APPENDIX B

BASELINE ENVIRONMENTAL SITE ASSESSMENT

VICROADS

MORDIALLOC BYPASS

ENVIRONMENTAL SITE ASSESSMENT

SEPTEMBER 2018

Report Number: 2135645A-SE-26-ENV-REP-0010 Rev01

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Mordialloc Bypass
Environmental Site Assessment

VicRoads

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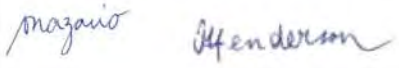
Prepared by:	Olfa Nazario; Olivia Henderson	17/09/2018	
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GLOSSARY

ACL	Added Contaminant Limit
ACM	Asbestos Containing Material
AHD	Australian Height Datum
ANZECC	Australian and New Zealand Environment and Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
ASS	Acid Sulfate Soil
BPEM	Best Practice Environmental Management
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
CBD	Central Business District
CCME	Canadian Council of Ministers of the Environment
CEC	Cation Exchange Capacity
COPC	Contaminants of Potential Concern
DBYD	Dial Before You Dig
DELWP	Department of Environment, Land, Water and Planning
DEPI	Department of Environment and Primary Industries
EIL/ESL	Ecological Investigation Level/Ecological Screening Level
EPA	Environment Protection Authority
ESA	Environmental Site Assessment
ESA	Geocentric Datum of Australia
HIL/HSL	Health Investigation Level/Health Screening Level
IBC	Intermediate Bulk Container
IWRG	Industrial Waste Resource Guidelines
LFG	Landfill Gas
LGRA	Landfill Gas Risk Assessment
LNAPL	Light Non-Aqueous Phase Liquid
LOR	Limits of Reporting (Laboratory)
MAH	Monocyclic Aromatic Hydrocarbon
mAHD	Metres above Australian Height Datum
mBGL	Metres Below Ground Level
mBTOC	Metres Below Top of Casing

MNA	Monitored Natural Attenuation
NATA	National Association of Testing Authorities
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NHMRC	National Health and Medical Research Council
OCP/OPP/PCB	Organochlorine Pesticide/Organophosphorus Pesticide/Polychlorinated Biphenyl
OH&S	Occupational Health and Safety
PASS/AASS	Potential Acid Sulphate Soil/Actual Acid Sulphate
PAH	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
PID	Photo-ionisation Detector
ppmV	Parts-per-million by Volume
QA/QC	Quality Assurance/Quality Control
PCP	Pentachlorophenol
PMCL	Prevention and Management of Contamination of Land
PSI	Preliminary Site Investigation
PVC	Poly Vinyl Chloride
RPF	Relative Percent Difference
RSL	Regional Screening Level (US EPA Region 9)
SEPP	State Environment Protection Policy
SPOCAS	Suspension Peroxide Oxidation Combined Acidity
SWL	Static Water Level
SVOC	Semi-volatile Organic Compounds
TPH/TRH	Total Petroleum Hydrocarbons/Total Recoverable Hydrocarbon
TDS	Total Dissolved Solids
TOC	Top of Casing
TSA	Titratable Sulfidic Acidity
UCL	Upper Confidence Level
VOC	Volatile Organic Compounds
VVG	Visualising Victoria's Groundwater

EXECUTIVE SUMMARY

WSP Australia Pty Ltd (WSP) was commissioned by VicRoads to undertake an Environmental Site Assessment (ESA) for the proposed Mordialloc Bypass project (the project), from Dingley Bypass in Dingley Village to Thames Promenade in Chelsea Heights, Victoria (the project area).

The purpose of the contaminated land investigations is to provide specialist environmental advice, regarding the presence of current and/or historical contamination levels at the project area.

The ESA aims to determine what indicative contamination may be present along the project area, developing an understanding of the existing conditions pertaining to land contamination and acid sulfate soils. This information will be utilised during the detailed design phase to guide any additional assessment works that may be required to confirm impacts (if indicative contamination is identified); and it will input into any management measures that may need to be considered as part of the detailed design.

The objectives of this ESA are to:

- Understand the potential for contamination to exist based on current and historical land use
- Assess the extent of potential or actual acid sulfate soils (PASS/ASS) within the project area
- Assess the magnitude contamination of contamination (including soil, groundwater and landfill gases) within the project area
- Provide an indicative waste classification of soil for offsite disposal purposes (prior to construction)
- Provide preliminary advice on potential environmental and/or human health risks associated with the identified contamination during construction and maintenance phases of the project.

The scope of works included an assessment of current and historical land use to identify potential sources of contamination, the physical setting to identify potential contaminant migration pathways and the environmental setting to identify potential sensitive receptors. An intrusive investigation was also undertaken to assess the extent of PASS, soil and groundwater contamination, and impacts associated with the former landfilling activities within the project area.

Based on the results of the review of historical information, the project area appears to have been predominantly used for agricultural purposes including nurseries and market gardens until the 1960s to 1970s. Industrial land use has become predominant since that time.

In the Northern Portion of the project area and its surrounds, quarrying, landfilling including industrial waste and liquid waste, various other industrial activities, market gardening and nurseries have operated since the 1960s. The Northern Portion of the project area intersects or adjacent to a number of known former landfills (including the western portion of Din San Landfill, Lot 1 Grange Road Landfill, Barraton Landfill among others).

The large Redwood Gardens Industrial Estate and Woodlands Industrial Estate was developed since the 1990s, which adjoins the Central Portion of the project area to the west. This area was formerly used for agriculture and some industrial uses including the former Braeside Wastewater/Sewage Treatment Plant which intersected the project area. Braeside Park adjoins the Central Portion of the project area to the east and was formerly used for agriculture including market gardening and horse training. Former wetlands and swampy land that has been filled over time is evident in the Central Portion of the project area and surrounds. This includes the Waterways Estate, north of Mordialloc Creek which is currently used for residential purposes. Moorabbin Airport is also located to the west of the Central Portion of the project area. The remainder of the nearby area has predominantly been redeveloped for residential purposes. ASS are anticipated on and within the vicinity of the Central Portion of the project area.

The Southern Portion of the project area has primarily been redeveloped for residential purposes to the west, as well as a some smaller commercial/industrial estates (Chelsea Business Park and Ashley Business Park) immediately adjoining the project area to the west. The majority of the area to the east of the Southern Portion of the project area remains agricultural land with an area used as a horse training ground. ASS are anticipated on and within the vicinity of the Southern Portion of the project area.

Of the above list, it is considered that the key contaminants of concern derived from the surrounding historical/current land uses include landfill gases, inorganics (including ammonia, sulphides, nitrates), pesticides and herbicides (namely: OCPs/OPPs), metals and metalloids, phenolics, petroleum hydrocarbons and volatile and semi-volatile hydrocarbons (chlorinated and non-chlorinated) and ACMs. There is also a potential for presence of aesthetic impacts (e.g. odours) within the vicinity of the project area, where odours emanating from the landfill are not managed appropriately.

Of note, given the ambiguity regarding the type of wastes (i.e. solid and liquid industrial) that have been disposed of within the former landfilled area that is currently occupied by Enviromix, it is considered possible that solid and/or liquid PFAS-impacted wastes may be present and may have impacted soil and groundwater beneath the property and/or leachates generated from the waste mass. In addition, it is also considered plausible that surrounding landfills (to the Enviromix property) may also contain unknown quantities of solid and/or liquid PFAS-impacted wastes, with a potential to impact soil and groundwater in the area. Moorabbin Airport is also a likely regional source of PFAS.

The anticipated primary transport media for the migration of contaminants identified were:

- Inhalation of dusts from impacted shallow soil and fill
- Dermal contact and ingestion of impacted shallow soil and fill
- Direct contact exposure to impacted shallow groundwater that ingresses into excavations
- Inhalation of vapour sourced from impacted shallow groundwater, which migrates through soil into excavations, underground service trenches or road maintenance chambers/pits
- Inhalation of landfill gas which migrates through soil into excavations, underground service trenches or road maintenance chambers/pits
- Lateral migration of dissolved phase hydrocarbons and other potential contaminants within the leachate which may be present in groundwater, typically in the direction of the local hydraulic gradient expected to be to the south/south-east/south-west (in general) based on the project area's topography and expected regional groundwater flow
- Surface run-off and entry into stormwater drainage system(s) in the event of subsurface spillage
- Migration of landfill gases and/or vapours through soils, underground service trenches and/or pits and beneath building slabs in the event of subsurface leakages
- Odour emissions from the existing landfill located within the proposed road alignment.

Of the potential exposure pathways identified, the migration of fugitive dust emissions is considered to be the primary exposure pathway for contaminants to impact surface soils along the road alignment.

During construction of the road upgrades, potential exposure may occur (should contaminated fill material be present under the existing land area that will house the proposed road extension); via direct contact pathways (including soil ingestion and dermal contact); as well as the inhalation of dust particulates.

In addition, the migration of landfill gases and impacted groundwater from surrounding landfills in the area, into any shallow trench excavations along the road alignment during the construction phase are also considered potential exposure pathways for construction workers.

The results of the intrusive investigation identified the following:

- With respect to the current public open space use of the project area, and future similar use of the project area (i.e. road), the concentration of all analytes were below the relevant adopted assessment criteria except for lead concentrations in one location in the northern portion, within the former landfilled areas. Hence, a health risk to current and/or future users of the road corridor, from exposure to chemical concentrations in soil beneath the project area, are considered to exist in the northern portion and considered unlikely to exist in other areas of the project area.
- A concentration of TRH F2 fractions, TRH F3 fractions and zinc was identified to be above the adopted criteria for ecological health. The presence of the TRH F2 fractions, TRH F3 fractions and zinc was not widespread along the alignment; and was only found to be above the adopted criterion at one location in the northern portion, within the former landfilled areas. Concentrations above adopted guidelines were found in fill material and due to the nature of construction are considered to be of low risk.

- All results for soil samples analysed were below the adopted HSLs for risks to intrusive maintenance workers from soil via vapour inhalation and direct contact exposure pathways. Based on the soil results, there is **not** considered to be a health risk to existing and/or future intrusive maintenance workers at the project area.
- Soil analytical results are indicative of a mixture of *Category C* and *Fill Material* classifications for off-site disposal within the northern and central portion. Analytical results from the southern portion are indicative of a *Fill Material* classification.
- Suspected ACM was identified at one location (B17-68327 at 0.8 mBGL in fill) within a rural residential allotment adjacent to Lower Dandenong Road and was subsequently positively identified as asbestos type 'Ch' Chrysotile (white asbestos). The sample submitted was described as brown soil with multiple friable asbestos fragments approximately 11 x 7 x 1.5 mm in size and multiple asbestos bundles measured at approximately 6 x 1 x 0.5 mm. Further assessment of the extent of ACM at this location is required. ACM was not observed at any other sample location.
- PASS was identified to be present in the central and southern portions of the project area (from Mills Road to the southern boundary), generally consistent with geological mapping. These areas were defined as a High Risk site classification and will require EPA approval of an appropriate ASS MP (a subset of the CEMP) should disturbance of PASS not be avoidable.
- Elevated sulphate, chloride and TDS concentrations were identified in groundwater samples collected from wells adjacent to the Waterways Estate wetlands which suggests that some degree of CASS disturbance may have historically occurred in this area.
- Based on the preliminary landfill gas assessment works and the LGRA undertaken for the project area, landfill gas (including bulk and trace gases) was identified to be present within the northern portion of proposed road alignment footprint. Based upon the available data and qualitative and quantitative interpretation thereof, WSP consider that the section of the Mordialloc Bypass to be constructed above the former Enviromix Landfill will significantly impact how gas emits from the waste mass in the landfills west. The main risks identified by the assessment can be summarised as follows:
  - Risk to workers during the construction of the bypass
  - Gas accumulation beneath planned roadways presenting a fire and explosion risk for users and workers
  - Migration of gas into service trenches, voids and conduits increasing the potential for long-distance migration of gas away from site and risk to workers accessing those conduits; and
  - Dissolution of methane and carbon dioxide into groundwater impacting the water quality of Dunlop's Drain and also potentially migrating further downgradient and impacting off-site receptors.
- Monitoring of sub-surface landfill gas concentrations within the planned Bypass footprint outside of the Enviromix site indicates a very low to low risk for development in these areas. As such it is considered that the primary landfill gas risk relating to the development from the adjacent former Din San and Barraton landfills is the migration of gas into service trenches within the alignment.
- PFAS is present in soil and groundwater in the targeted areas of potential contamination. PFAS is present in leachate and has the potential to migrate to groundwater and surface water where there is hydraulic connectivity. It is considered that exposure will only occur should the waste mass be disturbed during the construction phase for the road alignment; or if PFAS impacted groundwater and/or leachate is encountered by workers during the construction phase.
- Leachate was identified within the former Enviromix landfill. Concentrations of benzene, metals (barium, boron, nickel and zinc) were reported above one or more beneficial use criteria for extractive uses and maintenance of ecosystems. Concentrations of benzene and metals were not identified in groundwater monitoring wells to the south of the leachate well.

- Dissolved methane was identified within the leachate bore at the former Enviromix landfill, however potential migration of impacts within groundwater is considered to be of low likelihood based on the analytical results from surrounding groundwater wells.
- The low pH identified in groundwater (4.13–4.8 pH units) adjacent to the l=former landfill areas may impact on the integrity of future structures (i.e. piling) if they were to come into direct contact with groundwater.
- The groundwater investigation across the wider project area indicated that all beneficial uses of groundwater have been precluded. Extractive uses within the project area, in particular irrigation and domestic use requires confirmation.

1 INTRODUCTION AND BACKGROUND

1.1 INTRODUCTION

WSP Australia Pty Ltd (WSP) was commissioned by VicRoads to undertake an Environmental Site Assessment (ESA) for the proposed Mordialloc Bypass project (the project), from Dingley Bypass in Dingley Village to Thames Promenade in Chelsea Heights, Victoria (the project area).

1.2 BACKGROUND

Population and urban growth has outpaced road infrastructure capacity investment in many outer suburban areas of metropolitan Melbourne. The Victorian Government has made one of the biggest investments ever for outer suburban roads to cater for the rapid growth.

Melbourne's southern movement corridor connects the Mornington Peninsula and Southern and Bayside suburbs to the central city and to National Employment Clusters in Monash and Dandenong. In addition to enabling cross-city movements, the corridor provides road users with access to residential zones, recreation areas and employment and activity centres within the City of Kingston and adjacent municipalities, including the significant national employment cluster in the City of Monash. This project connects the Mornington Peninsula Freeway in the south to the Dingley Bypass to the north.

The project corridor is approximately 9.7 km in length, comprising two two-lane 7.5 km long carriageways (with a path for walking and cycling) along the greenfield alignment, and 2.2 km of roadworks required to integrate the project with the Mornington Peninsula Freeway. It is expected that each carriageway will provide for two 3.5 m wide lanes, with a 3.0 m wide outside shoulder and 1.0 m wide inside shoulder. The Mordialloc Bypass will also provide connections from the freeway onto the Dingley Bypass, Centre Dandenong Road, Lower Dandenong Road, Governor Road, Springvale Road and new north facing ramps at Thames Promenade. There will also be an overpass at Old Dandenong Road. Mordialloc Creek and the associated Waterways Estate Wetlands will be spanned by twin 400 m long bridges.

The proposed alignment allows for a future upgrade of the project to a six-lane freeway standard road within the construction footprint.

The proposed alignment is generally located within the existing road reservation, most of which is already covered by Public Acquisition Overlay, and some of which is already in VicRoads' ownership.

The project area, shown in report Figure 2.1 and in more detail in Figures 1A to 1C, Appendix A, runs approximately north to south, from the Dingley Bypass at the project area's northern boundary to Thames Promenade at the project area's southern boundary.

A Phase 1 preliminary site investigation (PSI) was completed in July 2017 (WSP 2017). The PSI comprised a desktop review of available current and historical site information to identify potential current and/or historical contaminating activities; and to provide preliminary advice regarding any requirements for further investigation.

1.3 PURPOSE AND OBJECTIVES

The purpose of the contaminated land investigations (subject to limitations in Section 12) is to provide specialist environmental advice, regarding the presence of current and/or historical contamination levels at the project area.

The ESA aims to determine what indicative contamination may be present along the project area, developing an understanding of the existing conditions pertaining to land contamination and acid sulfate soils. This information will be utilised during the detailed design phase to guide any additional assessment works that may be required to confirm

impacts (if indicative contamination is identified); and it will input into any management measures that may need to be considered as part of the detailed design.

The objectives of this ESA are to:

- Understand the potential for contamination to exist based on current and historical land use
- Assess the extent of potential or actual acid sulfate soils (PASS/ASS) within the project area
- Assess the magnitude contamination of contamination (including soil, groundwater and landfill gases) within the project area
- Provide an indicative waste classification of soil for offsite disposal purposes (prior to construction)
- Provide preliminary advice on potential environmental and/or human health risks associated with the identified contamination during construction and maintenance phases of the project.

1.4 PROJECT STAGING

Due to the nature of the project area being several kilometres long, the project area has been divided into three key study areas for ease of reference and discussion purposes, as follows:

- **Northern Portion:** between Dingley Bypass and Centre Dandenong Road
- **Central Portion:** between Centre Dandenong Road and Mordialloc Creek
- **Southern Portion:** between Mordialloc Creek and the southernmost boundary of the project area at Thames Promenade, Chelsea Heights.

The key sections are shown in Figures 1A to 1C in Appendix A.

1.5 SCOPE OF WORKS

The scope of the environmental investigations is outlined below:

- Undertake an assessment of historical land use within the project area with relevant information obtained from the previous PSI undertaken by WSP (WSP, 2017).
- Provide a summary of the physical and environmental setting including site specific geology and hydrogeology information obtained from other WSP investigations undertaken within the project area.
- Undertake a soil investigation to provide indicative information on the soil magnitude of potential contamination within the project area. Specifically, the following tasks were undertaken:
  - Excavation and sampling of 35 locations to a maximum depth of 2.2 metres below ground level (mBGL), or refusal and submission of a total of 36 soil samples for contaminants of potential concern (COPC)
  - Drilling and sampling of 21 locations to a maximum depth of 7.4 mBGL or refusal and submission of a total of 45 soil samples for COPC
  - Investigation locations were positioned to provide an assessment of general soil conditions and also to target identified sources of contamination within the project area.
- Undertake a soil investigation to investigate PASS within the project areas, specifically in areas identified to have prospective coastal acid sulphate soils (CASS) based on information obtained during the PSI (WSP, 2017). The scope of works was undertaken in general accordance with Table 1 of EPA Publication 655.1 (EPA, 2009c) and included:
  - A total of 30 investigation locations along the first 3km north of Springvale Road (1 per 100 m distance) where a higher potential for PASS was identified from desktop investigations
  - A total of 18 investigation locations along the remaining 3km of the alignment (1 per 250 m distance) where PASS was less likely to occur

  - Investigation locations were extended to depths ranging between 1.5 and 20 mBGL depending on the proposed construction method (i.e. shallow excavation or piling)
  - Selection of 46 primary samples for laboratory analysis to confirm PASS based on the results of the qualitative field screening assessment for the analysis of SPOCAS, % clay content and cation exchange capacity (CEC).
- Undertake a targeted investigation within the former landfilled areas that fall within the project area including:
  - Review of available environmental investigations previously undertaken for the former landfill areas
  - Drilling and sampling of two groundwater monitoring wells and one leachate well for investigation of potential groundwater contamination in the area
  - Drilling and sampling of 10 gas monitoring wells for investigation of potential landfill gas contamination
  - Sampling of existing landfill gas bores installed to the west of the former Din San landfill (and within the project area)
  - Submission of soil, groundwater and gas samples for laboratory testing of COPC
  - Preparation of a preliminary landfill gas risk assessment.
- Undertake a targeted soil, groundwater and surface water investigation to assess potential for Per and Polyfluoro-alkyl Substances (PFAS) contamination within the project area, Investigations targeted the former landfilled areas and Moorabbin Airport which were identified as major areas of potential concern, and including the following:
  - Drilling and sampling of six shallow soil sampling locations to a maximum depth of 1.0 mBGL
  - Sampling of one leachate well within the former landfilled areas
  - Sampling of three monitoring wells in the vicinity and downgradient of major potential sources
  - Sampling of surface water drain in the vicinity of former landfilled areas that fall within the project area footprint.
- Undertake a review of groundwater data collected and presented by WSP as part of hydrogeological assessments undertaken within the project area (WSP, 2018).
- Production of this ESA report.

1.6 LIMITATIONS

This ESA is based on the alignment presented in Figure 1A to 1C, Appendix A and is still at concept stage. Should the project area or design change, then a reassessment of the environmental contamination status may be required.

Further report limitations are included in Section 11 of this report.

2 PHYSICAL SETTING

This section presents a summary of desktop review of physical setting information presented in the PSI (WSP, 2017).

The desktop review information was primarily taken from reports prepared by a Lotsearch Pty Ltd (Lotsearch). Lotsearch divided their reports for the project area into 1.0 km sections and included a 150 m buffer zone around each section for ease of reference (i.e. 11 Lotsearch reports were provided as road sections 1 to 11 for the project area). An overview of the road sections is shown in Figure 2, Appendix A.

The Lotsearch reports were also supplemented with recent aerial imagery sourced Google imagery. Information pertaining to geology and hydrogeology specific to the project area were obtained from extensive geological and hydrogeological study as presented in the Environmental Effects Statement – Groundwater Technical Impact Assessment Report (WSP, 2018).

2.1 PROJECT AREA SETTINGS SUMMARY

A summary of the project area setting is provided in Table 2.1. Further detailed information regarding the project area setting is provided in this section.

Table 2.1 Summary of project area details

PARAMETER	PROJECT AREA DETAILS
Project area address	Proposed Mordialloc Bypass which traverses the suborns of Clayton South, Dingley Village, Braeside, Waterways, Aspendale Gardens, Chelsea Heights and Bangholme, Victoria
Current project area use(s)	Road, open space and commercial/industrial
Proposed project area use	Road (freeway)
Zoning	— Road Zone – Category 1 (RDZ1) — Road Zone – Category 2 (RDZ2) — Commercial 2 Zone (C2Z) — Commonwealth Land Not Controlled by Planning Scheme (CA) — General Residential Zone – Schedule 3 (GRZ3) — Green Wedge Zone (GWZ) — Green Wedge Zone – Schedule 1 (GWZ1) — Green Wedge Zone – Schedule 2 (GWZ2) — Industrial 1 Zone (IN1Z) — Public Park and Recreation Zone (PPRZ) — Public Use Zone – Service & Utility (PUZ1) — Public Use Zone – Education (PUZ2) — Public Use Zone – Other Public Use (PUZ7) — Urban Floodway Zone (UFZ).
Road alignment length (km)	Approximately 9.0 km

2.2 LOCAL AND REGIONAL SETTING

2.2.1 SITE SETTING

The project area for Mordialloc Bypass traverses the suburbs of Clayton South, Dingley Village, Braeside, Waterways, Aspendale Gardens, Chelsea Heights and Bangholme within the City of Kingston and City of Greater Dandenong. The project area is situated approximately 25 km south east of the Melbourne CBD and 5.0 km east of Mordialloc.

The proposed road is approximately 9.7 km in length and runs approximately north to south, from the Dingley Bypass at the project area's northern boundary to Thames Promenade at the project area's southern boundary.

The project alignment is shown in report Figure 2.1 and its location relative to Melbourne is shown on report Figure 2.2.

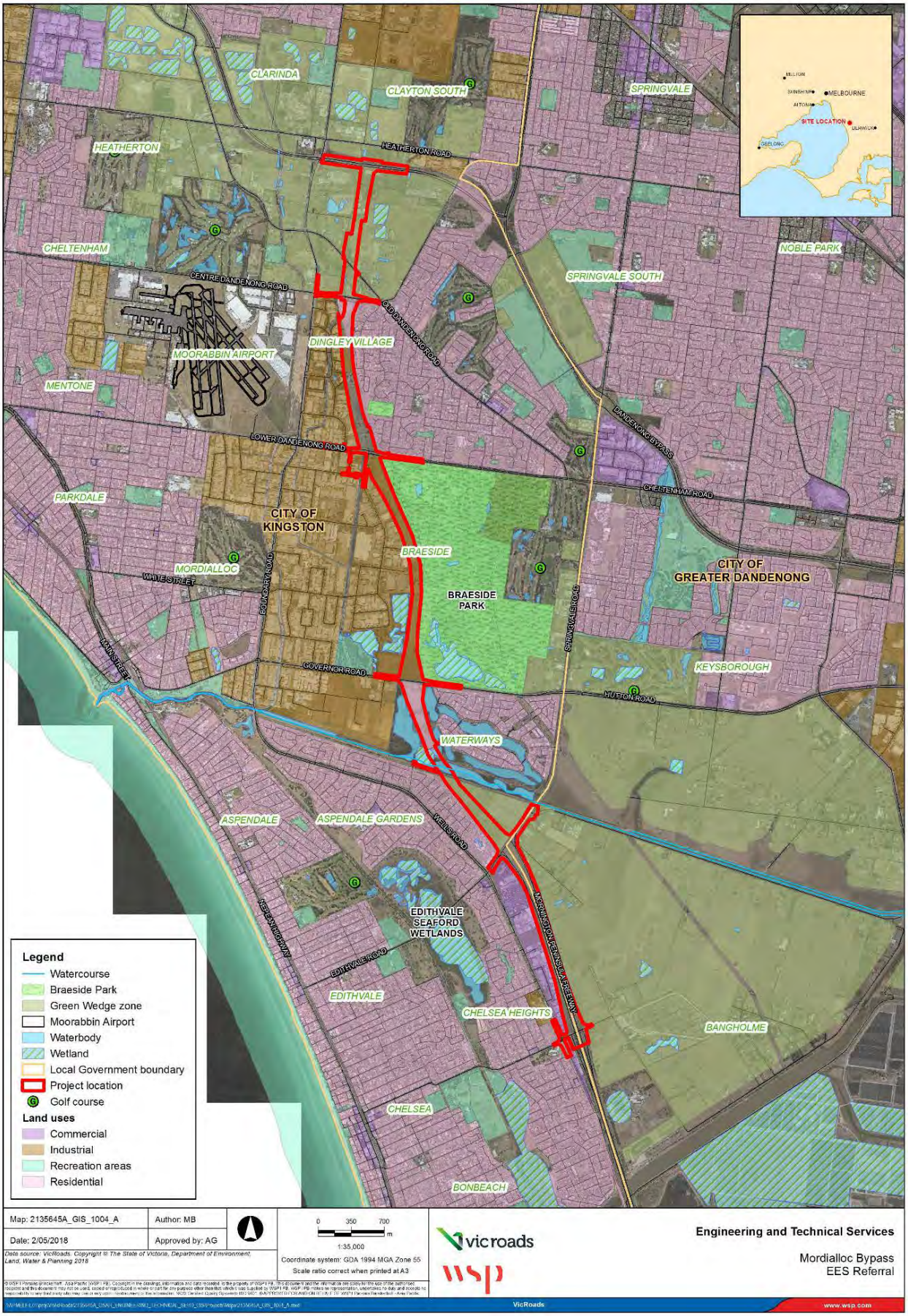


Figure 2.1 Project alignment

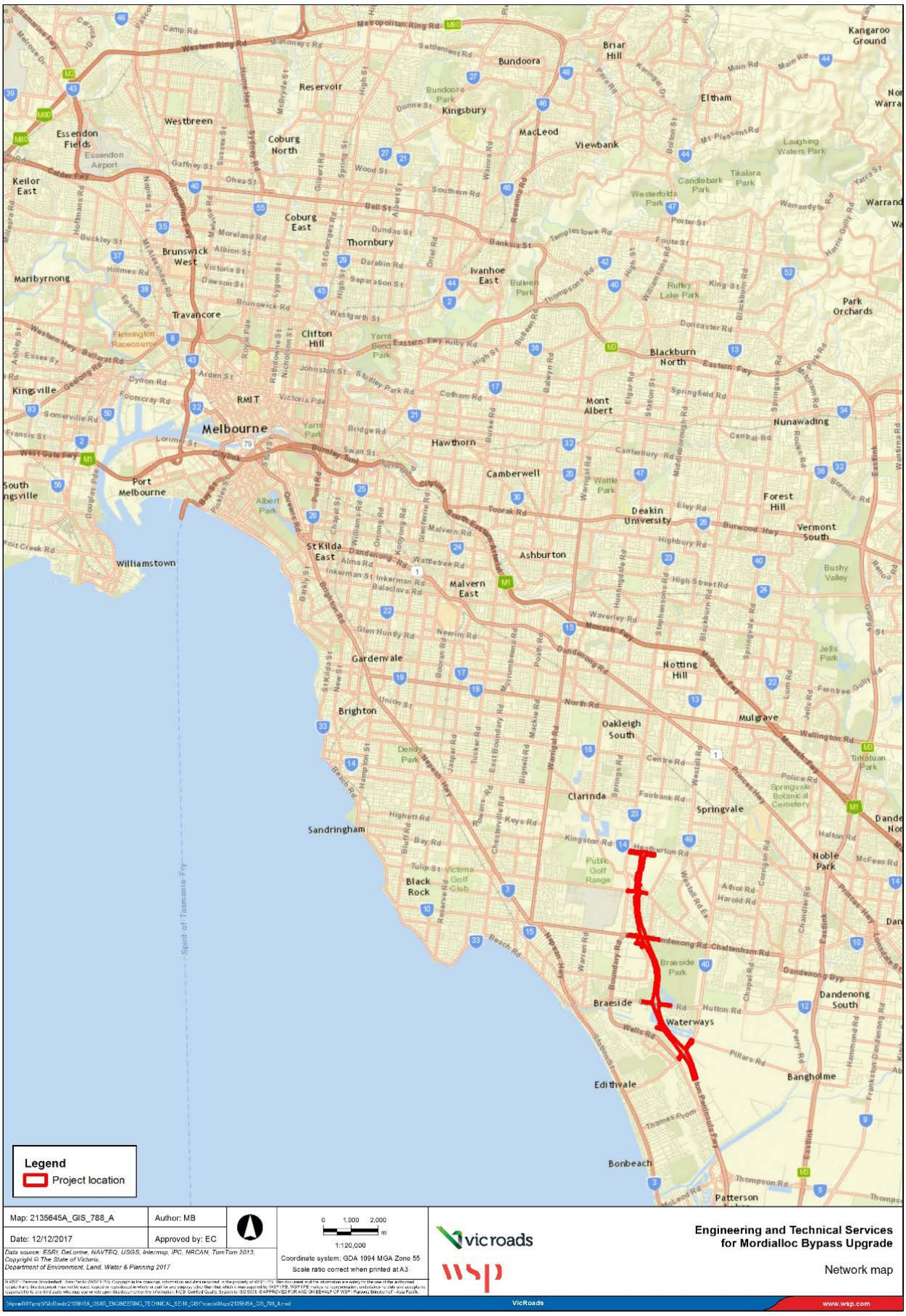


Figure 2.2 Mordialloc Bypass location relative to Melbourne

2.2.2 CURRENT LAND USES

The land uses identified within and surrounding the project area during desktop review and validated during intrusive investigations are presented in the succeeding subsection.

2.2.2.1 NORTHERN PORTION

The northern portion of the project area is bounded by Dingley Bypass in the north and Centre Dandenong Road in the south. The land uses within this portion of the project area includes the following:

- The property immediately south of the Dingley Bypass is an open space likely used as a market garden
- The property immediately south of the inferred market garden is identified as Lot 1 Grange Road, Dingley and is understood to be a former landfill (also called as Lot 1 Grange Road or former Lot 1 Grange Road Landfill). It is currently occupied by Enviromix Pty Ltd (Enviromix) which is a soil composting facility. The surface is covered by a combination of concrete (central to the project area), silt and sand covered the surface. Odours were evident within this property and were considered to be associated with the soil and garden waste composting activities being undertaken
- Immediately south of Lot 1 Grange Road is occupied by a nursery. The surface is covered with gravel; and south of the nursery, the area comprised a grassed surface with patches of compacted silt and sand
- Immediately south of the nursery is an open space understood to be formerly used by Multiskill Training (a provider of vocational education and courses) as commercial driving training area. All buildings have now been demolished and is currently vacant
- Immediately south of the training area is a commercial/industrial property where the presence of disused building materials and storage vans were observed
- Immediately south of the commercial/industrial property is Lower Dandenong Road
- Immediately south of Lower Dandenong Road up to Centre Dandenong Road are nurseries and/or market gardens.

The land surrounding the northern portion the project area is mainly used for commercial/industrial purposes.

The uses of land to the north of Dingley Bypass include waste recycling/waste processing facility (Alex Fraser), landfills (Deals Road Landfill, market gardens, nurseries, a commercial/industrial precinct with a mechanic and Heatherton Park understood to be a rehabilitated landfill.

The land east of the project area is mainly occupied by a property owned by Ernest Smith Contractors who operates Din San Landfill. The uses of land within this property includes current/former landfill, nurseries, recreational facility (paintball centre) and a church. Uses of land to the north of the Ernest Smith property is landfill (Lot 1 Grange Road) and market gardens.

The land west of the project area is used as a liquid waste processing facility (KS Environmental), a fuel supplier (AP Fuel Merchant) a truck park understood to be a former landfill (Barraton Landfill), market gardens and commercial premises including the Multiskills Training building and a church (Jehovah's Witness).

2.2.2.1 CENTRAL PORTION

The central portion of the project area is bounded by Centre Dandenong Road to the north and Mordialloc Creek to the south. The land use within the project area is mainly open space as a road reserve with portions of the project area that fall within major intersections are used as a road. Some portions of the project area are used for agricultural purposes mainly as grazing land. Other uses identified are commercial/industrial and rural residential as follows:

- The land immediately south of Centre Dandenong Road is occupied by a bricks distributor (Uneeda Bricks)
- A portion of project area east of Holly Drive is a disturbed patch of land with gravel roads understood to be used as a truck yard
- A portion of the project area north of Lower Dandenong Road is understood to be a rural residential property
- A portion of project area south of Lower Dandenong Road is used as a telecom tower

- A portion of project area west of Cypress Drive is used as Parks Victoria (Braeside Park) office
- South of Parks Victoria office is an open space that is understood to be part of a former waste water treatment plant and was heavily filled land
- Land between Governor Road and Mordialloc Creek is an open space that is part of Braeside Park wetlands and waterways and understood to be former swamps and was heavily filled land.

The land to the east of the project area consist mainly of residential properties from Centre Dandenong Road to Lower Dandenong Road, mainly parkland (Braeside Park) from Lower Dandenong Road to Governor Road and mainly waterways, wetlands and residential properties from Governor Road to Mordialloc Creek.

The land west of the project area from Centre Dandenong Road to Lower Dandenong Road is mainly occupied by commercial/industrial properties (Redwood Gardens Industrial Estate), beyond which is Moorabbin Airport. The land west of the project area from Lower Dandenong Road to Mordialloc Creek is a mix of commercial/industrial properties (Woodlands Industrial Estate), waterways and wetlands. The wetland between Malcolm Road and Governor Road is understood to be part of the former Wastewater Treatment Plant.

Commercial/industrial uses of the land included service stations/motor garages/mechanics, steel manufacturing, plastics manufacturing, chemical manufacturing and industrial laundry/drycleaner.

2.2.2.2 SOUTHERN PORTION

The southern portion of the project area is bounded by Mordialloc Creek to the north and Thames Promenade to the south. The land uses within the project area from Mordialloc Creek and Edithvale Road is mainly open space understood to be a grazing land. The uses of land within the project area from Springvale Road to Thames Promenade include roads (Mornington Peninsula Freeway) and open spaces (road reserve).

The land east/north-east of the project area are mainly open spaces understood to be used as grazing and farming land along with rural residential properties. Other uses include a firewood manufacturer and/or distributor, Christmas tree farm and market gardens.

The land west/south-west of the project area from Mordialloc Creek to Springvale Road is mainly residential use. Immediately west of Mornington Peninsula Freeway, from Springvale Road to Thames Promenade, are a mix of residential and commercial/industrial properties (Chelsea Business Park and Ashley Business Park) followed by residential properties. Commercial/industrial uses included service stations/mechanics/motor garages.

The Edithvale-Seaford Wetlands is present approximately 700 m further to the west which are listed under the Ramsar Convention on wetlands of international importance, as an internationally significant wetland

The land uses south of Thames Promenade include an educational complex (Cornish College), horse training ground (Jolong Park) and farmlands to the south-east with commercial/industrial and residential uses to the south-west.

2.2.3 PLANNING OVERLAYS

The project area is under the Kingston City Council and City of Greater Dandenong Planning Schemes and is affected by the following planning overlays as summarised in Table 2.2. Further details regarding the planning overlays is provided in Appendix B.

Table 2.2 Summary of planning overlays

SECTION	1	2	3	4	5	6	7	8	9	10	11
Airports Environs Overlay (AEO1)	×	✓ BZ	✓ BZ	×	×	×	×	×	×	×	×
Design and Development Overlay (DDO4, DDO5, DDO6)	✓ BZ, RA (DDO5)	✓ BZ (DDO4, DDO5)	✓ BZ, RA (DDO4, DDO5)	✓ BZ, RA (DDO5)	✓ BZ, RA (DDO5, DDO6)	✓ BZ (DDO6)	✓ BZ, RA (DDO6)	✓ BZ, RA (DDO6)	✓ BZ (DDO6)	×	×
Environmental Audit Overlay (EAO)	×	×	×	×	×	×	×	×	×	×	×
Environmental Significance Overlay (ESO3)	×	×	×	×	×	×	×	×	✓ BZ, RA (ESO3)	×	✓ BZ, RA (ESO3)
Heritage Overlay (HO3, HO104)	×	✓ BZ (HO3)	-	✓ BZ (HO104)	×	×	×	×	×	×	×
Incorporated Planning Overlay (IPO2, IPO3)	×	×	×	×	✓ BZ, RA (IPO2)	✓ BZ (IPO2)	✓ BZ, RA (IPO2, IPO3)	✓ BZ, RA (IPO2, IPO3)	✓ BZ (IPO2, IPO3)	✓ BZ (IPO3)	×
Land Subject to Inundation Overlay (LSIO)	×	✓ BZ	✓ BZ, RA	×	✓ BZ, RA	✓ BZ, RA	✓ BZ, RA	✓ BZ, RA	✓ BZ, RA	✓ BZ	×
Public Acquisition Overlay (PAO1, PAO2)	✓ BZ, RA (PAO1); BZ (PAO2)	✓ BZ, RA (PAO1);	✓ BZ, RA (PAO1)	✓ BZ, RA (PAO1)	✓ BZ, RA (PAO1)	✓ BZ, RA (PAO1)	✓ BZ, RA (PAO1)	✓ BZ, RA (PAO1)	✓ BZ (PAO1)	✓ BZ (PAO1)	×
Special Building Overlay (SBO)	×	✓ BZ, RA	✓ BZ, RA	×	×	×	×	×	×	×	×
Vegetation Protection Overlay (VPO1)	×	×	×	×	×	×	×	×	×	×	✓ BZ, RA (VPO1)

Notes:

× – planning overlay not applicable

✓ – planning overlay applicable

BZ – within buffer zone

RA – within road alignment

2.2.4 SENSITIVE LAND USES

Sensitive land uses identified within a 2 km radius of the project area comprise:

- Residential properties to the south, east and west of the project area
- Recreational areas including waterways and wetlands in the Central Portion of the project area
- Mordialloc Creek (running north-west to south-east in the south-eastern portion of the project area)
- Edithvale-Seaford Wetlands (also known as 'Edithvale Wetlands').

In addition to above, it is noted that numerous surface water bodies and/or drains are present throughout the project area with articular prevalence in the central and southern portions.

2.3 TOPOGRAPHY AND DRAINAGE

The topography of the project area is relatively flat, with gentle rises in the landscape. The lowest lying section of project area around Mordialloc Creek, at approximately 1.0 m above the Australian Height Datum (mAHD). The topography increases gradually heading north, to approximately 31 mAHD at the northern edge of the project area (refer to Appendix C).

There are numerous surface water bodies present on and nearby the project area. Most of these surface water bodies are present in the central to southern portion of the project area within the former Carrum Swamp area. Prior to the European settlement, the former Carrum Swamp consisted of a large freshwater wetland that drained to Port Philip Bay via Kananook Creek. The hydrology of the Carrum Swamp has been significantly altered since European Settlement. Patterson River was excavated in the 1870's to drain the swamp as part of works to prevent flooding along the Eumemmering Creek. The drained swampland was converted into rural landholdings for settlement.

