site is not located within a declared water supply catchment area. However, the Narracan Creek Catchment area is located within 1.2 km from the western site boundary.

The proposed WTG layout does not appear to directly impact upon surface water drainage courses or declared water supply catchment areas. Furthermore, drainage from the site is towards the north west and south east toward the Morwell River, generally away from the Narracan Creek Catchment.

### 6.2.2 Project implications

If uncontrolled erosion and sediment run off is allowed to occur at WTG sites, it is conceivable that sediment run off could impact upon surface water. However, the flow length for sediment to reach water courses from the proposed WTG locations is long, typically 100 m or more. With normal erosion control measures implemented in accordance with the guidelines referenced in Section 6.1.2 including capping roads and hardstand areas, the provision of drainage, temporary dust suppression and silt barriers during construction, we expect that erosion can be controlled and sediment retained such that the impact to surface water courses is negligible.

## 6.3 Groundwater

### 6.3.1 Summary of findings

Figure 4 presents the estimated depth to groundwater level expected at the proposed WTG locations and indicates that at the proposed WTG locations, the depth to groundwater is expected to generally be more than 10 m below ground surface. Excavations for WTG foundations are expected to be less than about 5.0 m depth and are not expected to encounter groundwater, although borehole investigation will be required at specific WTG locations in order to confirm this. Figure 5 presents groundwater dependent ecosystems. Note that none of the proposed WTG impact upon these areas. The project built elements are therefore not expected to impact groundwater.

There are existing groundwater wells within the vicinity of the project area from which groundwater is extracted, including for agriculture and for quarrying operations at the Kennedy Quarry. It is not known at this stage whether groundwater extraction will be undertaken to provide a source of water for this project.

However, there is precedent in the area for this. If groundwater extraction is proposed, further detailed assessment will be required at the specific well location proposed to assess the groundwater yields that could be achieved and the potential impact to groundwater systems and surface water receptors.

### **6.3.2 Project implications**

The project is not expected to encounter groundwater and therefore not expected to have any influence on groundwater levels or quality.

## **6.4 Stone resources**

### **6.4.1 Summary of findings**

The operations at the Kennedy Quarry (location indicated in Figure 1) extract rock and soil from the Thorpdale Volcanics geological unit. Exploration boreholes provided by the Kennedy Quarry indicate there are potentially stone resources underlying the location of WTG T08. The desk study did not identify stone resources elsewhere within the proposed DWF area.

We have been provided with a proposal from Kennedy Haulage to supply quarry products to the proposed development. This indicates proposed work authority extensions intended to open areas for quarrying in order to source material supply for the proposed wind farm development. It is noted that these areas do not impact on the proposed WTG T08 location, which anecdotally we understand is because investigation has indicated the material expected to be present beneath the WTG T08 location is a lower quality resource compared to other areas.

### **6.4.2 Implications for project**

There is a potential conflict between stone resource and WTG T08, whereby the construction of WTG08 may preclude access to stone resource over the time the WTG is in place.

## **6.5 Natural hazards**

### **6.5.1 Summary of findings**

Other than landslide the only natural hazard identified from the geotechnical desk study that could feasibly impact upon the project is earthquake. The Thorpdale area has a history of low magnitude earthquakes with earthquakes up to Magnitude 5.4 having occurred within about 3 km of the site based on indications of the GeoVic website.

### **6.5.2 Implications for project**

The effects on structures of earthquakes of this magnitude are typically mitigated through engineering design using the methods set out in AS1170.4 – 2007 'Structural design actions Part 4: Earthquake actions in Australia'.

## **6.6 Dry land salinity**

### **6.6.1 Summary of findings**

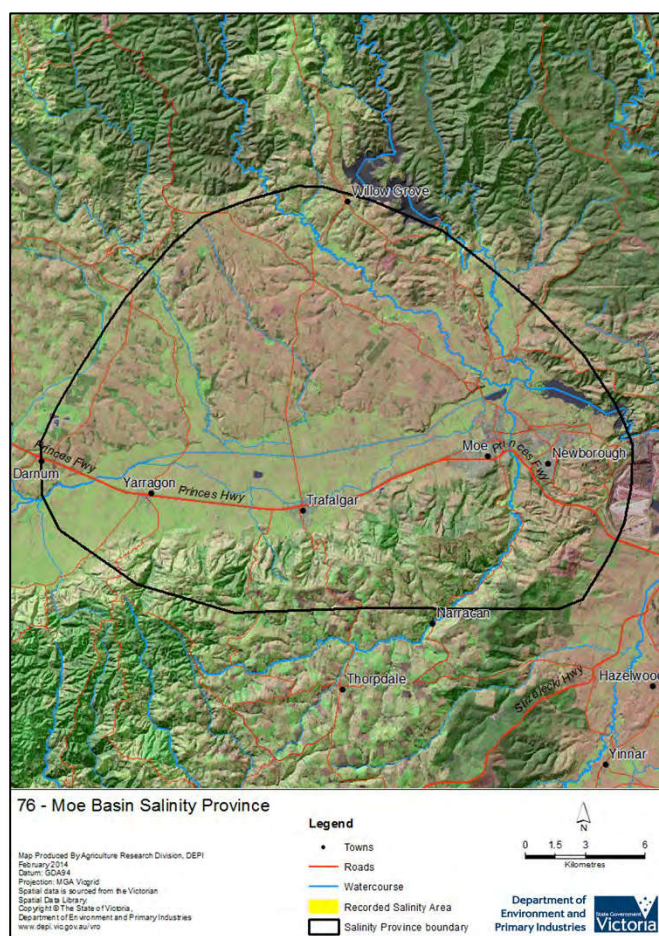
An increase in the salt content within soils (dry land salinity) affects some areas of Australia. It occurs as a result of groundwater rising to near surface levels. Some soils within Australia have a naturally high salt content and groundwater rise can leach salts from within the soil, depositing them at higher levels in the soil profile causing impact to vegetation. Evaporation of groundwater can occur where groundwater is shallow or

discharging, which can concentrate salt in the soil if groundwater is saline. Groundwater rise can be triggered by the removal of vegetation and typically affects areas of Australia that have been cleared for agricultural purposes.

The proposed DWF area has a very low susceptibility dry land salinity for the following reasons:

- The Thorpdale Volcanics which cover most of the site are derived from volcanic eruption and have a low sodium and potassium content. Soils derived from deposition in saline water have a much higher susceptibility, however soils with this origin are not expected to underlie the proposed DWF.
- The project does not involve widespread vegetation clearance of the type that is known to trigger groundwater rise.
- Measured dissolved salt concentrations within the groundwater wells within the vicinity of the site are typically less than 1,000 mg/L, a level which is generally considered fresh water.
- Groundwater in area where WTGs are proposed is likely to be more than 10 m deep, and construction is not proposed in areas likely to receive groundwater discharge.
- The proposed DWF is not within a designated salinity province, with the nearest salinity province that of the Moe Basin as indicated in Plate 2. Furthermore, based on the Victorian Department of Environment and Primary Industries, there are no recorded instances of land salinity within the Moe Basin Salinity Province.
- No Salinity Management Overlay applies to the site under the planning scheme.





**Plate 2: Moe Basin Salinity Province - Victorian Department of Environment and Primary Industries**

## 6.6.2 Implications for project

The project is not expected to be impacted by or have an impact upon dry land salinity.

## 6.7 Soil and groundwater contamination

### 6.7.1 Summary of findings

The review of historical information has indicated that the risk of potential contamination of soil is likely to be low with a localised risk in the immediate vicinity of dwellings, farm sheds and disturbed areas. However, it is understood that the DWF development is not expected to involve construction near existing areas of residential or agricultural infrastructure, therefore the overall risk of soil contamination to the project is considered to be low.

### 6.7.2 Implications for project

Assuming the adoption of good construction practices such as erosion protection of exposed cut and fill batter slopes, drainage controls and the implementation of silt fences where required, erosion of cut and fill batters is not considered to be a significant issue for the proposed DWF taking into account the shallow site slopes. Consequently, the potential for contaminant migration, if contaminants are present at all is very low.

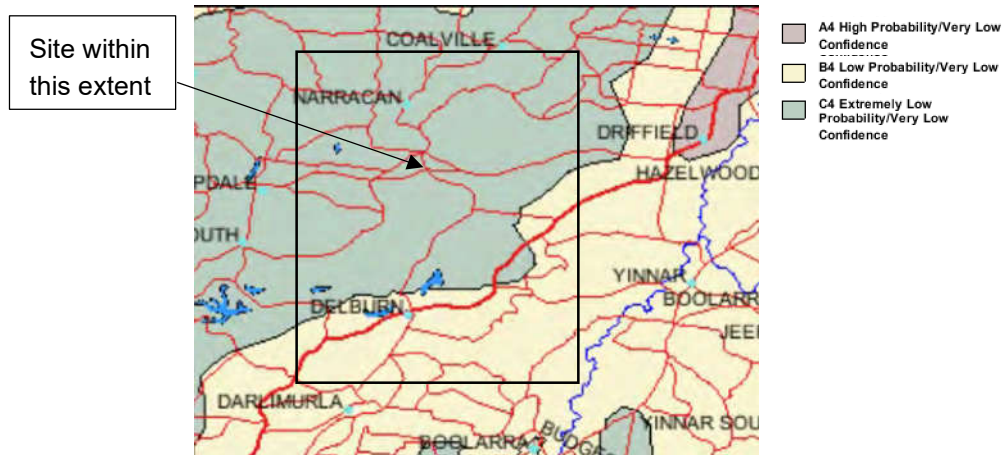
In the unlikely event that contaminated soil is encountered, it may need to be disposed of off-site at a facility licensed to accept the waste.



## 6.8 Acid sulfate soils

### 6.8.1 Summary of findings

The CSIRO Acid Sulfate Soils Probability map indicate generally a “low probability of occurrence” to “extremely low probability of occurrence” in the vicinity of the site. Discrete localised areas of “high probability of occurrence” are present in the vicinity of the site, but located near waterbodies outside of the extent of the proposed development. None of the proposed WTG sites are located within potential acid sulfate soils, and no potential acid sulfate soils are expected to be impacted by the project. Volcanic soils such as those of the Thorpdale Volcanics are not expected to be potential acid sulfate soils.



**Plate 3: Acid Sulfate Spoils Probability (CSIRO Australian Soil Resource Information System)**

### 6.8.2 Implications for project

No acid sulfate soils are expected to be disturbed by the project.

## 6.9 Other impacts

### 6.9.1 Summary of findings

There is expected to be an increase in construction traffic, including heavy vehicles which will need to access sealed and unsealed roads within the area. The existing roads are generally in good condition, servicing heavy vehicles associated with the quarrying and forestry activities in the area, however the increase in construction traffic could increase the rate of dilapidation of existing roads.

### 6.9.2 Implications for project

We anticipate that maintenance of public roads (e.g. re-grading, and potentially resurfacing of asphalt roads) may need to be undertaken as part of the proposed DWF construction works, in accordance with typical construction practices for wind farms. We consider it would be prudent to perform a dilapidation survey of existing structures and roads prior to construction works commencing so there is a record of the ‘pre-construction’ conditions.

## 6.10 Future investigation

We recommend that future investigation for proposed wind farm development include a borehole at each proposed WTG location, with boreholes advanced to a depth of 15 m to 25 m. In addition to the boreholes, a series of shallow test pits and geophysical tests would be conducted at wind turbine locations and along proposed access and underground cable routes. The principal objective of the borehole, test pits etc will be to assess the strength and stiffness of the underlying soil and rock to inform foundation and access track design.

However, the boreholes and test pits would also assist in assessing the depth to rock beneath the proposed WTG locations, informing the size and depth of excavation required for the footings, assessing the erosion potential of soil materials, measuring groundwater level and assessing whether the footings could interact with groundwater. This information can be used to further assess potential impacts to groundwater or surface water.

In addition, we recommend the installation of groundwater investigation wells at locations where bore water is expected to be sourced (if any), for the purposes of assessing potential groundwater bore yields and water quality.

Some geophysics surveys will likely be required along proposed underground cable routes in order to provide information on ground electrical and thermal resistivity. Soil samples would also be obtained from test pits and boreholes to allow laboratory testing of electrical and thermal resistivity.

## 7.0 SUMMARY AND CONCLUSIONS

The proposed DWF development involves temporary excavation to depths of about 5 m for WTG footing construction, the excavation and backfilling of trenches and the construction of unsealed access roads and hard stands. The impact from the development associated with geotechnical, contaminated land and hydrogeological considerations is assessed to be very low for the following reasons:

- Infrastructure is not proposed for construction in areas that are susceptible to landslides.
- Excavation is not expected to extend to sufficient depth such that groundwater is encountered.
- The soils have a low susceptibility to erosion and the WTG locations are a significant distance from surface water courses that could be susceptible to impact from eroded soil. Erosion of exposed soils during construction is expected to be managed using standard construction techniques including dust suppression, silt fences and temporary drainage. Long term, crushed rock materials will be required on roads and hardstands to provide erosion protection. Provided erosion controls are in place and erosion is appropriately managed the impact to surface water is expected to be negligible.
- The area is not susceptible to salinity based on the groundwater level, quality and geological conditions.
- There are no potential acid sulfate soils expected to be encountered at locations where infrastructure is proposed.
- No contaminated land has been identified at the proposed development locations. Although there is some potential for contamination associated with past farming and logging activities, it is expected that contaminated land could be managed through off-site disposal to a facility licensed to receive the waste.

Based on the planning provisions set out in Section 3.0, the potential impacts of the proposed DWF and impacts to the proposed DWF from erosion and landslip; surface water; groundwater; stone resources; natural hazards (e.g. earthquakes); dry land salinity; soil and groundwater contamination; and acid sulfate soils are considered to be low and manageable. This conclusion is subject to the results of the site investigations recommended in Section 6.10.

## 8.0 IMPORTANT INFORMATION

Your attention is drawn to the document 'Important information relating to this report' which is included in Appendix C of this report. The statements presented in that document are intended to inform a reader of the

report about its proper use. There are important limitations as to who can use the report and how it can be used. It is important that a reader of the report understands and has realistic expectations about those matters. The Important Information document does not alter the obligations Golder Associates has under the contract between it and its client.

## Signature Page

**Golder Associates Pty Ltd**

A handwritten signature in black ink, appearing to read 'Darren Paul', written in a cursive style.

Darren Paul  
*Principal*

DRP-DA/JMW-DLG/drp

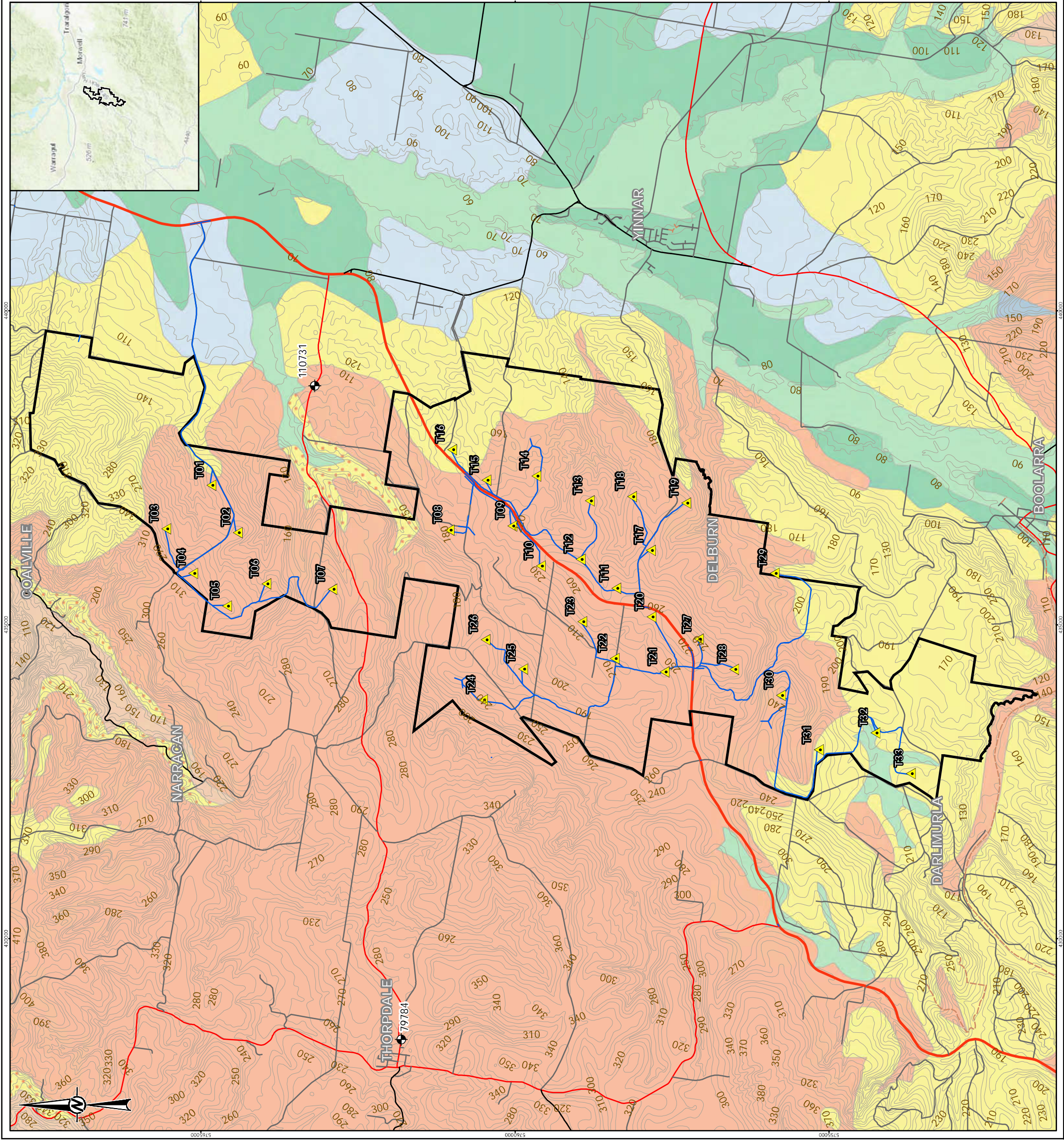
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[https://golderassociates.sharepoint.com/sites/115925/project files/6 deliverables/19130636-003-r/19130636-003-r-rev0.docx](https://golderassociates.sharepoint.com/sites/115925/project%20files/6%20deliverables/19130636-003-r/19130636-003-r-rev0.docx)









LEGEND

- Project Boundary
- VVG Bores
- WTG
- 10 m elevation contour
- Roads
  - Highway
  - Local Road
  - Sealed Road
  - Other Road
  - Track
  - Reticulation
- Surface Geology
  - Thorpdale Volcanics (-Put)
  - Latrobe Valley Group (-Pv)
  - Childers Formation (-Pvc)
  - Sirzelecki Group (Ksw)
  - Incised colluvium (Nc1)
  - Haunted Hills Formation (Nlh)
  - Howqua Chert (Oah)
  - Sand, silt, clay, gravel of Recent alluvial flats (Qa1)
  - Alluvial terrace deposits (Qa2)

NOTES

1. PROJECTION: GDA 1994 MGA ZONE 55.

REFERENCE(S)