The waterways and wetlands within the former Carrum Swamp have been constructed since the 1980s, including the Woodlands Industrial Estate Wetlands, Braeside Park Wetlands and Waterways Estate wetlands. Mordialloc Creek is a natural drainage feature south of waterways and wetlands. Mordialloc Creek has been significantly altered and channelised where water levels and flow is controlled by levees on Dandenong Creek. It is noted that the waterways, wetlands and Mordialloc Creek intersect the project area.

A number of artificial drains are also present on and nearby the project area which are generally orientated in a north-south direction and includes the Clayton South Drain, Old Dandenong Road Drain, Mordialloc Settlement Drain and Dingley Drain. It is expected that the artificial drainage systems will all drain into the natural surface water bodies located in the Central to Southern portion of the project area (i.e. Mordialloc Creek). Some of the identified drains also intersect the Northern Portion (Old Dandenong Drain) and the Central Portion (Dingley Drain) of the project area.

Based on the topography of the project area and the location of the surface water bodies, surface water flow/run-off is expected to be towards the south-east. Of note, the identified surface water bodies will eventually drain into Port Phillip Bay, located approximately 2.6 km to the south-west of the Southern Portion of the project area (at its closest point).

Between the project area and Port Phillip Bay, a coastal dune system runs parallel to the coast between Mordialloc and Frankston with a surface elevation up to 8.0 mAHD. In the coastal dune areas, elevations drop to at or below mean sea level, particularly within the Edithvale Wetlands (as low as -1.0 mAHD) and nearby wetlands, such as the Seaford and Carrum Wetlands.

Edithvale-Seaford Wetlands is a partially-modified wetland system which are listed under the Ramsar Convention on wetlands of international importance, as an internationally significant wetland. These wetlands provide important habitat for protected fauna, including threatened water birds, and as such they are the key focus of further risk and impact assessment.

2.4 GEOLOGY

The geological units described below were current at the time of intrusive investigations. Geoscience Australia maintains the Australian Stratigraphic Units Database, renamed both the Brighton Group sediments and the Fyansford Formation to the Sandringham Sandstone and Gellibrand Marl respectively in January 2018. To maintain consistency with previous reports, the previous stratigraphic names have adopted for ease of interpretation and comparison with previous project data.

Situated within the Port Philip Basin, the regional surface geology of the project area obtained via the Department of Economic Development, Jobs, Transport and Resources, 1:250,000 Geology Structures map (DEDJTR, 2010) is presented in Figure 2.3. This illustrates that the surface geology comprises Tertiary-aged sediments assigned to the Brighton Group as well as Quaternary-aged swamp and wind-deposited dune sediments, which were deposited on top of the Brighton Group sediments. Various thicknesses of fill material derived from various sources (not shown) is also present across the region. These geological profile features were confirmed by the outcome of intrusive investigation undertaken for geotechnical assessment and groundwater assessments undertaken along the project alignment.

These revealed two primary geological units:

- The *Quaternary* swamp sediments comprising the current wetlands are the remnants of the former Carrum Swamp. The swamp sediments penetrated in geotechnical boreholes located along the project area ranged in thickness between approximately 2 mBGL and 8 mBGL. Typically, a layer of peat formed the basal portion of the swamp deposits also referred to as the Pleistocene Clay. Between the shoreline of Port Phillip Bay and the swamp deposits unconsolidated sediments comprising aeolian sands deposited in dunes running parallel to the coast.
- The *Brighton Group* sediments, which were deposited in a fluvial environment, comprise clayey sands to sandy clays with sand intervals. Tertiary sediments assigned to the Fyansford Formation underlie the Quaternary and Brighton Group sediments. The Fyansford Formation sediments were deposited on the sediments assigned to the Werribee Formation, which were deposited on the regional bedrock consisting of strata assigned to the Palaeozoic-aged Melbourne Formation.

The site geotechnical and groundwater intrusive investigations intersected the natural profile including the Quaternary gravel, sand and silts of the alluvium (thin, locally variable and surficial), Tertiary Brighton Group materials and the Fyansford Formation. Table 2.3 presents a summary of the geological units along the alignment. It is anticipated that Recent fill, Quaternary alluvium, Brighton Group and Fyansford Formation sediments would be encountered during construction of the motorway.

Table 2.3 Geological units underlying the alignment

AGE	FORMATION	LITHOLOGY
Recent	Fill	Variable (anthropogenic fill – mixed materials).
Quaternary	Alluvium (Coastal lagoon deposits, Swamp and lake deposits) (thin, locally variable and surficial). Includes Cranbourne Sands (aeolian dune deposits)	Poorly sorted gravel, sand and silty sand (thin, locally variable and surficial).
		Silt, clay: dark grey to black; variably consolidated.
		Grey to black carbonaceous mud, silt, clay, minor peat: generally unconsolidated – dune deposits/swamp deposits.

AGE	FORMATION	LITHOLOGY
Tertiary	Red Bluff Sandstone (part of the Brighton Group) currently known as Sandringham Sandstone.	Highly weathered sandstone, conglomerate: pale yellow and brown; fine to coarse-grained, massive to well-bedded; cross-bedded; local ironstone; clayey sands to sandy clays with sand intervals.
	Black Rock Member (part of the Brighton Group) currently known as Sandringham Sandstone.	Basal layer of ferruginous and phosphatic nodules in a matrix of quartz sand and gravel; clayey sands to sandy clays with sand intervals.
	Fyansford Formation	Clayey silt, clay to sandy silt and silty sand of marine origin.
	Werribee Formation	Sand, gravel, clay and silt with minor coal.
Palaeozoic	Melbourne Formation	Sedimentary (fractured rock) comprised of sandstone, siltstone and mudstone.

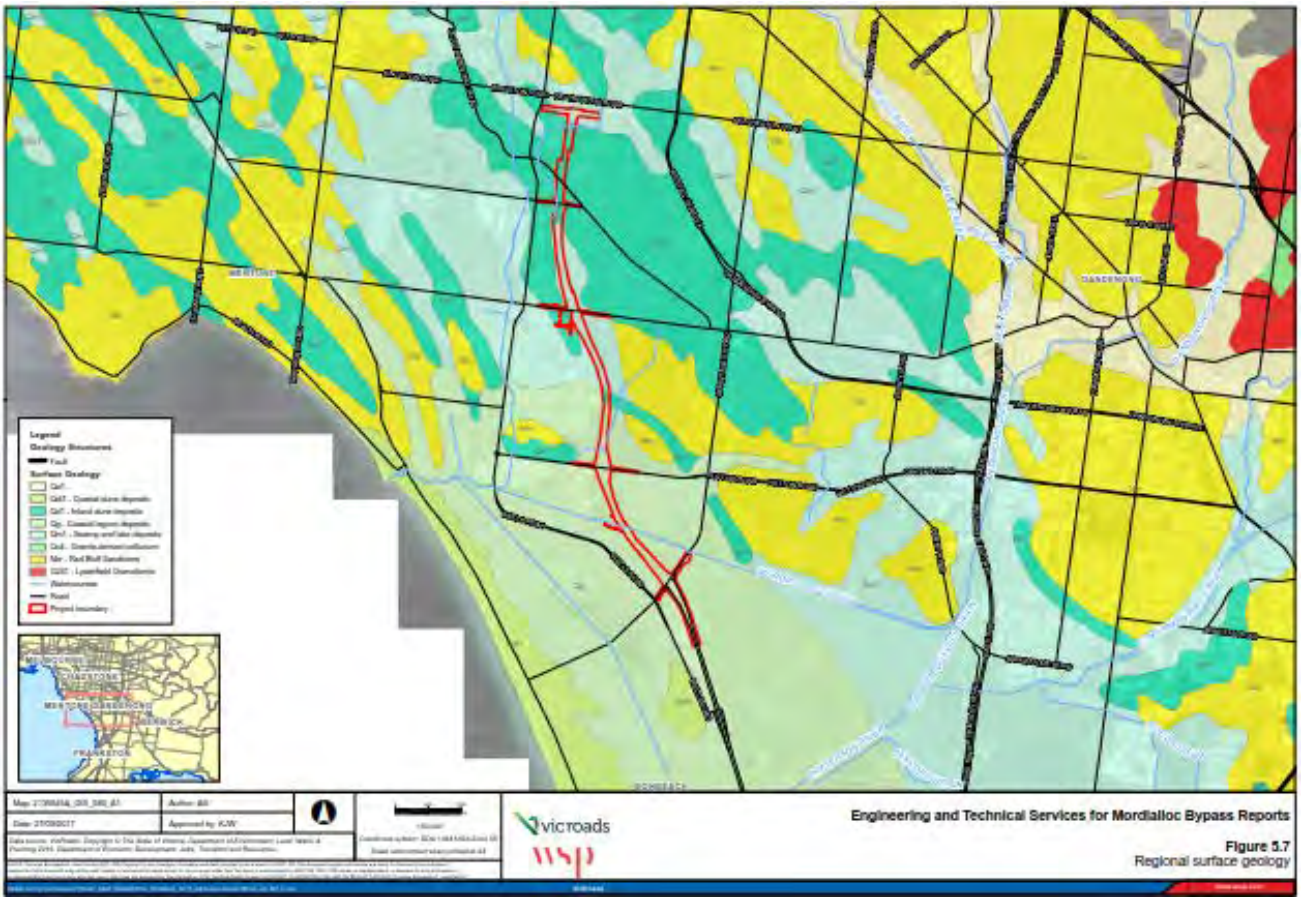


Figure 2.3 Geology map for the Mordialloc Bypass project area (WSP, 2018)

2.5 ACID SULPHATE SOILS

Prospective coastal acid sulphate soils (CASS) have been identified within the road alignment and project area buffer within Sections 4 to 10. Refer to Lotsearch reports (Sections 4 to 10) within Appendix D for further details. The road alignment overlies areas mapped as comprising Quaternary coastal lagoon deposits and Quaternary swamp and lake deposits which occurred during the Holocene epoch consistent with the potential for CASS. Refer to Regional Geology Section 2.3.

2.6 HYDROGEOLOGY

2.6.1 HYDROSTRATIGRAPHY

The Victorian Aquifer Framework (VAF), developed by the Department of Environment, Land, Water and Planning (DELWP), developed and delineated a three-dimensional model of Hydrostratigraphic Units (HSUs) within Victoria. HSUs are comprised of geological materials of similar hydrogeological properties. To ensure that the HSUs behave as a hydrogeological unit they are generally based on stratigraphic units, although similarity in storage and transfer of groundwater is more of an importance than just stratigraphic units.

The HSUs delineated within the VAF were adopted as the VAF provides a consistent state wide framework defining aquifers and aquitards. The HSUs present within the project area have been identified using the DELWP's interactive online map and Victorian Groundwater Resource Report (DEWLP 2018b). The VAF model was also downloaded and used in the development of the numerical groundwater model and refined through observations and results of the drilling and installation of dedicated groundwater monitoring bores and geotechnical investigation.

A summary of all HSUs present within the project area is summarised in Table 2.4. Within the project area, the HSUs largely align with the geological stratigraphy outlined in Table 2.3.

Table 2.4 Groundwater resource units present at Mordialloc Bypass (DELWP, 2018b)

GROUNDWATER RESOURCE UNIT (GEOLOGY UNIT)	ESTIMATED DEPTH BELOW SURFACE (m)	GROUNDWATER SALINITY (mg/L)	CHARACTERISTICS
Quaternary Aquifer (QA) – sand, gravels, clay, silt	0–3	1,001–3,500	Unconfined to semi-unconfined water bearing zones.
Upper Tertiary Aquifer (UTAF) (fluvial) – sand, gravel and clay (Red Bluff Sandstone, Brighton Group)	3–16	501–1,000 (N) 1,001--3,500 (S)	Mostly confined by overlying clay, silt and basalt deposits. Completely eroded in some areas. Low productivity.
Upper-Mid Tertiary Aquitard (UMTD) – clay, silt, marl (fractured rock) and minor sand (Fyansford Formation)	16–47	Unknown	Widespread subsurface aquitard with low yields and poor water quality.
Lower Tertiary Aquifer (LTA) - sand, gravel, clay and silt, minor coal (Werribee Formation)	47–53	1,001–3,500	Extensive semi-confined to confined fractured rock water bearing zones.
Mesozoic and Palaeozoic Bedrock (BSE) – basement sedimentary (fractured rock): sandstone, siltstone, mudstone, shale, igneous (fractured rock), includes volcanics, granites, granodiorites Murrindindi Supergroup	53–253	<500 (S) 501–1,000 (N)	Widespread subsurface aquitard, generally with low yields and poor water quality.

2.6.2 RELEVANT AQUIFERS

Two key hydrostratigraphic units (aquifers) have been identified in the region; an unconfined (locally variable water table) Quarternary aquifer (QA) which occurs in the swamp and dune deposits associated with the former Carrum Swamp, and a semi-confined (artesian) aquifers (UTAF) which occurs in the Tertiary Sandringham Sandstones. The underlying Gelibrand Marl (UMTD) forms the regional subsurface aquitard.

In the northern section of the project alignment, the UTAF is unconfined and is considered the water table aquifer. Governor Road forms the approximate boundary of the former Carrum Swamp where the UTAF is overlain by the QA becoming semi-confined. Where present, the UTAF is likely hydraulically connected to the overlying QA. However, the UMTD aquitard limits vertical recharge into underlying HSU.

Hydraulic properties of the relevant aquifers are further discussed in the EES Groundwater Technical Impact Assessment Report (WSP 2018).

2.6.3 GROUNDWATER RECHARGE AND DISCHARGE

The primary recharge mechanism to the QA and UTAF aquifers is considered to be direct rainfall infiltration, as observed in recorded water levels. The proportion of net rainfall recharging the groundwater systems depends largely on the characteristics of the surface geology, soils, the land use and depth to the water table. Recharge is expected to be lower in areas where the surface is covered by residual clayey soils and colluvium with a low hydraulic conductivity and specific yield.

Recharge to the residual clayey soils is a predominantly recharge-in/recharge-out process, associated with rainfall infiltration, which typically characterise the behaviour of shallow perched water systems and limited vertical infiltration from the perched, shallow system down to the deeper regional UTAF aquifer.

Recharge also occurs via leakage from surface water features in areas where the groundwater table is below the stream and wetland water levels. Recharge rates will largely depend on the river stage and hydraulic characteristics of the river bed material and underlying geology.

The lower aquifers are recharged locally where they outcrop and by vertical leakage from the upper aquifers in places where the hydraulic head of the upper aquifer is above that of the lower aquifer, mostly where low permeability units are absent.

Groundwater can discharge from shallow perched aquifers into creeks or drains via seepage depending on the porosity of the geological units in the aquifer. Groundwater in lower aquifers moves by subsurface flow discharging into wetlands and surface streams providing baseflow to streams or discharging directly into Port Phillip Bay and Westernport Bay.

Extraction of groundwater through the use of existing bores in the project areas is also considered a mechanism of discharge from the groundwater systems. Evapotranspiration from the water table is another mechanism of groundwater discharge. The evapotranspiration rate depends on land use and depth to groundwater. In areas where the water table is shallow and within the rooting depth of vegetation evapotranspiration can be a significant component of the water.

2.7 SITE SPECIFIC HYDROGEOLOGY

The groundwater elevation data collected during the site investigation and monitoring program completed as part of the Baseline ESA ranged between -3.75 metres above the Australian Height Datum (mAHD) and 1.54 mAHD in the surficial aquifer (Quaternary Alluvium) and -0.78 mAHD and 0.27 mAHD in the semi-confined aquifer (UTAF) (WSP 2018). It is important to note that the HSU's have a large seasonal variation with levels dropping in summer months and levels gaining in winter months. Natural variation in the dataloggers installed within the project area is generally +/- 1.0 m.

As mentioned in Section 2.2, there are numerous surface water bodies present on and nearby the project area. Most of the surface water bodies are present in the Central to Southern Portion of the project area, which includes the Woodlands Industrial Estate wetlands, Braeside Park wetlands, Waterways Estate wetlands and Mordialloc Creek. Current surface

water assessments suggest that the Woodlands Industrial Estate wetlands and the Braeside Park wetlands are largely sustained by surface water and urban run-off (including: Mordialloc Creek/Dandenong Creek catchments) and that, consequentially, groundwater inflow contributions may be minor, and as such, impacts to the groundwater regime may be negligible. The Waterways Estate wetlands most likely acts as a recharge mechanism to groundwater and could potentially be a pathway to groundwater contamination from surface water impacts.

Some anthropogenic drains are present generally running in a north-south direction which includes the Clayton South Drain, Old Dandenong Road Drain, Mordialloc Settlement Drain and Dingley Drain. Old Dandenong Drain intersects the Northern Portion of the project area and Dingley Drain intersects the Central Portion of the project area. It is expected that the anthropogenic drainage systems will all drain into the natural surface water bodies located south-east of the project area (i.e. Mordialloc Creek) which ultimately drains to Port Phillip Bay located 2.8 km to the south west at its closest point.

Depth to groundwater across the site was measured as between 0.8 to 4.5 meters below ground level in both aquifers. Water levels within both units experience seasonal variability with water levels responding to rainfall within the region.

The water-table QA aquifer consists of numerous local flow systems, which are influenced strongly by topography and variable connected with adjacent surface-water features. The underlying UTAF is also influenced by topography and groundwater flow is towards the south-east discharging into Port Philip Bay and Patterson River.

2.8 GROUNDWATER BENEFICIAL USES

Based on information obtained from Visualising Victoria's Groundwater[1] (VVG 2018) (www.vvg.org.au) (accessed April 2018), the project area is characterised by salinity (total dissolved solids or TDS) concentrations ranging from <500 milligrams per litre (mg/L) to 7,000 mg/L, generally increasing from the Northern to the Southern Portion. TDS in the Northern Portion to Central Portion (up to Lower Dandenong Road) ranged between <500 mg/L to 1,000 mg/L. TDS in the Central Portion (from Lower Dandenong Road) ranged between 1,000 mg/L to 3,500 mg/L. TDS in the southern portion ranged between 3,500 mg/L to 7,000 mg/L.

TDS concentrations recorded from groundwater monitoring ranged between 825–26,300 mg/L with an average concentration of 6,700 mg/L (WSP, 2018). Based on the average TDS concentration, the regional aquifer is defined as Segment C. For the purpose of this report, Segment A2 is adopted as a conservative approach based on the lowest recorded TDS value (and consistent with available regional data (VVG 2018). As defined in the State Environment Protection Policy – Groundwaters of Victoria (SEPP GoV, 1997), Segment A2 groundwater has the potential to be used for the beneficial uses detailed in Table 2.5.

[1] Note: VVG referenced Department of Environment, Land Water and Planning (DEWLP)

Table 2.5 Protected groundwater beneficial uses

BENEFICIAL USES[1]	SEGMENTS (mg/L TDS)				
	A1 (0–500)	A2 (501–1,000)	B (1,001–3,500)	C (3,501–13,000)	D (>13,000)
Maintenance of ecosystems	x	x	x	x	x
Potable water supply					
— Desirable	x				
— Acceptable		x			
Potable mineral water supply	x	x	x		
Agriculture, parks and gardens	x	x	x		
Stock watering	x	x	x	x	
Industrial water use	x	x	x	x	x
Primary contact recreation	x	x	x	x	
Buildings and structures	x	x	x	x	x

WSP notes that the project area is not located within a mineral springs area and as such this beneficial use of "Potable Mineral Water Supply" is unlikely to be realised.

2.9 GROUNDWATER DATABASE SEARCH

A search of the licensed borehole register from the DEWLP interactive online map (WMIS) (DWELP 2018a) (as conducted by Lotsearch) was undertaken for the length of the project area. A total of 402 registered groundwater bore users were identified within 2.0 km of the project area. Five registered groundwater bores were identified within the project area footprint. The search results are summarised in Table 2.6. The 10 closest bores to the project area are summarised in Table 2.7. Additional information on the groundwater bore search and the data obtained is presented in Appendix E.

Table 2.6 Groundwater database summary

ROAD SECTION	1	2	3	4	5	6	7	8	9	10	11
Static water level (mBGL)	<5-10	<5-10	<5	<5	<5	<5	<5	<5	<5	<5	<5
TDS (mg/L)	<500 to 1,000	<500 to 1,000	500 to 3,500	1,000 to 3,500	1,000 to 3,500	1,000 to 3,500	1,000 to 7,000	3,500 to 7,000	1,000 to 7,000	3,500 to 7,000	3,500 to 7,000
Surface elevation (mAHD)	17 to 31	12 to 23	8 to 12	4 to 8	3 to 4	3	3	2 to 3	2 to 3	2 to 3	2 to 5
Aquifer type		Porous, extensive, highly productive aquifers									
Lithology		Mud, silt, clay, peat and sand									
Bore use		One or more of the following bore uses were listed: — Domestic and stock use — Agro industries — Dairy — Irrigation — Commercial — Groundwater investigation and observation.									

Notes: mBGL – meters below ground level; TDS – total dissolved solids; mAHD – meters Australian Height Datum.

Table 2.7 Groundwater database summary of 10 closest bores to project area

BORE NUMBER	DISTANCE FROM PROJECT AREA BOUNDARY (m)	YEAR INSTALLED	BORE USES	TOTAL BORE DEPTH (mBGL)	INFORMATION PROVIDED IN THE DATABASE
WRK966394	0	Unknown	Unknown	Unknown	Coordinates
WRK043346	0	Unknown	Unknown	Unknown	Coordinates
WRK039072	0	1986	Domestic, irrigation, stock	24.4	Coordinates, well construction, groundwater investigation use, lithology.
81673	0	1970	Unknown	42.3	Coordinates, well construction, groundwater investigation use, lithology.
81419	0	1971	Observation, state observation	43.0	Coordinates, well construction, groundwater investigation use, lithology.
127483	7	1996	Groundwater investigation	15.0	Coordinates, well construction, groundwater investigation use, lithology.
WRK982650	19	Unknown	Unknown	Unknown	Coordinates
76479	20	1986	Domestic	24.4	Coordinates, well construction, groundwater investigation use, lithology.
WRK069052	23	2012	Observation	9.5	Coordinates, well construction, groundwater investigation use, lithology.
WRK989236	47	Unknown	Unknown	Unknown	Coordinates

Notes: mBGL – meters below ground level.

It was inferred that the three ‘unknown’ and one ‘state observation bore’ in Table 2.7, that falls within the project area is associated with the Melbourne Sewer (WSP, 2018). Attempts to locate the domestic bore (WRK039072) within the project area were undertaken but could not be located with the coordinates specified.

A copy of data obtained from the search has been provided in Appendix E.

3 SITE HISTORY INVESTIGATION

This section presents a summary of the project area's historical information. The information reviewed was taken from reports prepared by Lotsearch and supplemented with a review of recent Google imagery to further assess business names, where available.

3.1 AERIAL IMAGERY REVIEW (HISTORICAL AND CURRENT)

WSP has reviewed the available aerial imagery from 1951 to 2016 (at least one image per decade) obtained by Lotsearch and via Google imagery. The results of the review have been summarised in Table 3.1.

Copies of the historical and current aerial imagery that were reviewed as part of the investigation are provided in Appendix F.

Table 3.1 Summary of aerial photograph review

ROAD SECTION	1951/1956	1961/1962/1963/1966	1974	1981/1982/1985	1990/1991	2005	2009	2016
1	Onsite: The project area comprises **farmlands**, mainly used for **cropping** with some vacant land/open space. Some rural properties exist to the north-east and in the central portion of the project area. Grange Road was visible and appears to be an unsealed road. Offsite: The surrounding area comprised farmlands and vacant land/open space. A dam was present immediately north of project area at the corner of Grange Road and Heatherton Road. Some nurseries and/or greenhouses appear to be present to the north.	Onsite: Farming/cropping activity is ongoing. Some **commercial** activities present in the north-eastern portion. **Landfilling and/or quarrying** in the central portion of the project area (Lot 2 Grange Road) appear to have commenced and extend within the project boundary Offsite: More **commercial developments** present in all directions. **Landfilling and/or quarrying** activities in the property south-east of the project area (370-418 Old Dandenong Road) appear to have commenced. Another **dam** now present immediately to the north-west.	Onsite: Expansion of the **landfilling and/or quarrying activity** in the central portion observed. Offsite: More **dams** were constructed north-east of the project area and appear to be a part of a treatment plant. **Landfilling and/or quarrying** activities appear to have commenced north-west of the project area, at the corner of Grange Road and Heatherton Road. The **landfilling and/or quarrying** activities in the property south-east of the project area appears to have expanded.	Onsite: Expansion of the **landfilling and/or quarrying activity** in the central portion appears to be present. Offsite: The dams north-east of project area have been **backfilled**. Landfilling and/or quarrying activities north of project area and east of Deals Road appear to have commenced. All other areas appear to be largely the same while the **quarry/landfills** surrounding the project area appeared to be capped and/or filled.	Onsite: The project area remains largely the same. More **greenhouse**s have been built in the **farmland** in between Old Dandenong Road and Centre Dandenong Road. Offsite: The surrounding area remains largely the same. The former treatment plant has been developed into a commercial precinct. **Quarrying/land** clearing to the west of the project area (corner of Junction Road and Grange Road) appears to have commenced.	Onsite: **Landfilling** in the central portion of the project area appears to have ceased and some **building structures** were erected. **Landfill cells** along the proposed road alignment have been filled. A **soil processing facility** appears to be present (currently Enviromix located at Lot 1 Grange Road). Offsite: The **dam** in the north-west corner has been **filled**. The quarry to the west of the project area appears to have expanded. **Quarrying/landfilling** activities surrounding the project area have been curbed. Soil processing appears to be present to the east.	Onsite: The project area remains largely the same. Offsite: The surrounding land remains largely the same. Most **landfill cells** surrounding the project area appear to have been capped. The **soil processing area** appears to have expanded further to the east.	Onsite: The project area remains largely the same except for the construction of Dingley **Bypass** in the northern portion. Offsite: The **landfill** south and south-east of the project area appears to have ceased operation although some **landfill cells** remain open. The l**andfill** to the north of the project area appears to have been filled and/or levelled. Further **commercial development** to the north-east is present.

ROAD SECTION	1951/1956	1961/1962/1963/1966	1974	1981/1982/1985	1990/1991	2005	2009	2016
		Farm structures (i.e. greenhouses and nurseries) appear to be present in the property further to the north-west (corner Deals Road and Heatherton Road).	**The nurseries and/or greenhouses** to the north of the project area appear to have been removed. Systematic **cropping** in the eastern portion of Deals Road also appears to have ceased. All other areas appear to be largely the same with some patches of c**ommercial** development mainly to the west and south.		Residential properties appear to be present to the south-east and south. More commercial development was underway to the south.	More residential properties appear to be present to the south and south-east. Boundary **Road** to the west was expanded with more lanes in both directions.		Further residential development to the east, south-east and south has occurred.

ROAD SECTION	1951/1956	1961/1962/1963/1966	1974	1981/1982/1985	1990/1991	2005	2009	2016
2	Onsite: The project area comprises **farmlands**, mainly used for **cropping** with some vacant land/open space. Centre Dandenong Road is present in the central portion of the project area. Centre Dandenong Road was visible and comprises one lane each way. Old Dandenong Road is also visible and appears to be an unsealed road. Offsite: The surrounding areas comprise **farmlands** and vacant land/open space.	Onsite: The project area remains largely the same. Offsite: The surrounding areas remains largely the same.	Onsite: The project area remains largely the same. Farm structures (e.g. greenhouses and dams) appear to be constructed in the land between Old Dandenong Road and Centre Dandenong Road. Offsite: Land to the south-east of the project area has been converted to residential properties.	Onsite: The project area remains largely the same. Offsite: The surrounding area remains largely the same. More residential properties constructed offsite to the south-east. Refer to Lotsearch Report Section 1 (Appendix F) for changes to the north/north-east of the project area.	Onsite: **Cropping** has occurred along the northern portion of the project area. An additional dam is present in the northern portion of the project area. Offsite: **Commercial/industrial** properties have been constructed immediately to the west. Construction of residential properties further expanded and have now extended up to the land immediately to the east.	Onsite: Some **greenhouses** in the between Old Dandenong Road and Centre Dandenong Road have been removed. Commercial development (i.e. motor mechanic and brick supplies) has occurred immediately south of Centre Dandenong Road. Another commercial property/activity has commenced along the southern boundary. Offsite: The area to the west of the project area remains largely the same except for more commercial properties. Construction of residential properties is evident immediately to the south-east of the project area. Boundary Road to the west appears to be expanded with more lanes in both directions.	Onsite: The project area remains largely the same. Majority of the **greenhouses** in between Old Dandenong Road and Centre Dandenong Road have been removed. Offsite: The area to the west of the project area remains largely the same with the exception of more commercial properties. Construction of residential properties is evident immediately to the south-east of the project area.	Onsite: The project area remains largely the same. The c**ommercial** activity at the southern boundary appears to have ceased. Offsite: More **commercial developments** in areas to the west of the project area; and more residential development in areas to the east, south-east and south-west.

ROAD SECTION	1951/1956	1961/1962/1963/1966	1974	1981/1982/1985	1990/1991	2005	2009	2016
3	Onsite: The project area comprises farmlands, mainly used for cropping with some vacant land/open space. Lower Dandenong Road is present in the central portion of the project area. Offsite: The surrounding areas comprise **farmlands** and vacant land/open space, mainly used for cropping.	Onsite: The project area remains largely the same. Offsite: The surrounding area remains largely the same. **Trenching** immediately and parallel to the south-eastern boundary were present and appears to be a drainage system.	Onsite: The project area remains largely the same. **Commercial** activity appears to be present in the area immediately north of Lower Dandenong Road. The vacant land in the south-eastern portion of the project area appears to have been prepared for commercial redevelopment. Offsite: **Commercial** properties have been constructed to the south and south-west of the project area. Residential properties have been constructed to the north-east of the project area.	Onsite: The project area remains largely the same. **Structures** in the land immediately north of Lower Dandenong Road where commercial activity was observed have been removed. Offsite: More commercial properties have been constructed to the south and south-west of the project area; and more residential properties have been constructed to the east and north-east of the project area.	Onsite: The project area remains largely the same. **Commercial** activity in the south-eastern portion of the project area appears to have ceased and structures previously present were removed. Offsite: The area surrounding the project area continues to be developed for either **commercial** (to the west) or residential use (to the east/north-east).	Onsite: Old Dandenong Road has been upgraded and a dual carriageway constructed north of the existing road. Woodlands Drive has been constructed servicing the commercial properties to the south. The rest of the project area remains largely the same. Offsite: Some buildings are apparent in the area immediately north. Further commercial properties have now been constructed immediately south of the project area. Further residential development also appears to have occurred to the east and north-east.	Onsite: The project area remains largely the same. Offsite: The surrounding area remains largely the same.	Onsite: The project area remains largely the same. Offsite: The surrounding area remains largely the same.

ROAD SECTION	1951/1956	1961/1962/1963/1966	1974	1981/1982/1985	1990/1991	2005	2009	2016
4	Onsite: The project area comprises **farmland**, mainly used for **cropping** with some vacant land/open space. Some storage tanks understood to be part of the former Braeside Park Treatment Plant were present in the southern portion. Offsite: The surrounding area comprises f**armlands** and vacant land/open space. A race track is present in the south-eastern portion.	Onsite: The project area remains largely the same. More infrastructure including **aboveground storage tanks and ponds/dams** have been constructed along the southern boundary. Offsite: The surrounding area remains largely the same. **Trenching** immediately and parallel to the north-eastern boundary was present and appears to be a **drainage system** connected to the ponds/dam that were constructed immediately south of the project area.	Onsite: The project area remains largely the same. The former Braeside Treatment Plant appears to be fully operational. Offsite: The trenched area east of the project area no longer appears in this image and is assumed to be **filled**. Ponds south of the project area appear to be dry, or have been **backfille**d.	Onsite: The project area remains largely the same. Some **aboveground storage tanks** appear to be decommissioned. Offsite: Majority of the ponds south of the project area appear to be dry or have been **backfilled**.	Onsite: The project area remains largely the same. Offsite: The surrounding area remains largely the same. Parklands east of the project area have been developed.	Onsite: The former Braeside Treatment Plant has been decommissioned. Some office structures understood to be part of the Braeside Park management were present. The rest of the project area remains largely the same. Offsite: A wetland (Woodlands Lake) is present immediately to the south-east. A walking trail east of the project area was constructed. **Commercial** properties have been constructed to the west of the project area.	Onsite: The project area remains largely the same. Offsite: The surrounding area remains largely the same.	Onsite: The project area remains largely the same. Offsite: The surrounding area remains largely the same.

ROAD SECTION	1951/1956	1961/1962/1963/1966	1974	1981/1982/1985	1990/1991	2005	2009	2016
5	Onsite: The project area comprises farmland, mainly used for **cropping** with some vacant land/open space. Governor Road is visible and appears to be an unsealed road. Large ponds understood to be part of the former Braeside Treatment Plant were present in the central to western portion. Offsite: A highly vegetated area was present to the north-east. Remaining offsite areas comprise **farmland** and vacant land/open space.	Onsite: The project area remains largely the same. More infrastructure including **aboveground storage tanks and ponds/dams** have been constructed in the north/north-east portion. Offsite: The surrounding area remains largely the same.	Onsite: The project area remains largely the same. Additional **ponds** and dams appear to have been constructed on the southern side of existing dams, located to the north-east of project area. Offsite: The surrounding area remains largely the same. Additional **ponds/dams** to the west of the project area have been constructed. Walking trails are apparent to the east of the project area.	Onsite: The project area remains largely the same. Majority of the ponds/dams north/north-east of the project area appear to be dry or have been **backfilled.** Offsite: Majority of the ponds east of project area appear to be dry or have been **backfilled**.	Onsite: The project area remains largely the same. Offsite: The surrounding area to the west remains largely the same. Wetlands/lakes and parklands east of the project area have been developed. A **commercial property** was constructed to the south-west	Onsite: The rest of the project area remains largely the same. A residential property appears to have been built immediately to the south-east of Boundary Road. Offsite: A wetland (Woodlands Lake) was built immediately to the north-east. Wetlands were also built immediately to the south-east and south-west. Further **commercial developments** to the north-west and south-west are apparent.	Onsite: The project area remains largely the same. Offsite: The surrounding area remains largely the same. Residential properties have been built to the south-east. Further **commercial properties** are present to the north-west and south-west.	Onsite: The project area remains largely the same. Offsite: The surrounding area remains largely the same. More residential properties have been built to the south-east. Further **commercial properties t**o the north-west and south-west are present.

ROAD SECTION	1951/1956	1961/1962/1963/1966	1974	1981/1982/1985	1990/1991	2005	2009	2016
6	Onsite: The project area comprises an unsealed **road** running east to west. Offsite: The surrounding project area comprises **farmland** and vacant land/open space. A residential property and vegetated area appears immediately to the central north. Mordialloc Creek is visible further south and running north-west to south-east.	Onsite: The project area remains largely the same. Offsite: The surrounding area remains largely the same. More residential properties have been built to the north-west and south-west. A dam/pond was built to the north-east.	Onsite: The project area remains largely the same. Offsite: **Farm structures (e.g. greenhouses, nurseries)** were built in the property located in the central portion of road Section 6. A drain line that runs approximately north-south was built in the central portion. This drain line extends further south and connected to Mordialloc Creek. Boundary **Road** was built and **commercial developments** have commenced to the west. More **dams/ponds** were built to the north-east.	Onsite: The project area remains largely the same. Offsite: More **commercial development** has occurred to the north-west. More **dams/ponds/wetlands** were built to the south-west. Majority of the ponds north-east of project area appear to be dry or have been **backfilled**.	Onsite: The project area remains largely the same. Offsite: The rural property/**farm** immediately to the north was removed and the majority of the land to the north/north-west has now been converted into **commercial developments**. The majority of the dams/ponds/wetlands located in the south-west appear to be dry, or have been **backfilled**. A **commercial property** was built to the south-east.	Onsite: The project area remains largely the same. Offsite: **Commercial properties** now occupy most of the land to the north/north-west. Wetlands/lakes have been built to the north-east and south-east. Residential properties occupy most of the land south of Mordialloc Creek.	Onsite: The project area remains largely the same. Offsite: The surrounding area remains largely the same except for more **commercial properties** present immediately to the south.	Onsite: The project area remains largely the same. Offsite: The surrounding area remains largely the same except for additional **commercial properties** located immediately to the south.

ROAD SECTION	1951/1956	1961/1962/1963/1966	1974	1981/1982/1985	1990/1991	2005	2009	2016
7	Onsite: The project area comprises vacant land/open space. Mordialloc Creek runs approximately east-west and is visible to the south. Offsite: The surrounding land comprises vacant land/open space with some vegetated areas immediately to the north-west.	Onsite: The project area remains largely the same. Offsite: The surrounding area remains largely the same.	Onsite: The project area remains largely the same. Offsite: The surrounding area remains largely the same Wells Road and more **rural residential** properties were built to the south-west.	Onsite: The project area remains largely the same. Offsite: The surrounding area remains largely the same.	Onsite: The project area remains largely the same. Offsite: The surrounding area remains largely the same.	Onsite: Water bodies occupy most of the project area. Offsite: **Ponds/lakes** were built immediately to the east and west to encourage water to channel into wetlands. Residential properties occupy most of the land to the south and south-west.	Onsite: The project area remains largely the same. Offsite: More residential properties were built to the south, south-west and north-east.	Onsite: The project area remains largely the same. Offsite: The surrounding area remains largely the same with more residential properties built to the south, south-west and north-east.

ROAD SECTION	1951/1956	1961/1962/1963/1966	1974	1981/1982/1985	1990/1991	2005	2009	2016
8	Onsite: The project area comprises **vacant land/open space.** Offsite: The surrounding land comprises vacant land/open space. Springvale **Road** is visible to the south-east and Wells Road is visible to the west. Some residential properties were present along Springvale Road and Wells Road.	Onsite: The project area remains largely the same. Offsite: The surrounding area remains largely the same.	Onsite: The project area remains largely the same. Offsite: The surrounding area remains largely the same.	Onsite: The project area remains largely the same. Offsite: The surrounding area remains largely the same. Mornington Peninsula Freeway was built south-east of Springvale Road.	Onsite: The project area remains largely the same. Offsite: The surrounding area remains largely the same. More roads were built south-west of the project area and appears to be prepared for more **development.**	Onsite: The project area remains largely the same. Offsite: Most of the land to the west and south-west have been occupied by residential properties. A large **commercial complex** was built immediately west of the Mornington Peninsula Freeway. **Water bodies** have been built north of Mordialloc Creek.	Onsite: The project area remains largely the same. Offsite: The surrounding area remains largely the same with more residential properties built to the north-east and south/south-west.	Onsite: The project area remains largely the same. Offsite: The surrounding area remains largely the same.

ROAD SECTION	1951/1956	1961/1962/1963/1966	1974	1981/1982/1985	1990/1991	2005	2009	2016
9	Onsite: The project area comprises an unsealed **road** running north-east to south-west (Springvale Road); and north-west to south-east (Wells Road). Some **rural residential** properties present along Wells Road and Springvale Road. Offsite: The surrounding project area comprises **farmland** and vacant land/open space.	Onsite: The project area remains largely the same. Offsite: The surrounding area remains largely the same.	Onsite: The project area remains largely the same. Wells **Road**/Springvale Road intersection was upgraded. Offsite: The surrounding area remains largely the same. **Commercial developments** underway to the north-east.	Onsite: Springvale **Road** was upgraded to dual carriageway. Offsite: The surrounding area remains largely the same. Mornington Peninsula Freeway was built south-east of Springvale Road. More **commercial developments** to the east.	Onsite: The project area remains largely the same. Offsite: Further **commercial developments** are present to the north, east and south.	Onsite: The project area remains largely the same. Offsite: **Water bodies** have been built north of Mordialloc Creek. Some residential properties have been built further north and to the west and south-west. Further **commercial development** has occurred to the south, east and west.	Onsite: The project area remains largely the same. Offsite: The surrounding area remains largely the same with additional residential and/or **commercial properties** being built.	Onsite: The project area remains largely the same. Offsite: The surrounding area remains largely the same with additional residential and/or **commercial properties** being built.