1. KEY MAP AND IMAGERY SOURCED FROM ESRI ONLINE BASEMAPS.

2. ROAD & PROPERTY DATA © THE STATE OF VICTORIA, DEPARTMENT OF ENVIRONMENT, LAND, WATER & PLANNING, 2017.

CLIENT

OSMI AUSTRALIA

PROJECT

DESKTOP ASSESSMENT OF GEOTECHNICAL, CONTAMINATED LAND AND HYDROLOGICAL CONSTRAINTS

TITLE

GEOLOGICAL PLAN

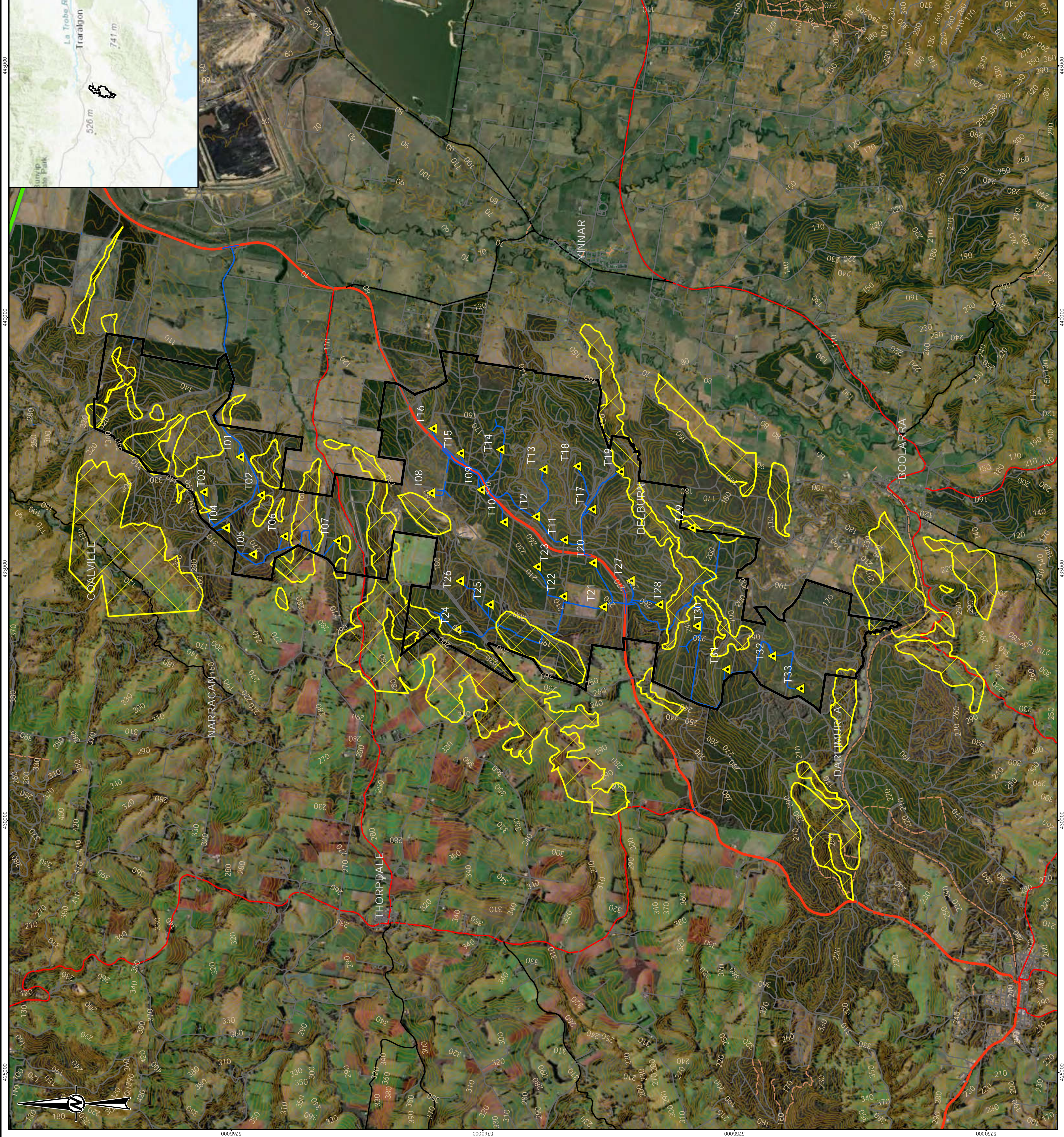
CONSULTANT	YYYY-MM-DD	2020-06-09
DESIGNED		-
PREPARED	MAH	
REVIEWED	DRP	
APPROVED	DRP	



PROJECT NO. CONTROL REV. FIGURE

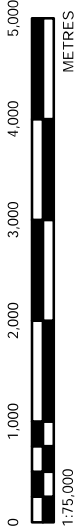
19130636 003-R 0 2





LEGEND

- Project Boundary
- WTG
- 10 m elevation contour
- Landslide Susceptibility
- Roads
  - Freeway
  - Highway
  - Local Road
  - Sealed Road
  - Other Road
  - Track
  - Reticulation



NOTES(S)  
1. PROJECTION: GDA 1994 MGA ZONE 55.

REFERENCE(S)  
1. KEY MAP AND IMAGERY SOURCED FROM ESRI ONLINE BASEMAPS.  
2. ROAD & PROPERTY DATA © THE STATE OF VICTORIA, DEPARTMENT OF ENVIRONMENT, LAND, WATER & PLANNING, 2017.

CLIENT  
OSMI AUSTRALIA

PROJECT  
DESKTOP ASSESSMENT OF GEOTECHNICAL,  
CONTAMINATED LAND AND HYDROLOGICAL CONSTRAINTS

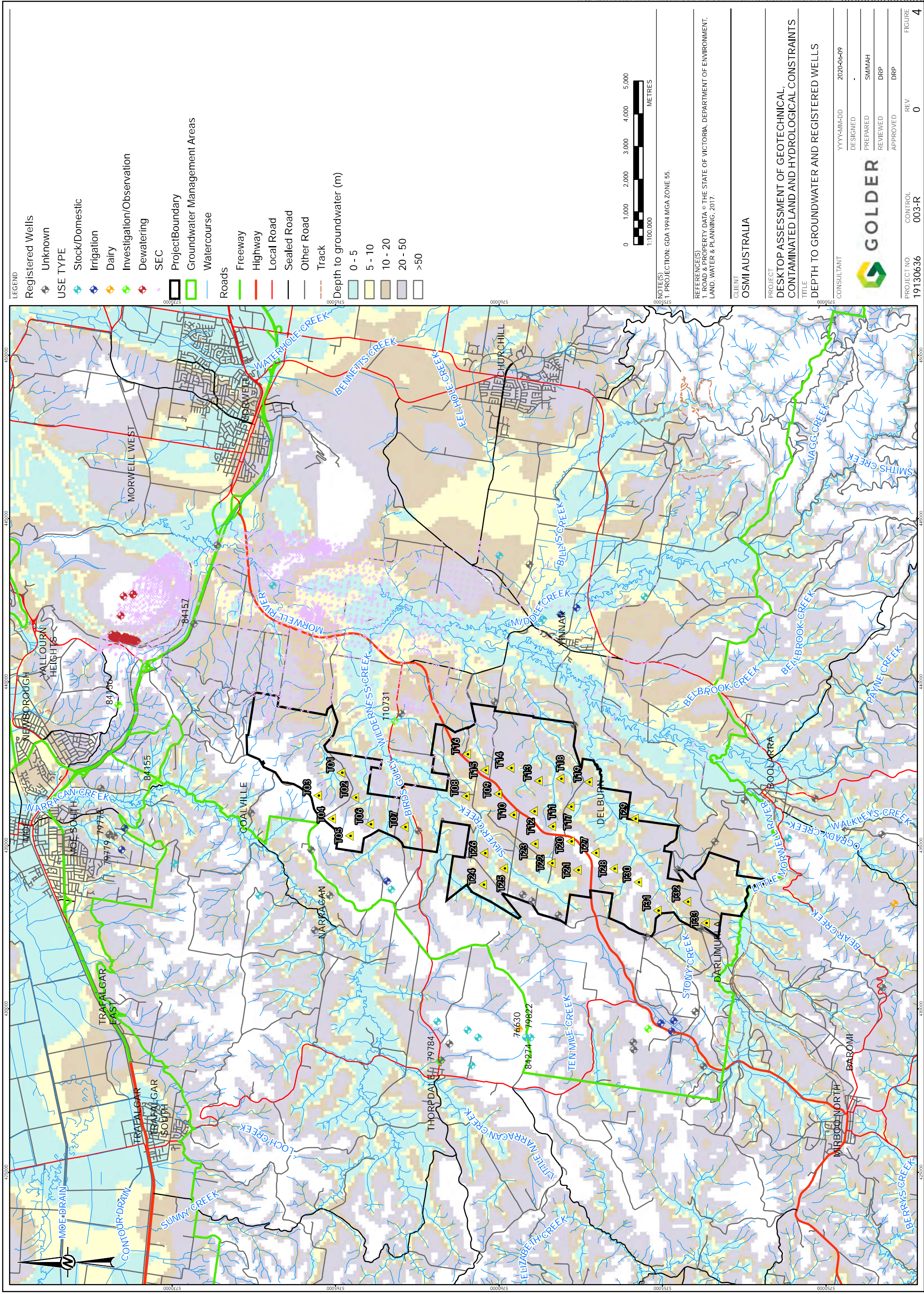
TITLE  
INFERRED LANDSLIDE SUSCEPTIBILITY

CONSULTANT	YYYY-MM-DD	2020-06-09
DESIGNED	-	
PREPARED	MAH	
REVIEWED	DRP	
APPROVED	DRP	

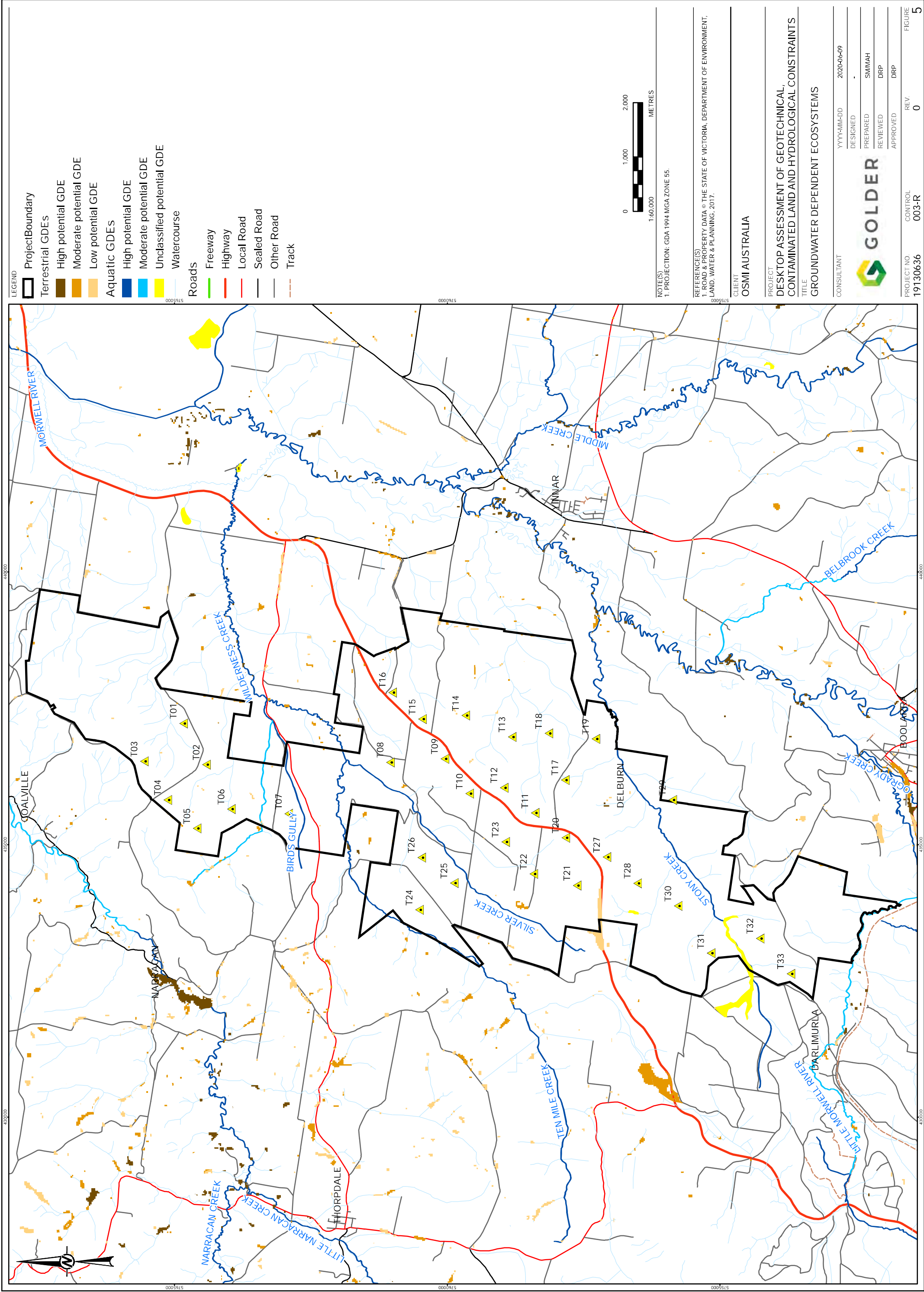


PROJECT NO.	CONTROL	REV.	FIGURE
19130636	003-R	0	3









LEGEND

Project Boundary

Terrestrial GDEs

High potential GDE

Moderate potential GDE

Low potential GDE

Aquatic GDEs

High potential GDE

Moderate potential GDE

Unclassified potential GDE

Watercourse

Roads

Freeway

Highway

Local Road

Sealed Road

Other Road

Track

0

1,000

2,000

METRES

NOTE(S)

1. PROJECTION: GDA 1994 MGA ZONE 55.

REFERENCE(S)

1. ROAD & PROPERTY DATA © THE STATE OF VICTORIA, DEPARTMENT OF ENVIRONMENT, LAND, WATER & PLANNING, 2017.

CLIENT

OSMIAustralia

PROJECT

DESKTOP ASSESSMENT OF GEOTECHNICAL,  
CONTAMINATED LAND AND HYDROLOGICAL CONSTRAINTS

TITLE

GROUNDWATER DEPENDENT ECOSYSTEMS

CONSULTANT

YYYY-MM-DD 2020-06-09

DESIGNED

-

PREPARED

SMMAH

REVIEWED

DRP

APPROVED

DRP

PROJECT NO.

19130636

CONTROL

003-R

REV.

0

FIGURE

5

0

1,000

2,000

METRES

NOTE(S)

1. PROJECTION: GDA 1994 MGA ZONE 55.

REFERENCE(S)

1. ROAD & PROPERTY DATA © THE STATE OF VICTORIA, DEPARTMENT OF ENVIRONMENT,  
LAND, WATER & PLANNING, 2017.

CLIENT

OSMIAustralia

PROJECT

DESKTOP ASSESSMENT OF GEOTECHNICAL,  
CONTAMINATED LAND AND HYDROLOGICAL CONSTRAINTS

TITLE

GROUNDWATER DEPENDENT ECOSYSTEMS

CONSULTANT

YYYY-MM-DD 2020-06-09

DESIGNED

-

PREPARED

SMMAH

REVIEWED

DRP

APPROVED

DRP

PROJECT NO.

19130636

CONTROL

003-R

REV.

0

FIGURE

5

**APPENDIX A**

# Results of Desktop Study

## DESKTOP STUDY

The following sets out the results of the desktop study. The information gathered through the course of the desktop study has been used to inform the impact assessment which is set out in this report.

### Topographic setting

The topographic setting of the site is presented on Figure 1. The following comments relate to the topography of the site:

- The WTG locations are predominantly located on a remnant plateau formed by the Thorpdale Volcanics geological unit. The plateau has been incised, with predominant drainage direction to the north east. Surface levels range between about 100 m AHD in creek valleys on the eastern side of the site to 260 m AHD on the crest of hills.
- Due to inferred relict landslide features, the site has an irregular, or 'stepped' surface over some areas, with several hundred metres separating prominent breaks in slope.
- The drainage courses are valleys with relatively steep sided (20° to 30°) slopes. There is evidence for recent landslide activity on the sides of some of the gullies. Silver Creek and Stony Creek are two prominent drainage courses that flow towards the north east from the site.
- Catchment dams have been constructed in some natural drainage paths for agricultural purposes.
- The Kennedy Haulage quarry is located near the centre of the site and comprises two pits from which materials of the Thorpdale Volcanics are extracted.
- There are numerous forestry roads throughout the area in various states of repair and accessibility.

## Geology and subsurface materials

### Regional geology

The 1:63,360 scale geological mapsheet for Mirboo North (GSV, 1967, see Figure 2) shows the surface geology in the project area to consist primarily of Tertiary (Oligocene) age Thorpdale Volcanics (formally Thorpdale Volcanic Group), described on the mapsheet as comprising basic lava flows, plugs, dykes and pyroclastics, along with interbedded bands of clay and coal. Limited areas of outcropping Tertiary (Oligocene) age Childers Formation have been recorded beneath the Thorpdale Volcanics near the centre of the project area. The Childers Formation consists of sand, clay, conglomerate, gravel, quartzite and thin brown coal seams. The Tertiary (Pliocene to Miocene) age Latrobe Valley Group is mapped in the north and south of the project area, interbedded with the Thorpdale Volcanics and Childers Formation. Minor areas of Quaternary aged alluvium are mapped within creek channels. Basement rock beneath the site is expected to be of the Cretaceous age Wonthaggi Formation, although this is not mapped as outcropping within the project area. This is composed of sandstone and siltstone with minor conglomerate and black coal.

### Near surface materials

With reference to Figure 2, there are two predominant geological units that are expected to underlie the site. Most of the site, including around Delburn are expected to be underlain by the Eocene to Oligocene Older Volcanics (Thorpdale Volcanics). The eastern and part of the southern part of the site are expected to be

underlain by the more recent Pliocene to Miocene age Latrobe Valley Group, although based on the current WTG layout, a maximum of six WTG locations are expected to be underlain by this material.

Localised Quaternary alluvium is expected to be present around water courses, although this material is not expected to significantly influence the development of the DWF. A brief description of the main geological units expected at the surface of the site is provided in Table A1. We anticipate there could be local areas of uncontrolled (i.e. non-engineered) fill associated with past activities on the site including works associated with logging activities.

**Table A1: Anticipated near surface geological units**

Age	Unit reference	Map symbol	Description
Quaternary (Holocene)	Unit 1	Qra	Alluvium – gravel, sand, silt and clay (fluvial deposits).
Latrobe Valley Group (Pliocene to Miocene)	Unit 2	Tph	Sand, silt, gravel and ferruginous sand. Interbedded with sand and clay in varying proportion.
Thorpdale Volcanics (Eocene to Oligocene)	Unit 3	Tvd	Basic Lava and associated pyroclastics, basic plugs, dykes, interbedded clay and coal.

Note that given the Unit 2 (Latrobe Valley Group) materials are expected to be interbedded with the Unit 3 materials (Thorpdale Volcanics), it is possible that excavation near the geological boundaries, will pass through the Latrobe Valley Group and into the Thorpdale Volcanics. Note that the geological map appears to indicate that WTG T32 is to be located on alluvial materials. However, site inspections indicate this is unlikely to be the case.

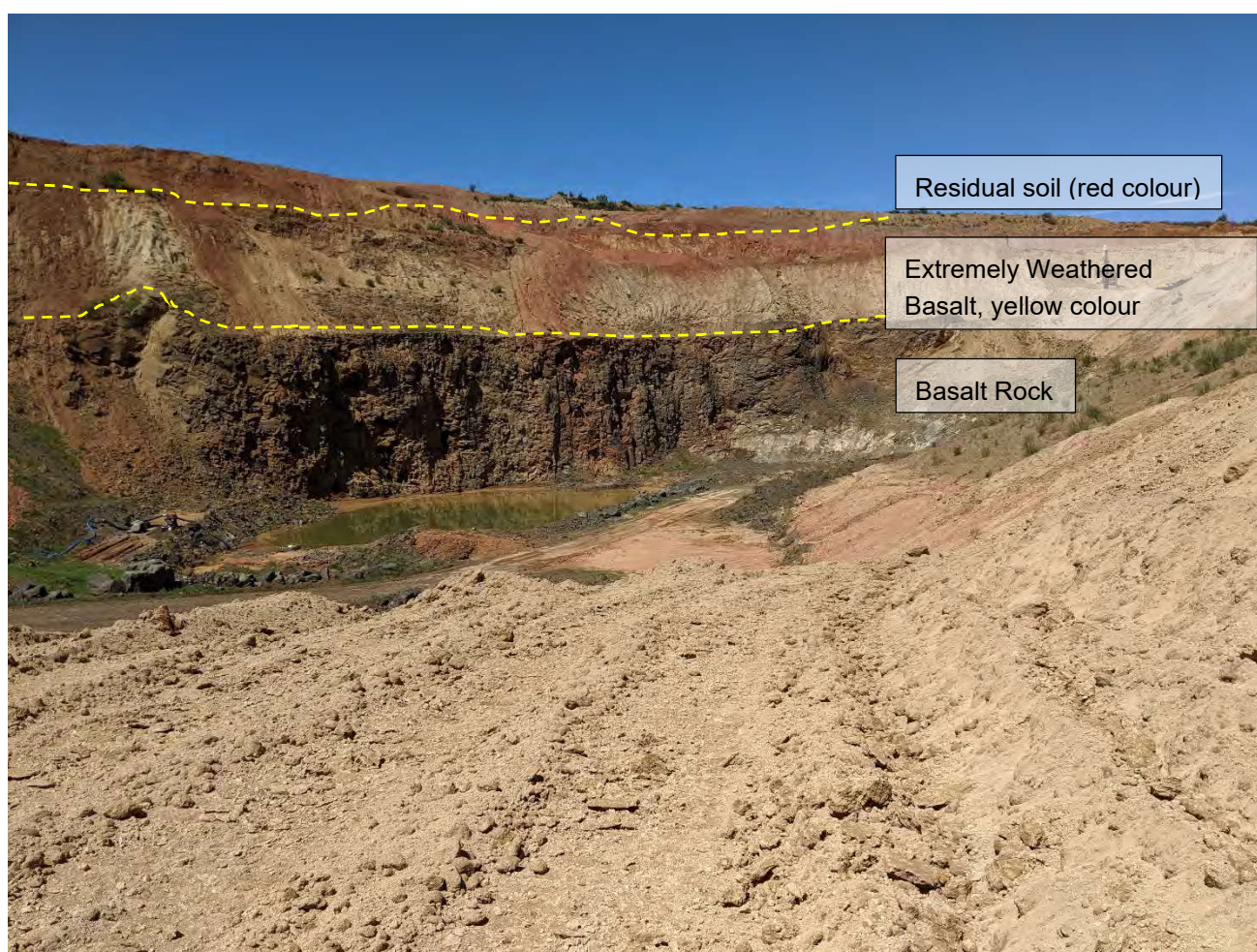
## Weathering

The upper portions of the Unit 3 Thorpdale Volcanics which are expected to underlie most of the proposed WTG are typically deeply weathered to a red-brown high plasticity clay, which is characteristic of the Thorpdale area. This clay is susceptible to volume changes in response to moisture changes. The clay is expected to be underlain by basalt rock, however the depth to basalt can be highly variable.