ROAD SECTION	1951/1956	1961/1962/1963/1966	1974	1981/1982/1985	1990/1991	2005	2009	2016
10	Onsite: The project area comprises farmlands and vacant/open space. Offsite: The surrounding land comprises either farmland or vacant land/open space. Wells Road is visible to the west and parallel to the project area. Springvale Road is visible to the north-east. Some rural residential properties were present along Wells Road and Springvale Road (immediately north of the project area).	Onsite: The project area remains largely the same. Offsite: The surrounding area remains largely the same.	Onsite: The project area remains largely the same. Offsite: The surrounding area remains largely the same. The Wells Road/Springvale Road intersection was upgraded. Some **commercial properties** were built to the north-east.	Onsite: A roadway (Mornington. Peninsula Freeway) is now apparent. Offsite: Additional **commercial development** is evident to the north, east and west. Residential properties were built further to the south-west.	Onsite: The project area remains largely the same. Offsite: Additional commercial development to the north, east and west. Additional residential properties were built further to the west and south-west.	Onsite: The project area remains largely the same. Offsite: The land immediately to the west is developed with commercial properties. Residential properties are present further to the west.	Onsite: The project area remains largely the same. Offsite: The surrounding area remains largely the same with additional residential and/or commercial properties having been built.	Onsite: The project area remains largely the same. Offsite: The surrounding area remains largely the same with additional residential and/or commercial properties having been built.

ROAD SECTION	1951/1956	1961/1962/1963/1966	1974	1981/1982/1985	1990/1991	2005	2009	2016
11	Onsite: The project area comprises farmlands and vacant/open space. A farming property is present in the northern portion of the project area. Wells Road and Thames Promenade are visible running in the south western portion of the project area. Offsite: The surrounding land comprises either farmland or vacant land/open space. Land clearing appears to be occurring directly to the west of the project area.	Onsite: The project area remains largely the same. Wells Rd and Thames Promenade appear to be sealed in the later 1960s. Offsite: The surrounding area remains largely the same. Land clearing to the west of the project area is still present. Residential development further west of this is occurring. Residential development occurred to the south-west of the project area in the late 1960s.	Onsite: The project area remains largely the same. Offsite: The surrounding area remains largely the same. Land clearing to the west of the project area is no longer present. A large commercial property (Dairy processing plant) is now present to the west of the project area.	Onsite: The project area now contains the 2 lane Mornington Peninsular Highway running north-south, including on/off ramps onto Thames Promenade. The corner of Wells Road and Thames Promenade has been converted to a roundabout intersection. Offsite: The surrounding area remains largely the same. Land clearing to the west of the project area is no longer present and has potentially been **filled**. A large commercial property or school is now present to the west of the project area.	Onsite: The project area remains largely the same. Offsite: The area to the west of the project area now contains a road and appears to have been prepared for residential or **commercial development.** Some land clearing has occurred to the east of the project area likely for farming activities.	Onsite: The project area remains largely the same. Offsite: **Commercial/industrial development** has now occurred directly west of the project area. Residential development further west of this has also increased in density. Greenhouses appear to be present to the south east of the project area beyond Riverend Road.	Onsite: The project area remains largely the same. Offsite: The surrounding area remains largely the same.	Onsite: The project area remains largely the same. Offsite: The surrounding area remains largely the same

3.2 REGULATORY REVIEW

3.2.1 ENVIRONMENT PROTECTION AUTHORITY PRIORITY SITES REGISTER

Priority Sites are sites for which the Environment Protection Authority (EPA) Victoria has issued a Clean-up Notice pursuant to Section 62A or a Pollution Abatement Notice (relevant to land and/or groundwater), pursuant to Section 31A or 31B of the Victorian Environment Protection Act 1970. Typically, Priority Sites are properties where identified pollution may present an unacceptable risk to human health; or to the environment. EPA maintains the Priority Sites Register as a listing of all properties identified by the EPA as requiring assessment and/or clean up.

A search of the EPA Priority Sites Register was conducted in February 2017 (undertaken by Lotsearch). The search indicated that there is currently one landfill site located in the norther portion registered as a Priority Sites. Details of this priority site are summarised in Table 3.2. A copy of the priority site search is included as Appendix H.

Table 3.2 Summary of EPA priority sites

MUNICIPALITY	SUBURB	ADDRESS	ISSUE	NOTICE NUMBER
Kingston City Council	Dingley Village	370 Old Dandenong Road (understood to be the former Din San Landfill)	Former landfill site. Requires ongoing management	90006969

3.2.2 FORMER EPA PRIORITY SITES AND OTHER POLLUTION NOTICES

A search of the EPA Former Priority Sites Register was conducted in February 2017 (undertaken by Lotsearch). The search indicated that EPA former priority sites are listed and eleven pollution notices have been issued for businesses in the vicinity of the project area. Table 3.3 provides a summary of the former EPA listed sites. Refer to Appendix H for search details.

The former EPA notices NO9888, NO9143, NO10317, 90006313, 90005004, 90004129, 90003832 and 90003831 (as detailed below) all relate to the same property located at 370-418 Old Dandenong Road, Dingley Village (i.e. former Din San landfill). As indicated above, it is understood that the property is under an existing EPA directed notice and is the subject of environmental audit and soil remediation works.

Table 3.3 Former EPA priority sites and other pollution notice summaries

NOTICE NUMBER	NOTICE TYPE	COMPANY	ADDRESS	STATUS	POTENTIAL CONTAMINATION ISSUE	DATE ISSUED
NO2716	31A (1)	AGJ cartage Contractors P/L	Lot 2 Grange Road, Dingley	Legacy EPA database pollution notice	Unknown	9/3/2001
NO9888	62(A)1	Ernest Smith Contractors P/L	370-418 Old Dandenong Rd, Dingley Village	Legacy EPA database pollution notice	Current landfill, requires assessment and/or clean up Sits within the proposed project area buffer zone and partially within the project area boundary	10/10/2011

NOTICE NUMBER	NOTICE TYPE	COMPANY	ADDRESS	STATUS	POTENTIAL CONTAMINATION ISSUE	DATE ISSUED
NO9143	62(A)1	Ernest Smith Contractors P/L	370-418 Old Dandenong Rd, Dingley Village	Legacy EPA database pollution notice	Current landfill, requires on-going management Sits within the proposed site buffer zone and partially within the site boundary	24/02/2011
NO10317	31A (1)	Ernest Smith Contractors P/L	370-418 Old Dandenong Rd, Dingley Village	Legacy EPA database pollution notice	Current landfill, requires on-going management Sits within the proposed project area buffer zone and partially within the project area boundary	03/04/2012
90006313	Pollution Abatement Notice	Ernest Smith Contractors P/L	370 Old Dandenong Rd, Dingley Village	Previous pollution notice	Air quality contamination (legacy) Sits within the proposed project area buffer zone and partially within the project area boundary	20/08/2015
90005004	Pollution Abatement Notice	Ernest Smith Contractors P/L	370 Old Dandenong Rd, Dingley Village	Previous pollution notice	Unknown Sits within the proposed project area buffer zone and partially within the project area boundary	11/09/2014
90004129	Hydrogeological Assessment PAN	Ernest Smith Contractors P/L	370 Old Dandenong Rd, Dingley Village	Previous pollution notice	Liquid contamination (legacy) Sits within the proposed project area buffer zone and partially within the project area boundary	25/09/2015

NOTICE NUMBER	NOTICE TYPE	COMPANY	ADDRESS	STATUS	POTENTIAL CONTAMINATION ISSUE	DATE ISSUED
90003832	Previous Priority Notice, monitoring, rehab and aftercare PAN	Ernest Smith Contractors P/L	370 Old Dandenong Rd, Dingley Village	Previous priority notice	Former landfill, requires on-going management Sits within the proposed project area buffer zone and partially within the project area boundary	27/11/2014
90003831	Previous Priority Notice, Hydrogeological Assessment PAN	Ernest Smith Contractors P/L	370 Old Dandenong Rd, Dingley Village	Previous priority notice	Former landfill, requires on-going management Sits within the proposed project area buffer zone and partially within the project area boundary	17/07/2014
NO1950	31A (1)	Stino Nominees P/L	Lot 1 Grange Road, Springvale South	Legacy EPA database pollution notice	Unknown Sits within the proposed project area buffer zone	04/04/1990
NO2825	31A (1)	Super Soil P/L	Lot 1 Grange Road, Springvale South	Legacy EPA database pollution notice	Unknown Sits within the proposed project area buffer zone	28/09/2001

3.2.3 EPA LICENCED ACTIVITIES

Two companies in the vicinity of the project area (road Sections 1 and 2) were listed as EPA licenced activities. A summary is provided in Table 3.4.

Table 3.4 Summary of EPA licenced activities

TRANSACTION NUMBER	LICENCE NUMBER	COMPANY	ADDRESS	POTENTIALLY CONTAMINATING ACTIVITIES	STATUS
3005972	EA63780#6	Enviromix Pty Ltd	Lot 2 Grange Road, Dingley Village, Vic 3172	A07 Composting	Current
-	ES146#10	Ernest Smith Contractors Pty Ltd	370-418 Old Dandenong Road, Dingley Village, Vic 3172	A05 Landfills	Former

Both premises were issued with former EPA notices as detailed in Table 3.3 above. Refer to Appendix H for further details.

It is understood that the property located at Lot 1, Grange Road, Dingley Village, Victoria (currently occupied by Enviromix Pty Ltd) was formerly a sand quarry that was progressively landfilled during the early 1960s with both liquid and solid industrial waste. It is further understood that Industrial Waste Collection Pty Ltd were operating the waste disposal facility. The former sand quarry was completely filled by 1968. Refer to Figure 3A in Appendix A for the depicted landfilled areas; and suspected landfills within close proximity of the project area.

3.2.4 EPA WORKS APPROVAL

No businesses that require an EPA works approval exist within the project area buffer zone.

3.2.5 WASTE MANAGEMENT FACILITIES

3.2.5.1 NATIONAL WASTE MANAGEMENT SITE DATABASE

A search of the national waste management site database identified two businesses (road Section 1) for Ernest Smith Contractors Pty Ltd and Vidotta that previously operated as landfills. A summary of the national waste management plan database results is shown in Table 3.5 below.

Table 3.5 Summary of the state-wide waste and resource recovery facilities

COMPANY	ADDRESS	CATEGORY	OWNER
Ernest Smith Contractors Pty Ltd	Tootal Road, Dingley Village, Vic 3172	Landfill	Kingston City Council
Vidotta	Corner Grange Road and Heatherton Road, Clayton South	Landfill	Kingston City Council

The two properties listed above are understood to have operated as former landfills. The property listed for Tootal Road, Dingley Village is currently operating as a nursery (Din San nursery) and the property located on the Corner of Grange Road and Heatherton Road, Clayton South appears to have been capped and is currently vacant.

A copy of the national waste management site database search is provided in Appendix G.

3.2.5.2 WASTE AND RESOURCE RECOVERY INFRASTRUCTURE PLAN FACILITIES

A search of the state-wide waste management database identified four businesses that were operating as a waste resource and recovery facility. A summary of the waste and resource recovery infrastructure plan facility is shown in Table 3.6 below.

Table 3.6 Summary of the state-wide waste and resource recovery facilities

COMPANY	ADDRESS	CATEGORY	SUB CATEGORY
Enviromix	Lot 1, Grange Road, Dingley Village, Vic 3172	Organics	Garden waste
Ernest Smith Contractors Pty Ltd	370-418 Old Dandenong Road, Dingley Village, Vic 3172	Landfill	Landfill
Transpacific Industries (Dingley Soils)	Lot 1, Grange Road, Dingley Village, Vic 3172	Organics	Garden waste
Transpacific Industries	Lot 1, Grange Road, Dingley Village, Vic 3172	Commercial & Industrial	C&I recovery

A copy of the state-wide waste management site database search is provided in Appendix G.

3.2.6 EPA PRESCRIBED INDUSTRIAL WASTE SITES

Three EPA Prescribed industrial waste sites were reported within the project area buffer zone (road Section 1). A summary of the sites is listed in Table 3.7 below.

Table 3.7 Summary of EPA prescribed industrial waste sites

COMPANY	ADDRESS	TREATMENT/ DISPOSAL	TRANSPORT
KS Environmental Pty Ltd	544 Boundary Road, Dingley Village, Vic 3172	No	Yes
Padget Pty Ltd	544-554 Boundary Road, Dingley Village, Vic 3172	No	Yes
Padget Pty Ltd (Dingley Village)	544-554 Boundary Road, Dingley Village, Vic 3172	No	Yes

A google search of the property address located at 544-554 Boundary Road, Dingley Village indicated that Eastern Liquid Services is a company owned by KS Environmental, that are involved in liquid waste collection, transport, recycling and disposal.

A copy of the national and state wide waste management site database search is provided in Appendix G.

3.2.7 ENVIRONMENTAL AUDIT REPORT SEARCH

A search of environmental audits within a 150 m radius of the project area identified three records of a completed environmental audit. All the completed audits relate to the former landfill site located in 370-418 Old Dandenong Road, Dingley Village, Vic 3172. A summary of the audit sites is presented in Tables 3.8 to 3.10 below. A copy of the audit sites search is included as Appendix H.

Table 3.8 Nearby audit report search 1

REPORT	INFORMATION
Din San Landfill, 370-418 Old Dandenong Road, Dingley Village, Vic 3172	
CARMs No.	69419-2
Site background	Site was the former Din San Landfill located in Dingley Village. The Din San Landfill (owned by Ernest Smith Contractors Pty Ltd (ESC)) was licensed by EPA (waste discharge license number ES146) to receive solid inert waste. The landfill was unlined and does not have a leachate management or landfill gas (LFG) management system. Landfilling at the site ceased on 30 June 2012 and the license was surrendered to EPA in April 2013.
Audit background and outcome	Section 53V environmental audit. An environmental audit of the risk of any possible harm or detriment to the environment. The Audit considers the March 2013 – March 2014 groundwater monitoring events as well as leachate monitoring at the centre of the former landfill cells. The audit also considered landfill gas (LFG) monitoring and surface emission monitoring. Surface water monitoring was not undertaken and could not be evaluated. A landfill operations risk assessment and monitoring program was prepared for the site. The Auditor's review of the program indicated that it was adequate to enable ESC and EPA to determine compliance with best practice environmental management, with some amendments recommended. Further monitoring and site management measures were necessary to reduce the risks to groundwater and the risks from LFG migration to an acceptable level. The risk to surface water also needed to be further investigated.

REPORT	INFORMATION
	Specifically, audit recommendations included: — Site management measures as specified in the Landfill Best Practice Environmental Management (Landfill BPEM) for landfill caps. — Install additional groundwater wells to the south and east of the site to ascertain the extent of the groundwater pollution. — Stormwater drains to be visually inspected after significant rain events, and if possible, surface water in the drain should be monitored. — Integrity of the landfill caps should be investigated and rectified where necessary. — Install additional LFG bores in the south of the site, to measure the extent of LFG migration. — The type of material contained in the subsurface of Cell 4B should be investigated to determine if any waste materials had been deposited within this section of the site. It is recommended that this cell should be included in the rehabilitation plan of the landfill, and may require capping.
Completion date	30 June 2014.
Proximity to site	North-eastern boundary at its closest point. Parts of the former landfill falls within road alignment (Section 1) and buffer zone.
Groundwater and leachate monitoring	The results of the groundwater monitoring indicate that leachate originating from waste at the landfill is impacting on the protected beneficial uses of the Segment A1 groundwater at the site. Since all cells are unlined, and there is evidence of erosion of the landfill caps, there was potential for groundwater impacts to continue to occur in the future. Leachate mounding has been identified in all cells which can cause increased hydrostatic pressure and local alteration of the groundwater flow direction towards the south and east of the site (note: actual groundwater flow inferred to be to the south-west).
Surface water monitoring	A shallow stormwater channel immediately to the west of the site may intersect the shallow groundwater aquifer, especially during significant rain events. This drain also accepts stormwater runoff from the site. It is therefore possible for contaminated groundwater or runoff to discharge to the stormwater channel, and possibly to nearby surface water bodies.
Landfill gas monitoring	Elevated levels of LFG measured on the slopes, edges and corners of landfill Cells 1, 2, 3 and 4A. Furthermore, elevated methane concentrations have been measured in bores at the site near Cell 4B which was in an area not considered to have been landfilled. The elevated concentrations suggest that there is some organic material in the vicinity of these bores. ***(Note: western boundary of Cells 3 and 4A fall along the sites proposed alignment and buffer zone, in road Section 1)***. Based on the results of the LFG monitoring conducted at the site and the landfill gas risk assessment for the audit, the risk to potential offsite receptors from the migration of methane has been assessed as being low to very low, except for one location (GB33) in the south of the site. ***(Note: GB33 sits within the project areas buffer zone)***. The CO_2 concentrations in most bores have decreased or remained at similar levels to those found in the previous monitoring period (December 2009 to March 2012); except for offsite soil gas bore GB29 to the north-west which has increased in the recent monitoring period. The CO_2 concentrations in most soil gas bores have remained at an elevated level and present low to moderate risks to potential offsite receptors, apart from in the south of Stage 4B, where the risks were assessed to be moderate to high. The extent of LFG migration to the west of the site has not been fully determined and should be investigated.
CUTEP/GQRUZ	N/A

Table 3.9 Nearby audit report search 2

REPORT	INFORMATION
Din San Landfill, 370-418 Old Dandenong Road, Dingley Village, Vic 3172	
CARMs No.	69419-3
Site background	As above (Table 3.8)
Audit background and outcome	Section 53V audit. An environmental audit of the risk of any possible harm or detriment to the environment. The Audit considers the 1 April 2014 – 1 April 2015 and includes groundwater monitoring and the monitoring of LFG in bores, surface emissions, buildings, structures and underground services. Surface water monitoring was not undertaken and could not be evaluated. A landfill operations risk assessment and monitoring program was prepared for the site. Further monitoring and site management measures were necessary to reduce the risks to groundwater and the risks from LFG migration to an acceptable level. The risk to surface water also needs to be further investigated. Specifically, audit recommendations included: — Further assessment of the performance of the existing landfill caps should be performed and where appropriate, the performance of the caps improved to minimise the potential for leachate generation and impacts to groundwater — Increased frequency of LFG monitoring — Delineation of LFG impacts in the eastern portion was considered warranted.
Completion date	30 June 2015.
Proximity to site	North-eastern boundary at its closest point. Parts of the former landfill falls within road alignment and buffer zone.
Groundwater and leachate monitoring	The results of the groundwater monitoring indicate that leachate from the former landfill impacted the protected beneficial uses of the site. The polluted groundwater in the western portion of the site was not indicated to extend any significant distance beyond Old Dandenong Road to the south of the site. However, the polluted groundwater does extend beneath a VicRoads freeway reserve located to the west of the site **(Note: this sits within the project area's proposed road alignment and buffer zone)**. Polluted groundwater emanating from the eastern portion of the site is likely to extend beyond Tootal Road. However, the extent of the plume has not been delineated. There is one registered stock and domestic groundwater well in close proximity to the eastern boundary which should be monitored to confirm that it is not being impacted. Leachate mounding has been identified in all the landfill cells.
Landfill gas monitoring	The results of the LFG monitoring demonstrate that elevated methane concentrations in the sub-surface are constrained to the site and are not migrating offsite at concentrations that would present an unacceptable risk to human health, the environment or buildings and structures. By comparison, carbon dioxide is indicated to be migrating beyond the physical extent of the landfill cells at distances of up to 150 m from the site. The risk of onsite impacts is considered to be high in the absence of effective management measures (for example a monitoring program and management plan). However, the risk to offsite receptors is considered to be very low in relation to methane, and moderate to high in relation to carbon dioxide.

REPORT	INFORMATION
	Notably, elevated carbon dioxide concentrations were measured in one LFG bore located in close proximity to residential dwellings to the east of the site, two of which include basements. It was noted that the LFG gas concentrations measured in buildings and structures and underground services have all been low and below the EPA Action Levels, apart from an elevated carbon dioxide concentration in a sewer pit.
CUTEP/GQRUZ	N/A

Table 3.10 Nearby audit report search 3

REPORT	INFORMATION
Din San Landfill, 370-418 Old Dandenong Road, Dingley Village, Vic 3172	
CARMs No.	69419-4
Site background	As above (Table 3.8)
Audit background and outcome	An environmental audit of the risk of any possible harm or detriment to the environment. The Audit was undertaken during the 01 March 2015 to 30 April 2016 and includes supporting data from groundwater and LFG monitoring in bores, surface emissions, buildings, structures and underground services. Surface water monitoring was not undertaken and could not be evaluated. A landfill operations risk assessment and monitoring program was prepared for the site. Further monitoring and site management measures were necessary to reduce the risks to groundwater and the risks from LFG migration to an acceptable level. The risk to surface water also needed to be further investigated. Specifically, audit recommendations included: — Ongoing monitoring required — Consider installing additional groundwater wells to delineate plume.
Completion date	22 July 2016.
Proximity to site	North-eastern boundary at its closest point. Parts of the former landfill sit within the proposed road alignment (Section 1) and buffer zone.
Groundwater and leachate monitoring	The results of the groundwater monitoring indicate that leachate from the former landfill impacted the protected beneficial uses of the site. Groundwater contaminant concentrations was comparable to previous monitoring rounds except for groundwater well 124425A located south-east of the site. The polluted groundwater in the western portion of the site was not indicated to extend any significant distance beyond Old Dandenong Road to the south of the site. However, the polluted groundwater does extend beneath a VicRoads freeway reserve located to the west of the site **(Note: this sits within the project area's proposed road alignment and buffer zone)**. Impacted groundwater emanating from the eastern portion of the site is likely to extend beyond Tootal Road. However, the extent of the plume has not been delineated. Leachate mounding has been identified in all the landfill cells, however more significant mounding was present in Stages 2 and 3. Assessment of performance of landfill caps and a hydrogeological assessment were undertaken in 2015. The leachate levels in 2015 were below allowable levels.

REPORT	INFORMATION
Landfill gas monitoring	The results of the LFG monitoring demonstrate that elevated methane concentrations in the sub-surface are constrained to the site and are not migrating offsite at concentrations that would present an unacceptable risk to human health, the environment or buildings and structures. By comparison, carbon dioxide is indicated to be migrating beyond the physical extent of the landfill cells at distances of up to 150 m from the site. The risk to offsite receptors is considered to be low in terms of methane and moderate in relation to carbon dioxide. It was noted that LFG gas concentrations measured in buildings and structures and underground services offsite have all been low and below the EPA Action Levels.
CUTEP/GQRUZ	N/A

3.3 PREVIOUS ASSESSMENT WORKS

It is understood that several stages of environmental assessment and statutory environmental audit works have been completed for the property located at 370-418 Old Dandenong Road, Dingley Village, Vic 3172 (Din San Landfill), a portion of which is located within the proposed Mordialloc Bypass (refer to Figure 3A, Appendix A). Soil, surface water, groundwater; and landfill gas were sampled and analysed and environmental management plans were consequently prepared and implemented.

The assessment report attached in the Audit reports were reviewed to be able to further characterise the Din San Landfill. The historical landfill gas monitoring data from the existing reports were collated and included in the landfill gas risk assessment.

It is inferred that previous environmental investigations have been undertaken to characterise other former landfill operations in the northern portion of the project area, however environmental assessment reports were not available at the time of reporting.

3.4 NEARBY BUSINESS SEARCH

A desktop search of nearby business activities (historical and current) identified several properties within the vicinity of the project area (up to 500 m radius) that may conduct potentially contaminating activities (such as landfills, service stations, mechanics, etc.). A summary of these surrounding businesses is provided in Table 3.11 and presented in Figures 3A to 3C, Appendix A.

The historical businesses were found via a search of the 1980 and 1991 business directories and a review of historical aerial imagery. The current businesses were conducted via a review of Google imagery only.

Table 3.11 Summary of nearby businesses that may that may conduct potentially contaminating activities

LOCATION ID	ADDRESS	PROPERTY USE/NAME	DISTANCE AND DIRECTION FROM THE PROJECT AREA (m)
Historic			
N/A	‘Original’ local area	Farming/grazing land	0 m
3	Deals Rd Clayton, Clayton South VIC 3169	Deals Road landfill (former landfill)	180 m to the north
4	Heatherton Rd, Clayton South VIC 3169	Heatherton Park (former landfill)	180 m to the north

LOCATION ID	ADDRESS	PROPERTY USE/NAME	DISTANCE AND DIRECTION FROM THE PROJECT AREA (m)
5	468 Heatherton Rd, Clayton South VIC 3169	Former landfill	0 m to the north
7	580-650 Heatherton Rd, Clayton South VIC 3169	Suspected former wastewater treatment plant	50 m to the north-east
8	544 Boundary Rd, Dingley VIC 3172	Former landfill	10 m to the west
9	494 Boundary Rd, Dingley Village VIC 3172	Former landfill (Barraton)	10 m to the west
10	2 Grange Rd, Dingley Village VIC 3172	Former landfill (Lot 1 Grange Road)	within project area
11	Grange Rd, Dingley Village VIC 3172	Market garden (Twigg garden supplies) potential former landfill	within project area
13	370-418 Old Dandenong Rd, Dingley Village	Former Din San landfill	0 m to the west, former western boundary suspected to be within project area
16	Open plot of land immediately west of Din San Landfill	Potential former landfill	within project area
27	immediately north of Lower Dandenong Road	Former commercial/industrial area	within project area
28	immediately south of Lower Dandenong Road	Former commercial/industrial area	within project area
33	Braeside Park	Former racetrack	200 m to the east
34	Woodlands Industrial Estate Environmental Wetland, Braeside VIC 3195	Former Braeside Wastewater Treatment Plant	within project area
38	Various	Filled land – former ponds	within project area
Current			
1	275 Kingston Rd, Clarinda VIC 3169	Recycling facility and quarry	220 m to the north-west
2	461 Heatherton Rd, Clayton South VIC 3169	Market garden	180 m to the north
6	550 Heatherton Rd, Clayton South VIC 3169	Nursery (Greenline indoor plants)	10 m to the north
7	580-650 Heatherton Rd, Clayton South VIC 3169	Commercial precinct	50 m to the north-east
8	544 Boundary Rd, Dingley VIC 3172	Commercial waste (liquid waste) management (KS environmental)	10 m to the west
9	494 Boundary Rd, Dingley Village VIC 3172	Melbourne truck park	10 m to the west
10	2 Grange Rd, Dingley Village VIC 3172	Soil composting (Enviromix)	within project area

LOCATION ID	ADDRESS	PROPERTY USE/NAME	DISTANCE AND DIRECTION FROM THE PROJECT AREA (m)
11	Grange Rd, Dingley Village VIC 3172	Market garden (Twigg garden supplies)	within project area
12	Lot 1 Grange Rd, Dingley Village VIC 3172	Soil processing (wholesale soil and quarry products) (Monk Resource Management)	100 m to the west
13, 14	370-418 Old Dandenong Rd, Dingley Village	Landfill and nurseries (Din San)	0 m to the west
15	302 Old Dandenong Rd, Dingley Village VIC 3172	Market gardens	100 m to the west
16	1 Junction Road, Dingley (and plot of land west of Din San Landfill)	Commercial driving (e.g. forklifts, backhoes, trucks, etc.) school (Multiskills Training, Currently vacant	within project area
17	431 Boundary Rd, Heatherton VIC 3202	Nursery (Landscape Link)	20 m to the west
18	339-351 Old Dandenong Rd, Dingley Village VIC 3172	Nursery and market gardens (Dingley Flower Cottage)	within project area
19	66 Bundoora Parade, Moorabbin Airport VIC 3194	Moorabbin Airport	20 m to the west
20	Various	Redwood Gardens Industrial Estate	10 m to the west
21	368 Boundary Rd, Dingley Village VIC 3172	Service station (Coles Express)	90 m to the south
22	260 Centre Dandenong Road, Dingley Village, 3172	Mechanic (Dingley Village Mechanical Services)	0 m to the west
23	262 Centre Dandenong Road, Dingley VIC 3172	Brick manufacturer and/or distributor (Uneeda Bricks)	within project area
24	277 Centre Dandenong Rd, Dingley Village VIC 3172	Service station (7-eleven Dingley)	100 m to the east
25	8 Chifley Dr, Moorabbin Airport VIC 3194	Service station (Costco Fuel)	500 m to the west
26	403 lower Dandenong Rd, Dingley VIC 3175.	Plastic bottle manufacturer	0 m to the north
29	1-7 Bell Grove, Braeside VIC 3195	Chemical manufacturer (Tasman Chemicals)	0 m to the west
30	412/402 Lower Dandenong Road, Braeside, 3195	Service station (United)	5 m to the south
31	Various	Commercial/industrial area (Woodlands Industrial Estate)	10 m to the west
32	25-27 Park Way, Braeside VIC 3195	Commercial laundry/drycleaner (Princes Laundry Services)	10 m to the west

LOCATION ID	ADDRESS	PROPERTY USE/NAME	DISTANCE AND DIRECTION FROM THE PROJECT AREA (m)
35	Corner Wells Road and Edithvale Road, Aspendale 3195	Service station (7-Eleven)	80 m to the south-west
36	102 Soden Rd, Bangholme VIC 3175	Christmas Tree farm	10 m to the east
37	116 Soden Rd, Bangholme VIC 3175	Farming activity	10 m to the east
39	Various	Commercial/industrial area (Chelsea Business Park)	0 m to the west
40	Thames Promenade	Commercial/industrial area (Ashley Business Park)	0 m to the west
41	241 Wells Rd, Chelsea Heights VIC 3196	Service Station and carwash (Caltex)	0 m to the west
42	170 Riverend Rd, Bangholme VIC 3175	Winery - The Craft and Co	240 m to the east
43	128 Riverend Rd, Bangholme VIC 3175	Horse training ground - Riverend Park Pty Ltd	240 m to the east
44	150 Wells Road, Chelsea	Dairy processing facility (National Foods/Lion Co., formerly Kinross Milk Products)	0-100 m to the north/west

3.5 HISTORICAL LAND USE SUMMARY

Based on the results of the review of historical information, the project area appears to have been predominantly used for agricultural purposes including nurseries and market gardens until the 1960s to 1970s. Industrial land use has become more prevalent since that time.

In the Northern Portion of the project area and its surrounds, quarrying and subsequent landfilling including industrial waste and liquid waste, various other industrial activities, market gardening and nurseries have operated since the 1960s. The Northern Portion of the project area intersects or adjacent to a number of known former landfills including the western portion of Din San Landfill, Lot 1 Grange Road Landfill, Barraton Landfill and potential other unnamed former landfills.

The Redwood Gardens Industrial Estate and Woodlands Industrial Estate was developed since the 1990s, which adjoins the Central Portion of the project area to the west. This area was formerly used for agriculture and some industrial uses including the former Braeside Wastewater/Sewage Treatment Plant which intersected the project area. Braeside Park adjoins the Central Portion of the project area to the east and was formerly used for agriculture including market gardening and horse training. Former wetlands and swampy land that has been filled over time is evident in the Central Portion of the project area and surrounds. This includes the Waterways Estate, north of Mordialloc Creek which is currently used for residential purposes. Moorabbin Airport is also located to the west of the Central Portion of the project area. The remainder of the nearby area has predominantly been redeveloped for residential purposes.

The Southern Portion of the project area has primarily been redeveloped for residential purposes to the west, as well as a some smaller commercial/industrial estates (Chelsea Business Park and Ashley Business Park) immediately adjoining the project area to the west. The majority of the area to the east of the Southern Portion of the project area remains agricultural land with an area used as a horse training ground.

4 CONCEPTUAL SITE MODEL

The following section summarises potential sources and associated contaminants of potential concern (COPC) within the project area along with associated potential pathways for contaminant migration and impact to receptors. A potential risk is considered to exist when a source-pathway-receptor linkage is identified.

4.1 POTENTIAL SOURCES AND ASSOCIATED CHEMICALS OF POTENTIAL CONCERN (COPC)

Based on the identified current and historical land use within and surrounding the project area, several potentially contaminating activities were identified to exist. The potentially contaminating activities and associated chemicals of potential concern (COPC) are summarised as Table 4.1 and presented as Figures 3A to 3C in Appendix A.

Table 4.1 Nearby potentially contaminating activities and associated COPCs

LOCATION ID	ADDRESS	PROPERTY USE/NAME	DISTANCE AND DIRECTION FROM THE PROJECT AREA (m)	POTENTIALLY CONTAMINATING ACTIVITY	CONTAMINANTS OF POTENTIAL CONCERN*	COMMENT
Historic						
N/A	'Original' local area	Farming/grazing land	0 m	Application of pesticides, herbicides and fertilisers.	— OCP and OPP — Herbicides — Metals and metalloids — Nitrogen compounds	Potential impacts to the project area likely limited to shallow soil and fill. Regional groundwater may be impacted by nitrogen compounds.
N/A	Portions of site with road intersections	Construction of road	0 m	Importation of fill for use as building material. Specifically, for use as a foundation (subbase) for embankments and for construction of roads. Introduction of asbestos containing materials (ACM) if present in fill. Runoff causing contamination to nearby land or surface waters. Exhaust particulates from diesel vehicles.	— ACM — Metals — PAHs — Dioxins	Potential impacts to the project area likely limited to shallow soil and fill.

LOCATION ID	ADDRESS	PROPERTY USE/NAME	DISTANCE AND DIRECTION FROM THE PROJECT AREA (m)	POTENTIALLY CONTAMINATING ACTIVITY	CONTAMINANTS OF POTENTIAL CONCERN*	COMMENT
3, 4, 5, 8, 9, 16	Various sites within and surrounding the Northern Portion of the project area	Deals Road Landfill, Heatherton Park, Barraton Landfill, Lot 1 Grange Road Landfill, Din San Landfill (including various unnamed unknown properties)	Within and up to 500m of the project area	Disposal, containment and degradation of waste (possible municipal, industrial or commercial) which results in generation of landfill gases and leachate. Potential migration of landfill leachate to and within groundwater and possibly surface water if in hydraulic continuity.	— Landfill gases (methane, carbon dioxide, hydrogen sulphide) — TPH/TRH — PAHs — VOCs & SVOCs — Cyanide — Ammonia — Sulphates/sulphides — Metals — Organic acids — Microbiological parameters — PFAS	Impacts to the project area is likely in soil and groundwater which may be encountered during construction (i.e. <5 mBGL depth in the vicinity) and vapour above the groundwater bearing zone. Presence of leachates generated from the waste mass

LOCATION ID	ADDRESS	PROPERTY USE/NAME	DISTANCE AND DIRECTION FROM THE PROJECT AREA (m)	POTENTIALLY CONTAMINATING ACTIVITY	CONTAMINANTS OF POTENTIAL CONCERN*	COMMENT
7	580-650 Heatherton Rd, Clayton South VIC 3169	Former wastewater/sewer treatment plant (Note that these sites have been converted into commercial/industrial precincts)	50 m to the north-east	Storage (including in tanks, lagoons and ponds) or treatment (including recycling) of wastewater or disposal of wastewater to land or water Importation of fill for use as backfill material to level the site. Introduction of asbestos containing materials (ACM) if present in fill.	— Metals — Fluoride — Lime — Nutrients — Ammonia — Nitrates — Micro-organisms — ACMs	Impacts to the project area limited to shallow groundwater which may be encountered during construction (i.e. <5 mBGL depth in the vicinity) and vapour above the groundwater bearing zone, however it is noted that this potential source is likely to be up-hydraulic gradient from the project area.
34	Woodlands Industrial Estate Environmental Wetland, Braeside VIC 3195		Within project area			Impacts to the project area is likely in soil and groundwater which may be encountered during construction (i.e. <5 mBGL depth in the vicinity) and vapour above the groundwater bearing zone.

LOCATION ID	ADDRESS	PROPERTY USE/NAME	DISTANCE AND DIRECTION FROM THE PROJECT AREA (m)	POTENTIALLY CONTAMINATING ACTIVITY	CONTAMINANTS OF POTENTIAL CONCERN*	COMMENT
27, 28	immediately north and south of Lower Dandenong Road	Former commercial/industrial area	Within project area	Storage of junk that may cause spills and leaks of various contaminants (e.g. solvents, fuels and oils) Potential Bulk storage of chemicals that may result in spills and leaks with a potential to migrate to the sub-surface	— Hydrocarbons — OCPs and OPPs — Herbicides — PAHs and phenols — Metals and metalloids — ACMs	Impacts to the project area is likely in soil and groundwater which may be encountered during construction (i.e. <5 mBGL depth in the vicinity) and vapour above the groundwater bearing zone.
33	Braeside Park	Former racetrack	200 m to the east	Application of pesticides and herbicides along the racetrack. Fuels and oils spills and leaks at any sidings.	— Hydrocarbons — Heavy metals — Nitrates and ammonia	Impacts to the project area likely limited to shallow soil and fill.
38	Various	Filled land - former ponds	Within project area	Widespread filling of wetlands/importation of fill (likely from surrounding site) for use as backfill material to level the site. Introduction of impacted soil and asbestos containing materials (ACM) if present in fill.	— OCPs and OPPs — Herbicides — Metals and metalloids — ACMs	Impacts to the project area is likely in soil and groundwater which may be encountered during construction (i.e. <5 mBGL depth in the vicinity) and vapour above the groundwater bearing zone. Presence of leachates generated from the waste mass

LOCATION ID	ADDRESS	PROPERTY USE/NAME	DISTANCE AND DIRECTION FROM THE PROJECT AREA (m)	POTENTIALLY CONTAMINATING ACTIVITY	CONTAMINANTS OF POTENTIAL CONCERN*	COMMENT
Current						
1	275 Kingston Rd, Clarinda VIC 3169	Recycling facility and quarry	220 m to the north-west	Disposal, containment and degradation of waste (possible municipal, industrial or commercial) which results in generation of landfill gases and leachate. Potential migration of landfill leachate to and within groundwater and possibly surface water if in hydraulic continuity.	— Landfill gases (methane, carbon dioxide, hydrogen sulphide) — TPH/TRH — PAHs — VOCs & SVOCs — Cyanide — Ammonia — Sulphates/sulphides — Metals — Organic acids — Microbiological parameters — PFAS	Impacts to the project area is likely in soil and groundwater which may be encountered during construction (i.e. <5 mBGL depth in the vicinity) and vapour above the groundwater bearing zone. Presence of leachates generated from the waste mass.
13, 14	370-418 Old Dandenong Rd, Dingley Village	Landfill	0 m to the west			
2, 6, 11, 13, 14, 15, 17, 18, 36, 37, 42	Various	Market gardens, nurseries, farms, wineries	Within and within 500 m of the project area	Potential application of chemicals such as pesticides and herbicides. Bulk storage of chemicals that may result in spills and leaks with a potential to migrate to the sub-surface.	— OCPs and OPPs — Herbicides — Metals and metalloids — Nitrates, nitrites, ammonia	Potential impacts to the project area likely to shallow soil and fill. Regionally groundwater may be impacted by nitrogen compounds.

LOCATION ID	ADDRESS	PROPERTY USE/NAME	DISTANCE AND DIRECTION FROM THE PROJECT AREA (m)	POTENTIALLY CONTAMINATING ACTIVITY	CONTAMINANTS OF POTENTIAL CONCERN*	COMMENT
7	580-650 Heatherton Rd, Clayton South VIC 3169	Commercial precinct	50 m to the north-east	Importation of fill for use as backfill material to level the site. Bulk storage of chemicals that may result in spills and leaks with a potential to migrate to the sub-surface. Introduction of asbestos containing materials (ACM) if present in fill.	— Metals — Fluoride — Lime — Nutrients — Ammonia — Nitrates — PAHs and phenols — Micro-organisms — ACMs	Impacts to the project area is likely in soil and groundwater which may be encountered during construction (i.e. <5 mBGL depth in the vicinity) and vapour above the groundwater bearing zone.
8	544 Boundary Rd, Dingley VIC 3172	Commercial waste (liquid waste) management (KS environmental)	10 m to the west	Bulk storage of chemicals. Maintenance of trucks causing oils, solvents, lubricants and fuel spills.	— TPH and BTEX — PAH and Phenols — VHC and CHC — OCP and OPP — Herbicides — Metals	Impacts to the project area limited to shallow groundwater (which may be encountered during construction) and vapour above the groundwater bearing zone.
10	Lot 1 and Lot 2 Grange Rd, Dingley Village VIC 3172	Soil processing (composting, wholesale soil and quarry products)	within project area and 100 m to the west	Use of nutrients to enhance soil quality Maintenance of trucks causing oils, solvents, lubricants and fuel spills.	— TPH and BTEX — PAH and Phenols — VHC and CHC — Metals — Nitrates — Nutrients	Impacts to the project area is likely in shallow soil.

LOCATION ID	ADDRESS	PROPERTY USE/NAME	DISTANCE AND DIRECTION FROM THE PROJECT AREA (m)	POTENTIALLY CONTAMINATING ACTIVITY	CONTAMINANTS OF POTENTIAL CONCERN*	COMMENT
16	1 Junction Road, Dingley (and plot of land west of Din San Landfill)	Commercial driving (e.g. forklifts, backhoes, trucks, etc.) school (Multiskills Training)	within project area	Maintenance of trucks causing oils, solvents, lubricants and fuel spills.	— TPH and BTEX — PAH and Phenols — VHC and CHC — OCP and OPP — Herbicides — Metals	Impacts to the project area is likely in shallow soil.
19	66 Bundoora Parade, Moorabbin Airport VIC 3194	Moorabbin Airport	20 m to the west	Bulk storage of fuels and chemicals including firefighting foams that may result in spills and leaks with a potential to migrate to the sub-surface. Presence of firefighting training grounds with potential to dispose firefighting foams into the surface and subsurface via stormwater drains. Maintenance of landing grounds using herbicides.	— TPH and BTEX — PAH and Phenols — VHC and CHC — Herbicides — Metals — PFAS	Impacts to the project area is likely in shallow soil (via dust migration) and groundwater which may be encountered during construction and vapour above the groundwater bearing zone. The stormwater drain network does not directly intersect the project area but eventually drains towards Mordialloc Creek. Surface water impacts maybe present at the drain outfalls.

LOCATION ID	ADDRESS	PROPERTY USE/NAME	DISTANCE AND DIRECTION FROM THE PROJECT AREA (m)	POTENTIALLY CONTAMINATING ACTIVITY	CONTAMINANTS OF POTENTIAL CONCERN*	COMMENT
20, 26	Various	Commercial/industrial uses (Redwood Gardens Industrial Estate)	10 m to the west	Commercial/industrial uses in the area including plastic bottle manufacturing, steel fabrication and engineering facilities. Bulk storage of chemicals that may result in spills and leaks with a potential to migrate to the sub-surface.	— TPH and BTEX — PAH and Phenols — VHC and CHC — VOCs and SVOCs — Metals and metalloids	Impacts to the project area limited to shallow groundwater (which may be encountered during construction) and vapour above the groundwater bearing zone. Impacted shallow soil in the periphery of the commercial/industrial land may also be encountered.
9, 21, 22, 24, 25, 30, 35, 41	368 Boundary Rd, Dingley Village VIC 3172	Service stations (Coles Express, 7-Eleven, Costco Fuel, United), carwash, mechanics and truck parking area	adjacent to and within 500 m of the project area	Underground fuel storage and supply infrastructure. Fuel/oil/and leaks. Maintenance of trucks causing oils, solvents, lubricants and fuel spills.	— TPH, MAH and BTEX — PAHs and Phenols — Metals	Impacts to the project area limited to shallow groundwater (which may be encountered during construction) and vapour above the groundwater bearing zone.
23	262 Centre Dandenong Road, Dingley VIC 3172	Brick manufacturer and/or distributor (Uneeda Bricks)	within project area	Potential presence of kiln. Potential use of ACMs in the whole plant.	— Metals — Acids — Chlorides, fluorides and sulfates — Phenolics — ACMs	Potential impacts to the project area likely limited to shallow soil and fill.

LOCATION ID	ADDRESS	PROPERTY USE/NAME	DISTANCE AND DIRECTION FROM THE PROJECT AREA (m)	POTENTIALLY CONTAMINATING ACTIVITY	CONTAMINANTS OF POTENTIAL CONCERN*	COMMENT
29, 31, 32	Various	Commercial/industrial uses (Woodlands Industrial Estate)	adjacent to and within 500 m of the project area	Commercial/industrial uses in the area including chemical manufacturer, commercial laundry/dry cleaner, steel fabrication and engineering facilities. Bulk storage of chemicals that may result in spills and leaks with a potential to migrate to the sub-surface.	— TPH and BTEX — PAH and Phenols — VHC and CHC — VOCs and SVOCs — Metals and metalloids	Impacts to the project area limited to shallow groundwater (which may be encountered during construction) and vapour above the groundwater bearing zone. Impacted shallow soil in the periphery of the commercial/industrial land may also be encountered.
39, 44	Various	Commercial/industrial area in the Southern Portion (Chelsea and Ashley Business Park)	0 m to the west	Commercial/industrial uses in the area including dairy processing plant, mechanics and engineering facilities.	— TPH and BTEX — PAH and Phenols — VHC and CHC — VOCs and SVOCs — Metals and metalloids	Impacts to the project area limited to shallow groundwater (which may be encountered during construction) and vapour above the groundwater bearing zone. Impacted shallow soil in the periphery of the commercial/industrial land may also be encountered.

LOCATION ID	ADDRESS	PROPERTY USE/NAME	DISTANCE AND DIRECTION FROM THE PROJECT AREA (m)	POTENTIALLY CONTAMINATING ACTIVITY	CONTAMINANTS OF POTENTIAL CONCERN*	COMMENT
43	128 Riverend Rd, Bangholme VIC 3175	Horse training ground - Riverend Park Pty Ltd	240 m to the east	Maintenance of horse training grounds using herbicides.	— Herbicides	Impacts to the project area limited to shallow groundwater (which may be encountered during construction) and vapour above the groundwater bearing zone.

Of the above list, it is considered that the key contaminants of concern derived from the surrounding historical/current land uses include landfill gases, inorganics (including ammonia, sulphides, nitrates), pesticides and herbicides (namely: OCPs/OPPs), metals and metalloids, phenolics, petroleum hydrocarbons and volatile and semi-volatile hydrocarbons (chlorinated and non-chlorinated) and ACMs. There is also a potential for presence of aesthetic impacts (e.g. odours) within the vicinity of the project area, where odours emanating from the landfill are not managed appropriately.

Of note, given the ambiguity regarding the type of wastes (i.e. solid and liquid industrial) that have been disposed of within the former landfilled area within Lot 1 Grange Road, it is considered possible that solid and/or liquid PFAS-impacted wastes may be present and may have impacted soil and groundwater beneath the property and/or leachates generated from the waste mass. In addition, it is also considered plausible that surrounding landfills (to Lot 1 Grange Road property) may also contain unknown quantities of solid and/or liquid PFAS-impacted wastes, with a potential to impact soil and groundwater in the area. Moorabbin Airport is also a likely regional source of PFAS.

4.2 POTENTIAL EXPOSURE PATHWAYS

The anticipated primary transport media for the migration of contaminants identified were:

- Inhalation of dusts from impacted shallow soil and fill
- Dermal contact and ingestion of impacted shallow soil and fill
- Direct contact exposure to impacted shallow groundwater that ingresses into excavations
- Inhalation of vapour sourced from impacted shallow groundwater, which migrates through soil into excavations, underground service trenches or road maintenance chambers/pits
- Inhalation of landfill gas which migrates through soil into excavations, underground service trenches or road maintenance chambers/pits
- Lateral migration of dissolved phase hydrocarbons and other potential contaminants within the leachate which may be present in groundwater, typically in the direction of the local hydraulic gradient expected to be to the south/south-east/south-west (in general) based on the project area's topography and expected regional groundwater flow
- Surface run-off and entry into stormwater drainage system(s) in the event of subsurface spillage
- Migration of landfill gases and/or vapours through soils, underground service trenches and/or pits and beneath building slabs in the event of subsurface leakages
- Odour emissions from the existing landfill located within the proposed road alignment.

4.3 POTENTIAL RECEPTORS OF CONCERN

Identified potential receptors of concern within the project area during construction works and future use include:

- Onsite construction and maintenance/utility workers
- Sensitive flora and fauna in Mordialloc Creek and Waterways Estate wetlands that runs in the central portion of the project
- Extractive groundwater users (potential extractive uses of groundwater were identified within the project area and includes stock watering and domestic purposes).

Potential offsite receptors of COPC sourced from the project area during road alignment construction works include:

- Offsite residential and/or commercial/industrial occupants and school and recreational land users
- Offsite extractive groundwater users (potential extractive uses of groundwater were identified in the immediate vicinity of the project area i.e. within 2 km, which includes stock watering, domestic, agricultural industries, dairy and irrigation purposes.)
- Sensitive flora and fauna in Mordialloc Creek, Woodlands Industrial Estate wetlands, Braeside Park wetlands and Waterways Estate wetlands as well as the RAMSAR listed Edithvale-Seaford Wetlands located offsite and down hydraulic gradient of the project area (i.e. to the south-east).

5 SAMPLING AND ANALYSIS PROGRAM

5.1 FIELD WORK SUMMARY

To meet the objectives of the ESA, WSP undertook a combined lineal and targeted (i.e. targeting specific sources of contamination located within the project area footprint) sampling strategy.

Field works were completed at the project area between 22 March 2017 and 2 May 2018 and were largely undertaken in conjunction with geotechnical investigations. Fieldworks included project area inspections, underground services clearance, excavation of test pits, drilling of soil bores, drilling and installation of groundwater and leachate monitoring wells, drilling and installation of soil gas bores, subsurface and surface emission monitoring; and the collection of soil, groundwater, leachate and land fill gas samples.

A total of 68 soil boreholes, 40 soil excavation test pits were drilled/excavated. For the purposes of investigating the landfilled areas, two groundwater monitoring wells, 1 leachate monitoring well and 10 soil gas bores were installed by WSP in the Northern Portion of the project area. However, a wide groundwater monitoring well network, with 36 more wells, covering the project area and its surrounds was installed mainly for hydrogeological investigations (WSP 2018). Samples were collected to investigate groundwater quality and discussion of results included in his report.

Field works conducted as part of the scope of works were undertaken in accordance with the reverse briefs submitted to VicRoads as follows:

- ‘Reverse Brief: Baseline Landfill Investigation and Groundwater Observation Bores’ dated 7 August 2017 (WSP 2017b)
- ‘Reverse Brief: Mordialloc Bypass: Acid Sulphate Soil Detailed Site Investigation dated 18 August 2017 (WSP 2017c)
- ‘Task Brief: Mordialloc Bypass Preliminary and Targeted Assessment dated 15 March 2018 (WSP 2018a)
- ‘Task Brief: Mordialloc Bypass Landfill Additional Works dated 10 April 2018 (WSP 2018b)
- ‘Task Brief: Mordialloc Bypass Additional Works – Thames Promenade dated 17 April 2018 (WSP 2018c).

Some variations from proposed scope of works, discussed with VicRoads were undertaken during PASS sampling to consider piling locations and depth of piling.

A chronology of fieldwork activities and sampling rationale are summarised in Table 5.1 below.

Table 5.1 Chronology of fieldwork activities and sampling rationale

ACTIVITY	DATES	LOCATION ID	INVESTIGATION AREA	SAMPLING RATIONALE
Soil investigation				
Excavation of 35 test pits for lineal soil sampling to a maximum depth of 2.2 mBGL	12, 22, 23, 24, 25, 26 and 31 May 2017 1, 14, 15, 18 and 19 June 2017	TP17-26-03, TP17-26-05, TP17-26-07, TP17-26-09, TP17-26-10	Southernmost portion of the project area from Springvale Road to ~600 m south-east (approximately 580 m)	Lineal soil sampling locations for project area coverage, to provide an indicative waste classification to address the potential that soils may need to be excavated during the planned upgrade works and disposed to an appropriately licensed offsite facility.
		TP17-26-14, TP17-26-16, TP17-26-18, TP17-26-20, TP17-26-23, TP17-26-24	Springvale Road to Governor Road (approximately 2 km)	
		TP17-26-25, TP17-26-27, TP17-26-29, TP17-26-31, TP17-26-33, TP17-26-35, TP17-26-37, TP17-26-64, TP17-26-69	Governor Road to Lower Dandenong Road (approximately 2.5 km)	
		TP17-26-41, TP17-26-43, TP17-26-45*, TP17-26-47, TP17-26-49, TP17-26-52, TP17-26-53, TP17-26-55, TP17-26-68, TP17-26-70	Lower Dandenong Road to Centre Dandenong Road (approximately 1.7 km)	
		TP17-26-56, TP17-26-58	Centre Dandenong Road to Old Dandenong Road (approximately 0.35 km)	
		TP17-26-60, TP17-26-62, TP17-26-63	Dingley Bypass	

ACTIVITY	DATES	LOCATION ID	INVESTIGATION AREA	SAMPLING RATIONALE
Drilling of 17 boreholes for lineal and targeted soil sampling	22 March 2017 10 May 2017 16, 17, 21, 22, 28 and 30 August 2017	B17-68167, B17-68170	Waterways Estate/Waterways wetlands area (between Governor Road and Bowen Parkway Road)	As above
		B17-68379, B17-68382, B17-68386, B17-68388, B17-68389, B17_68391, B17-68395, B17-68396, B17-68397, B17-68399, B17-68417, B17-68418, B17-68419, B17-68420, B17-68421	Northern Portion of the project area, between Dingley Bypass and Centre Dandenong Road	To assess potential for soil contamination targeting specific sources located within the alignment of the project (i.e. former landfilled areas within project area footprint).
Drilling and sampling of 3 shallow soil bores west of Lot 1 Grange Road (WSP 2018a)	29/03/2018	BH1, BH2 and BH3	along Grange Road (immediately west of Lot 1 Grange Road	To assess potential contamination west of Lot 1 Grange Road in the event that project area footprint is moved outside of Lot 1 Grange Road (i.e. to avoid landfill waste mass).
Drilling and sampling of 5 lineal and 2 targeted shallow soil bores (WSP 2018c)	3-4 May 2018	T1-26A, T2-26A, TP18-26A-01, TP18-26A-02, PD18-26A-04, TP18-26A-09, PD18-26A-10	Springvale Road to Thames Promenade	To assess potential for soil contamination within the extended project area footprint.
Former landfilled areas investigation				
Drilling and installation of 2 groundwater monitoring wells and 1 leachate monitoring well	7 September 2017	GW17-26-01 and GW17-26-02 LW17-26-01	Northern Portion of the project area, between Dingley Bypass and Centre Dandenong Road	To provide information on the groundwater quality in the vicinity of former Lot 1 Grange Road landfill.
Drilling and installation of 10 soil gas bores	24, 25 and 31 August 2017 1 September 2017	GB17-26-01 to GB17-26-10	Northern Portion of the project area, between Dingley Bypass and Centre Dandenong Road	To assess former landfilled areas in the northern portion and to provide information for the preliminary landfill gas risk assessment (LGRA).
Sampling of groundwater and leachate monitoring wells and slug testing of groundwater	3 October 2017	*(as above GW17-26-01, GW17-26-02 and LW17-26-01)*	*(as above)*	*(as above)*

ACTIVITY	DATES	LOCATION ID	INVESTIGATION AREA	SAMPLING RATIONALE
Site walkover and surface emissions gas testing in former landfill target areas (WSP 2017a)	6, 9 and 20 October 2017	n/a	Northern Portion of the project area, between Dingley Bypass and Centre Dandenong Road	To assess the potential migration of landfill gas within former landfilled areas.
Sampling of gas bores (active gas and sorbent tubes)	9, 10, 20, 26 and 27 October 2017	(*as above GB17-26-01 to GB17-26-10*)	*(as above)*	*(as above)*
Surface emissions monitoring and subsurface landfill gas monitoring (WSP 2018b)	2 May 2018	GB17-26-01 to GB17-26-10 and gas bores to the west of Din San Landfill	Northern Portion of the project area, between Dingley Bypass and Centre Dandenong Road	To undertake another round of landfill gas monitoring to further refine the landfill gas risk assessment within former landfilled areas.
PASS Investigation				
Site walkover and subsurface utilities clearance	— 27 and 28 September 2017 — 11 October 2017	n/a	Whole alignment	Pre-field prep for PASS sampling.
Drilling of 38 shallow soil bores to 1.5 mBGL and 5 deep soil bores to between 10 and 20 mBGL for PASS sampling (WSP 2017b)	— 27 and 28 September 2017 — 3, 4, 5, 11, 12 and 13 October 2017	SB1 to SB17 (to 1.5 mBGL)	Old Dandenong Road to Governor Road	To investigate PASS potential at a rate of 1 sample location per 200-250 m. This area was considered to have a lower potential for ASS.
		SB18 to SB38 (to 1.5 mBGL)	Governor Road to Springvale Road (approximately 2 km)	To investigate PASS potential at a rate of 1 sample location per 100 m. This area considered to have a higher potential for ASS.
		DB1 to DB3 (to 10 mBGL)	Lower Dandenong Road to Bowen Parkway	To investigate PASS in locations where piling for cross over structures is to be undertaken.
		DB4 to DB5 (to 20 mBGL)	Bowen parkway to Springvale Road	

ACTIVITY	DATES	LOCATION ID	INVESTIGATION AREA	SAMPLING RATIONALE
PFAS Investigation				
Drilling and sampling of 3 shallow soil bores west of Lot 1 Grange Road, drilling and sampling of 3 shallow soil bores along alignment and east and south-east of Moorabbin Airport, surface water and sediment sampling in Dunlop Drain, leachate well sampling (x1 well) and groundwater sampling (x3 wells) (WSP 2018a)	29/03/2018	BH1 to BH6 (soil) SED1, SED (sediment) SW1, SW2 (surface water)	Grange Road (immediately west of Lot 1 Grange Road Centre Dandenong Road to Lower Dandenong Road Dunlop Drain (immediately north and west of Lot 1 Grange Road)	To investigate potential for PFAS contamination in soil, surface water, sediment, groundwater and leachate within identified likely source areas (i.e. former landfilled areas and Moorabbin Airport).
Groundwater investigation (wider area) (WSP, 2018)				
Installation of 36 groundwater monitoring wells, including nested shallow and deep wells in various locations.	2017-2018	GW17-26-03 to GW17-26-09, GW17-26-10S to GW17-26-15S, GW17-26-10D to GW17-26-15D, GW18-26-16S to GW18-26-23S and GW18-26-16D to GW18-26-23D, B18-68673S. (Note 'S' for shallow and 'D' for deep well).	Project area and surrounds	To undertake geologic and hydrogeologic investigations within the project area and surrounds, including groundwater numerical modelling.

* TP17-26-45 sampled twice at various depths.

Investigation locations are provided in Figure 4A-5A and 6 (northern portion), Figure 4B-5B (central portion) and Figure 4C-5C (southern portion) in Appendix A.

5.2 FIELDWORK METHODOLOGY

5.2.1 SOIL INVESTIGATION

Table 5.2 below summarises the soil investigation methodology.

Table 5.2 Soil investigation methodology

TASK	METHODOLOGY
Permit Requirements	Prior to commencement of drilling works, WSP required in-house safety permits were completed i.e. Ground Penetration Permit.
Service Location	All drilling locations were checked for the presence of buried services by a professional services locator before the commencement of the intrusive investigations. In addition, underground service plans for the area (Dial Before You Dig) were obtained prior to the commencement of the investigations and were used to assist with locating underground services.
Soil Sample Collection Method	Samples collected from test pits, advanced to depths of between 2 mBGL and 2.2 mBGL, were obtained by means of a tractor loader backhoe (TLB). Samples collected from boreholes, advanced to depths of between 5.95 mBGL and 49.5 mBGL, were obtained using a solid stem auger drill rig. Samples obtained for PASS Sampling were collected at 0.5 mBGL interval through the soil profile from the surface to the base of the borehole. The shallow soil bore locations were drilled to 1.5 mBGL using a combination of hand auger and direct push drilling techniques (using a Geoprobe). Deeper soil bores drilled to 10 mBGL were advanced using direct push drilling techniques, whilst bores advanced to 20 mBGL were drilled using a combination of direct push and solid stem augers.
Soil Logging	Soil logging was based on field interpretation and was consistent with AS 1726-1993. Borehole logs are presented in Appendix I.
Field screening	Soil samples were screened in the field using a photo-ionisation detector (PID) to assess whether volatile organic compounds (VOCs) were likely to be present. The PID was calibrated to a known concentration of isobutylene gas at the commencement of each day of fieldwork.
Sample collection method	Soil samples were collected directly from the backhoe/solid auger/hand auger and handled using gloves and/or a clean trowel. Nitrile gloves were changed prior to the collection of each sample. Samples from the test pit locations were taken generally collected between 0.2 mBGL and 1 mBGL and samples taken from the drilled soil bore locations were collected between 0.5 mBGL and 3.2 mBGL dependant on the ground conditions observed. All samples collected were placed in laboratory-supplied containers with Teflon lined lids and/or laboratory supplied snap-lock bags dependant on the analysis required for each sample. Samples for PASS investigation were taken at every 0.5 mBGL interval up to the base of the borehole (i.e. up to 20 mBGL). Samples collected for PASS sampling were placed in air tight zip lock bags, supplied by the testing laboratory. Air was removed from the bag as much as practical in the field before sealing.
Sample Preservation	Samples were stored in an insulated chest with ice immediately after sampling. Samples were kept chilled prior to and during delivery to the selected National Association of Testing Authorities (NATA) accredited laboratories. Samples were delivered to the analytical laboratory at the end of each sampling day (where practical and if the laboratory holding times allow) with appropriate ‘chain of custody’ documentation.
Bore Reinstatement	Borehole locations were backfilled with soil cuttings where visual and olfactory evidence suggested no contamination was present.

5.2.2 LANDFILL GAS AND SOIL VAPOUR ASSESSMENT

A total of ten soil gas bores were installed in the Northern Portion of the project area (between Dingley Bypass and Old Dandenong Road) to intercept any potential landfill gas which has migrated into the project area and to identify the location of potential sources and pathways. The bores were installed approximately 100 m–200 m apart along the proposed road alignment and at least 20 m away from the boundary of the waste except for the three gas bores (GB17-26-04, GB17-26-05, GB17-26-06) installed within the former Lot 1 Grange Road landfilled area. The gas bores were installed to depths of between 2 mBGL and 4 mBGL. Figure 6 in Appendix A shows the locations of the gas bores.

Field methodologies adopted during the gas monitoring well installation and sampling program were consistent with WSP's ESA Field Procedures and have been summarised in Table 5.3 below.

Table 5.3 Soil vapour/landfill gas assessment methodology

ACTIVITY	DESCRIPTION
Drilling	After checking for underground utilities using Dial Before You Dig Plans and conducting underground service clearance, a Geoprobe 305 was used advance the soil gas bores from surface 0 mBGL to the maximum depth reached of 4 mBGL. Gas bores were installed to a maximum depth of 4 mBGL due to shallow groundwater (i.e. <5 mBGL) being encountered within the northern portion of the project area.
Soil gas bore installation	Soil gas bores were constructed by inserting 50 mm inside diameter poly vinyl chloride (PVC) casing to the base of each bore. Solid casing was installed from 0 mBGL to 2 mBGL thereafter. Screened casing was generally used to the base of the bore. Where the total depth of the bore was 2 mBGL, 1m of solid casing and 1 m of screened PVC pipe was used. Backfilling comprised a combination of washed sand to the approximate same thickness as the screen, followed by a layer of bentonite to between 0.2 mBGL and 0.5 mBGL; and then a layer of cement/grout to surface. Soil gas bores were finished with a gas monitoring cap and at surface with a flush-mounted steel road box or monument.
Surface gas emissions monitoring	The inspection of the study area included a site inspection to check for signs of landfill gas emissions and potential migration (i.e. depressions or holes in the ground or drains and other service conduits). Two surface emissions testing were undertaken, one in October 2017 and one in May 2018, using a Flame Ionisation Detector (FID), Inspectra Laser Diode (TDL-500) which measures methane in ppm. In October 2017, surface emissions were monitored continuously along the investigation area by taking readings every 50 m at a walking speed of 3-4 kilometres per hour (km per hour). In May 2018, surface emissions were monitored by creating approximately 25 m^2 grids within the Northern Portion of the project area and within the Lot 1 Grange Road property and recorded FID readings within each grid (refer to Appendix M). Readings in drains and services (refer to Appendix M) were also undertaken. While the walkover was being undertaken, wind speed was monitored using a hand-held anemometer such that windspeed during sampling do not exceed 10 km per hour.
Sub-surface gas sampling / monitoring	Two rounds of subsurface gas monitoring were undertaken, one in October 2017 and one in May 2018, using a calibrated portable landfill gas meter (GA 5000) (refer to Appendix O). **Round 1 (October 2017)** In October 2017, monitoring of sub-surface landfill gases in all newly installed gas monitoring wells (GB1 – GB10). Each monitoring point were tested in the field with for the following: — Methane (%v/v) — Carbon Dioxide (%v/v) — Oxygen (%v/v) — Carbon Monoxide (ppm) — Hydrogen Sulfide (ppm).

ACTIVITY	DESCRIPTION
	In addition, active soil vapour sampling was undertaken using laboratory supplied evacuated canisters for ten soil vapour bore locations. Sorbent tubes and an SKC Aircheck Sampler were also utilised for the sampling of ammonia and hydrogen cyanide. Each sample location was screened with a PID calibrated to a known concentration of isobutylene gas at the commencement of field work. To ensure that representative soil vapour samples were obtained, each vapour point was tested for leaks prior to sampling. Isopropanol was used as a tracer gas at the soil vapour sampling locations. A swab soaked with isopropanol solution was placed near each soil gas bore and then covered by a shroud. Leak testing of the sampling train was undertaken by measuring 'background' isopropanol underneath the shroud with a calibrated PID and comparing this concentration against PID readings from the sampling train itself. Elevated PID readings through the sampling train and consistent with the 'background' levels of isopropanol would be considered an integrity breach. Prior to sampling, the sampling train (leading to the sample points) was purged three times and then sampled at the predetermined flow rate and time. Ten samples were submitted to ALS and analysed for the following gases: — Methane — Oxygen — Carbon dioxide — Carbon monoxide — Hydrogen — Hydrogen sulphide — Hydrogen cyanide — Ammonia — Tracer gas isopropyl alcohol. Five samples were also analysed for a T015 volatile organic compound (VOC) suite. Refer to Section 6.3.4 for further details. Duplicate samples were collected for the canister sampling as well as the sorbent tube sampling. Vapour samples were collected in laboratory supplied evacuated canisters and sorbent tubes. Samples were transported in laboratory supplied casing accompanied by Chain of Custody documentation and were received by the laboratory within the required holding time. **Round 2 (May 2018)** In May 2018, monitoring of sub-surface landfill gases in all gas monitoring wells GB17-26-01 to GB17-26-02 and GB17-26-07 to GB17-26-10 as well as the wells installed west of Din San Landfill (including GB01, 02, 03, 04, 30 and 41) was undertaken. WSP note that the three gas monitoring wells installed at the Lot 1 Grange Road site (GB17-26-0.4 to GB17-26-0.6) could not be located during the May 2018 round and were inferred to be destroyed. Accessible landfill gas bores tested in the field with calibrated landfill gas meters for the following: — Methane (%v/v) — Carbon Dioxide (%v/v) — Oxygen (%v/v) — Carbon Monoxide (ppm) — Hydrogen Sulfide (ppm) — Flow rate (L/hr). Prior to undertaking monitoring, barometric pressure was monitored via the Bureau of Meteorology website and testing undertaken during conditions of falling barometric pressure.

5.2.3 GROUNDWATER AND LEACHATE INVESTIGATION

For the purpose of investigation of the former landfilled areas, two groundwater monitoring wells (GW17-26-01 and GW17-26-02); and one leachate monitoring well (LW17-26-01) were installed and sampled during a separate sampling event.

Field methodologies adopted during the groundwater and leachate monitoring well installation and sampling program were consistent with WSP's ESA Field Procedures and have been summarised in Tables 5.4 and 5.5.

It should be noted that additional wells have been installed within the project area for hydrogeological studies. It is understood that these monitoring wells were also installed consistent with WSP's ESA Field Procedures and were screened to intercept the target aquifer.

Figure 5A-5C in Appendix A shows the locations of all groundwater and leachate monitoring wells.

Table 5.4 Groundwater and leachate well installation and sampling methodology

ACTIVITY	DETAILS
Service Location	Soil bore/groundwater/leachate monitoring well locations were checked for the presence of buried services by a professional services locator before the commencement of the field investigations. In addition, underground service plans (Dial Before You Dig) for the area were obtained prior to the commencement of the investigations and were used to assist with locating underground services.
Drilling Method	Drilling of bores to allow installation of groundwater monitoring wells and the leachate well was completed using a Comaccio Geoprobe® 305 drill rig using solid auger drilling technique. The bores were converted into groundwater monitoring wells (GW17-26-01, GW17-26-02) and one to a leachate well (LW17_26_01) during this assessment. Depths ranged between 7.0 mBGL and 10 mBGL.
Well Construction	All groundwater monitoring wells were constructed with 50 mm, class 18 threaded, flush-jointed PVC screen and casing. No organic solvents or glues were used during construction or installation of the monitoring wells. A filter pack comprising clean graded sands and/or gravels of suitable size (1–2 mm average grain size, silica material) to provide sufficient inflow of groundwater was installed within the annular space between the bore and the well casing. The filter pack extended from the base of the screened interval to 1.0 m above the termination of the slotted casing. In order to minimise the likelihood of surface water or perched groundwater infiltrating the aquifer, a bentonite plug, comprising pelleted or granulated bentonite, was placed above the filter pack to 0.4 mBGL. Grout or concrete was used to complete the well from 0.4 mBGL to the ground surface. The borehole installation details for the wells installed to investigate former landfilled areas is provided in the borehole logs attached as Appendix I. The borehole logs for the monitoring wells installed for site wide groundwater investigation is included in the EES Groundwater Technical Impact Assessment Report (WSP 2018).
Well Development	All groundwater monitoring wells were developed following installation to remove fines from the well and to allow the flow of a representative groundwater into the well for subsequent sampling. Development of the leachate well was undertaken using a micro purge pump. The well was developed by purging for 30 minutes.
Well Surveying	Following construction, the location of each groundwater monitoring well was surveyed to Geocentric Datum of Australia (GDA) 1994. The highest point on the top of the internal uPVC casing (TOC) was surveyed relative to Australian Height Datum (m AHD) and marked for future gauging reference.
Waste Disposal	All drill cuttings from the monitoring wells were temporarily placed in drums and were later removed by a waste disposal contractor. Purge water from the leachate well was temporarily stored in and IBC and later disposed of by a waste disposal contractor.

Table 5.5 Groundwater assessment methodology

ACTIVITY	DETAILS
Timing of Sampling	The gauging and sampling of the wells was conducted on the 02 and 03 October 2017. In addition to sampling, multiple slug tests were conducted on each of the groundwater monitoring wells to determine the rate of recovery of each well. These works were conducted approximately a month following their installation. All gauging and slug testing data are presented in the EES Groundwater Technical Impact Assessment Report (WSP 2018).
Well Gauging	The two groundwater monitoring wells and the leachate well were gauged for standing water level (SWL) as well as the depth to the bottom of the well.
Well Sampling	Groundwater samples were collected from the groundwater monitoring wells using a bladder pump which was decontaminated between each well, dedicated disposable bladders were also used. The leachate well was sampled using a biodegradable bailer. Samples were taken directly from the tubing and bailer and decanted into the laboratory supplied bottles. All bottles were labelled clearly with well ID and sampling date. Field parameters (pH, dissolved oxygen, conductivity, oxidation-reduction potential and total dissolved solids (TDS) were recorded during the sampling event using a water quality meter, calibrated prior to use. The groundwater was visually assessed for turbidity and evidence of contamination such as odour or unusual discoloration. Gauging data are presented as Appendix E.
Sample Preservation and Transport	All samples were collected in bottles which were supplied by the laboratory and contained the appropriate preservatives (where required). All samples were stored on ice in an insulated chest immediately after sampling. Samples were kept chilled prior to and during delivery to the selected NATA accredited laboratories via a courier under appropriate ‘chain of custody’ documentation laboratory (Appendix K).

5.3 LABORATORY ANALYSIS

Primary samples were dispatched to Australian Laboratory Services (ALS) in Melbourne and secondary samples were dispatched to Eurofins. Both laboratories are accredited by NATA for the analytical suites requested as follows:

5.3.1 GENERAL SOIL CONDITIONS

All soil samples from lineal and targeted soil locations (boreholes and test pits) were submitted for a broad suite analysis based on EPA Vic IWRG621 and included the following analytes:

- Total recoverable hydrocarbons (TRH); benzene, toluene, ethylbenzene, xylene, naphthalene (BTEXN)
- Inorganics: total cyanide, fluoride and sulphate
- Metals: arsenic, cadmium, chromium, hexavalent chromium, copper, lead, mercury, molybdenum, nickel, selenium, silver, tin and zinc
- Polycyclic aromatic hydrocarbons (PAH)s
- Phenols
- Organochlorine pesticides
- Polychlorinated biphenyls (PCBs)
- Volatile organic compounds (VOCs)
- Moisture content
- pH ($CaCl_2$).

5.3.2 ACID SULFATE SOIL

Samples were collected at 0.5 m intervals down the soil profile from every proposed PASS sample location and submitted for initial screening analysis comprising of field pH (pH_F) and pH following peroxide oxidation (pH_{FOX}). Following the assessment of the initial screening analysis results, samples were selected for further assessment using Suspension Peroxide Oxidation Combined Acidity Sulphur (SPOCAS) suite. The samples selected for SPOCAS analysis were based on a review of the soil lithology observations and the reported pH_F and pH_{FOX} results.

In addition to above analytes, select soil samples per location at depths no greater than 1.0 mBGL were submitted for analysis of physicochemical properties including percentage clay and cation exchange capacity (CEC).

The SPOCAS is a broad range of analysis that includes acidity trial, sulfur trail, Calcium/Magnesium values and Acid/Base accounting. The Acid Sulfate Soils Laboratory Methods Guidelines 2004 by the Department of Natural Resources, Mines and Energy, Queensland, Australia (Aherns et al 2004) used an acid-base accounting approach for predicting Net Acidity from sulphide oxidation of acid sulfate soils.

Net Acidity is calculated using the following equation:

Net acidity = Potential acidity + actual acidity + retained acidity – (ANC/FF)

Where:

- ANC = measured acid neutralising capacity; and
- FF = Fineness factor. Assumed to be 1.5 for safety.

Samples selected for SPOCAS analysis were analysed for the following parameters:

- Acidity trail – quantification of the level of existing acidity present within the soil; the amount of acid in the soil that is likely to be produced if oxidation were to occur during or as a result of disturbance; and the amount of acid (existing or potential) in the soil that is attributable to pyrite (FeS_2).
- Sulfur trail – results from sulfur trail were used to quantify the level of extractable sulfuric material present within the soil, which includes soluble and absorbed sulfate as well as sulfate from gypsum. The results are used as input into the acid-base accounting for accounting of the net acidity of the soil attributable to sulfur content available through oxidation.
- Retained Acidity – quantifies the fraction of existing acidity in soil that is present in the “less available” forms, such as jarosite, natrojarosite and aluminium hydroxysulfate minerals. The retained acidity may be released slowly into the environment by hydrolysis of these relatively insoluble sulfate minerals. The retained acidity is used as input to the acid-base accounting for the net soil acidity.
- Neutralising capacity – the neutralising capacity of soils is controlled by calcium and magnesium carbonates content of the soil which reacts with the acid CEC and the percentage of clay, which buffers the acid. The results of the analysis of calcium, magnesium carbonates and particle size are used in the acid-base accounting to determine overall liming rates.
- Acid-base accounting – these acid-base accounting results are used to provide information required for the development of appropriate management measures for the effective treatment of AASS/PASS materials disturbed during operations at the project area.
- Liming rate – the rates as provided by the acid-base accounting is based on the use of agricultural lime (i.e. ag-lime as calcium carbonate) to neutralize the net acidity. The reported liming rate as provided by the acid-base accounting assumes a dry density of the soil being assessed is 1 t/m^3. Where the bulk density is > 1 t/m^3 the liming rate as reported is to be adjusted by multiplying the reported value and bulk density. Although the liming rates as provided relates to ag-lime alternative neutralizing agents can be used such as dolomite, magnesite etc. If these alternative neutralizing agents are used, then the application rates will be different as to that provided by ag-lime and as such a correction factor will be required to be applied.

5.3.3 GROUNDWATER AND LEACHATE

All groundwater and leachate samples were submitted for analysis of the following:

- pH
- Major and minor ions: Total anions, calcium, total cations, chloride, ionic balance, magnesium, potassium, sodium, bicarbonate, sulphate (SO_4)
- TRH: C_{10}–C_{16}, C_{16}–C_{34}, C_{10}–C_{40}, C_{34}–C_{40}, C_6–C_{10} (minus BTEX), TRH C_6–C_{10} and TRH >C_{10}–C_{16} less naphthalene
- BTEX
- Inorganics: Alkalinity as CaCO3 (hydroxide and total), total cyanide, methane, nitrate, nitrite, TDS, total organic carbon (TOC) and ammonia as N
- Metals: Arsenic, barium, boron, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, selenium, vanadium, zinc
- PAH's
- Phenols; and
- VOC's.

5.3.4 LANDFILL GAS

Ten samples were analysed for the following gases:

- Methane (CH_4) Carbon dioxide (CO_2)
- Carbon monoxide (CO)
- Oxygen (O_2)
- Hydrogen sulfide (H_2S)
- Hydrogen (H_2)
- Helium (He)
- Hydrogen cyanide
- Ammonia
- Tracer gas isopropyl alcohol.

Five samples were also analysed for the following T015-VOC suite:

- Volatile Organic Compounds (VOCs)
- Semi-Volatile Organic Compounds (SVOC's)
- Benzene, toluene, ethylbenzene and xylene (BTEX)
- Total recoverable hydrocarbons (TRHs); and
- Tetrahydrofuran.

6 ADOPTED INVESTIGATION LEVELS

6.1 SOIL

Given the proposed use of the project area as a road, the most appropriate land use designation under the State Environment Protection Policy (SEPP) Prevention and Management of Contamination of Land (SEPP PMCL) commonly referred to as 'Land SEPP' is 'Recreational/Open Space', consisting of general open spaces and public access areas.

The protected beneficial uses of land classified as 'Recreational/Open Space' include human health, maintenance of modified ecosystems, maintenance of highly modified ecosystems, buildings and structures and aesthetics.

In general, the soil assessment criteria adopted are based on the National Environment Protection Council (2013) National Environment Protection (Assessment of Site Contamination) Amendment Measure 2013 (No.1) (NEPC, 2013), herein referred to as the NEPM 2013. Where no criteria have been set by NEPM 2013, other Australian sources and/or international criteria were adopted.

There are no published numeric criteria specific to the assessment of aesthetic impact. However, the Land SEPP states that '*contamination must not cause the land to be offensive to the senses of human beings*'. NEPM 2013 also states that site assessment requires balanced consideration of the quantity, type and distribution of foreign materials or odours in relation to the specific land use and its sensitivity. Fundamentally, the soil should not be discoloured, malodorous or of abnormal consistency.

6.1.1 HEALTH INVESTIGATION LEVELS AND HEALTH SCREENING LEVELS

The quality objectives for human health have been adopted which reference to the NEPM 2013 Health Investigation Levels (HILs) setting 'C' – Recreational/Open Space. Results were also screened against the NEPM 2013 Health Screening Levels (HSLs) for petroleum hydrocarbons in soil for a recreational land use scenario (i.e. HSL C). The HSLs for vapour intrusion in sand at 0 m to <1 m were adopted as a conservative approach.

The adopted soil assessment criteria have been summarised in Table 6.1 below.