The Unit 2 Latrobe Valley Group shows some evidence of weathering, including ferruginisation whereby there is some cementation of sand by iron oxides and occasional very high strength ferricretes.

Exposures through the Thorpdale Volcanics observed in the Kennedy Haulage Quarry along with borehole logs provided by quarry management indicate a varied subsurface profile through this material. In general, the profile comprises a 6 m to 7 m thick layer of high plasticity clay inferred to have derived from the in situ weathering of the Thorpdale Volcanics. This is underlain by inferred extremely weathered basalt, which occurs as a hard clay to low strength rock and has a characteristic yellow colour. There appears to be multiple layers and varied distribution of the extremely weathered basalt before competent basalt rock is typically encountered at a depth of 15 m or more, noting that at some locations in the vicinity of the quarry, the basalt rock is encountered near surface. A profile within the Thorpdale Volcanics observed at the Kennedy Quarry is shown in Plate A1.





**Plate A1: General profile exposed in Kennedy Haulage Quarry**

Silcrete rock was observed at one location within the vicinity of the quarry and appears to be present near the top of the extremely weathered basalt.

No exposures were observed through the Latrobe Valley Group. However, past experience with this material indicates that it is typically a dense to very dense sand or hard clay containing a variable proportion of clay to sand.

## Groundwater

### Aquifer units

The main hydrostratigraphic units in the project area and their properties are summarised in Table A2.

**Table A2: Summary of regional hydrogeological units**

Unit	Thickness (m)	Aquifer type	Typical salinity (TDS, mg/L)	Typical bore yield (L/s)
Thorpdale Volcanics	Up to 60	Unconfined and confined fractured basalt aquifer	Less than 1,000	Variable, less than 4

Unit	Thickness (m)	Aquifer type	Typical salinity (TDS, mg/L)	Typical bore yield (L/s)
Childers Formation	40 to 50	Confined sand aquifer	Less than 1,000	Less than 5
Latrobe Valley Group	> 100	Sand and gravel aquifers locally confined by interbedded coal and clay	Less than 900	Up to 150
Wonthaggi Formation	> 100	Fractured rock aquifer	1,000 to 3,500	Less than 5

Sources:

Nott, 2004. Groundwater Occurrence in the Gippsland Basin. Department of Sustainability and Environment, Note No. 5.

Lahey & Tickell, 1980. Explanatory Notes on the Western Port Groundwater Basin 1:100 000 Hydrogeological Map.

Geological Survey of Victoria, Report #69.

Australian Stratigraphic Units Database. <https://asud.ga.gov.au/search-stratigraphic-units/>

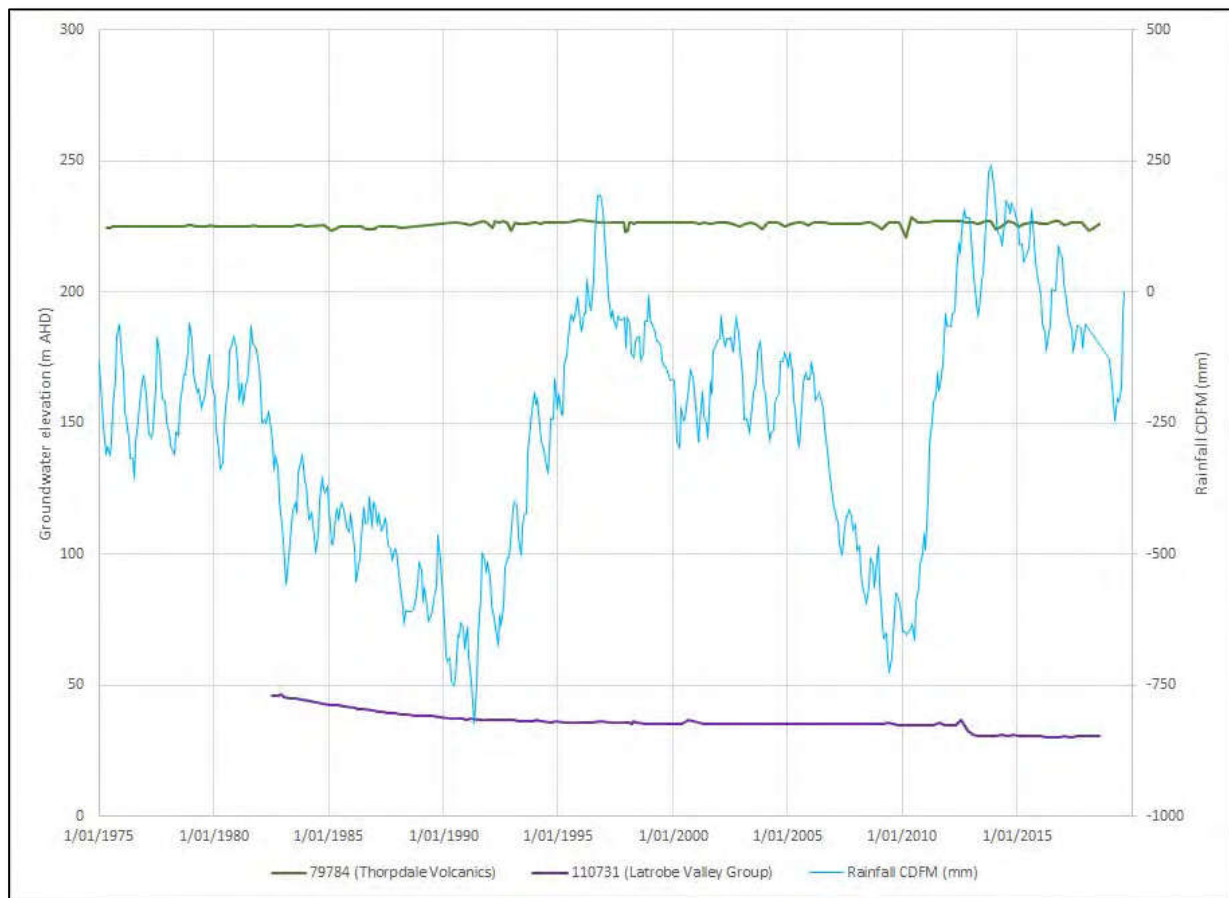
## Groundwater levels

Groundwater levels in the project area estimated as part of state-wide mapping of groundwater levels as part of the Victorian Aquifer Framework are shown in Figure 4. This indicates that depth to groundwater across the project area is likely to range from less than 5 metres below ground level (m bgl), in topographically lower areas close to streams, to over 100 m bgl in areas of higher elevation. Based on this map, depth to groundwater at the eight proposed wind turbine locations (WTG16, WTG 21, WTG 34, WTG 35, WTG 36, WTG 38, WTG 43, WTG 49) may be less than 20 m bgl. Further investigation may be warranted near these locations to confirm actual groundwater levels.

A search of registered boreholes on the Water Management Information System (WMIS) maintained by the Department of Environment, Land, Water and Planning (DELWP) was undertaken to identify the monitoring wells for which long term groundwater level monitoring data may be available. Two monitoring wells with groundwater level information (IDs 110731 and 79784) were identified within 5 km of the site. The groundwater levels observed in these bores are shown in Plate A2, along with the rainfall residual mass curve. Rainfall data was obtained from the Mirboo North Water Board weather station (BOM station #85282), approximately 7 km south-west of the project area.

Bore 110731, located approximately 2.5 km to the east of the project area, is recorded as 200 m deep, but the screened interval and lithology is not reported. Based on the surface geology and depth, this bore is likely to intersect the Latrobe Valley Group. A declining in groundwater level of approximately 9 m was recorded between 1982, when the well was installed, and 2000. Groundwater level then remained relatively stable from 2000 to 2012, declined by approximately 4 m from 2012 to 2013, then remained relatively stable to 2018. The most recent groundwater level recorded (August 2018) indicates a depth to water of approximately 62 m, corresponding to an elevation of approximately 30 m AHD.

Bore 79784, located approximately 4.9 km to the west, is screened from 21 m bgl to 37 m bgl, within the Thorpdale Volcanics. The groundwater level has remained relatively stable over the period of monitoring (from 1975 to 2018). The most recent groundwater level (August 2018) records indicate groundwater to be approximately at the ground surface level, corresponding to an elevation of 226 m AHD.



**Plate A2: Groundwater level at registered wells**

### Groundwater flow system and receptors

Surface topography is commonly inferred to be a good indication of a water-table aquifer flow system. Local flow towards streams would be expected, with regional flow to the east or north-east towards the Morwell River. The Morwell River and its tributaries in the project area fall within the Central Foothills and Coastal Plains Segment under the State Environment Protection Policy (SEPP Waters) (2018). Waterways within this segment are considered to be slightly to moderately modified, so a 95% level of protection applies when selecting water quality objectives.

Aquatic groundwater dependent ecosystems are mapped (BOM Groundwater Dependent Ecosystems Atlas) along the various creeks which cross the project area (See Figure 5):

- Little Morwell River,
- Stony Creek,
- Silver Creek,
- Ten Mile Creek,
- Bird's Gully,
- Wilderness Creek.

This indicates that the creeks are likely to be receptors of groundwater discharge, and associated ecosystems rely on the surface expression of groundwater. Terrestrial groundwater dependent ecosystems are mapped in scattered locations across and surrounding the project area. These areas have the potential for vegetation to be reliant on sub-surface groundwater. Much of the GDE mapping is based on remote sensing data, and would require confirmation on the ground.

Regionally, groundwater levels and flow within the Latrobe Valley Group aquifers are known to be influenced by dewatering of the Latrobe Valley coal mines (SRW, 2012). This influence may not extend to the adjacent/overlying Thorpdale Volcanics and Childers Formation. The Morwell open cut is located approximately 4 km to the north-east of the project area, beyond the Morwell River.