Table 6.1 Soil assessment criteria

ANALYTE	HSL C, SAND[1] (mg/kg)				HIL C[2]	DIRECT CONTACT[3]
	0 to <1 m	1 to <2 m	2 to <4 m	4 m+		
TRH/BTEX						
TRH C_6–C_{10} minus BTEX (F1)	NL	NL	NL	NL	–	5,100
TRH >C_{10}–C_{16} minus naphthalene (F2)	NL	NL	NL	NL	–	3,800
TRH >C_{16}–C_{34} (F3)	–	–	–	–	–	5,300
TRH >C_{34}–C_{40} (F4)	–	–	–	–	–	7,400
Benzene	NL	NL	NL	NL	–	120
Toluene	NL	NL	NL	NL	–	18,000
Ethylbenzene	NL	NL	NL	NL	–	5,300
Xylene (Total)	NL	NL	NL	NL	–	15,000

ANALYTE	HSL C, SAND[1] (mg/kg)				HIL C[2]	DIRECT CONTACT[3]
	0 to <1 m	1 to <2 m	2 to <4 m	4 m+		
PAHs						
Naphthalene	NL	NL	NL	NL	–	1,900
PAHs (Total)	–	–	–	–	300	–
Benzo(a)pyrene TEQ[4]	–	–	–	–	3	–
OC/OP Pesticides						
HCB	–	–	–	–	10	–
Heptachlor	–	–	–	–	10	–
Aldrin and dieldrin	–	–	–	–	10	–
Chlordane	–	–	–	–	70	–
Endosulfan	–	–	–	–	340	–
DDE, DDD and DDT	–	–	–	–	400	–
Endrin	–	–	–	–	20	–
Methoxychlor	–	–	–	–	400	–
Chlorpyriphos	–	–	–	–	250	–
Heavy metals						
Arsenic	–	–	–	–	300	–
Cadmium	–	–	–	–	90	–
Chromium (Total)	–	–	–	–	300[5]	–
Copper	–	–	–	–	17,000	–
Lead	–	–	–	–	600	–
Mercury	–	–	–	–	80	–
Nickel	–	–	–	–	1,200	–
Zinc	–	–	–	–	30,000	–
Phenols						
Phenol	–	–	–	–	40,000	–
Pentachlorophenol	–	–	–	–	120	–

– denotes assessment criteria not available

NL Not limiting due to maximum vapour concentrations being below the acceptable health risk level.

(1) NEPM (2013) – Schedule B-1 Investigation Levels for Soil and Groundwater – Table 1A(3) Soil HSLs for vapour intrusion (in sand) – HSL C recreational/open space.

(2) NEPM (2013) – Schedule B-1 Investigation Levels for Soil and Groundwater – Table 1A(1) HILs for soil contaminants Recreational C.

(3) Friebel and Nadebaum (2011) Technical Report No. 10 Part 1: Technical development document – Table B4 Soil HSLs for direct contact, HSL C recreational/open space

(4) As benzo(a)pyrene toxicity equivalent quotient (TEQ), calculated as a sum of weighted selected PAHs. Further details available in NEPM 2013 Schedule B2.

(5) HIL for chromium VI adopted for total chromium as a conservative approach.

6.1.2 INTRUSIVE MAINTENANCE WORKERS

To provide a qualitative assessment of the risk to maintenance/excavation workers from identified impacts in soil via inhalation and direct contact exposure pathways, concentrations of hydrocarbons have been compared to the risk-based HSLs detailed in CRC CARE Technical Report No. 10: *Health Screening Levels for Petroleum Hydrocarbons in Soil and Groundwater, Part 2: Application Document* (Friebel and Nadebaum, 2011).

HSLs for both vapour intrusion and direct contact pathways have been adopted for an intrusive maintenance worker (IMW). The values for sand have been adopted as conservative approach. The adopted reference values are outlined in Table 6.2.

Table 6.2 Soil assessment criteria – HSLs for IMW/excavation workers

ANALYTE	HSLS FOR VAPOUR INTRUSION, 0 to <2 m, SAND (mg/kg)(1)	HSLS FOR DIRECT CONTACT(2) (mg/kg)
TRH C_6-C_{10} minus BTEX (F1)	NL	82,000
TRH >C_{10}-C_{16} minus naphthalene (F2)	NL	62,000
TRH >C_{16}-C_{34} (F3)	–	85,000
TRH >C_{34}-C_{40} (F4)	–	120,000
Benzene	77	1,100
Toluene	NL	120,000
Ethylbenzene	NL	85,000
Xylene (Total)	NL	130,000
Naphthalene	NL	29,000

(1) Friebel and Nadebaum (2011) Technical Report No. 10 - Table A3 Soil HSLs for vapour intrusion, intrusive maintenance worker (shallow trench), sand

(2) Friebel and Nadebaum (2011) Technical Report No. 10 - Table A4 Soil HSLs for direct contact, intrusive maintenance worker

– denotes criteria not applicable for the vapour intrusion pathway

NL Not limiting due to maximum vapour concentrations being below the acceptable health risk level

6.1.3 ECOLOGICAL SCREENING LEVELS AND ECOLOGICAL INVESTIGATION LEVELS

NEPM (2013) provides ecological screening levels (ESLs) for TRH, BTEX compounds and PAHs for use as an initial screening risk assessment to determine whether laboratory analysed concentrations of contaminants, potentially pose a risk to plant growth. For the purpose of this investigation, ESLs for urban residential/public open space land uses with coarse-grained soil textures have been considered.

The NEPM (2013) also provides ecological investigation levels (EILs), which were developed for metals, naphthalene and the pesticide Dichlorodiphenyltrichloroethane (DDT). The EILs take into consideration the physicochemical properties of soil and contaminants and the capacity of the local ecosystem to accommodate an increase in the contaminant levels. The EILs are derived using the following equation:

$$EIL = added\ contaminant\ limit\ (ACL) + ambient\ background\ concentration\ (ABC)$$

The ABC is the background contaminant level and requires measurement at appropriate reference points at the site. The ACL, which is provided in NEPM (2013), is the maximum contaminant concentrations added to the naturally occurring background level, after which may result an adverse effect on plant health. EILs corresponding to urban residential/public open space use were applied for this investigation.

Adopted ecological assessment criteria are outlined in Table 6.3.

Table 6.3 Soil assessment criteria – ESLs

ANALYTE	ESLs[1] (mg/kg DRY SOIL)	EILs[2] (mg/kg DRY SOIL)
TRH C_6-C_{10} minus BTEX (F1)	180	–
TRH >C_{10}-C_{16} minus naphthalene (F2)	120	–
TRH >C_{16}-C_{34} (F3)	300	–
TRH >C_{34}-C_{40} (F4)	2,800	–
Benzene	50	–
Toluene	85	–
Ethylbenzene	70	–
Xylene (Total)	105	–
Benzo(a)pyrene (as TEQ)	0.7	–
Naphthalene	–	170
Arsenic	–	100[3]
Chromium	–	410[3]
Copper	–	220[3]
Lead	–	1,100[4]
Nickel	–	280[3]
Zinc	–	760[3]
DDT	–	180

– denote assessment criteria not available

(1) NEPM (2013) - Schedule B-1 Investigation Levels for Soil and Groundwater – Table 1B(6) ESLs, urban residential/public open space, coarse textured soil.

(2) NEPM (2013) – Schedule B-1 Investigation Levels for Soil and Groundwater – Table 1B(5) EILs, urban residential/public open space

(3) NEPM (2013) – Schedule B-1 Investigation Levels for Soil and Groundwater – Table 1B(2) Soil specific ACLs for aged copper, nickel, chromium and zinc in soil; urban residential/public open space; based on average pH of 6.9; and average cation exchange capacity (CEC) of 21 cmolc/kg. Refer to Appendix J for analytical data and Appendix L for EIL calculation spreadsheets.

(4) NEPM (2013) – Schedule B-1 Investigation Levels for Soil and Groundwater – Table 1B(4) Soil specific ACLs for lead in soil adopted as the EIL

6.1.4 MANAGEMENT LIMITS FOR TRH

In addition to appropriate consideration and application of the health and ecological investigation levels, there are a number of policy considerations which reflect the nature and properties of petroleum hydrocarbons:

- Formation of observable light non-aqueous phase liquids (LNAPL)
- Fire and explosive hazards and
- Effects on buried infrastructure e.g. penetration of, or damage to, in-ground services by hydrocarbons.

The Canada-wide Standard for Petroleum Hydrocarbons (CWS PHC) includes ‘management limits’ to avoid or minimise the potential effects of TRH as detailed above. The values are included in Table 1B(7) of Schedule B(1) of the NEPM 2013. For the purposes of this investigation the management limits for a ‘coarse’ soil profile has been adopted.

Application of the management limits requires consideration of site-specific factors such as the depth of building basements and services and depth to groundwater, to determine the maximum depth to which the limits should apply. The management limits may have less relevance at operating industrial sites which have no or limited sensitive receptors in the area of potential impact. When the management limits are exceeded, further site-specific assessment and management may enable any identified risk to be addressed.

The management limits are outlined in Table 6.4.

Table 6.4 Management limits for TPH fractions F1–F4 in soil, coarse soil, residential, parkland and public open space

ANALYTE	MANAGEMENT LIMITS (mg/kg DRY SOIL)
TRH C_6-C_{10} minus BTEX (F1)	700
TRH >C_{10}-C_{16} minus naphthalene (F2)	1,000
TRH >C_{16}-C_{34} (F3)	2,500
TRH >C_{34}-C_{40} (F4)	10,000

6.1.5 WASTE SOIL CLASSIFICATION

In the event that VicRoads undertake excavation of soil at the project area, preliminary classification of soil for potential offsite disposal and/or onsite reuse will be required. Characterisation of waste soil is necessary to identify management options according to its hazard category.

The EPA Victoria Industrial Waste Resource Guidelines (IWRG), *Soil Hazard Categorisation and Management* (IWRG621) – June 2009 (EPA 2009a) provides classification criteria for the disposal of soil and potential management methods for disposal (i.e. landfill category). There are four soil classification categories for disposal as described in Table 6.5.

Table 6.5 Waste soil classification criteria

WASTE SOIL CLASSIFICATIONS
Fill Material – Soil that exhibits levels of contaminants below the maximum concentration defined under Table 2 of the IWRG621 publication. Soil under this classification may be suitable for filling or levelling depending on an assessment of contaminant levels and intended use or disposed to a non-licensed landfill facility. The disposal of this contaminated soil must not pose a risk to human health, aesthetic concerns and the environment at the final disposal location.
Category C – Soil contaminated with any contaminant concentrations greater than those specified in Table 2 (Fill Criteria) of the IWRG621 publication, but not exceeding the contaminant and leachable concentrations specified in Table 2 for Category C. This is a prescribed waste and may be accepted by an appropriately licensed landfill.
Category B – Soil contaminated with any contaminant concentration or any leachable concentration greater than those specified in Table 2 (Category C) of the IWRG621 publication, but not exceeding the contaminant and leachable concentrations specified in Category B. This is a prescribed waste and may be accepted by an appropriately licensed landfill.
Category A – Soil is contaminated with any contaminant concentration or any leachable concentration greater than those specified in Table 2 for Category B of the IWRG621 publication. Category A is a prescribed waste and cannot be disposed of to any landfill. Alternative management options must be considered upon consultation with the EPA.

The Victorian EPA publication IWRG702 – *Soil Sampling* – June 2009 (EPA 2009b) also provides guidance as to the number of samples required to adequately classify soils that may be disposed offsite. This publication may be referred to for both stockpile and in situ soil sampling. As an indicative soil classification assessment was performed, the required number of samples according to IWRG702 was not applied.

Assessment criteria adopted for the soil classification are presented in Table 6.6.

Table 6.6 Soil classification criteria

ANALYTE	FILL MATERIAL UPPER LIMIT	CATEGORY C UPPER LIMIT	CATEGORY B UPPER LIMIT
TPH C_6–C_9	100	650	2600
TPH C_{10}–C_{36}	1000	10000	40000
Benzene	1	4	16
Cyanide Total	50	2500	10000
Fluoride	450	10000	40000
Arsenic	20	500	2000
Cadmium	3	100	400
Chromium (VI)	1	500	2000
Copper	100	5000	20000
Lead	300	1500	6000
Mercury	1	75	300
Molybdenum	40	1000	4000
Nickel	60	3000	12000
Tin	50	500	–
Selenium	10	50	200
Silver	10	180	720
Zinc	200	35000	140000
Aldrin + Dieldrin	–	1.2	4.8
Chlordane	–	4000	16000
Chlordane (cis)	–	–	16
Chlordane (trans)	–	–	16
DDT+DDE+DDD	–	50	50
Heptachlor	–	1.2	4.8
Benzo(a) pyrene	1	5	20
Total PCBs	2	–	–
Hexachlorobutadiene	–	2.8	11
Vinyl chloride	–	1.2	4.8
Halogenated phenols(1)	1	10	320
Non-halogenated phenols(2)	60	560	2200

ANALYTE	FILL MATERIAL UPPER LIMIT	CATEGORY C UPPER LIMIT	CATEGORY B UPPER LIMIT
Monocyclic aromatic hydrocarbons (MAHs)(3)	7	70	240
Monocyclic aromatic hydrocarbons (PAHs)(4)	20	100	400
Polychlorinated biphenyls (PCBs)(5)	2	5	5
Chlorinated hydrocarbons(6)	1	–	–
Other chlorinated hydrocarbons(7)	–	10	50
Organochlorine pesticides(8)	1	–	–
Other organochlorine pesticides(9)	–	10	50

Notes

'–' denotes criteria not available

(1) Total sum of 4-chloro-3-methylphenol, 2-chlorophenol, 2,4-dichlorophenol, 2,6-dichlorophenol, pentachlorophenol, 2,3,4,5-tetrchlorophenol, 2,3,4,6-tetrchlorophenol, 2,3,5,6-tetrchlorophenol, 2,4,5-trichlorophenol and 2,4,6-trichlorphenol

(2) Total sum of phenol, 2-methylphenol, 3-methylphenol, 4-methylphenol, 2,4-dimethylphenol, 2,4-dinitrophenol, 2-methyl-4,6-dinitrophenol, 2-nitrophenol, 4-nitrophenol, 2-cyclohexyl-4,6-fdinitrophenol and dinoseb

(3) Total sum of benzene toluene, ethylbenzenes, xylenes and styrene

(4) Total sum of naphthalene, acenaphthene, anthracene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, benzo(a)pyrene, chrysene, dibenzo(a,h)anthracene, fluorene, fluoranthene, indeno(1,2,3-c,d)pyrene, phenantrene and pyrene

(5) Soil containing polychlorinated biphenyls (PCBs) must be managed in accordance with the Notifiable Chemical Order for Polychlorinated Biphenyls.

(6) Total sum of carbon tetrachloride, chlorobenzene, chloroform, 1,2-dichlorobenzene, 1,4-dichlorobenzene, 1,2-dichloroethane, 1,1-dichloroethene,1,2-dichloroethene, dichloromethane (methylene chloride), 1,1,1,2-tetrachloroethane, 1,1,2,2-tetrachloroethane, 1,2,4-trichlorobenzene, 1,1,1-trichloroethane, 1,1,2-trichloroethane, trichloroethene, tetrachloroethene, vinyl chloride and hexachlorobutadiene

(7) Total sum of carbon tetrachloride, chlorobenzene, chloroform, 1,2-dichlorobenzene, 1,4-dichlorobenzene, 1,2-dichloroethane, 1,1-dichloroethene, 1,2-dichloroethene, dichloromethane (methylene chloride), 1,1,1,2-tetrachloroethane, 1,1,2,2-tetrachloroethane, 1,2,4-trichlorobenzene, 1,1,1-trichloroethane, 1,1,2-trichloroethane, trichloroethene and tetrachloroethene.

(8) Total sum of aldrin, hexachlorobenzene, alpha BHC, beta BHC, gamma BHC (lindane), delta BHC, chlordane, DDT, DDD, DDE, dieldrin, endrin, endrin aldehyde, heptachlor, heptachlor epoxide, methoxychlor and endosulfan (includes endosulfan I, endosulfan II and endosulfan sulphate).

(9) Total sum of hexachlorobenzene(HCB), alpha BHC, beta BHC, gamma BHC (lindane), delta BHC, chlordane, endrin, endrin aldehyde, heptachlor, heptachlor epoxide, methoxychlor and endosulfan (includes endosulfan I, endosulfan II and endosulfan sulphate).

6.1.6 ACID SULFATE SOIL

Interpretation of field pH (pH_F) and field pH peroxide (pH_{FOX}) tests have been developed for a rapid assessment of the likelihood of acid sulfate soils and in general accordance with EPA Victoria Publication 655.1 (EPA Vic 2009c), as detailed below:

- pH_F – measure of soil pH of a soil:water paste
- pH_{FOX} – measure of soil pH after rapid oxidation with hydrogen peroxide (H_2O_2)
- Effervescence of reaction rate – a visual measure of the vigorousness of the oxidation reaction rate where: 1 = slight; 2 = moderate; 3 = high and 4 = extreme.

Interpretation of the results and action criteria required are summarised in Table 6.7 below.

Table 6.7 Interpretation of field pH results

PH_F	PH_{FOX}	ΔPH	REACTION RATE	ACTION REQUIRED
≥ 5.0	≤ 5.0	≤ 2.0	1-2	If no other field indicators or ASS risk indicators are present, no further action required
> 4.0 and < 5.0	> 3.0 and < 5.0	> 2.0	≥ 2	PASS may be present, further assessment is required
≤ 4.0	≤ 3.0	> 2.0	≥ 2	AASS or PASS are likely to be present, further assessment is required

The laboratory analytical results for SPOCAS have been compared with the texture based criteria (EPA 2009c) for determining whether soils are classified as acid sulfate soils detailed in Table 6.8 below.

Table 6.8 Texture based action criteria for classification of acid sulfate soil

SOIL OR SEDIMENT TEXTURE	APPROXIMATE CLAY CONTENT (%)	NET ACIDITY CRITERIA (1-1000 TONNES)		NET ACIDITY CRITERIA (>1000 TONNES)	
		(%S) oven-dry basis	Mol H+/tonne (oven-dry basis)	(%S) oven-dry basis	Mol H+/tonne (oven-dry basis)
Sands to loamy sands	<5	0.03	18	0.03	18
Sandy loams to light clays	5-40	0.06	36	0.03	18
Medium to heavy clays and silty clays	>40	0.1	62	0.03	18

However; as > 1000 tonnes of soil are anticipated to be disturbed during the development works the assessment criteria of 0.03%S has been adopted as the assessment criteria.

6.2 GROUNDWATER

The SEPP (Groundwaters of Victoria) (SEPP GoV, 1997) classifies groundwater into segments based on background concentrations of total dissolved solids (TDS) and outlines the beneficial uses to be protected for each segment.

As discussed in Section 2.7, based on the lowest TDS values recorded, the groundwater at the project area is likely to be classified as Segment A2 in accordance with Table 2 in the SEPP (GoV 1997).

The beneficial uses of groundwater within Segment A2 include maintenance of ecosystems, potable water supply (acceptable), potable mineral water supply, agriculture, parks and garden, stock watering, industrial water use, primary contact recreation; and buildings and structures.

Groundwater quality objectives as specified in Table 3 of the SEPP (GoV 1997) are provided in Table 6.9 below.

Based on hydrogeological modelling (WSP 2018), local groundwater flow is directed towards the wetlands, as such criteria for marine based ecosystem was not considered.

Table 6.9 Groundwater quality indicators and objectives

BENEFICIAL USE	INDICATORS	OBJECTIVE
Maintenance of ecosystems – highly modified aquatic ecosystem	Those specified in the State Environment Protection Policy for surface waters.	Groundwater shall not cause receiving waters to be affected to the extent that the level of any water quality indicator is greater than the level of that indicator specified in the relevant State Environment Protection Policy for surface waters.
Potable water supply: acceptable	Those specified for raw water for drinking water supply in the Water Quality Guidelines for Fresh and Marine Waters	Groundwater shall not be affected to the extent that the level of any water quality indicator is greater than the level of that indicator specified for raw water for drinking water supply in the Australian Water Quality Guidelines for Fresh and Marine Waters. The constituents of groundwater shall not be affected in a manner or to an extent that leads to tainting.
Potable mineral water supply	Those specified for potable mineral water in the Australian Food Standards Code (1987) – Standard 08 Mineral Water	Groundwater shall not be affected to the extent that the level of any water quality indicator is greater than the level of that indicator specified in the Australian Food Standards Code (1987) – Standard 08 Mineral Water. The constituents of groundwater shall not be affected in a manner or to an extent that leads to tainting.
Agricultural water supply: irrigation	Those specified for irrigation in the Australian Water Quality Guidelines for Fresh and Marine Waters	Groundwater shall not be affected to the extent that the level of any water quality indicator is greater than the level of that indicator specified for irrigation in the Australian Water Quality Guidelines for Fresh and Marine Waters.
Agricultural water supply: stock watering	Those specified for livestock in the Australian Water Quality Guidelines for Fresh and Marine Waters.	Groundwater shall not be affected to the extent that the level of any water quality indicator is greater than the level of that indicator specified for livestock in the Australian Water Quality Guidelines for Fresh and Marine Waters.
Industrial water use	Those specified for industrial use in the Australian Water Quality Guidelines for Fresh and Marine Waters.	Groundwater shall not be affected to the extent that the level of any water quality indicator is greater than the level of that indicator specified for industrial water quality in the Australian Water Quality Guidelines for Fresh and Marine Waters.
Primary contact recreation	Those specified for primary contact recreation in the Australian Water Quality Guidelines for Fresh and Marine Waters.	Groundwater shall not be affected to the extent that the level of any water quality indicator is greater than the level of that indicator specified for primary contact recreation in the Australian Water Quality Guidelines for Fresh and Marine Waters.
Buildings and structures	— pH — Sulphate — Redox potential	Introduced contaminants shall not cause the groundwater to become corrosive to structures or building materials.

Criteria for the beneficial use ‘Potable Mineral Water Supply’ have not been included as there are no mineral springs indicated to be in the vicinity of the project area.

Criteria for the beneficial use ‘Industrial Water Use’ have not been included as the criteria are specific to the type of industrial use required; and groundwater is not currently used at the project area for industrial purposes and hence, has not been considered further.

The selection criteria for the beneficial use ‘Buildings and Structures’ is not specified in the SEPP GoV 1997. However, the Australian Standard, *Piling – Design and Installation AS2159-2009* comprises criteria (namely pH and sulphate values) which can be used to address potential impacts to the beneficial use ‘buildings and structures’. The criteria have been adopted to assess potential risks to ‘buildings and structures’.

6.2.1 HUMAN HEALTH – VAPOUR INTRUSION FROM GROUNDWATER

In addition to the guidelines associated with the beneficial uses defined in the SEPP GoV 1997, this investigation also includes comparison to Health Screening Levels (HSLs) associated with the health risk posed from vapour intrusion. The groundwater HSLs assuming a sand lithology and a recreational/open space setting (HSL C) as presented in the NEPM 2013 have been adopted.

Assessment criteria adopted for groundwater are presented in Table 6.10 below. Reference documents sourced for the adopted criteria for each beneficial use are also outlined in the notes underneath the table.

Table 6.10 Adopted groundwater assessment criteria (µg/L)

ANALYTE	MAINTENANCE OF ECOSYSTEMS[1]	POTABLE WATER SUPPLY[2]	PRIMARY CONTACT RECREATION[3]	AGRICULTURE, PARKS AND GARDEN[4]	STOCK WATERING[5]	BUILDINGS AND STRUCTURES[6]	HSL-C (µg/L)[7], SAND		
							2 m to <4 m	4 m to <8 m	8 m+
TRH/BTEX/PAHs									
TPH C_{10}-C_{36}	600*	–	–	–	–	–	–	–	–
Benzene	950	1	1	–	1	–	NL	NL	NL
Toluene	–	800	800	–	800	–	NL	NL	NL
Ethyl Benzene	–	300	300	–	300	–	NL	NL	NL
Xylene (o)	350	–	–	–	–	–	–	–	–
Total xylene	–	600	600	–	600	–	NL	NL	NL
Naphthalene	16	–	–	–	–	–	NL	NL	NL
Benzo (a) pyrene	–	0.01	0.01	–	0.01	–	–	–	–
TRH C_6–C_{10} less BTEX (F1)	–	–	–	–	–	–	NL	NL	NL
TRH >C_{10}–C_{16} less naphthalene (F2)	–	–	–	–	–	–	NL	NL	NL
Metals									
Cyanide	7	80	80	80[2]	80[2]	–	–	–	–
Arsenic	–	10	7	100	500	–	–	–	–
Barium	–	2,000	700	2,000[2]	2,000[2]	–	–	–	–
Beryllium	–	60[2]	60[2]	60[2]	60[2]	–	–	–	–
Boron	370	4,000	4,000	500	5,000	–	–	–	–

ANALYTE	MAINTENANCE OF ECOSYSTEMS[1]	POTABLE WATER SUPPLY[2]	PRIMARY CONTACT RECREATION[3]	AGRICULTURE, PARKS AND GARDEN[4]	STOCK WATERING[5]	BUILDINGS AND STRUCTURES[6]	HSL-C (µg/L)[7], SAND		
							2 m to <4 m	4 m to <8 m	8 m+
Cadmium	0.2	2	2	10	10	–	–	–	–
Chromium (total)	–	–	50	100	1,000	–	–	–	–
Chromium (VI)	–	50	50	50[2]	50[2]	–	–	–	–
Cobalt	–	–	–	50	1,000	–	–	–	–
Copper	1.4	2,000	2,000	200	2,000	–	–	–	–
Lead	3.4	10	10	2,000	100	–	–	–	–
Manganese	1,900	500	500	200	500[2]	–	–	–	–
Mercury	0.06	1	1	2	2	–	–	–	–
Nickel	11	20	20	200	1,000	–	–	–	–
Selenium	5	10	10	20	200	–	–	–	–
Vanadium	–	–	–	100	–	–	–	–	–
Zinc	8	–	3,000	2,000	20,000	–	–	–	–
Phenols									
2,4,5-trichlorophenol	–	–	1[6]	–	–	–	–	–	–
2,4,6-trichlorophenol	3	20	20	20[2]	20	–	–	–	–
2,4-dichlorophenol	120	200	200	200[2]	200	–	–	–	–
2-chlorophenol	340	300	300	300[2]	300	–	–	–	–
Pentachlorophenol	3.6	10	1[6]	10[2]	10	–	–	–	–
Phenol	320	–	–	–	–	–	–	–	–

ANALYTE	MAINTENANCE OF ECOSYSTEMS[1]	POTABLE WATER SUPPLY[2]	PRIMARY CONTACT RECREATION[3]	AGRICULTURE, PARKS AND GARDEN[4]	STOCK WATERING[5]	BUILDINGS AND STRUCTURES[6]	HSL-C (µg/L)[7], SAND		
							2 m to <4 m	4 m to <8 m	8 m+
Volatile organic Compounds (VOCs)									
1,1,2-trichloroethane	6,500	–	–	–	–	–	–	–	–
1,1-dichloroethene	–	30	30	30[(2)]	30	–	–	–	–
1,2,3-trichlorobenzene	3	30	30	30[(2)]	30	–	–	–	–
1,2,4-trichlorobenzene	85	30	30	30[(2)]	30	–	–	–	–
1,2-dichlorobenzene	160	1,500	1,500	1,500[(2)]	1,500	–	–	–	–
1,2-dichloroethane	–	3	3	3[(2)]	3	–	–	–	–
1,3-dichlorobenzene	260	–	–	–	–	–	–	–	–
1,4-dichlorobenzene	60	40	40	40[(2)]	40	–	–	–	–
Bromomethane	–	1	1	1[(2)]	1	–	–	–	–
Carbon tetrachloride	–	3	3	3[(2)]	3	–	–	–	–
Chlorobenzene	–	300	300	300[(2)]	300	–	–	–	–
Hexachlorobutadiene	–	0.7	0.7	0.7[(2)]	0.7	–	–	–	–
Styrene	–	30	30	30[(2)]	30	–	–	–	–
Tetrachloroethene	–	50	50	50[(2)]	50	–	–	–	–
Vinyl chloride	–	0.3	0.3	0.3[(2)]	0.3	–	–	–	–

ANALYTE	MAINTENANCE OF ECOSYSTEMS[1]	POTABLE WATER SUPPLY[2]	PRIMARY CONTACT RECREATION[3]	AGRICULTURE, PARKS AND GARDEN[4]	STOCK WATERING[5]	BUILDINGS AND STRUCTURES[6]	HSL-C (µg/L)[7], SAND		
							2 m to <4 m	4 m to <8 m	8 m+
Inorganics									
Sulfates (as SO_4)	–	500	–	–	1,000	<1,000	–	–	–
Chlorides	–	–	–	–	–	<6,000	–	–	–
pH	–	–	6.5-8.5[8]	–	6.0-8.5	>5.5	–	–	–
Total dissolved solids	–	–	1,000,000[8]	–	0-2,000	–	–	–	–

(1) NEPM (2013) – Groundwater Investigation Levels for Fresh Waters (references ANZECC & ARMCANZ (2000) – National Water Quality Management Strategy. Australian and New Zealand Guidelines for Fresh and Marine Water Quality: 95% Trigger values for freshwater).

(2) NEPM (2013) – Groundwater Investigation Levels for Drinking Waters (references the Ref: NHMRC, NRMMC (2011) – Australian Drinking Water Guidelines Paper 6 National Water Quality Management Strategy (updated October 2017).

(3) NHMRC (2008) – Guidelines for Managing Risks in Recreational Water. National Health and Medical Research Council. For zinc, the aesthetic value of 3,000 µg/L was adopted as no health-based criterion available.

(4) ANZECC (2000) – National Water Quality Management Strategy. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Agricultural irrigation long-term trigger values (LTV) for metals and metalloids in irrigation water. The NHMRC, NRMMC (2011) Australian Drinking Water guidelines were adopted for contaminants where no LTV was available in ANZECC (2000).

(5) ANZECC/ARMCANZ (2000) – Livestock Drinking Water Quality criteria. The NHMRC, NRMMC (2011) Australian Drinking Water guidelines were adopted for contaminants where no livestock criteria were available in ANZECC (2000).

(6) Australian Standard, Piling – Design and Installation (AS2159-2009). Adopted Soil condition A – high permeability soils (e.g. sands and gravels) which are in groundwater, mild exposure.

(7) NEPM (2013) Groundwater Health Screening Levels (HSLs) for Vapour Intrusion for Commercial/Industrial (HSL C).

(8) ANZECC/ARMCANZ (2000) – Recreational Water Quality and Aesthetics criteria.

* VROM (2013) – Groundwater Target value

– No assessment criteria

NL denotes not limiting due to maximum vapour concentrations being below the acceptable health risk level.

6.3 LEACHATE

No criteria typically apply to assess the quality of leachate. For the purposes of this report. Leachate will be assessed against the nominated groundwater criteria (detailed above in Section 6.2.2 to have an indicative assessment of impact in the event that leachate is comingled with groundwater and migrates to the identified receptors (e.g. Mordialloc Creek and extractive users).

6.4 LANDFILL GAS

The approach to the evaluation of landfill gases at the project area given the uncertainty in what the project area was filled with (understood to comprise both liquid and solid industrial waste based on historic reports for the former Lot 1 Grange Road landfill (PJRA 2016)) has considered the generation of bulk ground gases including methane (CH_4), carbon dioxide (CO_2), carbon monoxide (CO), hydrogen sulfide (H_2S), hydrogen cyanide (HCN) and ammonia (NH_3); as well as the generation of trace gases including BTEXN and other VOCs.

6.4.1 BULK AND TRACE GASES

The Victorian EPA *Best Practice Environmental Management for Siting, Design, Operation and Rehabilitation of Landfills* (BPEM) Publication 788.3 (EPA 2015) and herein referred to as the 'Landfill BPEM', outlines action levels for landfill operators that are required to be adhered to and if exceeded, requires the landfill operator to notify EPA; as well as determining what actions will be undertaken to reduce emissions to below the action levels.

The potential environmental risk associated with the presence of a former landfill has been assessed semi-quantitatively using the 'source-pathway-receptor' pollutant linkage concept, which states that for a risk to arise, each stage of the pollutant linkage must be present. In addition, the assessment of risks has also incorporated some landfill gas data collected during the preliminary investigation of the landfill, including results from both active landfill gas sampling and surface emission testing.

It is noted that although the Landfill BPEM has been referred to for the evaluation of potential risks, the property was filled and stopped accepting waste prior to the introduction of this guidance. However, as a precautionary approach for the landfill gas risk assessment (LGRA), requirements of the BPEM have been adopted.

The following elements of the BPEM are considered to be relevant to the assessment of landfill at the project area:

- Buffer distances to buildings and structures for Type 2 (putrescible waste) of 500 m.
- Landfill gas action levels of:
  - 1% v/v methane and 1.5% v/v carbon dioxide above background concentration within the subsurface geology; and subsurface services at the landfill boundary
  - 10,000 ppm of methane within subsurface services on the landfill and in adjacent area
  - 5,000 ppm of methane within buildings and structures on the landfill and in adjacent areas; and
  - 1% v/v methane within buildings.

The landfill gas bore monitoring in-field screening and laboratory results were assessed against the action levels for subsurface geology at the landfill boundary (i.e. the gas bores were installed in a linear pattern on either side of the bypass road alignment, to intercept any potential landfill gases, that may migrate laterally following the construction of the road; and in particular any embankments built above ground).

In addition to the BPEM, the following guidance documents sourced from Australian and international agencies have been utilised for the evaluation of potential health and environmental risks posed by the presence of landfill gases:

- NSW EPA (2012), 'Guidelines for the Assessment and Management of Sites Impacted by Hazardous Ground Gases'.
- SEPP (Air Quality Management) (SEPP AQM) No. S 240, 21 December 2001.

- WHO (200), Guidelines for Air Quality.
- US EPA (2016), Regional Screening Levels (RSLs) and/or health reference values as provided on the Integrated Risk Information System.

In addition to the BPEM, methane and carbon dioxide concentrations at sub-surface locations have be compared to flow rates within monitoring points for derivation of the Gas Screening Value (GSV) and subsequent Characteristic Gas Situation (CS) as per NSW EPA (2012), Guidelines for the Assessment and Management of Sites Impacted by Hazardous Ground Gases as summarised in the table below.

Table 6.11 Modified Wilson and Card Classification (NSW EPA 2012)

GAS SCREENING VALUE THRESHOLD (L/HR)	CHARACTERISTIC GAS SITUATION	RISK CLASSIFICATION	ADDITIONAL FACTORS	TYPICAL SOURCES
<0.07	1	Very low risk	Typically methane <1%v/v and/or carbon dioxide <5%v/v, otherwise consider increase to CS2	Natural soils with low organic content Typical fill
<0.7	2	Low risk	Borehole flow rate not to exceed 70L/hr, otherwise consider increase to CS3	Natural soils with high organic content Fill
<3.5	3	Moderate risk		Old inert waste landfill Flooded mine workings
<15	4	Moderate to high risk	Consider need for Level 3 risk assessment	Mine workings susceptible to flooding Closed putrescible waste landfill
<70	5	High risk	Level 3 risk assessment required	Shallow, un-flooded abandoned mine workings
>70	6	Very high risk		Recent putrescible waste landfill

The GSV and CS of the site for methane and carbon dioxide calculated during the ongoing monitoring program allows the sub-surface methane and carbon dioxide risk to be quantified in a way that can be applied to the management controls presented in the NSW EPA 2012 *Guidelines for the Assessment and Management of Sites Impacted by Hazardous Ground Gases.*

Whilst no action levels are specified in the BPEM for H_2S, CO, HCN and NH_3; criteria have been sourced from Time Weighted Average (TWA) criteria from *Workplace Exposure Standards for Airborne Contaminants* (Safe Work Australia, 2013). The adopted criteria for H_2S, CO, HCN and NH_3 are presented in Table 6.12.

For trace gases, the US EPA (2017) RSLs for industrial and residential air have been adopted for screening purposes and are presented in Table 6 Appendix J.

Table 6.12 Adopted assessment criteria for H_2S, CO, HCN and NH_3 (Safe Work Australia, 2013)

GAS TYPE	ADOPTED CRITERIA (µg/m^3)
H_2S	14,000
CO	34,000
HCN	11,000
Ammonia	17,000

6.5 PFAS

The National Environmental Management Plan (NEMP) for per- and poly-fluoroalkyl substances (PFAS) is Australia's first guidance document to provide a consistent approach and risk-based framework for the management and regulation of PFAS materials including contaminated sites. The plan was developed by the Heads of Environment Protection Authorities (EPAs) Australia and New Zealand (HEPA), in conjunction with the Australian Government Department of the Environment and Energy, and has been endorsed by Australia's Environment Ministers.

The NEMP provides for soil, groundwater and surface water health-based and ecological criteria to assess the potential human health and ecological risks posed by PFAS, summarised as Table 6.13 to 6.16.

Table 6.13 Soil criteria for investigation – human health based guidance values

EXPOSURE SCENARIO	PFOS/PFHXS	PFOA	LAND USE	COMMENTS AND SOURCE
Soil – Human health screening values	1.0 mg/kg	10 mg/kg	Public open space	Based on 20% of FSANZ TDI, i.e. up to 80% of exposure is assumed to come from other pathways. National Environment Protection (Assessment of Site Contamination) Measure Health Investigation Level C assumptions for public open space such as parks, playgrounds, playing fields (e.g. ovals), secondary schools (except where soil used for agriculture studies) and footpaths. It does not include undeveloped public open space (such as urban bushland and reserves) which should be subject to a site-specific assessment where appropriate.

Table 6.14 Soil criteria for investigation – ecological guidance values

EXPOSURE SCENARIO	PFOS/PFHXS	PFOA	LAND USE	COMMENTS AND SOURCE
Interim soil – ecological direct exposure	1.0 mg/kg	10 mg/kg	Public open space	Future work is recommended to review available soil – ecological direct exposure criteria proposed by Australian research and industry organisations. As an interim, it is proposed that the human health screening value for Public open space is used.

Table 6.15 Health-based drinking water and recreational water quality guideline values

EXPOSURE SCENARIO	PFOS/PFHXS	PFOA	DESCRIPTION	COMMENTS AND SOURCE
Health-based guidance values	0.07 µg/L	0.56 µg/L	Drinking water	Food Standards Australia New Zealand (FSANZ) 2017a
	0.7 µg/L	5.6 µg/L	Recreational water	Australian Government Department of Health 2017

Table 6.16 Aquatic ecosystems: freshwater water quality guideline values

EXPOSURE SCENARIO	PFOS	PFOA	BENEFICIAL USE / ENVIRONMENTAL VALUE	COMMENTS AND SOURCE
Freshwater	**0.00023 µg/L**	**19 µg/L**	High conservation value systems (99% species protection)	Australian and New Zealand Guidelines for Fresh and Marine Water Quality – technical draft default guideline values. Note 1: The 99% species protection level for PFOS is close to the level of detection. Agencies may wish to apply a 'detect' threshold in such circumstances rather than a quantified measurement. Note 2: The draft guidelines do not account for effects which result from the biomagnification of toxicants in air-breathing animals or in animals which prey on aquatic organisms. Note 3: The WQG advise that the 99% level of protection be used for '...slightly to moderately disturbed systems'. This approach is generally adopted for chemicals that bioaccumulate and biomagnify in wildlife.
	0.13 µg/L	220 µg/L	Slightly to moderately disturbed systems (95% species protection)	
	2 µg/L	632 µg/L	Highly disturbed systems (90% species protection)	
	31 µg/L	1824 µg/L	Highly disturbed systems (80% species protection)	

PFAS is known to bioaccumulate and as such a higher degree of species protection would normally be used. For the purposes of this report, high conservation value systems (99% species protection) will be adopted as criteria for beneficial use maintenance of ecosystem in both groundwater and surface water as a conservative approach.

The health based values for drinking water will also be adopted to assess beneficial uses potable water supply, agriculture, parks and gardens and stock watering.

7 INVESTIGATION RESULTS

7.1 SOIL

7.1.1 SUBSURFACE CONDITIONS

The general geology at the project area is discussed in Section 2.4. Specific descriptions of sub-surface geology are presented in the succeeding sections.

7.1.1.1 NORTHERN PORTION OF THE PROJECT AREA (EXCLUDING LOT 1 GRANGE ROAD PROPERTY)

A summary of the subsurface geological profile encountered is presented in Table 7.1.

Table 7.1 General stratigraphical log – Northern portion (excluding Lot 1 Grange Road property)

APPROXIMATE DEPTH (mBGL)	GENERAL SOIL DESCRIPTION
0 – 0.4	Fill consisting mostly of grey, brown and orange-brown sandy gravel, with more gravelly clay was observed further south. Gravel is fine to coarse
0.4 – 1.0	Fill consisting of slightly gravelly sand and sandy clay, dark grey and dark brown. Gravel is fine to coarse grained with occasional construction debris.
1 – 4	Brighton Group: Sand and firm sandy clays of medium to high plasticity, orange-brown to pale grey-brown in colour.

No suspected asbestos containing materials (ACM) were observed in shallow soils during the investigations.

7.1.1.2 NORTHERN SECTION OF THE PROJECT AREA (WITHIN LOT 1 GRANGE ROAD PROPERTY)

The subsurface conditions observed whilst drilling the geotechnical and gas bores (B17-68397, B17-68183, GB17-26-04 and GB17-26-05) encountered fill to approximately 2.5 mBGL (gravel and gravelly clays, possibly landfill cap) and then the waste mass from 2.5 mBGL to approximately 10 mBGL.