## Groundwater quality

State-wide mapping indicates shallow groundwater in the project area is likely to have salinity of less than 1,000 mg/L.

A review of information on groundwater quality in the project area was undertaken using the information provided in the WMIS database. A total of nine wells were identified with chemical data available within 5 km of the site. All available information was collected in the 1970s. A summary of the available data is provided in Table A3. The data indicate that salinity is generally below 500 mg/L, and pH, chloride and sulphate concentrations indicate non-aggressive groundwater conditions, with reference to AS2159-2009: Exposure classification for steel or concrete piles. However, as none of these wells is located within the project area, and the age of the data, it is recommended to confirm groundwater chemistry within the project area if structures are likely to intersect groundwater.

**Table A3: Summary of chemistry results from registered wells**

Well ID	pH	EC ( $\mu$ S/cm)	Total Soluble Salts (mg/L)	Chloride (mg/L)	Sulphate (mg/L)
76630	8.0	2740	1,670	653	39
79778	8.2	454	326	58.5	15
79779	7.3	305	119	47	3
79784	8.1	660	409	77.5	-
79822	6.6	550	322	139	1
84155	8.1	554.5	392	61.5	10
84156	8.2	466	353	50	7
84157	8.0	795	-	117	-
84274	7.1	322	235	59	3



## Groundwater use

The results of a search of the WMIS database of registered groundwater wells within 5 km of the site is summarised in Table A4. A total of 77 wells are registered within the project area, but none have an extractive use listed. The realised beneficial uses in the project area identified from the search are domestic use, use for stock watering, industrial (dairy) use and dewatering. A large number of wells are registered as SEC use (State Electricity Commission). The SEC wells are thought to have been drilled for coal exploration prior to 1992, and are not likely to represent ongoing extractive use of groundwater. Dewatering bores are associated with the Yallourn open cut, approximately 4 km to the north of the project area. The location of registered wells along with their use is presented in Figure 4.

**Table A4: Registered groundwater wells within 5 km**

Groundwater Use	Number of Registered Bores within Project Area	Number of Registered Bores within 5 km of Project Area
Domestic and/or Stock	0	14
Irrigation	0	7
Dairy	0	3
Dewatering	0	53
Investigation/Observation	0	5
SEC	71	2729
Not Known	6	33

The entire project area is within both the Rosedale and Stratford Groundwater Management Areas (GMAs). The Rosedale GMA applies to “Middle Aquifers”. In the project area, this would include the Morwell Formation and Yallourn Formation of the Latrobe Valley Group (i.e. upper part). The Stratford GMA applies to “Lower Aquifers”. In the project area, this would include the Thorpdale Volcanics, Childers Formation and Traralgon Formation/Burong Formation of the Latrobe Valley Group (i.e. lower part). Permission to extract groundwater would need to be sought from Southern Rural Water, subject to availability within the Permissible Consumptive Volume (PCV) for each GMA.

The Victorian Mineral Springs Database does not list any mineral springs in the project area. However, spring-fed creeks are common in the Thorpdale area, over the Thorpdale Volcanics (SRW, 2012<sup>1</sup>), so it is possible that groundwater springs other than mineral water are also present in the project area.

## Earthquake

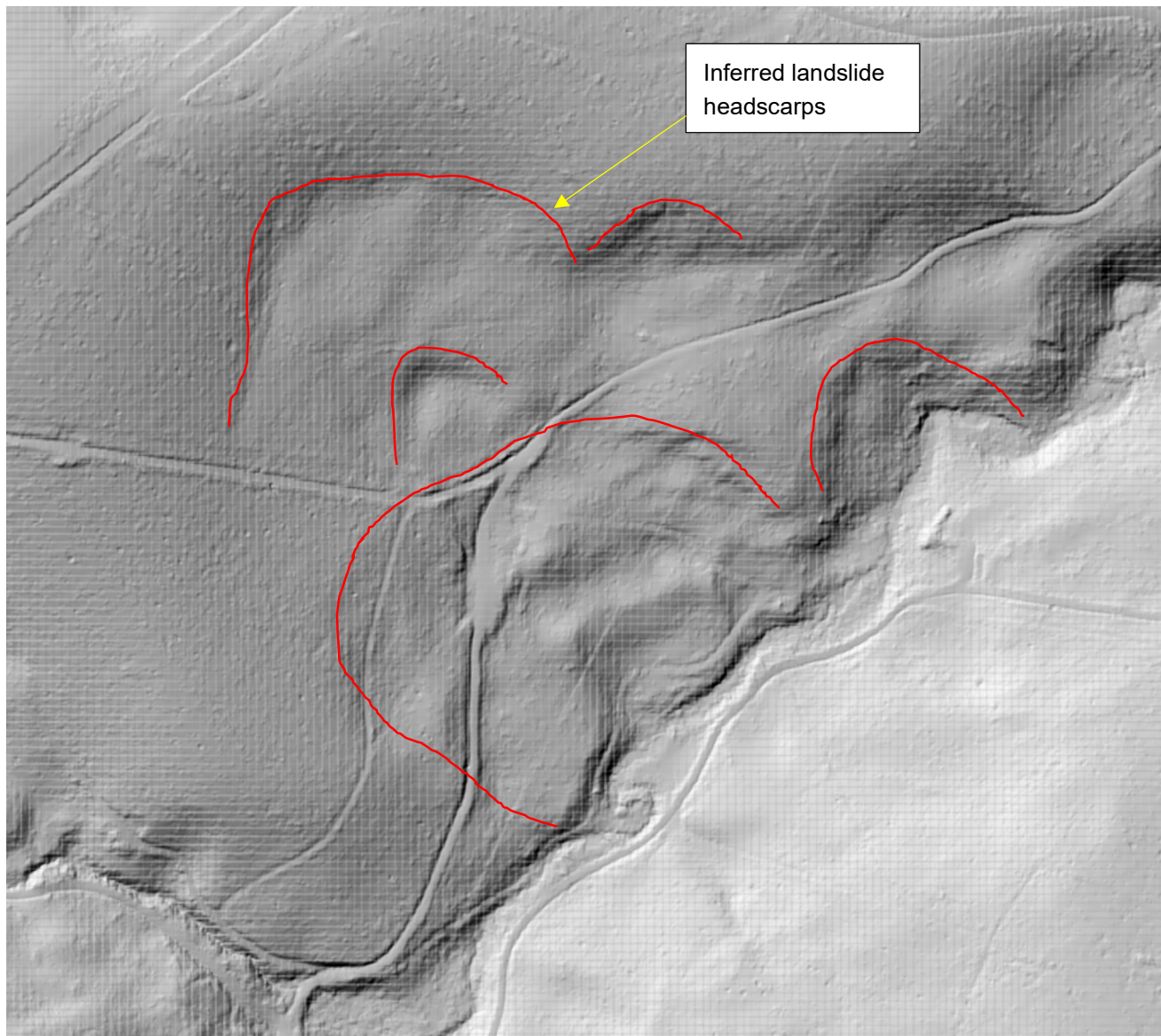
A review of earthquake epicentre records on the Geovic website indicates there have been earthquakes with magnitude up to 5.4 within about 3 km of the proposed DWF. Figure 3.2(A) of Australian Standard AS1170.4 –

<sup>1</sup> Southern Rural Water, 2012. Gippsland Groundwater Atlas.

2007 'Structural design actions Part 4: Earthquake actions in Australia' indicates that the hazard factor ( $z$ ) for the Delburn region is 0.11.

## Landslide and slope instability

Review of the digital terrain model by a principal engineering geologist has been undertaken to identify areas that appear to have been subject to previous slope instability. The residual soils of the Thorpdale Volcanics are known to be susceptible to landslides, with several landslides previously occurring around the Thorpdale area. Relict landslides have been identified based on indications in the digital terrain model, similar to that presented in Plate A3.



**Plate A3: Example of inferred landslide within project area**

Figure 3 indicates areas inferred to be subject to landslide and slope instability. These susceptible areas are typically associated with steeper slopes in the vicinity of water courses.



Field visit suggested that whilst there is evidence for past large scale landslide activity, there is no evidence for recent large scale landslide activity. Slightly hummocky and stepped ground observed in some locations appears to be indicative of historical landslides, probably thousands of years old. An example of stepped ground is presented in Plate A4 where the distance between breaks in slope is several hundred metres.



**Plate A4: Example of stepped ground, track into WTG41**

One example of a recent landslide was observed whilst traversing between WTG 8 and 9 (Plate A5), noting that the landslide was not observed to be at a WTG location. The landslide was observed to be about 30 m wide and had occurred on an approximately 30 degree slope, noting that this is one of the steepest slopes within the proposed wind farm area.





**Plate A5: Example of recent landslide, traverse between WTG 8 and WTG 9**

We note that no evidence for recent landslide activity was observed at any of the WTG locations visited during the site visit.

## Sites of geological significance

The GeoVic website does not identify any sites of geological significance within the project boundaries.

## Acid sulfate soils

The CSIRO Acid Sulfate Soils Probability map indicate generally a “low probability of occurrence” to “extremely low probability of occurrence” in the vicinity of the site. However, discrete localised areas of “high probability of occurrence” are present in the vicinity of the site located near waterbodies.

## Surface hydrology

The GeoVic website indicates that the site is not located within a designated water supply catchment area. However, the Narracan Creek Catchment area is located within 1.2 km of the western site boundary. The

project site does not appear to be within any declared water supply catchment or groundwater water supply protection areas.

## Sources of select fill and aggregate

During the site visit of the Kennedy Haulage quarry, observation was made of the products produced by the quarry. Based on discussions with quarry management, we understand that materials produced in the quarry are typically used for road construction, including most of the logging tracks within the proposed wind farm area. We were also provided with laboratory test results for some of the materials produced by the quarry. The following products are produced at the quarry:

- VicRoads 20 mm and 40 mm Class 3 and Class 4 crushed rock.
- 7 mm and 14 mm concrete aggregates.
- Various 'resheet' mixes, generally derived from extremely weathered basalt and screened to 20 or 40 mm minus.
- Various non-descript crushed rock products and spalls.

Based on our preliminary observations and on the test results viewed, we expect that the Kennedy Haulage quarry will be a feasible source of most of the select fill and aggregate products required for the project, including concrete aggregates and road base materials. However, this preliminary indication is subject to detailed assessment of specific material and volume requirements.

## Historical aerial photographs

Commercially available historical aerial photographs were obtained for review. The observations from the review are summarised in Table A5 and copies of the historical aerial photographs are provided in Appendix B.