Sub-surface conditions encountered during drilling of the leachate well (LW17-26-01) were similar; whereby fill (mixture of gravels and gravelly clays) to approximately 2.6 mBGL was observed followed by the waste mass from approximately 2.6 mBGL to 8.4 mBGL.

A summary of the sub-surface geological profile encountered is presented in Table 7.2.

Table 7.2 General stratigraphical log – Northern portion (within Lot 1 Grange Road property)

APPROXIMATE DEPTH (mBGL)	GENERAL SOIL DESCRIPTION
0 – 2.5	Fill consisting mostly of gravelly clays (understood to be the landfill cap)
2.5 – 10.0	Waste mass
10 – 15	Brighton Group: Sand and firm sandy clays of medium to high plasticity, orange-brown to pale grey-brown in colour

Visual and olfactory observations of potential contamination (odours, glass fragments, staining or elevated PID readings) were noted within the former Lot 1 Grange Road landfill area during the drilling of gas bore number four (GB17-26-04). The lower explosive limit (LEL) was measured and ranged between 36% and 100% at 2.4 mBGL. The landfill gas monitor (LFG) indicated methane readings were between 1220 ppm and 1249 ppm.

No suspected asbestos containing materials (ACM) were observed in shallow soils outside of the waste mass during the investigations.

7.1.1.3 OLD DANDENONG ROAD TO GOVERNOR ROAD

A summary of the subsurface geological profile encountered in this portion of the project area is presented in Table 7.3.

Table 7.3 General stratigraphical log – Old Dandenong Road to Governor Road

DEPTH (mBGL)	GENERAL SOIL DESCRIPTION
0 – 0.4	Largely brown to grey-brown silty sands with low plasticity fines becoming sandy clay closer to Governor Road.
0.4 – 1	Quaternary Alluvium and inferred Brighton Group: Silty sandy clay, grey-brown to brown, with orange-brown and darker grey mottling, occasionally gravelly.
1 – 4.5	Quaternary Alluvium and inferred Brighton Group: Slightly sandy, gravelly clay, grey and brown with orange-brown and darker grey mottling. Clay is firm to soft, moderate to high plasticity. Gravel is fine to medium and sub-angular.
4.5 – 8	Tertiary Brighton Group (Red Bluff Formation): Slightly gravelly, clayey sand, brown. Gravel is fine and rounded.
8 – 10	Tertiary Brighton Group (Red Bluff Formation): Clay, brown with grey mottling, soft with high plasticity.

Visual and olfactory observations of potential contamination (odours or staining) were not noted in most locations during soil bore drilling in this section of the project area. In one location (B17-68327) ACM was observed in one location and is further discussed in Section 8.2.4.

7.1.1.4 GOVERNOR ROAD TO MORDIALLOC CREEK

A summary of the subsurface geological profile encountered in this portion of the project area is presented in Table 7.4.

Table 7.4 General stratigraphical log – Governor Road to Mordialloc Creek

DEPTH (mBGL)	GENERAL SOIL DESCRIPTION
0 – 0.3	Silty clay, dark brown to dark grey, firm and of low to high plasticity, containing rootlets.
0.3 – 3.7	Quaternary Alluvium: Clay and sandy clay, dark brown to dark grey, firm becoming soft, low to high plasticity.
3.7 – 9	Clay, grey with orange mottling, firm with moderate plasticity and with pockets of brittle white clay.
9 – 10.8	Tertiary Brighton Group (Red Bluff Formation): Sand, fine grained and pale grey-brown to pale brown, with occasional bands of moderate to high plasticity clay and trace fine gravel.
10.8 – 14	Tertiary Brighton Group (Red Bluff Formation): Sandy silty clay, pale blue-grey and pale brown with orange-brown mottles, high plasticity.
14 – 15.8	Tertiary Brighton Group (Red Bluff Formation): Sand, pale grey to pale brown with trace thin bands of high plasticity clay.

DEPTH (mBGL)	GENERAL SOIL DESCRIPTION
15.8 – 20.5	Tertiary Brighton Group (Red Bluff Formation): Silty clay of high plasticity, pale brown-grey.
20.5 – 25	Tertiary Brighton Group (Weathered Beaumaris Sandstone): Silty, clayey sand, dark grey to grey, clay has low plasticity, trace marine shells present.
25 – 40	Tertiary Gellibrand Marl: Sandy clay, grey-green and of moderate plasticity containing marine shells, occasional darker grey and green mottling containing fine grained sand.
40 – 49.5	Residual Soil (Silurian Melbourne Formation): Grey, sandy silty clay and sandy clayey silts of medium plasticity, sand is fine grained.

Visual and olfactory observations of potential contamination (odours or staining) were not identified at any location during soil bore drilling.

No suspected ACM was observed in shallow soils during the investigations.

7.1.1.5 MORDIALLOC CREEK TO SOUTHERN BOUNDARY OF PROJECT AREA

A summary of the subsurface geological profile encountered in this portion of the project area is presented in Table 7.5.

Table 7.5 General stratigraphical log – Mordialloc Creek to southern boundary of project area

DEPTH (mBGL)	GENERAL SOIL DESCRIPTION
0 – 0.4	Silty clayey sand, dark brown with rootlets.
0.4 – 2	Quaternary Alluvium: Sandy silty clay, dark brown with orange-brown mottles, clay is firm to very stiff, low to high plasticity.
2 – 4.8	Quaternary Alluvium: Grey-brown sand with orange-brown mottles.
4.8 – 7.3	Quaternary Alluvium: Grey, clayey sand with orange-brown and darker grey mottles, firm with moderate plasticity.
7.3 – 20	(Northern End) Tertiary Brighton Group (Red Bluff Formation): Occasionally gravelly, sandy clay, blue-grey, grey-green and grey with darker brown and orange-brown mottles, gravel is fine and sub-rounded, clay is firm with high plasticity. Closer to Mordialloc Creek the sandy clay became a light red from 15.3 m.

With the exception of sample location DB04, visual and olfactory observations of potential contamination (odours or staining) were not identified during soil bore drilling. At approximately 9 mBGL within soil bore DB04, a faint burnt/smokey odour was noted in areas where orange-brown mottling was prevalent.

Environmental borehole logs are provided in Appendix I and borehole locations are shown in relation to project area features on Figures 4A to 4C, Appendix A.

7.1.2 SOIL ANALYTICAL RESULTS

Soil samples were submitted for laboratory analysis of:

- 88 primary soil samples (47 soil bore samples and 41 test pit samples) were submitted for an IWRG621 waste classification suite. 43 out of the 47 soil bore samples were collected from the northern portion targeting former landfilled areas
- 43 primary soil samples were submitted for % clay and cation exchange capacity (CEC)
- 252 primary soil samples were submitted for PASS initial pH screening parameters (pH_F and pH_{FOX})
- 55 primary soil samples were submitted for Suspension Peroxide Oxidation Combined Acidity and Sulphur (SPOCAS) analysis

- 6 primary soil samples and 2 soil sediment samples (collected from Dunlop Drain) were submitted for analysis of PFAS
- 1 primary sample was submitted for asbestos identification.

All sampling locations are shown on Figures 4A to 4C in Appendix A.

The following sections provide a summary of the results of the completed soil investigations. More detailed summary tables of analytical results are provided in Tables 1 to Table 6 in Appendix J, and laboratory certificates of analysis are provided in Appendix J.

7.1.2.1 HUMAN HEALTH – HILs/HSLs

A summary of the reported analytes that were above the adopted human health criteria (i.e. HILs/HSLs) for a recreational/open space scenario are provided in Table 7.6.

Table 7.6 Summary of soil HSL/HIL concentrations

ANALYTE	MINIMUM CONCENTRATION (mg/kg)	MAXIMUM CONCENTRATION (mg/kg)	LOCATIONS EXCEEDING HIL/HSL (DEPTH)
TRH F1 (C_6-C_{10} minus BTEX)	<10	29	None
TRH C_{10}-C_{40}	<50	340	None
Benzene	<0.2	<0.2	None
Toluene	<0.5	<0.5	None
Ethylbenzene	<0.5	0.8	None
Xylene	<0.5	3.5	None
Naphthalene	<0.5	0.8	None
Arsenic	<5	52	None
Cadmium	<1	7	None
Chromium (hexavalent)	<0.5	0.6	None
Copper	<5	98	None
Lead	<5	631	B17-68417 (0.4 mBGL)
Mercury	<0.1	0.4	None
Nickel	<2	75	None
Selenium	<5	<5	None
Zinc	<5	2,000	None
Aldrin + Dieldrin	<0.03	0.14	None
DDD+DDE+DDT	<0.05	0.09	None
Hexachlorobenzene	<0.3	0.15	None
Benzo(a)pyrene	<0.5	0.7	None
PAHs (sum)	<0.5	8.8	None
PCB	<0.1	0.2	None
Phenol	<1	1	None

All other soil samples analysed were either below the laboratory limit of reporting or below the adopted HIL and HSL criteria for a recreational/open space scenario.

7.1.2.2 MAINTENANCE/EXCAVATION WORKERS

All results for soil samples analysed were below the adopted HSLs for vapour inhalation and direct contact exposure pathways.

7.1.2.3 ECOLOGICAL - EILs/ESLs

Table 7.7 summarises soil concentrations which exceeded the adopted ESL/EILs for an 'urban residential and public open space' land use adopted for the project area.

Table 7.7 Summary of soil ESL/EIL exceedances

ANALYTE	SAMPLES EXCEEDING ADOPTED ESLs/EILs
TRH >C_{10}-C_{16} minus naphthalene (F2)	B17-68397 (3 m)
TRH >C_{16}-C_{34} (F3)	B17-68397 (2 m and 3 m), B17-68417 (0.4 m)
Zinc	B17-68397 (3 m)

All other soil samples analysed were below the adopted ESL and EIL criteria for ecological health.

7.1.2.4 MANAGEMENT LIMITS

All results for soil samples analysed were below the adopted management limit criteria.

7.1.2.5 WASTE SOIL CLASSIFICATION

Based on the reported analytical results, the following indicative waste classification is provided in Table 7.8 below:

Table 7.8 Summary of indicative waste classification

SAMPLE LOCATION AND DEPTH (mBGL)	DOMAIN	CLASSIFICATION DRIVER	INDICATIVE CLASSIFICATION
Northern portion			
B17-68386 (0.1)	Sandy CLAY	Arsenic, Lead	Category C
B17-68391 (1.5)	SILT	Fluoride, Arsenic	Category C
B17-68397-0.1 (2.0)	FILL (Gravelly CLAY)	TRH C_{10}-C_{36}, Lead, Zinc	Category C
B17-68397-0.1 (3.0)	FILL (Landfill Waste)	TRH C_{10}-C_{36}, Cadmium, Lead, Zinc	Category C
B17-68399 (0.3)	FILL (Clayey SAND)	Fluoride	Category C
B17-68418 (0.7), B17-68419 (0.7), B17-68420 (0.7), B17-68379 (0.1), B17-68388 (0.4 and), B17-68389 (0.2, 0.5 and 1.0), B17-68395 (0.1 and 0.5), B17-68396 (0.1, 0.5, 0.9 and 1.9)	n/a	n/a	Fill material
B17-68417 (0.3-0.4)	SAND	Lead	Category C
B17-68421 (0.7-0.8)	FILL (CLAY)	Zinc	Category C

SAMPLE LOCATION AND DEPTH (mBGL)	DOMAIN	CLASSIFICATION DRIVER	INDICATIVE CLASSIFICATION
TP17-26-52 (0.6), TP17-26-53 (0.6), TP17-26-55 (0.6), TP17-26-56 (0.6), TP17-26-62 (0.6) and TP17-26-63 (0.6)	n/a	n/a	Fill material
TP17-26-58 (0.6)	FILL (Sandy CLAY)	Arsenic	Category C
Central portion			
TP17-26-27 (0.8)	Silty CLAY	Fluoride	Category C
TP17-26-29 (0.4)	Silty CLAY	Fluoride	Category C
TP17-26-31 (1.0)	Gravelly silty CLAY	Fluoride	Category C
TP17-26-33 (0.5-0.6)	Silty CLAY	Arsenic	Category C
TP17-26-35 (0.5-0.6)	n/a	n/a	Fill material
TP17-26-37 (0.4)	FILL (Silty SAND)	Arsenic	Category C
TP17-26-41 (0.8), TP17-26-43 (0.7), TP17-26-45 (0.6), TP17-26-47 (0.7)	n/a	n/a	Fill material
TP17-26-49 (0.8)	Silty SAND	Nickel	Category C
TP17-26-64 (0.5), TP17-26-68 (0.6), TP17-26-69 (0.5), TP17-26-70 (0.7)	n/a	n/a	Fill material
Southern portion			
TP17-26-03 (0.6), TP17-26-05 (0.6), TP17-26-07 (0.6), TP17-26-09 (0.8), TP17-26-10 (1.0), TP17-26-14 (0.8), TP17-26-16 (0.7), TP17-26-18 (0.8)	n/a	n/a	Fill material
B17-68167 (0.5-0.6), B17-68170 (0.6-0.7)	n/a	n/a	Fill material

7.1.3 ASBESTOS CONTAINING MATERIAL (ACM)

Suspected ACM found in one location, B17-68327 (central portion within a rural residential allotment adjacent to Lower Dandenong Road) at 0.8 mBGL within the fill profile was submitted for analysis of ACM identification. The sample submitted was described as brown soil with multiple friable asbestos fragments approximately 11 x 7 x 1.5 mm in size and multiple asbestos bundles measured at approximately 6 x 1 x 0.5 mm.

Analytical results positively identified the sample as asbestos type ‘Ch’ Chrysotile (white asbestos). ACM was not observed at any other sample location. The laboratory certificate of analysis is provided as Appendix K and the sample location is depicted on Figure 6B, Appendix A.

7.2 PASS

7.2.1 PROJECT AREA INSPECTION FOR PASS

The preliminary hazard assessment for acid sulfate soils (ASS) involves the determination of the likelihood for the presence of ASS which involves undertaking a desktop assessment followed by a field inspection. The objective of the inspection was to characterise the project area, based on observations made during the inspection. Observations relating to landscape characteristics and surface water characteristics were noted as part of the inspection.

Given the nature of the project area (i.e. 9 km of proposed road), it was impractical to undertake a detailed survey of flora across the whole project area that may indicate PASS. The approach taken was to conduct an inspection in the vicinity of the proposed sampling locations, which were selected based on test locations being placed along the alignment, at 100 m–250 m intervals.

In order to assist in the discussions, results of the site inspection are presented into three sections below (from Old Dandenong Road to Governor Road, within the waterways area from Governor Road to Mordialloc Creek and in the southern portion from Mordialloc Creek up to the southernmost boundary of the project area). Corresponding photographs are presented in Appendix M.

7.2.1.1 OLD DANDENONG ROAD TO GOVERNOR ROAD

This portion of the site has a higher elevation (compared to the southern portion) and was considered to have lower potential for ASS. It consisted of locations SB1 to SB17 from Old Dandenong Road to Governor Road. Refer Figure 8A to 8B, Appendix A.

The majority of the area was covered mainly by grasses with occasional trees and shrubs (refer to Photograph 4 and Photograph 5, Appendix M).

Common Reed (*Phragmites Australis* are noted in the vicinity of SB16 and SB17, close to the waterways (refer to Photograph 6 and Photograph 7, Appendix M). No other obvious visual or olfactory signs of PASS were noted.

7.2.1.2 WATERWAYS ESTATE (GOVERNOR ROAD TO MORDIALLOC CREEK)

This portion of the project area consisted of locations SB18 to SB24 (refer to Figure 8B to 8C, Appendix A), between Governor Road and Mordialloc Creek. Refer to Photograph 9, Appendix M for typical features observed along this portion of the project area.

PASS indicators were noted in the area, particularly the presence of some Common Reed (*Phragmites Australis)* along Mordialloc Creek and the southern portion of the waterways (between Bowen Parkway and Mordialloc Creek) (refer to Photograph 8, Appendix M). However, water observed within the waterways and within Mordialloc Creek was noted to be slightly turbid and a light brown colour (refer to Photograph 8, Appendix M). No other visual evidence of PASS was observed.

7.2.1.3 MORDIALLOC CREEK TRAIL TO SPRINGVALE ROAD

The inspection extended from the Mordialloc Creek to the southern boundary of the project area (locations SB25 to SB33). Refer to Figure 5C, Appendix A.

The stretch of land between Mordialloc Creek and Springvale Road (SB25 to SB33) was covered primarily by long grasses with occasional trees and shrubs (refer to Photograph 10, Appendix M). The southernmost portion of the project area (locations SB34 to SB38) was located in the freeway reserve and vegetation consisted of grass and various sized shrubs and trees (refer to Photograph 11, Appendix M). A small, shallow drainage channel was observed between SB35 and SB36 and was noted to contain water as well as some small reeds and short grasses, the water appeared clear with no signs of acid sulphate conditions.

No other obvious visual signs of PASS were noted in any of the locations sampled.

7.2.2 PASS ANALYTICAL RESULTS

Soil samples (252 in total) collected from 43 soil bores were analysed using the initial screening analysis as a first pass to identify potential and actual ASS. Soil samples were collected at 0.5 m intervals down to the soil profile to get a broad picture of the ASS potential in various areas along the project area. Based on a review of the initial screening results, samples were then selected for SPOCAS analysis.

The pH of the initial screening analysis is summarised as follows:

- 4 out of the 252 samples reported a pH_F result between 4 and 5 pH units indicating the likely presence of actual ASS. Results were reported at depths between 1.0 mBGL and 1.5 mBGL from 3 of the 43 locations (SB26, SB36 and SB37).
- 99 out of the 252 samples reported a pH_{FOX} result between 3 and 5 pH units, a reaction to hydrogen peroxide, indicating PASS maybe present. Results were reported between 0.5 and 20.0 mBGL from 27 of the 43 locations sampled (DB3 to DB5, SB4 to SB8, SB20 to SB38).
- 11 out of the 252 samples reported a pH_{FOX} result lower than or equal to 3 pH units, a strong reaction to hydrogen peroxide, indicating the likely presence of PASS. Results were reported between 0.5 and 12.5 mBGL from 3 of the 43 locations sampled (DB4, DB5, SB25).
- 38 out of the 252 samples reported a change in pH (ΔpH) greater than 2 units indicating the likely presence of PASS. Results were reported from 14 out of the 43 locations sampled at depths ranging 0.5 to 13.0 mBGL.

Based on the results of the initial field screening analysis and a review of the recorded geology during field works (i.e. borelogs), 55 out of the 252 samples were submitted for SPOCAS analysis taking into account the soil conditions and characteristics observed at the time of sampling. In general, at least one sample was submitted per location. Some samples representative of the specific soil profile was also selected to provide a snapshot of the lithology present.

Results of the laboratory SPOCAS analysis is summarised as follows:

- 3 out of the 55 samples analysed (from location DB5) reported titratable sulfidic acidity (TSA) above the action level criteria of 0.03%. TSA values above criteria ranged between 0.044% to 0.141% at depths ranging 3.5 to 12.5 mBGL.
- 4 out of the 55 samples analysed (from locations SB21, SB33, SB35 and SB38) reported titratable actual acidity (TAA) above the action level criteria of 0.03 %S. The reported TAA above the criteria ranged from 0.034 %S to 0.058 %S.
- 10 out of the 55 samples analysed (from locations DB4, DB5, SB11, SB13, SB15, SB18, SB21 and SB23) reported peroxide oxidisable sulfur (S_{POS}) above the action level criteria of 0.03%. S_{POS} values above criteria ranged between 0.03% to 0.148% at depths ranging 0.5 to 12.5 mBGL.
- Comparison of the reported results for the acid trail (TSA) and sulfur trail (S_{POS}) indicate the presence of some anomalies. These anomalies were observed for samples observed to have reported levels of reacted calcium and magnesium.
- 17 out of the 55 samples analysed (from locations DB4, DB5, SB11, SB18, to SB23, SB27, SB30, SB33, SB34, SB35, SB37 and SB38) reported net acidity value equal to or above the action level criteria of 0.03%. Net acidity values above criteria ranged between 0.03 %S to 0.15%S at depths ranging from 3.5 mBGL to 12.5 mBGL.

Analytical results are presented as Table 2 in Appendix J and all laboratory certificates are presented in Appendix K Figures 8A to 8D in Appendix A shows the PASS impact plan.

7.3 LANDFILL GAS MONITORING

WSP conducted two rounds of surface and sub-surface landfill gas monitoring event (October 2017 and May 2018) in the northern portion of the project area. This section presents the results of the surface monitoring using an Inspectra Laser Diode (FID) and the in-field gas monitoring using the GA5000. The results of the canister sampling for bulk and trace gases during the first round of monitoring is also presented.

7.3.1 SURFACE GAS MONITORING

7.3.1.1 ROUND 1 (OCTOBER 2017)

The surface gas monitoring during this round was undertaken on 20 October 2017. Wind speed on that day ranged between 22 and 46 km per hr based on Bureau of Meteorology's (BOM) daily weather observations at Moorabbin Airport weather station (i.e. (located approximately 1.5 kilometres to the south-west and the closest weather station to the project area). This wind speed exceeds the recommended threshold of 10 km per hr for surface gas monitoring. BOM data is attached as Appendix N.

All equipment was calibrated prior to use. Equipment calibration records are attached as Appendix O.

The following observations were recorded within the Lot 1 Grange Road property:

- There were limited drainage channels where gases could potentially accumulate. Most drainage grates were filled with compost.
- The average ambient concentrations of flammable gas (inferred to be methane) measured via the FID ranged between 0.7 ppm along the western boundary of the project area; and 1.8 ppm along the eastern boundary.
- Concentrations of flammable gas (inferred to be methane) at the Lot 1 Grange Road property, towards the centre of the compost and soil stockpiles, recorded a peak concentration reading of 4.9 ppm.
- The highest concentration of methane recorded was 35.3 ppm. This occurred within a manhole near the Lot 1 Grange Road entranceway, to the north of the office buildings (west of the Lot 1 Grange Road site). The PID reading recorded at this location was 0 ppm.

Photograph 1 in Appendix M summarises the features within Lot 1 Grange Road and ambient concentrations of methane and VOCs, recorded by the ILD and PID respectively.

The following observations were recorded within the nursery south of the Lot 1 Grange Road property:

- The drainage manholes were located centrally within most of the sheds.
- Ambient methane concentrations ranged between 0.7 ppm in the south-western portion to 1.2 ppm in the north-eastern portion.
- No methane concentrations exceeded 1.9 ppm and all PID readings were 0 ppm.

Photograph 2 in Appendix M summarises the features and ambient concentrations of methane and VOCs within the nursery.

The following observations were recorded within the open plot of land, south of the nursery:

- The drainage channels were located along the eastern and western boundaries. Another small drainage channels with stagnant water was present along the eastern side of the entranceway to the nursery. Water was also noted within the drainage channel on the western boundary (refer Photograph 3, Appendix M).
- Ambient methane levels across this site ranged between 1.7 ppm near the entrance (northern end) to 2.2 ppm (at the southern end).
- The maximum methane reading measured was 2.5 ppm within the drainage channel centrally on the eastern boundary.
- PID readings of 0 ppm were recorded across the entire nursery site.

Photograph 3 in Appendix M summarises the features and ambient concentrations of methane and VOCs within this site.

7.3.1.2 ROUND 2 (MAY 2018)

The surface gas monitoring during this round was undertaken on 2 May 2018. Wind speed during that day ranged between 0 to 26 km per hr based on data collected from BOM's Moorabbin Airport weather station. The peak wind speed is recorded at around 11:30AM. BPOM data is attached as Appendix N.

A handheld anemometer was used by the field scientist to monitor actual wind speed within the study area presented as Table 7.9. Wind speed was recorded approximately every hour and where wind gust was experienced. No readings were collected where there is wind gust. The average wind speed recorded within the study area was 6.96 km per hr, lower than the maximum recommended threshold of 10 km per hr.

Table 7.9 Wind speed within the study area, 2 May 2018

TIME	WINDSPEED (km per hr)
8:00 AM	5.62
9:00 AM	4.72
10:15 AM	8.06
10:57 AM	11.38 (wind gust experienced)
11:54 AM	5.00
Average wind speed	6.96

All equipment was calibrated prior to use. Equipment calibration records are attached as Appendix O.

The following observations were recorded north of the Lot 1 Grange Road property:

- The maximum ambient concentrations of methane measured via the FID ranged from 5.2 ppm along the western area of the plot; and 7.8 ppm along the eastern boundary.
- The highest concentration of methane recorded was 10.1 ppm. This occurred over the slab on the plot in the north of the site.
- The maximum concentrations of methane found around the flood swale running through the west of the plot was 6.5 ppm.

The following observations were recorded within the Lot 1 Grange Road property:

- Drainage grates remain largely filled with compost. Elevated concentrations were recorded around two drains, 29.6 ppm and 33.2 ppm (see Appendix M, Photographs 12 and 13).
- The ambient concentrations of methane measured via the FID ranged from 3 ppm along the western boundary of the project area and 7.9 ppm along the eastern boundary.
- Concentrations of methane at the Lot 1 Grange Road property, towards the centre of the compost and soil stockpiles, ranged from 3.0 to 7.0 ppm.
- The highest concentration of methane recorded was 104 ppm. This occurred in front of the office buildings (west of the Lot 1 Grange Road site) in the gravel driveway/parking area.
- The area around the sludge tank/settling pond in the north-west of the site (see Appendix M, Photographs 16) had a maximum recorded methane concentration of 4.0 ppm.
- 14.6 ppm was also recorded around the gattic cover of LW01 in the centre of the site.

The following observations were recorded within the nursery south of the Lot 1 Grange Road property:

- Ambient methane concentrations ranged between 4.3 ppm in the south-western portion to 5 ppm in the north-eastern portion.
- No methane concentrations exceeded 5.2 ppm.

The following observations were recorded within the open plot of land, south of the nursery:

- The drainage channels were located along the eastern and western boundaries and appeared mostly dry. The highest methane readings in and around the drains was recorded as 2.5 and 3.2 respectively.
- Ambient methane levels across this site ranged between 2 ppm in the north-eastern end and 3.2 ppm in the north-west.
- Two elevated readings (89.1 and 86.8 ppm) were recorded at two stick up pipes in the north-western area of the site protruding from an area of fill (see Appendix M, Photographs 14 and 15).

Field data and photographs for this round of monitoring (i.e. grid references) are included in Appendix M.

7.3.2 SUB-SURFACE GAS MONITORING

7.3.2.1 ROUND 1 (OCTOBER 2017)

Sampling was undertaken on 9 and 20 October 2017. All equipment was calibrated prior to use and records are provided in Appendix O. The peak gas concentrations recorded at each location are summarised in Table 7.10.

Table 7.10 Subsurface gas readings, October 2017

BORE NUMBER	BORE DEPTH (m)	LOCATION	DATE	PEAK GAS CONCENTRATIONS				
				CH_4 (%)	CO_2 (%)	O_2 (%)	H_2S (ppm)	CO (ppm)
GB17_26_01	3.0	Northwest of Lot 1 Grange Road, along Dingley Bypass	20/10/2017	0.0	3.7	20.1	0	12
GB17_26_02	3.0	Northeast of Lot 1 Grange Road along Dingley Bypass	20/10/2017	0.0	9.3	2.3	0	0
GB17_26_03	4.0	North of Lot 1 Grange Road	9/10/2017	0.0	4.9	14.4	0	0
GB17_26_04	2.4	Inside northern boundary of Lot 1 Grange Road	9/10/2017	54.7	27.2	0.5	2	0
GB17_26_05	2.0	Central portion of Lot 1 Grange Road	9/10/2017	67.4	34.1	0.2	5	0
GB17_26_06	4.0	Southern boundary of Lot 1 Grange Road	9/10/2017	52.9	40.2	0.1	0	16
GB17_26_07	4.0	Southern boundary of nursery	9/10/2017	0.1	0.2	19.1	0	0
GB17_26_08	4.0	South of Nursery within open plot of land, to the west of the former Din San Landfill	9/10/2017	0.1	17.3	6.3	0	75
GB17_26_09	3.0		9/10/2017	1.0	13.9	0.1	0	0
GB17_26_10	3.0		9/10/2017	0.0	3.8	18.1	0	0

Notably, the highest recorded concentrations of methane and carbon dioxide occurred within soil gas bores BG17-26-04, GB17-26-05 and GB17-26-06 installed within the Lot 1 Grange Road property. Concentrations of methane at these locations exceeded adopted criteria. Concentrations of carbon dioxide in all locations (with the exception of GB17-26-07) also exceeded adopted criteria. Figure 6 in Appendix A shows the location of the landfill gas bores.

WSP endeavoured to undertake sampling in conditions of falling barometric pressure. The BOM website was checked prior to undertaking sampling. However, the predicted and actual conditions each day varied. Barometric pressure obtained during field monitoring is presented in Table 7.11. BOM data for the sampling dates is presented in Appendix N.

Table 7.11 Summary of barometric pressure readings during sampling period

MONITORING PERIOD	RAINFALL (mm)	BAROMETRIC PRESSURE (HPA)		COMMENT
		9 am	3 pm	
9 October 2017	3	1010.9	1012.8	Gradually rising pressure
10 October 2017	0	1017.8	1016.6	Falling Pressure
20 October 2017	4.4	1026.9	1027.8	Stable Pressure

7.3.2.2 ROUND 2 (MAY 2018)

Sampling was undertaken on 2 May 2018. All equipment was calibrated prior to use and records are provided in Appendix O. The peak gas concentrations recorded at each location are summarised in Table 7.12.

Table 7.12 Subsurface gas readings, May 2018

BORE NUMBER	DATE	PEAK GAS AND FLOW CONCENTRATIONS							
		FLOW RATE (L/HR)	CH_4 (%)	CH_4 CS	CO_2 (%)	CO_2 CS	O_2 (%)	H_2S (PPM)	CO (PPM)
WSP Installed Gas Monitoring Wells									
GB17_26_01	2/05/2018	-26.0	0.0	1	0.7	1	12.8	0.0	3.0
GB17_26_02	2/05/2018	0.0	0.0	1	5.9	2	21.2	0.0	1.0
GB17_26_03	2/05/2018	0.0	0.0	1	4.4	1	17.8	0.0	4.4
GB17_26_04*	2/05/2018	-	-	-	-	-	-	-	-
GB17_26_05*	2/05/2018	-	-	-	-	-	-	-	-
GB17_26_06*	2/05/2018	-	-	-	-	-	-	-	-
GB17_26_07	2/05/2018	0.0	0.0	1	7.0	2	18.5	0.0	2.0
GB17_26_08	2/05/2018	-0.7	0.0	1	22.4	2	0.0	0.0	2.0
GB17_26_09	2/05/2018	0.0	0.4	1	22.8	2	20.3	0.0	4.0
GB17_26_10	2/05/2018	0.0	0.0	1	10.0	2	0.0	0.0	2.0
Existing Wells West of Din San Landfill									
GB01**	2/05/2018	0.0	0.0	1	0.4	1	20.2	0.0	1.0
GB02**	2/05/2018	-0.1	0.0	1	1.7	1	20.9	0.0	1.0
GB03**	2/05/2018	0.0	0.0	1	3.5	1	16.4	0.0	0.0
GB04**	2/05/2018	0.0	0.0	1	5.3	2	4.3	0.0	2.0
GB30**	2/05/2018	0.0	0.0	1	10.0	2	18.2	0.0	4.0
GB41**	2/05/2018	0.0	0.0	1	0.2	1	20.3	0.0	1.0

*Monitoring wells could not be located (lost or destroyed)

** Bore depth data collected from Din San Landfill Audit Report (PJRA 2016) Appendix A (Compass Environmental 2016)

Note that negative flow rates are indicative of flow passing through the flow meter into the monitoring well. This provides an indication of the ability of gases to flow in or out of the well and are treated as positive flow rates in the calculation of the GSV.

Green denotes Characteristic Gas Situation (CS) of 1 (very low risk). Orange indicates CS of 2 or 3 (low and moderate risk). Red indicates CS of 4, 5 or 6 (Moderate to High, High and Very High Risk).

The results exclude the gas monitoring data from the Lot 1 Grange Road landfill as these monitoring wells could not be located and were inferred to be destroyed. Due to the lack of flow data for these locations a gas screening value (GSV) and subsequent characteristic gas situation (CS) could not be calculated. Refer to the Enviromix Landfill Gas Risk Assessment (WSP, 2018d) for site-specific risk characterisation for the former Lot 1 Grange Road Landfill.

All methane results for the May 2018 round indicated a CS of 1 (very low risk). Carbon dioxide results ranges between a CS or 1 and 2 (very low to low risk).

BOM data is provided in Appendix N. A summary is presented in Table 7.13.

Table 7.13 Summary of barometric pressure readings during sampling period

MONITORING PERIOD	RAINFALL (mm)	BAROMETRIC PRESSURE (HPA)			COMMENT
		9 am	12 noon	3 pm	
2 May 2018	0.0	1017.8	1016.2	1013.6	Falling Pressure

7.3.3 SUB-SURFACE GAS ANALYTICAL RESULTS, OCTOBER 2017

10 samples from each of the gas bores (GB17-26-01 to GB17-26-10) were submitted for laboratory analysis of bulk ground gases (CH_4, CO_2, CO, O_2, H_2S, NH_3 and HCN) and five soil gas bores (GB17-26-02, GB17-26-04, GB17-26-05, GB17-26-08 and GB17-26-10) were submitted for trace gases which included a suite of VOCs and TRH. Samples were collected using a combination of evacuated canisters and sorbent tubes. Analytical results are presented in the following sections.

7.3.3.1 BULK GROUND GASES

A summary of the results is presented below in Table 7.14 and laboratory certificates of analysis are attached in Appendix K.

Table 7.14 Summary of laboratory analytical results for bulk gases

GAS TYPE	MEASUREMENT UNIT	MINIMUM CONCENTRATION	MAXIMUM CONCENTRATION	LOCATIONS EXCEEDING ADOPTED CRITERIA
CH_4	%	<0.10	59.5	GB17-26-04, GB17-26-05 and GB17-26-06
CO_2	%	<0.010	42.4	All except GB17-26-01 and GB17-26-07
CO	µg/m^3	<10,000	35,000	GB17-26-08
HCN*	µg/m^3	<0.5	<0.5	None
NH_3*	µg/m^3	<1.0	<1.0	None
H_2S	µg/m^3	<30	<30	None

* Samples collected using sorbent tubes

Similar to the in-field bulk ground gas readings, the highest recorded concentrations of methane and carbon dioxide occurred within soil gas bores BG17-26-04, GB17-26-05 and GB17-26-06, installed in the footprint of the former landfilled area in Lot 1 Grange Road. Both the in-field and laboratory bulk ground gas data is compiled as Table 4 in Appendix J.

7.3.3.2 TRACE GASES

A summary of the reported results for trace gases that exceeded the adopted criteria is summarised in Table 7.15 below. All reported trace gas results are provided in Table 5, Appendix J.

Table 7.15 Summary of results for trace gases that exceed adopted criteria

ANALYTE	MEASUREMENT UNIT	MINIMUM CONCENTRATION	MAXIMUM CONCENTRATION	LOCATIONS EXCEEDING ADOPTED CRITERIA
1,2,4-trimethylbenzene	µg/m^3	<240	1,180	GB17-26-04GB17-26-05
1,3,5-trimethylbenzene	µg/m^3	<240	496	GB17-26-04 GB17-26-05
Acrylonitrile	µg/m^3	<110	132	GB17-26-02
Bromomethane	µg/m^3	<190	1,440	GB17-26-02, GB17-26-08, GB17-26-10
Chlorobenzene	µg/m^3	<230	4,880	GB17-26-05
Chloromethane	µg/m^3	<100	108	GB17-26-08
Cyclohexane	µg/m^3	<170	9,180	GB17-26-04 GB17-26-05
Dichlorodifluoromethane	µg/m^3	<250	277	GB17-26-05
Hexane	µg/m^3	<180	16,800	GB17-26-04 GB17-26-05
Iso-propanol	µg/m^3	127	1,950	GB17-26-02, GB17-26-04, GB17-26-05, GB17-26-08, GB17-26-10
Isopropylbenzene	µg/m^3	<250	5,800	GB17-26-04 GB17-26-05
n-propylbenzene	µg/m^3	<250	1,080	GB17-26-04 GB17-26-05
Propene	µg/m^3	<90	6,900	GB17-26-04, GB17-26-05, GB17-26-08
Styrene	µg/m^3	<210	222	GB17-26-04
Vinyl acetate	µg/m^3	<180	510	GB17-26-05

7.4 GROUNDWATER AND LEACHATE

Two sets of groundwater investigations were completed for the site. One was focused on collecting data within the landfilled area (northern portion) of the project area. This included the drilling and installation of three groundwater monitoring wells (GW17-26-01, GW17-26-02 and B18-68683S) and one leachate monitoring well (LW17-26-01).

A separate investigation (WSP, 2018) has been completed for the remaining areas across the project area (i.e. central and southern portions of the alignment). The broader groundwater conditions and findings for the works completed have been presented in the Groundwater Technical Impact Assessment Report (WSP 2018) and should be read in conjunction with this ESA report.

A summary of the analytical results in the UTAF and QA is presented as Tables 7.16 and 7.17. A summary of the pertinent findings is provided in the succeeding sections.

Table 7.16 Summary of groundwater analytical results

ANALYTE	MIN. CONCENTRATION (µg/L)	MAX. CONCENTRATION (µg/L)	SAMPLE LOCATIONS EXCEEDING INVESTIGATION LEVELS						
			HSL-D (SAND)	MAINTENANCE OF ECOSYSTEMS	POTABLE WATER SUPPLY	AGRICULTURE, PARKS AND GARDEN	PRIMARY CONTACT RECREATION	STOCK WATERING	BUILDINGS AND STRUCTURES
TRH									
TRH C_6-C_9	<20	<20	-	-	-	-	-	-	-
TRH C_6-C_{10} (F1)	<20	<20	-	-	-	-	-	-	-
TRH C_{10}-C_{16} (F2)	<100	<100	-	-	-	-	-	-	-
TRH C_{10}-C_{36}	<50	330	-	-	-	-	-	-	-
BTEX									
Benzene	<1	<1	-	-	-	-	-	-	-
Toluene	<2	3	-	-	-	-	-	-	-
Ethylbenzene	<2	<2	-	-	-	-	-	-	-
Xylene	<2	<2	-	-	-	-	-	-	-
Inorganics									
pH	3.88	7.06	-	-	-	-	Y	Y	Y
TDS	632	20,900	-	-	-	-	-	-	-
Sulfate as SO_4	13	4050	-	-	Y	-	-	Y	Y
Alkalinity (Total as $CaCO_3$)	<1	564	-	-	-	-	-	-	-
Methane	<0.01	0.124	-	-	-	-	-	-	-
Nitrate (as N)	<0.01	6.5	-	-	-	-	-	-	-
Nitrite (as N)	0.04	0.15	-	-	-	-	-	-	-
Nitrate + Nitrite as N	<0.01	6.65	-	-	-	-	-	-	-

ANALYTE	MIN. CONCENTRATION (µg/L)	MAX. CONCENTRATION (µg/L)	SAMPLE LOCATIONS EXCEEDING INVESTIGATION LEVELS						
			HSL-D (SAND)	MAINTENANCE OF ECOSYSTEMS	POTABLE WATER SUPPLY	AGRICULTURE, PARKS AND GARDEN	PRIMARY CONTACT RECREATION	STOCK WATERING	BUILDINGS AND STRUCTURES
Total Organic Carbon	10	19	-	-	-	-	-	-	-
Ammonia as N	0.01	2.53	-	Y	-	-	-	-	-
Metals									
Arsenic	<1	622	-	-	Y	Y	Y	Y	-
Barium	6	1060	-	-	-	-	Y	-	-
Beryllium	<1	9	-	-	-	-	-	-	-
Boron	<50	580	-	Y	-	Y	-	-	-
Cadmium	<0.1	1	-	Y	-	-	-	-	-
Chromium	<1	2	-	-	-	-	-	-	-
Cobalt	<1	859	-	-	-	-	-	-	-
Copper	<1	5	-	Y	-	-	-	-	-
Lead	<1	3	-	-	-	-	-	-	-
Manganese	35	8370	-	Y	Y	Y	Y	Y	-
Mercury	<0.1	<0.1	-	-	-	-	-	-	-
Nickel	<1	1540	-	Y	Y	Y	Y	Y	-
Selenium	<10	<10	-	-	-	-	-	-	-
Zinc	<5	892	-	Y	-	-	-	-	-

Y – exceeded criteria (both monitoring wells exceeded criteria unless indicated).

'-' did not exceed criteria, or investigation level not applicable.

NC = no criteria available.

7.4.1 GROUNDWATER INVESTIGATION IN THE FORMER LANDFILLED AREA

Two groundwater monitoring wells (GW17-26-01 and GW17-26-02) were installed within the former landfilled areas, one within Lot 1 Grange Road property and one within the nursery to the south, refer to Figure5A, Appendix A. One round of groundwater sampling was undertaken in October 2017.

The former landfill area is located within the outcropping Brighton Group Sediments. At this location, the UTAF is unconfined with standing water levels (SWL) for groundwater within the northern portion of the project area based on one monitoring event, ranged from 1.18 mBTOC (GW17-26-02) and 2.78 mBTOC (GW17-26-01). This is consistent with information obtained from Visualising Victoria's Groundwater (VVG) (www.vvg.org.au) in February 2017, the depth to groundwater at the project area is indicated to range from <5 m to 10 m below the surface. The groundwater gauging data is presented below in Table 7.17.

Table 7.17 Groundwater gauging data, GW17-26-01 and GW17-26-02 (Northern Portion wells)

WELL ID	DATE GAUGED	T.O.C. ELEVATION* (mAHD)	WELL DEPTH (mBTOC)	DEPTH TO WATER (mBTOC)	DEPTH TO PRODUCT (mBTOC)	APPARENT PRODUCT THICKNESS (m)	CORRECTED GROUNDWATER ELEVATION* (mAHD)
GW17-26-01	3/10/2017	29.586	6.92	2.780	–	–	26.806
	29/03/2018			NR	NR	NR	NR
GW17-26-02	11/10/2017	25.146	10.06	1.180	–	–	23.966
	29/03/2018			0.853	–	–	24.293
GW17-26-03	29/03/2018	8.716	NR	3.962	–	–	4.754

NR – Not recorded

– Not detected

Regional groundwater conditions within the UTAF was characterised within the Groundwater Impact Assessment (WSP 2018). Groundwater flow direction is largely topographically driven with regional groundwater flow inferred to be to the southwest towards Port Philip Bay. Groundwater levels are also seasonally variable with groundwater levels rising during the wetter winter months and falling during drier summer months with higher evapotranspiration rates. At a local scale, drainage lines and landfills cells can influence groundwater flow with increased recharge/evaporation through unlined drainage channels and landfill cells.

The following analytical results were reported:

- Copper was reported to exceed the adopted criteria for maintenance of ecosystems in the groundwater sample collected from GW17-26-01.
- Nickel was reported to exceed the criteria for beneficial uses maintenance of ecosystems, potable water supply and primary contact, recreation in both groundwater samples collected (GW17-26-01 and GW17-26-02).
- Zinc was reported above the maintenance of ecosystem criteria in both groundwater samples (GW17-26-01 and GW17-26-02).
- pH did not meet the specified criteria for buildings and structures, primary contact, recreation or stock watering.
- A dissolved concentration of methane (124 µg/L) was reported at GW17-26-01. This groundwater monitoring well is located at the southern boundary of the Lot 1 Grange Road property. The groundwater sample collected from GW17-26-02 reported methane below the laboratory LOR.
- All groundwater concentrations for VOCs and SVOCs (PAHs, phenols) are below laboratory LOR.

Tabulated groundwater analytical results are provided in Table 3, Appendix J and laboratory certificates of analysis are included in Appendix K. Groundwater investigation locations are shown on Figure 5A to 5C, Appendix A.

7.4.2 LEACHATE ANALYTICAL RESULTS

A single leachate well (LW17-26-01) was installed within the former Lot 1 Grange Road landfilled area and a sample was collected. The leachate sample was observed to be translucent, light brown, with a strong organic degrading odour. Based on the gauging data presented as Table 7.18 below, the apparent thickness of leachate is approximately 5.5 m.

Table 7.18 Leachate well (GW17-26-01) gauging data

DATE GAUGED	T.O.C. ELEVATION* (mAHD)	WELL DEPTH (mBTOC)	DEPTH TO LEACHATE (mBTOC)	DEPTH TO LEACHATE (mAHD)	DEPTH TO BOTTOM OF WASTE MASS (mAHD)	APPARENT LEACHATE THICKNESS (m)
11/10/2017	30.103	8.03	3.415	26.688	21.200	**5.488**
29/03/2018			3.340	26.763	21.200	**5.563**

In the absence of applicable criteria to assess leachate quality, the criteria adopted for groundwater quality was used as a screening indicator for potential contamination. The following analytes were identified to exceed at least one beneficial use criteria:

- TDS (1,580 µg/L) – exceeds the criteria for primary contact, recreation and stock watering.
- Benzene (39 µg/L) – exceeds the criteria for potable water supply, agriculture, parks and gardens, primary contact, recreation and stock watering.
- Barium (886 µg/L) – exceeds the criteria for agriculture, parks and gardens.
- Boron (38,000 µg/L) – exceeds the criteria for maintenance of ecosystems, potable water supply, agriculture, parks and gardens, primary contact, recreation and stock watering.
- Nickel (134 µg/L) – exceeds the criteria for maintenance of ecosystems, potable water supply and primary contact, recreation.
- Zinc (37 µg/L) – exceeds the criteria for maintenance of ecosystems.
- Methane (8,280 µg/L) – whilst no criteria is available to adopt for the identified groundwater beneficial uses, methane was identified in both the leachate sample and the groundwater sample collected from GW17-26-01. However, the groundwater sample collected from GW17-26-02 (located within the nursery to the south of GW17-26-01) reported methane below the laboratory LOR.

Leachate analytical results are provided on Table 3, Appendix J. Copies of laboratory certificates of analysis are included in Appendix K. The leachate monitoring well location is shown on Figure 6, Appendix A.

7.4.3 BROADER GROUNDWATER INVESTIGATION – CENTRAL AND SOUTHERN PORTIONS

The water quality results as reported in WSP (2017) showed that salinity and pH values had a wider range in the surficial Quaternary aquifer than in the semi-confined Brighton Group aquifer, whilst nutrients were low or not detected in both aquifers. Dissolved metals were more frequently detected above laboratory LOR. The results show that there were more dissolved metal concentrations recorded above the criteria adopted for maintenance of ecosystem protection (i.e. ANZECC 2000 freshwater 95% protection level) in the Quaternary aquifer compared to the Brighton Group aquifer. All samples were below the laboratory detection limit for BTEX compounds, hydrocarbons and pesticides in both aquifers (WSP, 2018).

7.5 PFAS

Samples for the analysis of PFAS were collected to provide a targeted and preliminary assessment of PFAS contamination. Soil, groundwater, surface water and leachate samples were collected from locations identified as potential sources of PFAS contamination (i.e. landfills and Moorabbin airport) and results are presented in succeeding subsections.

7.5.1 PFAS IN SOIL

Three samples were collected from west of the former Lot 1 Grange Road Landfill, a landfill of interest, as it intersects the project area. Three samples were also collected within the central portion of the project area, between Centre Dandenong Road and Lower Dandenong Road (east of Moorabbin Airport).

All soil analytical results were below adopted criteria. The following PFAS analytes were detected in BH2 (adjacent to Moorabbin Airport) at 0.2 mBGL.

- PFHxS (0.0007 mg/kg)
- PFOS (0.0036 mg/kg)
- PFOA (0.0008 mg/kg)
- PFHxA (0.0002 mg/kg).

PFOS (0.0002 mg/kg) was also detected in BH06 (adjacent to Moorabbin Airport) at 0.2 mBGL.

Analytical results are attached as Table 1B, Appendix J.

7.5.2 PFAS IN GROUNDWATER

Three groundwater samples were collected, two in the landfilled areas in the northern portion (GW17-26-01 and GW17-26-02) and one in a further down-gradient well of the landfilled areas and Moorabbin Airport (GW17-26-03).

The following PFAS analytes were detected in groundwater:

- PFBS (0.02 µg/L) in GW17-26-02
- PFOS (0.02 µg/L) and PFOA (0.02 µg/L) in GW17-26-03

Concentration of PFOS in GW17-26-03 exceeded the screening criteria for maintenance of ecosystems. Analytical results are attached as Table 3B, Appendix J.

7.5.3 PFAS IN LEACHATE

One leachate sample (LW17-26-01) was collected from within the former Lot 1 Grange Road landfill. The following analytes recorded exceedances to adopted criteria:

- PFHxS (0.07 µg/L) exceeded the adopted criteria for potable water supply, agriculture, parks and gardens and stock watering
- PFOS (0.17 µg/L) exceeded the adopted criteria for maintenance of ecosystems, potable water supply, agriculture, parks and gardens and stock watering.

Analytical results are attached as Table 3B, Appendix J.

7.5.4 PFAS IN SURFACE WATER AND SEDIMENT

Surface water and sediment samples were collected from Dunlop Drain, (locally known as Old Dandenong Drain), which borders the northern portion of the former Lot 1 Grange Road Landfill. Two surface water and two sediment samples were collected.

The following PFAS analytes were detected:

- PFOS (0.0005 to 0.0008 mg/kg) in sediment samples
- PFOS (0.02-0.03 µg/L) in surface water samples
- PFOA (0.02 µg/L) in surface water samples.

Concentration of PFOS in SW1 and SW2 exceeded the screening criteria for maintenance of ecosystems. Sediment analytical results are attached as Table 1B, Appendix J and surface water analytical results are attached as Table 3B, Appendix J.

8 QUALITY ASSURANCE AND QUALITY CONTROL (QA/QC)

Analytical results and RPD calculations for the intra-laboratory and inter-laboratory field duplicates are included in the analytical results tables in Appendix J. The precision of the results for each analyte between the primary sample and the field duplicate was determined by calculating the Relative Percentage Difference (RPD), as follows:

$$RPD = \frac{(Concentration\,1 - Concentration\,2) \times 100}{(Concentration\,1 + Concentration\,2) / 2}$$

Based on Australian Standard AS 4482.1-2005, a field duplicate RPD within the range of 30% to 50% is considered acceptable. Based on NEPM 2013, a field duplicate and secondary duplicate RPD of greater than 30% indicates that a review should be conducted of the cause (e.g. instrument calibration, extraction efficiency, appropriateness of methods used, etc.). Both guidelines recognise that higher variations can be expected for organic analysis and where low concentrations of analytes were recorded.

The results of internal laboratory quality control procedures are provided within the laboratory analysis reports (Appendix K). The acceptance criterion for internal laboratory replicates is generally set at an RPD of 20% to 50%. Laboratory recoveries should be in the range 75% to 125%.

Table 8.1 and Table 8.2 summarise the results of field QA/QC and laboratory QA/QC procedures, respectively.

Table 8.1 Field QA/QC procedures

QA/QC REQUIREMENT	COMPLETED	COMMENTS
Appropriate sampling strategy used and representative samples collected	Yes	A lineal sampling approach was adopted along the length of the road corridor.
Field instruments calibrated	Yes	Refer to Tables 5.2 to Table 5.4 for details. Equipment calibration records are attached as Appendix O.
Appropriate and well documented sample collection, handling, logging, transportation and decontamination procedures	Yes	Refer to Tables 5.2 to Table 5.4 for details.
Chain of custody documentation completed	Yes	All samples were transported under WSP chain of custody procedures and signed chain of custody documents are included in Appendix K.
Required number of blind and split duplicates collected (1:20)	Yes	87 soil samples (non-PASS) were analysed and 5 sets of blind and split duplicates were submitted for analysis. Due to the holding times of the ASS soil samples, no blind and split duplicate were submitted for analysis. 5 groundwater and 2 leachate samples were collected (for the purposes of investigating former landfilled areas) and 2 sets of blind and split duplicates was submitted for analysis. 10 gas samples (canister and sorbent tubes) were collected and one canister and one sorbent tube blind duplicate was submitted for analysis. No interlab split duplicate was submitted.

QA/QC REQUIREMENT	COMPLETED	COMMENTS
Soil QA/QC samples reported RPDs within limits set by AS4482.1-2005	Mostly	All RPD values were within the acceptable range except for arsenic (78%) in split duplicate from B17-68419. Soil RPD results are attached as Table 6 in Appendix J.
Groundwater QA/QC samples reported RPDs within limits set by AS4482.1-2005	Mostly	All RPD values were within the acceptable range except for the following: — Nickel (43%) in split duplicate from GW17-26-02. — PFHxS (44%), sum of PFHxS and PFOS (43%) and PFOS (42%) in split duplicate from LW17-26-01. Groundwater RPD results are attached as Table 7 in Appendix J.
Landfill gas QA/QC samples reported RPDs within limits set by AS4482.1-2005	Mostly	All RPD values were within the acceptable range except for pressure (as received) (52%) and vacuum (as received) (91%) in split duplicate from B17-68419. Landfill gas RPD results are provided in Table 8, Appendix J.
Vapour sampling leak testing isopropanol results within limits set by ITRC 2007 (spike in sample <10% shroud concentration)	Yes	Isopropanol was reported in the samples but the concentrations were less than 10% of the concentration in the shroud. Isopropanol concentration in shroud was calculated using the tracer concentration in ppm and converting to µg/m^3. $Concentration = concentration\ (ppm) \times \frac{Molecular\ Mass\ (\frac{g}{mol})}{Molar\ Volume\ (L)}$
Required numbers of trip and rinsate blank samples collected (one trip blank per esky, one rinsate blank per day)	Mostly	28 rinsate blanks and 13 trip blanks were collected and submitted for analysis.
Acceptable trip and rinsate blank results	Mostly	Metals (including arsenic, copper, chromium, lead, molybdenum, nickel and zinc) were detected in 4 out of the 28 rinsate blank samples submitted. All trip blank results were below the laboratory limit of reporting (LOR). Trip and rinsate blank results are attached as Table 9 in Appendix J
Samples delivered to laboratory within sample holding times and with correct preservative	Yes	Samples were delivered to the laboratories within the sample holding times and in laboratory-supplied containers prepared with the appropriate preservative (where required).

Table 8.2 Laboratory QA/QC procedures

QA/QC REQUIREMENT	COMPLETED	COMMENTS
Samples extracted and analysed within relevant holding times	Yes	All analytes were extracted within holding times. Refer to ALS Interpretive Quality Control reports in Appendix K.
All analyses NATA accredited	Yes	Both ALS and Eurofins are NATA accredited for all the analyses performed.
Appropriate analytical methodologies used, in accordance with Schedule B(3) of the NEPM	Yes	Refer to the Interpretive Quality Control reports in Appendix N for methods used and relevance to Schedule B (3) of the NEPM.
Acceptable laboratory Limits of Reporting (LORs) adopted	Yes	All LORs are acceptable
Acceptable laboratory QC results: — Surrogates: 70% to 130% recovery. — Matrix Spikes: 70% to 130% recovery for organics or 80% to 120% recovery for inorganics. — Control Samples: 70% to 130% recovery for soil or 80% to 120% recovery for waters. — Duplicate Samples: <30% to 50% RPD. — Method Blanks: zero to <PQL.	Yes	The results of internal laboratory quality control procedures are provided within the laboratory analysis reports (Appendix K). 99.9% of laboratory RPD values were within the range of 0.0 to 50%. All laboratory recoveries were within acceptable range. 98% of matrix spike results were within acceptable range. 99.7% of laboratory control blank results were all below the LORs. All method blank results were below the LORs.

The differences in soil and groundwater RPD results between the primary and split samples are attributed to sample heterogeneity and/or the different extraction methods applied by the laboratories. The difference in gas RPD results are related to the canister conditions and do not reflect anomalies or quality issues during sampling. These are not considered to impact on the interpretation of the landfill gas results or conclusions.

28 rinsate samples were collected during completion of the ESA to ensure there was no cross contamination of substances from the sampling equipment utilised. All rinsate samples analysed were reported below the LOR with exception of the following four samples:

- B17-68386 Rinsate – concentrations of arsenic (2 µg/L), copper (1 µg/L), lead (2 µg/L), nickel (1 µg/L) and zinc (11 µg/L)
- B17-68382 Rinsate – concentrations of arsenic (2 µg/L), copper (1 µg/L), lead (2 µg/L), nickel (4 µg/L) and zinc (12 µg/L)
- B17-68399 Rinsate – concentrations of arsenic (18 µg/L), copper (113 µg/L), lead (29 µg/L), molybdenum (2 µg/L), nickel (127 µg/L) and zinc (126 µg/L)
- RB/041017 – concentrations of arsenic (18 µg/L), cadmium (2 µg/L), chromium (36 µg/L), copper (1 µg/L), lead (477 µg/L), nickel (46 µg/L) and zinc (126 µg/L).

Of the above metal concentrations, arsenic, copper, lead, nickel and zinc exceed the adopted environmental criteria for maintenance of ecosystems in rinsate samples B17-68399 and RB/041017. Concentrations reported for zinc were above the adopted criteria in all four samples. Sample B17-68399 Rinsate was collected on 22 August 2017 and sample RB/041017 was collected on the 04 October 2017. A review of the soil samples collected on the above dates has shown that arsenic, copper, lead, nickel and zinc were detected.

Whilst the results indicate a non-compliance with respect to the decontamination processes performed during the sampling events on the above dates, the reported concentrations for arsenic, copper, lead, nickel and zinc are not likely to impact on the integrity of the dataset, due to the several metals being detected for the sampling events performed. In addition, only four out of the 28 rinsate samples analysed reported detectable metal concentrations.

In summary, it was considered that the QA/QC procedures and results were generally adequate and that the analytical results obtained were of acceptable quality for the purposes of this report.

9 DISCUSSION OF RESULTS

9.1 SOIL

9.1.1 HEALTH INVESTIGATION LEVELS

With respect to the current public open space use of the project area, and future similar use of the project area (i.e. as a road), one location (B17-68417) reported lead to be above the adopted human health criteria (i.e. HIL C) at a depth of 0.3–0.4 mBGL, in fill profile. The location of this sample is at the edge of the southern boundary of the Lot 1 Grange Road landfilled area that is in the northern portion of the project area.

Samples located to the north (B17-68418) and south (B17-68391) reported lead concentrations to be below the laboratory LOR (albeit at different depths). Hence, the lead impact is not considered to be laterally delineated, given the presence of fill of unknown origin within this area. The concentrations of remaining analytes were below the relevant adopted assessment criteria (i.e. HILs and HSLs) and/or below the laboratory LOR.

Based on the results of sampling undertaken within the project area, there is a potential risk to current and/or future users of the project area, likely to be encountered in the Northern Portion where former quarrying and landfilling activities were prevalent.

To address potential exposure during construction, consideration should be given to further investigation of this impact. The development of a construction environment management plan (CEMP) to limit exposure to workers; during the construction phase, should be considered. This will be dependent on the type of construction that is proposed for this portion of the project area and whether project area soils will be excavated in this area to accommodate the road extensions.

Figures 6A to 6C in Appendix A shows the soil impacts plans assessed against the HILs/HSLs.

9.1.2 ECOLOGICAL INVESTIGATION LEVELS

Sample B17-68397, within Lot 1 Grange Road property, reported the following concentrations above the adopted EIL/ESL criteria, at depths ranging from 2.0 mBGL to 3.0 mBGL:

- TRH F2 fraction >C_{10}-C_{16} at 340 mg/kg
- TRH F3 fraction >C_{16}-C_{34} at 910 mg/kg to 1,440 mg/kg and
- Zinc at 2,000 mg/kg.

Sample B17-68417 located at the southern boundary of the Lot 1 Grange Road property reported a concentration of TRH F3 fraction >C_{16}-C_{34} at 310 mg/kg which is above the adopted ESL criteria. All the locations with identified impact are located within or in the vicinity of the Lot 1 Grange Road property.

The risk to ecological receptors within this portion of the project area is considered to be low given the future use as a road and lack of ecological receptors identified within the buffer zone of the proposed road corridor.

Figures 6A to 6C in Appendix A shows the soil impacts plans assessed against the EILs/ESLs.

9.1.3 INTRUSIVE MAINTENANCE WORKERS

All results for soil samples analysed were below the adopted soil HSLs for petroleum hydrocarbons (i.e. BTEXN, TRH). Based on the results, there is not considered to be an existing and/or future vapour inhalation and/or direct contact exposure risk to maintenance/utility workers at the project area, from petroleum hydrocarbons. It should be noted that a vapour inhalation risk may exist from other sources (e.g. landfill gas), discussed further in Section 9.3 and 9.4.

Please note comments above in Section 9.1.1 regarding the lead impact identified at B17-68417 and the potential for exposure to workers during the construction phase.

9.1.4 MANAGEMENT LIMITS

All results for soil samples analysed were below the management limit criteria. Based on the results, the formation of LNAPL, fire or explosive hazards or impacts to buried services or infrastructure from petroleum hydrocarbons are not considered to be present at the project area. Landfill gases (in particular methane) have been identified in the vicinity of the former landfills and will likely require some level of management due to the risk of explosion and asphyxiation risk where accumulation in voids and service pits occurs.

9.1.5 WASTE SOIL CLASSIFICATION

In accordance with EPA Publication IWRG621, the indicative waste classification of soils identified the following analytes that are classified as Category C soil as per EPA Vic IWRG621 criteria:

- Northern portion
  - TRH C_{10}-C_{36}, cadmium, lead and zinc in B17-68397
  - Arsenic in B17-68386 and B17-68391,
  - Lead in B17-68386 and B17-68417
  - Fluoride in B17-68399.
- Central portion
  - Arsenic in TP17-26-33, TP17-26-37 and TP17-26-58
  - Fluoride in TP17-26-29 and TP17-26-31
  - Nickel in TP17-26-49.

Soil sampled within the southern portion of the project area were indicative of a Fill Material classification for offsite disposal purposes.

The soil classifications at the project area are indicative only. Leachability testing was not undertaken and may change or confirm the indicative soil classifications. It should be noted that given the lineal nature of sampling in majority of the project area and the presence of multiple sources of potential contamination within and surrounding the project area, it is possible that localised contaminated material is encountered during road construction works.

In the event that soils at the project area will be excavated and require offsite disposal or reuse on or offsite, a soil classification assessment should be undertaken in accordance with EPA Publication IWRG702 (i.e. apply appropriate sampling density). Note, this can be undertaken during the construction phase for the project.

Figures 4A to 4C in Appendix A show the soil impacts plans assessed against the IWRG criteria.

9.2 ACID SULFATE SOIL

The desktop review identified the presence of prospective coastal acid sulfate soil from Road Section 4 up to Road Section 11. Documented geological mapping indicates the southern portion of the alignment comprises a Holocene aged geology consistent with that of coastal acid sulfate soils.

The field inspection undertaken did not identify visual signs of PASS with the exception of the presence of Common Reeds in water logged areas.

The results of the initial screening analysis for ASS (i.e. pH_F, pH_{FOX}, reaction rate and ΔpH) indicated in general the potential for ASS to be present within the southern portion of the alignment (i.e. sample locations SB20 to SB38). However, quantitative analysis by the SPOCAS analysis indicates the presences of ASS from sample locations SB11, SB18 to SB38 and the presence of ASS which has a neutralising capacity sufficient to have a net acidity below the action criteria within SB12 to SB17. Figures 8A to 8D in Appendix A shows the PASS impact plans for the northern, central and southern portions of the project area.

The reported SPOCAS results for a number of samples indicated the acid trail to be less than that of the sulfur trail. The reported results for reacted calcium and magnesium indicates this could be a result of the presence of organic matter.

However, based on the results of SPOCAS analysis (i.e. exceedance to at least one adopted action criteria), PASS are likely present only from SB11 to SB38 or from Mills Road (central portion) to the Springvale Road. The analytical results are consistent with the prospective coastal acid sulfate soil mapping. The reported net acidity from SB11 to SB38 ranged from 2 to 12.5 kg $CaCO_3$/tonne based on a bulk density of 1.8 tonne/m^3. Testing was not undertaken between Springvale Road and Thames Promenade, however it was inferred that similar results will be identified.

Assessment of groundwater chemistry was also undertaken within the project area. Elevated sulfate (and TDS) was identified at a number of monitoring wells largely located adjacent to the Waterways Estate wetlands (GW17-26-04 to GW17-26-10) suggesting that some level of CASS disturbance has occurred in the past. It is important to note that the HSU's have a large seasonal variation with levels dropping in summer months and levels gaining in winter months. Natural variation in the dataloggers installed within the project area is generally +/- 1.0 m, however indicators of widespread activation of CASS has not occurred.

It is inferred that greater than 1,000 tonnes of PASS is likely to be generated during the construction process and therefore in accordance with the Best Practice Guidelines for Assessing and Managing CASS (DELWP, 2010), the project area is classified as a High Hazard meaning that an ASS Management Plan (ASSMP) (a subset of the CEMP) approved by the EPA will be required where CASS disturbance cannot be avoided.

9.3 LANDFILL GAS

9.3.1 BULK GASES

9.3.1.1 METHANE (CH_4)

Methane exceedances were recorded in gas bores installed in the former Lot 1 Grange Road landfilled area (GB17-26-04, GB17-26-05 and GB17-26-06) . Given that these locations are either above or at the edge of the waste mass, the BPEM action level criteria of 1.0% v/v may not be relevant but has been applied as a conservative measure. Concentrations of methane in other monitoring wells to the north and to the south of the former Lot 1 Grange Road landfill (including adjacent to the former Din San and Barraton landfills were all below or close to the level of detection and all were below adopted BPEM criteria.

With the exception of the monitoring wells within the former Lot 1 Grange Road landfill area which were unable to be monitored, combined flow rates and methane concentrations resulted in a CS of 1 which is indicative of a very low risk.

The project area walkover recorded ambient CH_4 concentrations between 0.9 ppm to 4.9 ppm across the Lot 1 Grange Road property. A CH_4 concentration of 35.3 ppm was recorded within a manhole located to the west of the Enviromix site (refer to Photograph 1, provided in Appendix M). However, the concentration recorded was below the criteria of 10,000 ppm of methane within services.

The project area walkover recorded ambient CH_4 concentrations between 0.7 ppm to 1.2 ppm across the nursery site to the south of Lot 1 Grange Road (refer to Photograph 2, Appendix M); and between 1.7 ppm to 2.5 ppm within the open plot of land south of the nursery (refer to Photograph 3, Appendix M). Recorded ambient CH_4 concentrations were below the adopted criteria of 5,000 ppm within buildings and structures on the landfill and in adjacent areas.

9.3.1.2 CARBON DIOXIDE (CO_2)

During the October 2017 monitoring round, detectable concentrations of CO_2 were reported above the BPEM action level of 1.5% v/v in all gas bores with the exception of GB17-26-07. During the May 2018 monitoring round detectable concentrations of CO_2 were reported above the BPEM action level of 1.5% v/v in all gas bores with the exception of GB17-26-01, GB01 and GB41.

A background concentration was established for the project area based on the lowest of the reported CO2 results for GB17-26-01 and GB17-26-10 (i.e. 3.7% v/v). The resulting CO_2 action level is based on the 1.5% v/v plus the background concentration of 3.7% v/v. This equates to an action level of 5.2% v/v. Based on the CO_2 action level of 5.2% all locations within Lot 1 Grange Road (i.e. GB17-26-04, GB17-26-05 and GB17-26-06); to the north of Lot 1 Grange Road at one location (i.e. GB17-26-02); and to the west of the Din San Landfill (i.e. GB17-26-08 and GB17-26-09) were above the action level criteria.

The bores within Lot 1 Grange Road are installed within or in close proximity to the waste mass (i.e. within 20 m of the inferred waste extent) and as such, the BPEM action level criteria may not be relevant but has been applied as a conservative measure.

The elevated concentrations within the Lot 1 Grange Road property as well as the elevated concentrations identified to the west of the Din San Landfill (i.e. at GB17-26-08 and GB17-26-09) are considered to be due to the proximity of the bores to the waste mass associated with the former landfill beneath the Lot 1 Grange Road property and the former Din San Landfill respectively. Concentrations of CO_2 are expected to attenuate further away from the waste mass. Refer Figure 11, Appendix A.

9.3.1.3 CARBON MONOXIDE (CO) AND OTHER BULK GASES

CO concentrations were detected in three out of the 10 gas bores sampled (i.e. GB17-26-01, GB17-26-06 and GB17-26-08), with one CO concentration reported to be above the Safe Work Australia criteria of 34,000 µg/m^3 at gas bore GB17-26-08 located to the west of the former Din San Landfill during the 2017 monitoring round. The incomplete combustion of organic materials, including methane in landfill waste can result in the generation of CO. In addition, the absence of methane and hydrogen sulfide could be indicative of aerobic degradation by methanogens during periods of intermittent oxygen loading within the waste mass leading to fluxes of carbon monoxide and (to a lesser extent) carbon dioxide generation. Given the proximity of gas bore BG17-26-08 to the former Din San Landfill, the reported concentration maybe associated with this landfill; as opposed to gas migration from the Lot 1 Grange Road property.

HCN and NH_3 were not detected in any of the gas bores sampled including bores located within close proximity of the former Din San Landfill (GB17-26-08 to GB17-26-10), where HCN and NH_3 had historically been reported above laboratory detection limits (PJRA, 2016).

Concentrations of H_2S were recorded at two locations (i.e. GB17-26-04 and GB17-26-05) within the Lot 1 Grange Road property but were below the adopted criteria and hence are not considered to pose a human health or occupational exposure risk to workers during the construction and/or maintenance works post development. Further evaluation of potential risks is provided in Section 9.4.

9.3.2 TRACE GASES

Concentrations of trace gases did not exceed adopted HILs/HSLs (where criteria are available) for an open space land use setting.

In the absence of available criteria for an open space land use for other trace gases (i.e. chlorinated hydrocarbons and other volatile contaminants), concentrations were compared against the US EPA RSLs for industrial and residential uses. Some trace gas concentrations were identified to be above the adopted criteria primarily within the gas bores located within the Enviromix property (i.e. GB17-26-05 and GB17-26-05).

Trace gas concentrations were also reported above criteria at GB17-26-02 and GB17-26-08, refer Table 8.12, Section 8.3.2. It is considered that the identified concentrations at GB17-26-02 and GB17-26-08 may be associated with other nearby surrounding landfills. Whilst some analytes were reported above the adopted RSLs, the closest residential property from the proposed road alignment is approximately 550m. As such, the risk to residential users is considered to be low. The closest commercial property is the Enviromix operations and the nursery located to the south of Enviromix, which are expected to be vacated and any buildings present are expected to be demolished and removed prior to construction of the road alignment. As such, potential risks to future commercial occupants (given there will not be any) is considered to be low.

Further details and commentary regarding landfill gas risk are provided below in Section 9.4.

9.4 PRELIMINARY LANDFILL GAS RISK ASSESSMENT (LFGRA)

9.4.1 INTRODUCTION

Landfill gas is generated by the biodegradation of wastes in a landfill and generally comprises approximately 50% CO2 dioxide, 50% CH4 as well as other trace gases. CH4 gas is odourless and colourless within the atmosphere and at room temperature, and is explosive at concentrations between 5% by volume (the lower explosive limit or LEL) and 15% by volume (the upper explosive limit or UEL). A higher concentration of CH4 can quickly dilute to flammable levels and therefore presents a risk of explosion and/or fire.

CO_2 is also an odourless and colourless gas but unlike CH_4 is non-flammable. Carbon dioxide and methane are both considered to be asphyxiants. Asphyxiants are gases that can displace oxygen in confined spaces, thereby lowering the concentration of oxygen. If the concentration of oxygen becomes low enough, there is a risk of asphyxiation, which may lead to losing consciousness or death.

Landfill gas located in the waste mass of the landfill presents little risk to humans. However, when landfill gas migrates from within the landfill to sensitive receptors it can present a high risk of asphyxiation, explosion or fire as well as toxicological effects.

In addition to the generation of CH_4 and CO_2; H_2S can form whenever sulphur compounds are subject to reducing conditions. Sewers, stormwater drains and pits, and landfilled plasterboard may be sources of hydrogen sulfide. Incomplete combustion of organic materials, including CH_4 in landfill waste can also result in the generation of CO. CO can also be produced in landfill environments where intermittent oxygen fluxes into a landfill lead to aerobic degradation of waste by methanogens. This is often characterised by lower methane and hydrogen sulfide concentrations but elevated carbon dioxide.

The formation of NH_3 and HCN can occur via natural processes including nitrogen fixation and the degradation of cyanohydrins in vegetables sand fruits, respectively (NSW EPA 2012). The formation of HCN can also occur via the degradation of plastics containing nitrogen and/or it can be synthesised by the reaction of CH_4 and ammonia, or by the action of acid on organic cyanide salts (if present).

The Landfill BPEM identifies the following three primary exposure pathways that can impact on sensitive receptors:

- Pathway 1: Direct emission of methane (within landfill boundaries) into the atmosphere:
  - This occurs primarily as a result of the degradation of organic waste within the landfill cell and the subsequent seepage or leakage of CH_4 through the cell cap.
- Pathway 2: Sub-surface vapour migration by convection and subsequent indoor vapour intrusion (either directly through the base of structures or via Pathway 1 that subsequently migrate indoors):
  - This can occur due to the degradation of organic waste in the landfill cell and the subsequent leakage of CH_4 through the cell liner and along porous geological profiles (i.e. sandy layers).
  - It can also include the migration of methane through underground services such as stormwater drains and telecommunication lines. In this scenario, CH_4 can either be released directly into the atmosphere (within the project area boundary); or migrate laterally (under impervious surface soils) to offsite locations. Methane can infiltrate structures from the base, directly through underground services into the building or above via surface emissions into buildings, if released into the atmosphere.
- Pathway 3: Indoor vapour infiltration from contaminated groundwater below structures (or via Pathway 2).

It is plausible that methane generated within the landfill cell can dissolve into leachate and migrates beyond the landfill cell. Methane present in an aqueous state is volatile and can be released from the contamination plume. It is also possible that organic waste may be dissolved in leachate and migrate offsite. Methane can also become dissolved in groundwater as it migrates laterally through the sub-surface. Whether the leachate co-mingles with groundwater, the organic waste can migrate significant distances before methanogenic degradation occurs and subsequent exposure of CH_4 to human receptors via Pathway 2.

To assess the potential human health and/or environmental risks associated with the presence and migration of landfill gases to current project area users and/or surrounding residential properties, a preliminary landfill gas risk assessment (LGRA) has been completed. The LGRA comprised the following tasks:

- Data review
- Numerical modelling relating to gas generation and migration from the former Lot 1 Grange Road landfill
- Development of a conceptual site model (CSM)
- Hazard identification and risk screening. The objective of this task is to consider the information contained within the CSM, the sensitivity of the identified receptors and select appropriate emission target limits (expected to be the identified action levels above) and consider the potential impacts to each receptor
- Preliminary quantitative risk assessment. This task will include quantification of risks via the application of Lot 1 Grange Road numerical modelling results, the Landfill BPEM action levels and derivation of the gas screening values and characteristic gas situations from subsurface methane and carbon dioxide concentration data as well as flow rates.

9.4.2 APPROACH AND LEGISLATIVE FRAMEWORK

The guidance provided in the Landfill BPEM (EPA 2015) (refer to Section 6.4) is expected to be used as the 'default' for mitigating adverse impacts from landfills. Landfill operators and owners are expected to meet the objectives and required outcomes by implementing the relevant best practice measures described by the Landfill BPEM as 'suggested measures'. Further, EPA may require additional measures to be undertaken to protect the environment.

As detailed in Section 7.4.1, the following elements of the Landfill BPEM are considered to be relevant to the assessment of landfill gas risk at the project area:

- Buffer distances to buildings and structures for Type 2 (putrescible waste) of 500 m.
- Landfill gas action levels of:
  - 1% v/v methane and 1.5% v/v carbon dioxide above background concentration within the subsurface geology; and subsurface services at the landfill boundary
  - 10,000 ppm of methane within subsurface services on the landfill and in adjacent area
  - 5,000 ppm of methane within buildings and structures on the landfill and in adjacent areas; and
  - 1% v/v methane within buildings.

The recommended way to evaluate the level of risk posed by landfill gases from an individual site is to conduct a site-specific landfill gas risk assessment (LGRA). Guidance on how to complete a LGRA is provided in Appendix 2 of the Landfill Licensing Guidelines (EPA Publication 1323.3, September 2016), which outlines the following tasks:

- Development of a conceptual site model of the landfill and its surroundings
- Hazard identification and risk screening
- Basic quantitative risk assessment.

As gas bores GB17-26-04 to GB17-26-06 were installed directly above the waste mass area of the former Lot 1 Grange Road landfill and as per the recommendations of the Landfill BPEM, the action levels may not be directly relevant for these data points (i.e. GB17-26-04 to GB17-26-06). However, as a conservative approach using numerical modelling of gas generation and migration from the former Lot 1 Grange Road landfill has been applied for the preliminary LGRA, the Landfill BPEM action levels (as detailed above) have been applied. The potential impacts of the former Barraton and Din San landfills upon the planned Bypass were able to be characterised by monitoring points outside the orientation of these two landfills and within the footprint of the Bypass.

9.4.3 LANDFILL INVESTIGATION AREA

The investigation area extended over an approximate 1 km distance from the Dingley Bypass to Old Dandenong Road and is surrounded by several former landfills to the north, east, south-east and to the west, including the former Din San and Barraton Landfills. The proposed road design also intersects the Lot 1 Grange Road property (former unlined sand quarry and landfill). Current investigations indicate that the waste mass located underneath the Lot 1 Grange Road property extends to approximately 8m BGL; with the natural geology underlying the waste mass comprising the Tertiary Brighton Group (i.e. sand with trace clays). The data currently indicates that the road orientation does not cross landfill areas associated with the former Barraton and Din San properties. Former market gardens are also present adjacent to the Dingley Bypass end of the investigation area. Refer Figure 2A, Appendix A.

The site inspections completed during October 2017 and May 2018 observed that the northern portion of land adjacent to the Dingley Bypass was being utilised as a laydown area by Interflow Pty Ltd. South of the laydown area was the Lot 1 Grange Road property. To the south of Lot 1 Grange Road was a nursery; and south of the nursery was an open plot of land, with some minor construction occurring.

9.4.4 GEOLOGICAL AND HYDROGEOLOGICAL SETTING

A review of the geological data available on the Department of Economic Development, Jobs, Transport and Resources, Victoria – Earth Resources – Geovic website shows that the project area is underlain by the following geological units:

- Qg: Quaternary coastal lagoon deposits comprising silt, clay; dark grey to black; variably consolidated; deposited during the Holocene epoch.
- Qm1: Quaternary swamp and lake deposits comprising grey to black carbonaceous mud, silt, clay, minor peat; generally unconsolidated; rare dolomite; deposited during the Pleistocene to Holocene epochs.
- Qd1: Quaternary inland dune deposits comprising sand, silt, clay; friable to consolidated; well sorted; includes both lunette deposits and deposits of longitudinal dunes.
- Nbr: Tertiary aged Red Bluff Sandstone of the Brighton Group, comprising: sandstone; conglomerate; pale yellow and brown; fine to coarse grained, massive to well bedded; crossbedded; local ironstone; deposited during the Miocene Pliocene epoch.

Of note, within the Brighton Group, the Beaumaris Sandstone, formerly known as the Black Rock Sandstone, underlies the Red Bluff Sandstone.

Based on information obtained from Visualising Victoria's Groundwater (VVG) (www.vvg.org.au) in May 2018, the depth to groundwater at the project area is indicted to range from <5 m to 10 m below the surface. Standing water levels (SWL) for groundwater within the northern portion of the project area based on the October 2017 monitoring event, ranged from 1.18 mBTOC (GW17-26-02) and 2.78 mBTOC (GW17-26-01).

Groundwater monitoring wells installed as part of the broader groundwater investigation (WSP 2018) along the proposed Mordialloc Bypass alignment (excluding the northern portion), identified groundwater levels to range from 1.12 mBTOC to 5.9 mBTOC over two monitoring events completed in August/September 2017 and November 2017, respectively.

The regional groundwater flow is expected to be towards the south and south-west based on the topography of the project area and the direction and distance to Port Phillip Bay (i.e. ~2.8 km south-west of the project area). It is noted that Dunlop drain is located to the north of the Lot 1 Grange Road property and as such, localised shallow groundwater flow may be towards the north and north-west.