**Table A5: Aerial photograph observations**

Date of Photograph Run	Notes
1945	The available photograph only covers the central northern portion of the site. This portion of the site mostly consists of tree covered areas with visible paddocks and roadways across the area. Rural residential dwellings and farm sheds are scattered across the area. A disturbed area is located between the proposed locations of WT08 and WT09 and to the west of WT45.
1965	The site mostly consists of tree covered areas with some visible paddocks and roadways. Inferred cropping is evident in the south of the site.
1980s	The available photographs cover limited sections of the site. The visible areas of the site appear to be generally unchanged from the 1965 photographs.

Date of Photograph Run	Notes
2010s (NearMap)	The site mostly consists of tree covered areas with some visible paddocks and roadways. Some areas have been cleared of trees since the previous photographs. A disturbed area is located in the north of the site. Kennedys Quarry is visible in the centre of the site. There does not appear to be any dwellings on the site however numerous dwellings and farm sheds are located near the boundary of the site. A number of creeks and surface water bodies are evident within the site.

## Environmental Protection Authority database

### Certificates and Statements of Environmental Audit (EPA Victoria)

Certificates and Statements of Environmental Audit are statutory documents that are issued after a statutory environmental audit of a property has been conducted. A *Certificate of Environmental Audit* is issued for property where, following an audit, an environmental auditor believes the environmental condition of the land is suitable for any beneficial use. A *Statement of Environmental Audit* is issued where, following an audit, an environmental auditor believes the land is not suitable for all possible beneficial uses, but is suitable for specific uses or developments; it may contain conditions of clean-up or management of contamination.

A search of the EPA Victoria 'List of Issued Certificates and Statements of Environmental Audit' and Visualising Victoria's Groundwater website did not identify any completed environmental audits within 1 km of the site.

The closest environmental audit to the site boundary is located approximately 7 km east north east from the closest corner of the site and was completed in 2002 (CARMS No. 47803-1).

### Groundwater Quality Restricted Use Zones (EPA Victoria website)

A groundwater quality restricted use zone (GQRUZ) is an EPA declared area where, following an environmental audit, groundwater pollution remains, usually as a result of previous industrial activity. A GQRUZ is implemented when attempts have been made to clean up the groundwater and EPA determines that restrictions should remain on how the water can be used without further treatment.

A search of Visualising Victoria's Groundwater website indicates there are no GQRUZs within 1 km of the site.

### EPA Priority Sites Register (EPA Victoria)

The Priority Sites Register lists sites for which the EPA has issued a Clean-Up Notice (CUN) or a Pollution Abatement Notice (PAN) pursuant to sections of the *Environment Protection Act 1970*. The condition of these sites is not compatible with the current or approved use of the site without active management to reduce the risk to human health and the environment. Such management can include clean-up, monitoring and/or institutional controls.

The Priority Sites Register (current to 30 September 2019) does not list the site, or any site within 1 km of the site.

## Post Closure Pollution Abatement Notices

Following closure, landfills continue to pose risks to the environment. In order to ensure that the risks are appropriately quantified and managed, owners of closed landfill sites are issued with a Post Closure Pollution Abatement Notices (PC PAN) that requires the closed landfill to be managed so there are no unacceptable risks to the environment.

EPA Victoria maintains a database for locating issued PC PAN documents (EPA Interaction Portal). The database was queried 28 October 2019 and did not list any PC PANs within the townships/localities (Boolarra, Darlimurla, Delburn, Driffield, Hernes Oak, Narracan and Yinnar) that intersect the site.

## Victorian Landfill Register

Publicly available to all Victorians, the Victorian Landfill Register (VLR) draws information from various sources. It lists all current and known closed landfills in Victoria. Information contained in the VLR is intended to be used only as a guide and is not to be relied upon as being either complete or accurate. The VLR brings together information from:

- EPA landfill licences and post closure pollution abatement notices;
- Regional Waste and Resource Recovery Implementation Plans; and
- Historic landfill records held by EPA.

Sites that are located within 500 m of landfills, or former landfills may require further assessment for potential ground gas risks, such as methane.

The VLR interactive webpage was queried on 28 October 2019 and shows that an operating landfill is located 750 m to the north of the site (at its closest point) and is operated by Energy Australia Yallourn Pty Ltd, the type of waste received was not available on the VLR. No other landfills were listed on the register within a 1 km radius of the site.

An interest search of Energy Australia Yallourn Pty Ltd found that Energy Australia Yallourn submitted a Financial Assurance proposal to the Victorian EPA for three operational landfills located at Yallourn. The three landfills include an ash landfill, a hard waste landfill and an asbestos landfill. The Financial Assurance Proposal was approved by EPA in December 2018.

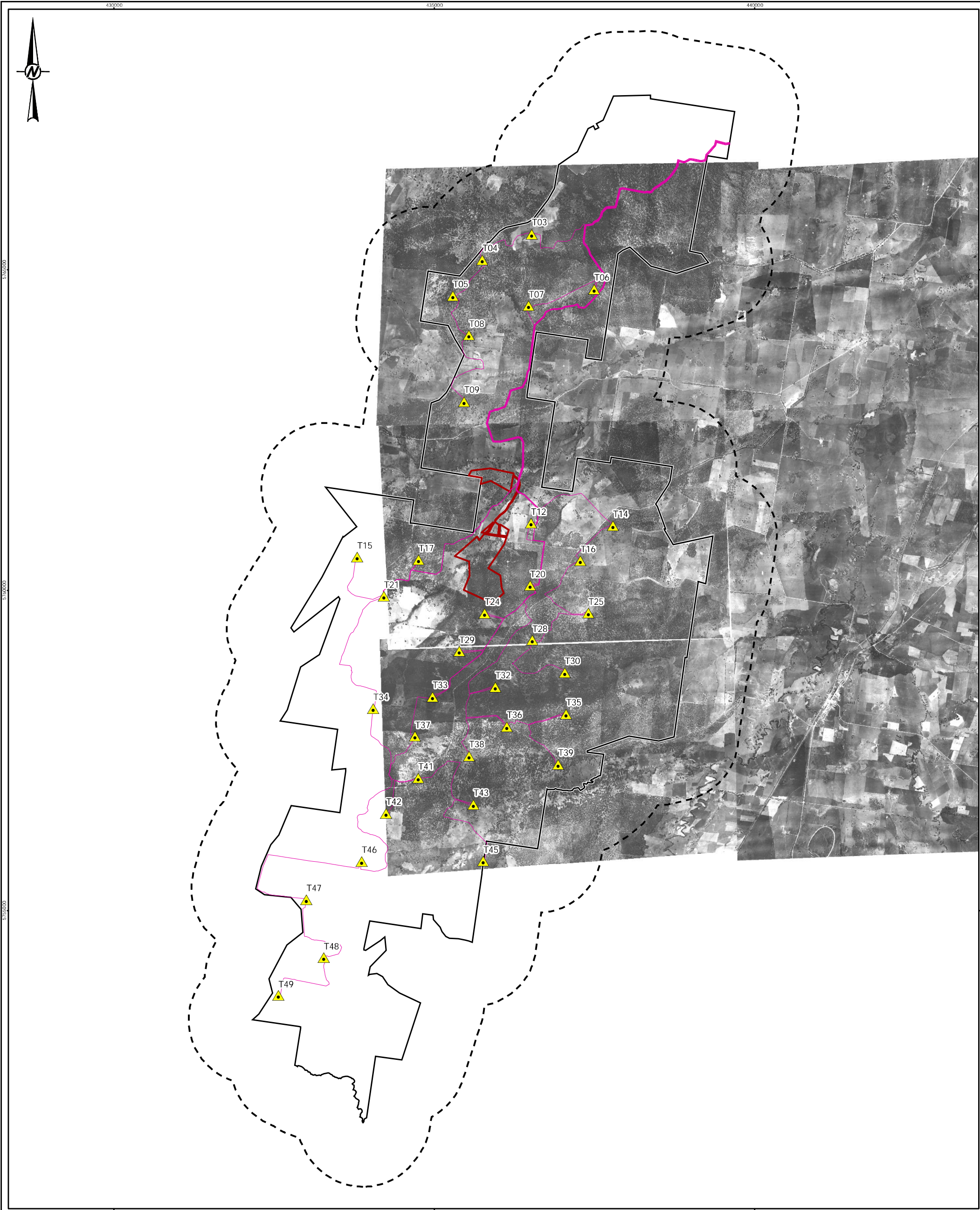
Additionally, the VLR interactive webpage shows that an operational landfill is located at the Hazelwood Power Complex and receives ceramic-based fibres, asbestos and ash waste, the landfill is located approximately 1.7 km south east of the site at its closest point.



**APPENDIX B**

# Historical Aerial Photographs



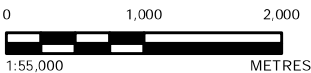


- LEGEND
- WTG Location
  - Reticulation
  - Kennedy Quarry
  - Project Boundary
  - Project Boundary (1km buffer)

DRAFT

NOTE(S)  
1. PROJECTION: GDA 1994 MGA ZONE 55

REFERENCE(S)  
1. IMAGERY SOURCED FROM GOLDER ARCHIVES.



CLIENT  
OSMI AUSTRALIA

CONSULTANT



YYYY-MM-DD	2019-11-07
DESIGNED	LMA
PREPARED	JPH
REVIEWED	JMW
APPROVED	JMW

PROJECT  
DESKTOP ASSESSMENT OF GEOTECHNICAL, CONTAMINATED  
LAND AND HYDROLOGICAL CONSTRAINTS

TITLE  
1945 AERIAL

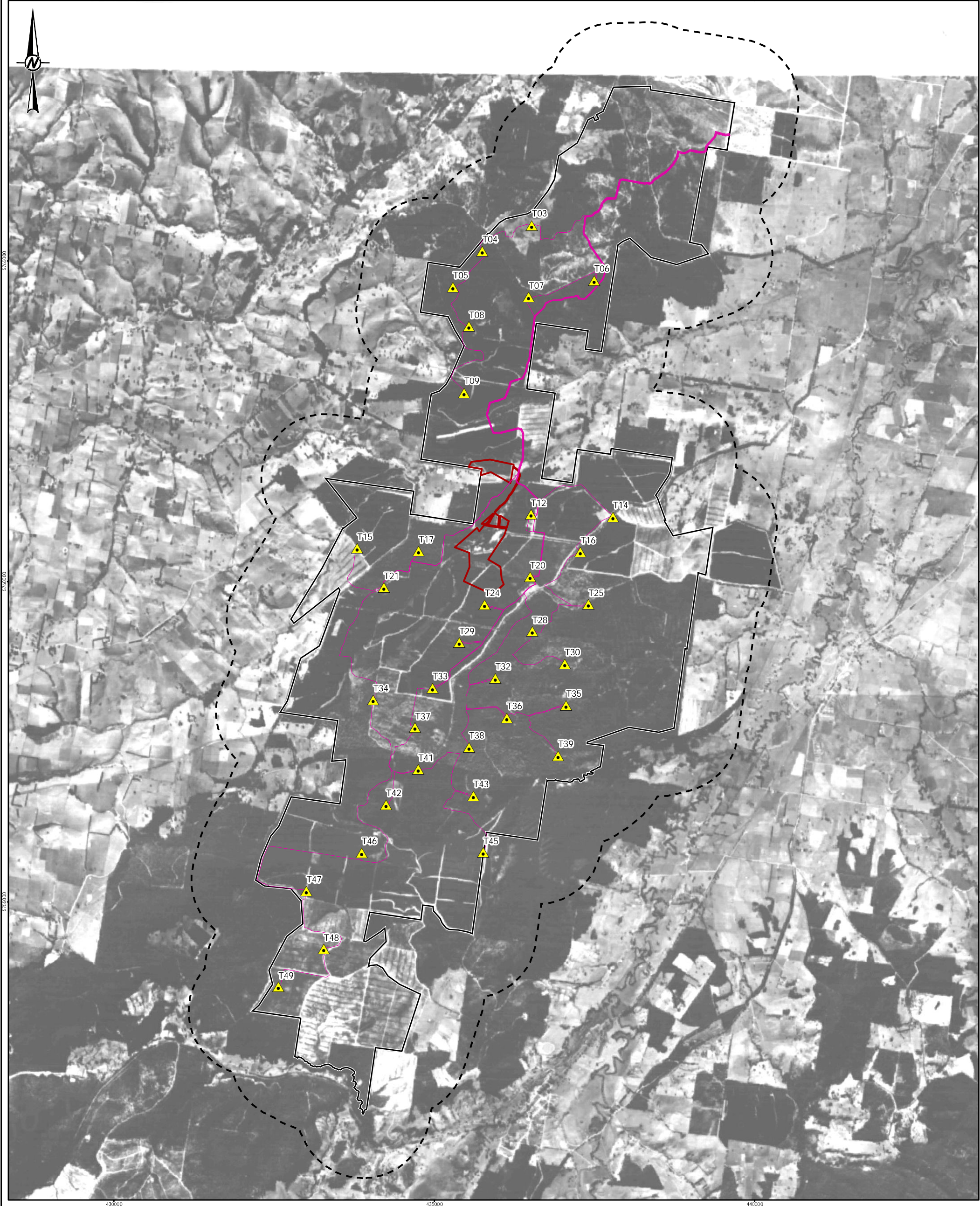
PROJECT NO.  
19130636

CONTROL  
001

REV.  
A

FIGURE  
B1



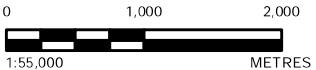


- LEGEND
- WTG Location
  - Reticulation
  - Kennedy Quarry
  - Project Boundary
  - Project Boundary (1km buffer)

DRAFT

NOTE(S)  
1. PROJECTION: GDA 1994 MGA ZONE 55

REFERENCE(S)  
1. IMAGERY SOURCED FROM GOLDER ARCHIVES.



CLIENT  
OSMI AUSTRALIA

CONSULTANT	YYYY-MM-DD	2019-11-07
	DESIGNED	LMA
	PREPARED	JPH
	REVIEWED	JMW
	APPROVED	JMW

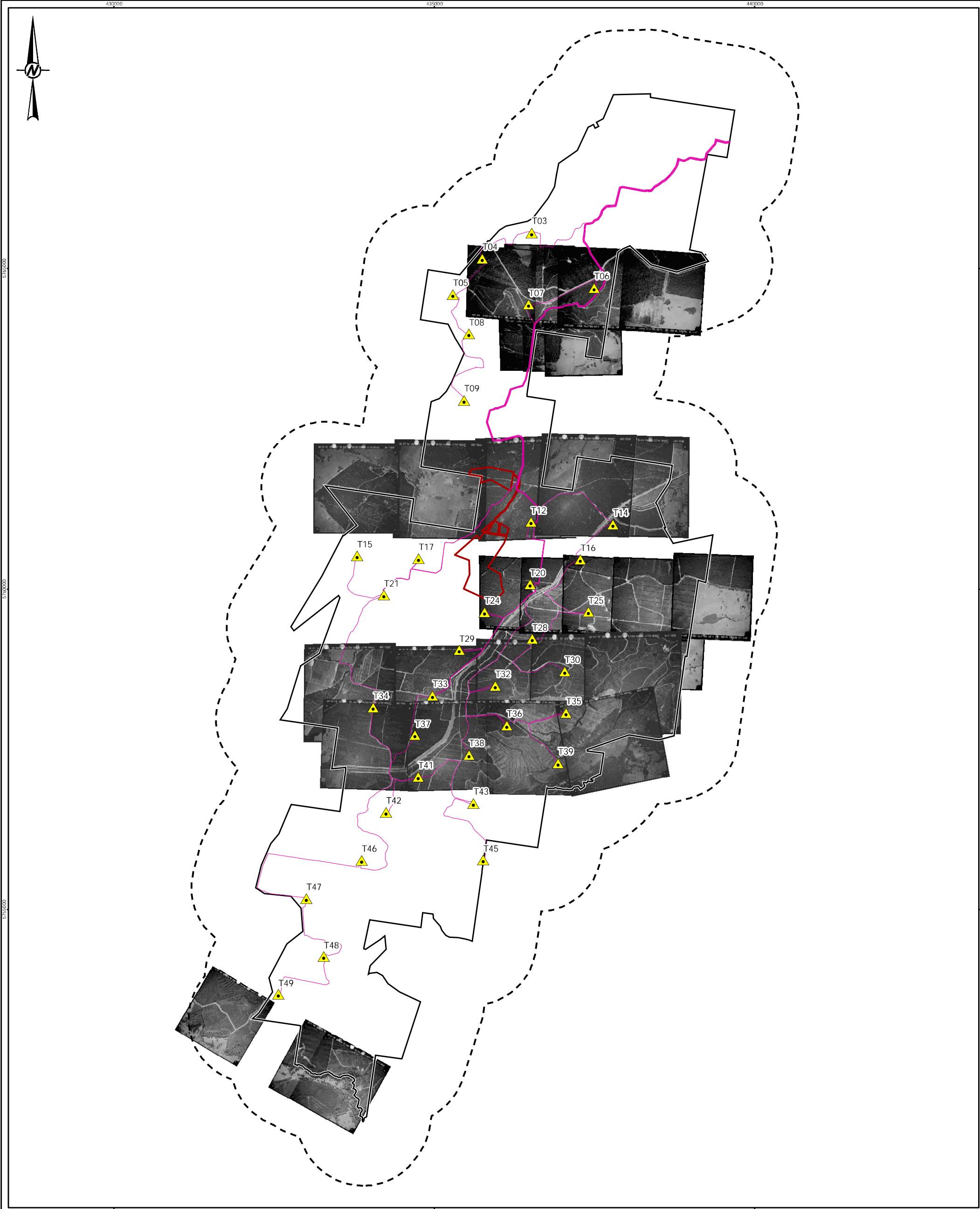


PROJECT  
DESKTOP ASSESSMENT OF GEOTECHNICAL, CONTAMINATED  
LAND AND HYDROLOGICAL CONSTRAINTS

TITLE  
1965 AERIAL

PROJECT NO.	CONTROL	REV.	FIGURE
19130636	001	A	B2



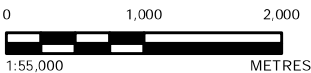


- LEGEND
- WTG Location
  - Reticulation
  - Kennedy Quarry
  - Project Boundary
  - Project Boundary (1km buffer)

DRAFT

NOTE(S)  
1. PROJECTION: GDA 1994 MGA ZONE 55

REFERENCE(S)  
1. IMAGERY SOURCED FROM GOLDBER ARCHIVES.



CLIENT  
OSMI AUSTRALIA

CONSULTANT	YYYY-MM-DD	2019-11-07
	DESIGNED	LMA
	PREPARED	JPH
	REVIEWED	JMW
	APPROVED	JMW



PROJECT  
DESKTOP ASSESSMENT OF GEOTECHNICAL, CONTAMINATED  
LAND AND HYDROLOGICAL CONSTRAINTS

TITLE  
1980 AERIAL

PROJECT NO.	CONTROL	REV.	FIGURE
19130636	001	A	B3



**APPENDIX C**

**Important information relating to  
this report**



## IMPORTANT INFORMATION RELATING OF THIS REPORT

The document ("Report") to which this page is attached and which this page forms a part of, has been issued by Golder Associates Pty Ltd ("Golder") subject to the important limitations and other qualifications set out below.

This Report constitutes or is part of services ("Services") provided by Golder to its client ("Client") under and subject to a contract between Golder and its Client ("Contract"). The contents of this page are not intended to and do not alter Golder's obligations (including any limits on those obligations) to its Client under the Contract.

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This Report has been prepared in the context of the circumstances and purposes referred to in, or derived from, the Contract and Golder accepts no responsibility for use of the Report, in whole or in part, in any other context or circumstance or for any other purpose.

The scope of Golder's Services and the period of time they relate to are determined by the Contract and are subject to restrictions and limitations set out in the Contract. If a service or other work is not expressly referred to in this Report, do not assume that it has been provided or performed. If a matter is not addressed in this Report, do not assume that any determination has been made by Golder in regards to it.

At any location relevant to the Services conditions may exist which were not detected by Golder, in particular due to the specific scope of the investigation Golder has been engaged to undertake. Conditions can only be verified at the exact location of any tests undertaken. Variations in conditions may occur between tested locations and there may be conditions which have not been revealed by the investigation and which have not therefore been taken into account in this Report.

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Having regard to the matters referred to in the previous paragraphs on this page in particular, carrying out the Services has allowed Golder to form no more than an opinion as to the actual conditions at any relevant location. That opinion is necessarily constrained by the extent of the information collected by Golder or otherwise made available to Golder. Further, the passage of time may affect the accuracy, applicability or usefulness of the opinions, assessments or other information in this Report. This Report is based upon the information and other circumstances that existed and were known to Golder when the Services were performed and this Report was prepared. Golder has not considered the effect of any possible future developments including physical changes to any relevant location or changes to any laws or regulations relevant to such location.

Where permitted by the Contract, Golder may have trained subconsultants affiliated with Golder to provide some or all of the Services. However, it is Golder which remains solely responsible for the Services and there is no legal recourse against any of Golder's affiliated companies or the employees, officers or directors of any of them.

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