9.4.5 BORE NETWORK

The landfill gas monitoring bore network consists of 10 gas bores (GB01 to GB10) (refer to Figure 7, Appendix A). Three gas bores were installed within the Lot 1 Grange Road property (GB17-26-04 to GB17-26-06) and seven gas bores were installed along the investigation area and proposed alignment (i.e. GB17-26-01, GB17-26-02, GB17-26-03, GB17-26-07 to GB17-26-10). We note that during the May 2018 round of monitoring, the bores on the Lot 1 Grange Road property were unable to be monitored and only contribute to the dataset for the October 2017 round of monitoring.

Where possible, the soil gas bores were installed linearly along the proposed alignment to intersect and monitor any potential landfill gas migration that may be occurring. Gas bore GB17-26-01 was installed to monitor for background concentrations of carbon dioxide. All soil gas bores were installed to depths ranging from 2 mBGL to 4 mBGL.

In addition to the above network, a further six monitoring wells located to the west of the former Din San landfill (GB01, GB02, GB03, GB04, GB30 and GB41) were utilised during the May 2018 monitoring round.

9.4.6 LANDFILL GAS MONITORING

A landfill gas monitoring event was conducted on 09, 10 and 20 October 2017. This comprised the monitoring of landfill gases via a portable landfill gas analyser; as well as the active sampling of the gas bores using an evacuated canister. Methane was detected in elevated concentrations in monitoring wells installed directly above or immediately adjacent to the waste mass (between 52.9%v/v in GB17-26-06 and 67.4%v/v in GB17-26-05). Further away from the waste mass, sub-surface methane concentrations were greatly reduced (maximum of 1.0%v/v in GB17-26-09 which may have been attributed to the adjacent former Din San Landfill to the south of the site). Surface methane monitoring across the site found only background concentrations with the exception of a concentration of 35.3 parts per million which was recorded in a manhole to the west of the former Lot 1 Grange Road Landfill.

Carbon dioxide concentrations were also elevated around the landfill site (between 27.2%v/v in GB17-26-04 and 40.2%v/v in GB17-26-06). Carbon dioxide was also generally elevated in other monitoring wells further away from the site. This may partially be the result of releases from surrounding former landfills, decomposition of old swamp deposits and re-emission of carbon dioxide moving out of solution in groundwater.

Low concentrations of carbon monoxide and hydrogen sulphide were recorded in several monitoring wells across the site. A large concentration of carbon monoxide was identified to the west of the former Din San Landfill (inferred to have migrated from Din San and not sourced from the Lot 1 Grange Road Landfill). Hydrogen Cyanide (HCN) and NH_3 were not detected in any gas monitoring bores during the monitoring rounds.

Concentrations of trace gases did not exceed adopted Health Investigation Levels and Health Screening Levels outlined in the ESA (where criteria are available) for an open space land use setting.

In the absence of available criteria for an open space land use for other trace gases (i.e. chlorinated hydrocarbons and other volatile contaminants), concentrations were compared against the US EPA Regional Screening Levels (RSLs) for industrial and residential uses. Some trace gas concentrations were identified to be above the adopted criteria primarily within the gas bores located within the Lot 1 Grange Road landfill property (i.e. GB17-26-05 and GB17-26-05).

Trace gas concentrations were also reported above criteria at GB17-26-02 and GB17-26-08. It is considered that the identified concentrations at these two locations may be associated with other nearby surrounding landfills. Whilst some analytes were reported above the adopted RSLs, the closest residential property from the proposed road alignment is approximately 550 m. As such, the risk to residential users is considered to be low. The closest commercial property is the Enviromix and the nursery located to the south of Enviromix, which are expected to be vacated and any buildings present are expected to be demolished and removed prior to construction of the road alignment. As such, potential risks to future commercial occupants (given there will not be any) resulting from emission of trace gases is considered to be low.

During the October 2017 round of monitoring, dissolved methane concentrations were analysed from samples collected from landfill leachate (LW17-26-01) and groundwater (GW17-26-01 and GW17-26-02). The results demonstrate leachate held elevated dissolved methane concentrations (8.28 mg/L) and groundwater had substantially less concentrations (between <0.01 mg/L and 0.124 mg/L).

An additional round of surface, sub-surface and service trench landfill gas monitoring was undertaken in May 2018. The surface gas monitoring is discussed in detail in Section 7.3.1 of this ESA. The monitoring area included the full extent of the former Lot 1 Grange Road landfill as well as sections of the alignment to the north which were bound by former Barraton and Din San landfills. The results of the monitoring were generally around background concentrations with a minor spike of 104 ppm in front of the existing office building on the Enviromix property.

Sub-surface landfill gas monitoring during the May 2018 involved recording of bulk gas concentrations and flow rates in seven gas monitoring wells installed by WSP and six pre-existing gas monitoring wells on the western boundary of Din San Landfill. This round of monitoring did not include monitoring of three gas monitoring wells on the former Lot 1 Grange Road Landfill for reasons already discussed in this document. The monitoring found that methane concentrations along the alignment outside the footprint of the former Lot 1 Grange Road landfill were predominantly non-detect with only one monitoring well (GB17-26-09) holding a methane concentration above detection (0.4 %v/v). This concentration was below the adopted site criteria. Carbon dioxide concentrations were elevated in the majority of monitoring wells ranging from 0.2 %v/v in GB41 to 22.8 %v/v in GB17-26-09. With the exception of a significant negative flow rate in GB17-26-01 (-26.0 L/hr), flow rates were generally very low (i.e. between 0.0 L/hr and -0.7 L/hr).

Landfill gas monitoring of service pits and drains with a flame ionisation detector was undertaken during the May 2018 monitoring event. Elevated (though not exceeding) concentrations of volatile compounds ranging from 29.6 ppm to 33.2 ppm were identified in two drain grates. This indicates the potential for underground services within the alignment potentially acting as a migration pathway for landfill gas.

9.4.7 NUMERICAL MODELLING

In order to better characterise the direct impact of the road construction on landfill gas production and migration at the former Lot 1 Grange Road landfill WSP undertook numerical modelling of key components of the gas production and migration regime. The different aspects related to landfill gas risk from the former Lot 1 Grange Road landfill included the following:

- Modelling of landfill gas generation rates over time within the identified waste mass in the portion of the former Lot 1 Grange Road Landfill within the roadway construction footprint
- Calculation of emission rates through the existing surface filling only versus through the surface filling and the proposed roadway and changes resulting from altered permeability of surface materials; and
- Potential for groundwater to act as a secondary migration pathway for methane and carbon monoxide.

The capacity for generation (and subsequently emission) of landfill gas within the waste mass was derived through the application of the LandGEM Landfill Gas Emission Model (Version 3.02) which was developed by the United States Environmental Protection Agency Clean Air Technology Centre.

The California Landfill Methane Inventory Model (CALMIM) Version 5.4 was applied to quantify likely changes to surface gas emission within the footprint of the roadway before and after construction. CALMIM is maintained by the United States Department of Agriculture. It is a one-dimensional process-based annual inventory model for landfill methane emissions which factors in seasonal variability in methane oxidation.

The potential for methane to become dissolved in groundwater (and thus groundwater to become a secondary pathway for landfill gas migration) was quantified through application of a methane solubility tool developed by the WSP project team. The tool uses site-specific groundwater and atmospheric data to simulate the interactions between multiple parameters to affect the potential for methane to become dissolved in groundwater. It recognises the interactions between salinity and temperature in water as well as pressure and gas concentration at the water – atmosphere interface to affect the potential dissolved methane concentration in water.

We note that due to the nature and age of the former landfill there is limited information relating to details of waste deposition, volumes of waste and rate of deposition. As a result, relevant input data had to be extrapolated from secondary information sources (for example historic aerial photographs, past contamination reports and drilled boreholes). The issue related to available data in itself is a limitation which should be considered when applying the results of this modelling.

For more information relating to modelling capabilities and input parameters specific to this project refer to WSP (February 2018), Landfill Gas Risk Assessment – Former Lot 1 Grange Road Landfill, Mordialloc Bypass. The findings are incorporated with field and analytical results in the CSM and hazard identification and risk screening sections below.

9.4.8 CONCEPTUAL SITE MODELS (CSM)

The following CSMs has been developed to consider landfill gas risks based on the following parameters for the former Lot 1 Grange Road, Din San and Barraton Landfills.

Table 9.1 Former Lot 1 Grange Road Landfill Summary of risk factors and source-pathway-receptor scenarios

RISK FACTOR	DETAIL
Source Risk Factors	
Age of Filling	Approximately 49 years
Nature of Waste	Solid/liquid industrial, putrescible waste
Scale of Filling	Maximum depth if waste mass is ~8m
Gas Mitigation Measures	Existing soil cover. No engineered vapour mitigation measures
Pathway Risk Factors	
Volatilisation and Atmospheric Dispersion	Landfill gas emission through landfill cap and air dispersion
Volatilisation and enclosed space accumulation	Lateral migration of landfill gas and offsite emissions and accumulation in commercial buildings and sub-surface structures (service trenches)
Vertical migration of leachate into groundwater. Lateral migration of groundwater	Vertical and lateral migration of contaminants from leachate/waste mass into groundwater.
Receptor Risk Factors	
Human Health – planned Mordialloc Bypass	Earthworks and construction workers during the construction phase of the Mordialloc Bypass. Users of the bypass during standard operational phase. Maintenance and utility workers during the standard operational phase.
Human Health – commercial/industrial properties	Commercial workers to the south of the Lot 1 Grange Road (Enviromix) property.
Human Health – commercial/maintenance/ utility workers	Construction/maintenance/utility workers working onsite or in the vicinity of the project area, working on the proposed road construction during development; and post development, maintenance/utility workers within service trenches etc.
Surface water	Surface water features located within the central and southern portions of the project area located approximately 4.5 km from the Barraton Property (i.e. Braeside Park Wetlands, Waterways Estate), the Mordialloc Creek (located ~5.5 km from the Lot 1 Grange Road property), and Dunlop's Drain immediately to the north.
Groundwater including extraction bores	Groundwater beneath and nearby to the project area. Shallow Segment A1 Aquifer; and potential nearby groundwater extractive uses. Groundwater is reportedly used for irrigation at the nearby Peninsula Kingswood Country Golf Club, located approximately 370 m south-east of the Former Din San Landfill.

Table 9.2 Former Din San Landfill Summary of risk factors and source-pathway-receptor scenarios

RISK FACTOR	DETAIL
Source Risk Factors	
Age of Filling	Operated as a sand quarry in mid-1950s. Approximately 26 years (commenced landfilling in 1992 and ceased in June 2012)
Nature of Waste	Five engineered cells (Cell 1, 2, 3, 4A). Stated to be filled with solid inert waste in 2016 Peter J. Ramsay Audit Report
Scale of Filling	Cells located in east and west of the site area. Fill depth included Cell 1: 18m, Cell 2: 17 m, Cell 3: 11m and Cell 4A: 11 m.
Gas Mitigation Measures	All five cells are unlined. Inferred suitable capping (Cells 2 and 3 capped in 2004), Cell 1 capped in 2008. Stage 4A capped in 2012 (landfilling ceased after this time). In August 2015, VIC EPA issued ESC with a PAN (90006313) relating to elevated methane concentrations above Cells 1, 2 and 4A. By November 2015, EPA was satisfied that ESC had rectified the issues. There is currently an ongoing monitoring program in place on the landfill as part of the Post-Closure Management Plan which incorporates a landfill gas management plan in accordance with PAN 90003832.
Pathway Risk Factors	
Volatilisation and Atmospheric Dispersion	Landfill gas emission through landfill cap and air dispersion
Volatilisation and enclosed space accumulation	Lateral migration of landfill gas and offsite emissions and accumulation in commercial buildings and sub-surface structures (service trenches)
Vertical migration of leachate into groundwater. Lateral migration of groundwater	Vertical and lateral migration of contaminants from leachate/waste mass into groundwater.
Receptor Risk Factors	
Human Health – planned Mordialloc Bypass	Earthworks and construction workers during the construction phase of the Mordialloc Bypass. Users of the bypass during standard operational phase. Maintenance and utility workers during the standard operational phase.
Human Health – commercial/industrial properties	Current and future site users including proposed playing field above Cell 1 and 2 and Paintball business above Cell 3.
Human Health – commercial/maintenance/ utility workers	Construction/maintenance/utility workers working onsite or in the vicinity of the project area, working on the proposed road construction during development; and post development, maintenance/utility workers within service trenches etc.
Surface water	Surface water features located within the central and southern portions of the project area located approximately 4.5 km from the Barraton Property (i.e. Braeside Park Wetlands, Waterways Estate), the Mordialloc Creek (located ~5.5 km from the Lot 1 Grange Road property), and Dunlop's Drain 200m to the north.
Groundwater including extraction bores	Groundwater beneath and nearby to the project area. Shallow Segment A1 Aquifer; and potential nearby groundwater extractive uses. Groundwater is reportedly used for irrigation at the nearby Peninsula Kingswood Country Golf Club, located approximately 370 m south-east of the Former Din San Landfill.

Table 9.3 Former Barraton Landfill Summary of risk factors and source-pathway-receptor scenarios

RISK FACTOR	DETAIL
Source Risk Factors	
Age of Filling	Approximately 18 years
Nature of Waste	Former sand extraction pit. No available information about waste composition
Scale of Filling	Unknown
Gas Mitigation Measures	Unknown
Pathway Risk Factors	
Volatilisation and Atmospheric Dispersion	Landfill gas emission through landfill cap and air dispersion
Volatilisation and enclosed space accumulation	Lateral migration of landfill gas and offsite emissions and accumulation in commercial buildings and sub-surface structures (service trenches)
Vertical migration of leachate into groundwater. Lateral migration of groundwater	Vertical and lateral migration of contaminants from leachate/waste mass into groundwater.
Receptor Risk Factors	
Human Health – planned Mordialloc Bypass	Earthworks and construction workers during the construction phase of the Mordialloc Bypass. Users of the bypass during standard operational phase. Maintenance and utility workers during the standard operational phase.
Human Health – commercial/industrial properties	Commercial workers on the Barraton property.
Human Health – commercial/maintenance/ utility workers	Construction/maintenance/utility workers working onsite or in the vicinity of the project area, working on the proposed road construction during development; and post development, maintenance/utility workers within service trenches etc.
Surface water	Surface water features located within the central and southern portions of the project area located approximately 4.5 km from the Barraton Property (i.e. Braeside Park Wetlands, Waterways Estate), the Mordialloc Creek (located ~5.5 km from the Lot 1 Grange Road property), and Dunlop's Drain immediately to the north.
Groundwater including extraction bores	Groundwater beneath and nearby to the project area. Shallow Segment A1 Aquifer; and potential nearby groundwater extractive uses. Groundwater is reportedly used for irrigation at the nearby Peninsula Kingswood Country Golf Club, located approximately 370 m south-east of the Former Din San Landfill.

9.4.9 HAZARD IDENTIFICATION AND RISK SCREENING

The source, pathway and receptor risk factors identified in Table 9.1, 9.2 and 9.3 have been reviewed in detail and commentary is provided below regarding any potential linkage(s) identified that may result in a potentially unacceptable risk. The source and pathway linkages have been split between the former Lot 1 Grange Road landfill and the former Din San and Barraton landfills. This split is due to the inferred greater risk to the development associated with the former Lot 1 Grange Road landfill due to the planned Bypass being constructed over the top of the waste mass.

9.4.9.1 SOURCE

FORMER ENVIROMIX LANDFILL

The discussion relating to source characterisation is based on limited desktop information (most notably URS 2005, Statement of Evidence Relevant to VCAT – Assessment of Leachate Sources Influent to Barraton Clean Backfill Operations, Junction Road, Dingley) (URS 2005) as well as the intrusive investigations and groundwater and landfill gas monitoring carried out by WSP in 2017 along the alignment of the planned Mordialloc Bypass. Refer to Figure 3 in Appendix A-1 for Conceptual Cross Section of subsurface stratigraphy across the planned road alignment.

The landfill area underlying the planned roadway alignment forms the western end of the former Lot 1 Grange Road Landfill. The landfill covers the footprint of a former sand quarry and was filled between 1975 and 1980 with mixed industrial solid waste, liquid waste with some municipal solid waste noted during the field investigation. There is limited information available as to the composition of the waste.

According to URS 2005 the maximum depth of waste on the site is approximately 10 metres below the ground level. Based upon an aerial photograph from 1974 showing the sand quarrying operation, what are inferred to be sizeable water-filled pits were present in the eastern portion of the site. This indicates that the deepest part of the quarry (and thus inferred to be the zone of thickest waste) was in the east of the site.

Based upon the boreholes and monitoring wells installed during the WSP investigation works (refer to Figure 2 of Appendix A-1 of this report) the waste mass was thinnest towards the western boundary (represented by borehole B17 68421) with a waste thickness of 1.2 metres. The remaining boreholes which intercepted the waste mass with a thickness range of between 4.25 metres and 5.5 metres. This information lends weight to the hypothesis of gradual increase of waste depth towards a deep point in the east of the landfill site.

During the field investigations in 2017 WSP found the waste material to be highly variable in composition and consistency. Notable components of the waste included broken glass, aluminium cans, car parts, plastic, carpet, organic matter, cables and wood mixed with sand and clay.

During the 2017 field investigations, it was noted that a large proportion of the waste mass was close to saturated with water and leachate and overlying waste described as moist. A single sample collected from B17-68397 at 3.0 metres below ground level (within the moist portion of the waste mass) returned a moisture content of 21.1%. No samples were tested for moisture content within the leachate/groundwater saturated waste mass, however the depth where waste saturation is encountered corresponds with URS 2005 where the author references a Sinclair Knight Merz report from 1997 which indicates groundwater on-site to be within three metres of the ground surface.

The peer reviewed literature on the subject as well as project team experience on other landfill sites has demonstrated a strong link between moisture content and the expanse of time over which a landfill waste mass will produce gas. This is because methanogenic anaerobes have optimal moisture limits within which they generally prefer to operate. If the waste is either too dry or too wet, the rate of biodegradation will be significantly reduced. This means that landfill gas is produced in smaller volumes but it also means that production will take place over a substantially extended time period.

Because of the variability in moisture content, WSP undertook an assessment of landfill gas generation rates based on the waste mass beneath the planned bypass comprising a moist and a saturated component. WSP employed LandGEM (a model developed by the US Environmental Protection Agency) to calculate landfill gas emission rates over time for both components of the waste mass.

The results of modelling the two separate components of the waste demonstrate a substantial difference in generation rates and life expectancy. The modelling found that the moist waste mass reached peak production around 1980 and production rates dropped off sharply so that by around 2030 the shallow moist waste will be producing negligible volumes of landfill gases.

Meanwhile, while the peak in methane in the saturated waste is estimated at slightly over 18 tonnes per annum (versus approximately 30 tonnes per annum for the moist waste) and the peak is roughly around the same time, the rate of degradation is clearly much slower. The modelling indicated that if the saturated waste continued to remain in a saturated state over the course of its gas production lifespan, the material will continue to produce elevated volumes of landfill

gases past the modelled period (i.e. beyond 2050). This indicates that any monitoring, management or mitigation options to be put in place for and in response to changes resulting from the planned bypass should be adequately designed for landfill gas being a long term issue on the site (albeit at slowly decreasing rates of production).

It should be noted however, that the estimates presented in this assessment may be better refined through further characterisation of the waste mass within the planned alignment. If new information is made available through excavation works or additional investigations these may be used to further refine the outputs of this modelling.

FORMER BARRATON AND DIN SAN LANDFILLS

According to the Peter J. Ramsay 2016 Audit Report (PJRA, 2016) the Din San property was utilised as a sand quarry in the mid-1950s and landfilled between 1992 and 2012. The landfilling is understood to have comprised inert solid waste which was filled in four discrete engineered cells (Cells 1, 2, 3 and 4A) with Cells 1 and 2 filled first and situated in the east of the site and Cells 3 and 4A situated in the west of the site and filled last. It is understood that final caps have been constructed over Cells 1, 2 and 3 but Cell 4A may only be covered with a temporary cap (unknown as the Audit report dates back to 2016).

All five cells are understood to be unlined. In August 2015 VIC EPA issued ESC (the site owner) with a PAN (90006313) relating to elevated methane concentrations above Cells 1, 2 and 4A. By November 2015 EPA was satisfied that ESC had rectified the issues. There is currently an ongoing monitoring program in place on the landfill as part of the Post-Closure Management Plan which incorporates a landfill gas management plan in accordance with PAN 90003832.

Recent gas monitoring data at the former Din San landfill undertaken by Compass and detailed in Peter J. Ramsay's 2016 Audit report concluded that the methane CS in gas bores presented a low to very low risk with the exception of GB7 and GB8 which were classified as moderate risk. We note however that GB5 and GB8 are located between approximately 50 m and 150 m to the east of the planned Bypass footprint. Similarly most CS calculated for carbon dioxide concluded low to very low risk with the exception of monitoring bores GB32, GB33 and GB34 with high risk ratings (between 60 m and 120 m to the east of the planned Bypass footprint.

Very little information is available around the nature of filling at the former Barraton landfill to the west of the planned Bypass. Landfilling commenced in the early 1990s. The date of completion of landfilling is unknown and the volume, location or type of material brought onto site is unknown. WSP is unaware of any information available relating to landfill gas production within the waste mass, historic data relating to monitoring of migration pathways or any form of gas mitigation (if required).

9.4.9.2 PATHWAY

FORMER LOT 1 GRANGE ROAD LANDFILL

As part of our investigations to date WSP have identified a number of landfill gas migration pathways which have the potential to be impacted by the planned bypass development. The following section details identified potential pathways and the inferred risk in relation to the planned bypass above the former Lot 1 Grange Road landfill.

The cross section (based on borehole logs from the WSP 2017 investigations) shows that the identified waste mass is unlined and is predominantly bounded by sandy highly permeable soils. The surface filling overlying the waste mass comprises a 2.0 to 2.5 metre thick layer of sandy clay and gravel. CALMIM modelling (as discussed in Section 2.2) demonstrates that the existing surface filling has the potential to emit approximately 70 tonnes of methane per annum (i.e. 70 tonnes of methane per annum which is not migrating laterally, entering service trenches or dissolving into groundwater). The model predicts that in the event of the bypass being constructed with no landfill gas extraction controls, this emission rate will drop to less than a tonne per year.

We note that the LandGEM modelling for the site currently predicts substantially less volumes of methane are being produced within the waste mass than the emitting capacity of the existing surface filling (approximately 10 tonnes per year). However, the modelling clearly demonstrates that the bypass will effectively remove what was likely the primary means of landfill gas emission from the waste mass.

The single monitoring round carried out to date by WSP indicates that lateral migration of landfill gas through the sandy geology was not taking place at the locations where monitoring points were installed during the monitoring round. This is possibly due to the surface filling currently acting as the preferential pathway for migration. In its current form, the planned bypass will likely cut off this preferential pathway. Due to the porous nature of the surrounding geology it is considered that landfill gas produced within the waste mass will largely begin migrating laterally.

Based on the available information migration will likely take place in a diffuse manner through the unconsolidated sands. Geological data available does not indicate that the sands are confined. This information and the predicted lower (albeit consistent) rates of methane production indicates that it is likely that landfill gas emitted through the sub-surface will not migrate a substantial distance through the geology before passively emitting at the surface, entering voids or dissolving into groundwater. Based upon this it is considered that any controls targeting the surrounding sub-surface geology would best be focussed either near the landfill boundary or at identified secondary pathways that may intersect that zone of higher lateral migration risk.

Groundwater is often identified as a secondary migration pathway for methane. This is largely due to the limitations with regards to methane's ability to dissolve into groundwater. As an example, carbon dioxide (another landfill gas of interest for this project) can dissolve into water to concentrations of up to 1,450 mg/L due to its ability to form carbonates and bicarbonates in water. In comparison however, the maximum concentration at which methane is able to dissolve into water is approximately 25 mg/L.

The ability of methane to dissolve into water is governed predominantly by the salinity and temperature of the water and the concentration of methane, humidity and pressure at the water-atmosphere interface.

While methane can only dissolve into groundwater in limited concentrations it has the capacity to travel over longer distances in this medium and to accumulate slowly beneath slabs and in voids until it becomes a hazard.

Dissolved methane sampling was undertaken at one on-site leachate point and two groundwater monitoring wells. The results are presented in the following table.

Table 9.4 Dissolved methane results

SAMPLE LOCATION	PROXIMITY TO THE SITE	DISSOLVED METHANE CONCENTRATION
LEACHATE	Leachate sample collected on-site from LW17-26-01	8.28 mg/L
GW17-26-01	Southern boundary of the Lot 1 Grange Road landfill	0.124 mg/L
GW17-26-02	220 m to the south of the site	<0.01 mg/L

The results demonstrate that the leachate generated on the site has the capacity to contain dissolved methane even with the inferred elevated salinity and temperature which act as limiters to methane dissolution. The two monitoring wells sampled at the southern site boundary and further to the south demonstrate that methane is currently not migrating to these locations in elevated concentrations (though groundwater is inferred to flow to the north and north-west towards Dunlop's Drain).

WSP used site specific data to calculate the potential for methane to become dissolved in groundwater migrating off-site (refer to Section 2.3 for details). The results of the calculations indicated that the groundwater surrounding the site has the capacity to hold between 11 mg/L and 15 mg/L of dissolved methane. Based upon these calculations and the methane concentration in leachate there is potential for groundwater to act as a secondary pathway for methane migration.

No field testing of carbon dioxide concentrations in groundwater were undertaken as part of the investigation works. However, the ratio of methane to carbon dioxide in bulk gas sample locations GB17-26-04 and GB17-26-05 are indicative of carbon dioxide becoming dissolved in water. Elevated concentrations of carbon dioxide as bulk gas in the absence of methane in monitoring wells off-site could also be an indicator of migration of carbon dioxide through groundwater, however, due to the proximity of several landfills to these locations the source of these emissions cannot be confirmed.

Elevated but not exceeding concentrations of methane have already been detected in a service trench off-site to the west. As indicated above, due to the predicted drop in surface gas emission resulting from the construction of the planned bypass over the existing surface filling, there is expected to be an increase in lateral migration. This increased lateral migration is anticipated to increase the risk of infiltration of landfill gas into existing underground services, voids and conduits on and immediately adjacent to the site. Moreover, without necessary controls, it is considered that any conduits constructed under the roadway and above the waste mass will also become a preferential pathway for gas migration.

Landfill gases which enter conduits and similar voids have the capacity to change the atmosphere in those enclosed spaces. Longer linear conduits can also allow landfill gas to migrate over longer distances than it otherwise would which could lead to impacts to sites and receptors a substantial distance away from the original source.

FORMER BARRATON AND DIN SAN LANDFILLS

Historic monitoring data from the former Din San landfill indicates a history of elevated gas risk for methane (CS indicating moderate risk) and carbon dioxide (CS indicating high risk) to the east of the planned Bypass footprint. However long term monitoring data provided by Peter J. Ramsay in his 2016 Audit report for gas monitoring bores within the footprint of the planned Bypass indicates very low to medium risk based on the modified Wilson and Card Characteristic Gas Situation tool (refer to the summary table below).

Table 9.5 Summary sub-surface gas results from Peter J. Ramsay 2016 Dataset

MONITORING POINT	METHANE (ALL RECORDED MONITORING ROUNDS)	CARBON DIOXIDE (ALL RECORDED MONITORING ROUNDS)
GB01	Very Low	Low
GB02	Very Low	Medium
GB03	Very Low	Medium
GB29	Unable to be Monitored	Unable to be Monitored
GB30	Very Low	Low
GB40	Very Low	Low
GB41	Very Low	Low

This is reflected by the May 2018 sub-surface gas monitoring round undertaken by WSP which show all methane results for GB01, GB02, GB03, GB04, GB30 and GB41 indicating very low risk and for carbon dioxide, low to very low risk.

Surface gas monitoring within the planned Bypass footprint in May 2018 lying outside the former Lot 1 Grange Road landfill found no elevated concentrations of flammable gases (inferred to represent methane) venting at the surface.

Based upon the information available to date, the former Din San landfill is producing elevated concentrations of landfill gases but they do not currently appear to be migrating onto the proposed Bypass area. There is currently no available information relating to gas production or migration from the former Barraton landfill, however monitoring data does not indicate that it is migrating onto the proposed Bypass footprint.

9.4.9.3 RECEPTORS

The information collected to date relating to surface and sub-surface gas concentrations as well as source and pathway interactions indicate that the planned bypass will impact the existing gas migration regime on and off the site particularly in relation to the former Lot 1 Grange Road landfill. This is anticipated to lead to changes in how landfill gas generated at the Lot 1 Grange Road Landfill will interact with potential human and ecological receptors. The following sections outline how these receptors may be impacted.

Human health risks associated with landfill gas generated from the Lot 1 Grange Road Landfill can be split into two main categories:

- Risks to the planned bypass and human receptors using or working within its boundaries; and
- Risks to other receptors resulting from changes to gas migration regimes following construction of the bypass.

The saturated portion of the Lot 1 Grange Road waste mass is anticipated to continue producing landfill gas in reasonable volumes past 2050. Thus, gas will continue to accumulate beneath the impermeable surface of the planned bypass before migrating laterally through the geology, through service pits or dissolved in the groundwater. As such explosion risk associated with explosive concentrations of gases and ignition sources along the roadway (e.g. cigarette butts, fires or spark or flame emitting roadworks) may increase the potential risk of fires and explosions.

Due to the roadway construction it is anticipated that the landfill gas which would traditionally have vented through the surface filling will migrate through alternative pathways (namely laterally through the geology, dissolved in groundwater and through underground voids such as service conduits. As a result, the risk of an increase in flow rates and concentrations through these migration mediums is anticipated.

The sandy and unconfined nature of the surrounding geology mean that only nearby receptors or secondary pathways are likely to be affected by landfill gas migrating laterally out of the site. Based on current landuse in the area, there are limited immediate human receptors beyond the site boundaries which are likely to be substantially affected by laterally migrating landfill gas (predominantly vacant land to the immediate north and more landfills to the east, west and south).

However, the anticipated increased migration of landfill gases into groundwater and service trenches may increase the extent of potential migration. Landfill gas can travel substantial distances relatively quickly through service trenches and become an issue for both human receptors accessing those conduits and also infrastructure which may intersect them.

Human receptors down-hydraulic gradient from the landfill have the potential to be affected by methane dissolved in groundwater which can slowly accumulate under slabs and within underground voids and other enclosed spaces over time. The potential migration of gas from Lot 1 Grange Road as well as Din San and Barraton former landfills entering underground services is an identified potential risk which will need to be controlled for during and following development of the roadway.

It is anticipated that some dissolved methane will enter Dunlop’s Drain immediately to the north of the site, however deeper impacted groundwater will likely continue to flow downgradient and affect potential human receptors.

The planned bypass is not anticipated to substantially impact the rate of gas generation or the volume of methane, carbon dioxide and other bulk and trace gases to be produced over time. As a result it is not considered that the planned bypass will increase or decrease the volume of gases entering the surrounding environment over time. Therefore the implications with regards to landuse change and greenhouse gas emission (and subsequent contribution to climate change) are considered to be negligible.

Due to the inferred porous nature of the surrounding geology and its unconfined nature it is believed that increased volumes of landfill gas will migrate laterally in a generally diffuse manner and vent passively at the surface close to the landfill. As a result, WSP do not anticipate the changed gas migration regime will substantially impact terrestrial ecosystems around the landfill.

9.4.10 RISK QUANTIFICATION

9.4.10.1 FORMER LOT 1 GRANGE ROAD LANDFILL

Based upon the available data and qualitative and quantitative interpretation thereof, WSP consider that the section of the Mordialloc Bypass to be constructed above the former Lot 1 Grange Road Landfill will significantly impact how gas emits from the western portion of the former landfill. The main risks identified by the assessment can be summarised as follows:

- Risk to workers during the construction of the bypass
- Gas accumulation beneath planned roadways presenting a fire and explosion risk for users and workers
- Migration of gas into service trenches, voids and conduits increasing the potential for long-distance migration of gas away from site and risk to workers accessing those conduits
- Dissolution of methane and carbon dioxide into groundwater impacting the water quality of Dunlop's Drain and also potentially migrating further downgradient and impacting off-site receptors.

WSP recommend the following actions be taken to reduce the residual landfill gas risk associated with the former Lot 1 Grange Road Landfill along this section of the Mordialloc Bypass:

- Preparation and implementation of Construction-phase Landfill Gas Environmental Management Plan for the affected section of the bypass outlining management protocols and monitoring systems to mitigate risk associated with landfill gas.
- Specific monitoring and risk mitigation requirements to be implemented during the construction phase to reduce landfill gas risk to site workers, plant and equipment.
- Installing a gas drainage blanket or a series of trenches beneath the roadway with appropriate venting (e.g. stacks or biofiltration) to minimise accumulation below roadways as well as minimising potential for the development altering the gas migration regime.
- Gas protection infrastructure installed in all underground services, pits and other voids installed within the road alignment which may include sealing (e.g. geomembranes, etc.) and sealing of conduits and pits (where applicable) entering and leaving the site area.
- Preparation and implementation of an Operational-phase Environmental Management Plan for the affected section of the bypass which outlines procedures for any future works within the target area, means of protection of inground gas protection/mitigation systems and monitoring requirements.
- Implementation of a monitoring program (surface, sub-surface and internal/underground voids, pits and service trenches) to assess ongoing risk associated with landfill gas generated by the former Lot 1 Grange Road Landfill. The details of the monitoring program are to be presented in full in the OEMP document.

9.4.10.2 FORMER BARRATON AND DIN SAN LANDFILLS

WSP note that monitoring of sub-surface landfill gas concentrations within the planned Bypass footprint outside of the Lot 1 Grange Road site indicates a very low to low risk for development in these areas. As such it is considered that the primary landfill gas risk relating to the development from the adjacent former Din San and Barraton landfills is the migration of gas into service trenches within the alignment.

Based upon the investigation findings it is considered that the primary control for sections of roadway between the former Din San and Barraton landfills is to consider that service pits, trenches and open excavations within the footprint of the planned Bypass be treated as confined spaces with potentially hazardous atmospheres. This should be incorporated into both construction and operational-phase worker health and safety and environmental documentation along with required controls, monitoring and personal protective equipment.

9.5 GROUNDWATER

9.5.1 GROUNDWATER INVESTIGATION IN FORMER LANDFILLED AREAS

The former landfill area is located within the outcropping Brighton Group Sediments. At this location, the UTAF is unconfined with standing water levels (SWL) for groundwater within the northern portion of the project area based on one monitoring event, ranged from 6.92 mBTOC (GW17-26-01) and 10.06 mBTOC (GW17-26-02).

Groundwater flow direction is largely topographically driven with regional groundwater flow inferred to be to the southwest towards Port Philip Bay. Groundwater levels are also seasonally variable with groundwater levels rising during the wetter winter months and falling during drier summer months with higher evapotranspiration rates. At a local scale, drainage lines and landfills cells can influence groundwater flow with increased recharge / evaporation through unlined drainage channels and landfill cells.

Results of the groundwater investigation identified:

- Copper above the adopted criteria for maintenance of ecosystems in the groundwater sample collected from GW17-26-01.
- Nickel above the criteria for beneficial uses maintenance of ecosystems, potable water supply and primary contact, recreation in both groundwater samples collected (GW17-26-01 and GW17-26-02).
- Zinc above the maintenance of ecosystem criteria in both groundwater samples (GW17-26-01 and GW17-26-02).

As detailed above, copper, nickel and zinc were identified to exceed one or more beneficial use criteria including extractive uses for potable water and primary contact recreation. The identified concentrations may preclude the use of groundwater for extractive purposes within the northern portion of the project area should this be required post development. Potential risks to groundwater beneficial uses should be considered as part of the design options assessment for the project area.

Copper, nickel and zinc concentrations were also reported to be above the maintenance of ecosystem criteria. The concentrations may represent naturally occurring concentrations associated with the Brighton Group aquifer. However, given that only one GME has been performed to date, the reported results are considered inconclusive. Additional groundwater testing should be undertaken to confirm and evaluate what is representative of background concentrations in the area.

The low pH identified in groundwater (4.13-4.8 pH units) may impact on the integrity of future structures (i.e. piling) if they were to come into direct contact with groundwater.

As discussed earlier, limited sampling and analysis of leachate and groundwater for the presence of dissolved methane was undertaken during the October 2017 works. Dissolved methane sampling was undertaken at one on-site leachate point and two groundwater monitoring wells. The results are presented in Table 9.6.

Table 9.6 Dissolved methane results

SAMPLE LOCATION	PROXIMITY TO THE LOT 1 GRANGE ROAD SITE	DISSOLVED METHANE CONCENTRATION
LEACHATE	Leachate sample collected on-site from LW17-26-01	8.28 mg/L
GW17-26-01	Southern boundary of the Lot 1 Grange Road site	0.124 mg/L
GW17-26-02	220 m to the south of the site	<0.01 mg/L

The results indicate the presence of elevated concentrations of methane in the leachate with substantially lower concentrations in the surrounding groundwater aquifer. The results demonstrate that the leachate generated on the site has the capacity to contain dissolved methane even with the inferred elevated salinity and temperature which act as limiters to

methane dissolution. The two monitoring wells sampled at the southern site boundary and further to the south demonstrate that methane is currently not migrating to these locations in elevated concentrations.

9.5.2 GROUNDWATER INVESTIGATION IN THE WIDER AREA

The groundwater investigation across the wider project area indicated that all beneficial uses of groundwater have been precluded.

The ten closest bores to the project area have been identified to be in use for a mixture of uses including groundwater investigation, domestic, irrigation and stock watering purposes. As this information was based on a database search, with bore installation dates for some bores indicated to be in the 1970s; in the first instance confirmation for the use of nearby monitoring bores for extractive purposes, should be undertaken in consultation with EPA Victoria.

An assessment of the likelihood of these impacts to be realised is summarised in Table 9.7 below.

Table 9.7 Groundwater beneficial uses risk assessment

BENEFICIAL USE	BENEFICIAL USE PRECLUDED (Y/N)?	POTENTIAL RISK AND LIKELY EFFECTS
Maintenance of ecosystems – highly modified aquatic ecosystem	Yes	Given that there are receptors identified within and surrounding the project area, a potential risk exists if impacted groundwater migrates into the surface water receptors.
Potable water supply: acceptable	Yes	This beneficial use is unlikely to be realised given that the future use of the site as a road and the presence of reticulated water in the project area.
Potable mineral water supply	N/A	This beneficial use is unlikely to be realised as the project area is not located within a mineral springs area.
Agricultural water supply: irrigation	Yes	An extraction bore is reported to be present within the project area but this bore could not be located. It is likely that this bore no longer exist. Given that the future use as a road, this bore is likely to be decommissioned if found.
Agricultural water supply: stock watering	Yes	An extraction bore is reported to be present within the project area but this bore could not be located. It is likely that this bore no longer exist. Given that the future use as a road, this bore is likely to be decommissioned if found.
Industrial water use	N/A	This beneficial use is unlikely to be realised given the future use of the site as a road and the presence of reticulated water in the area.
Buildings and structures	Yes	Given that shallow groundwater exists within the project area (i.e. <5 mBGL), it is likely to be encountered during construction. Given the presence of ASS in the Central and Southern Portions and the presence of acidic groundwater exceeding adopted criteria for buildings and structures in the Northern Portion, it is likely that groundwater conditions will affect integrity of buildings and structures. An ASSMP should be considered during construction phase to manage the impacts.

9.6 LEACHATE

The criteria adopted for groundwater quality was used as a screening indicator for potential contamination associated with leachate. Concentrations of benzene, metals (barium, boron, nickel and zinc) were reported above one or more beneficial use criteria for extractive uses and maintenance of ecosystems. Concentrations of benzene and metals were not identified in groundwater monitoring wells to the south of the leachate well.

Methane was identified in the sample collected from LW17-26-01 at a concentration of 8,280 µg/L. Whilst no criteria was available to adopt in the context of groundwater beneficial uses it is noted that dissolved methane was identified in both the leachate sample LW17-26-01 and the groundwater sample collected from GW17-26-01. However, the groundwater sample collected from GW17-26-02 (located within the nursery to the south of GW17-26-01) reported methane below the laboratory LOR.

9.7 PFAS

Based on the sample results, PFAS is present in soil, sediments, groundwater and surface water in the targeted areas of potential contamination.

PFOS concentrations exceeded the adopted assessment criteria for maintenance of ecosystems in samples collected from the leachate well (LW17-26-01), one of the three groundwater samples submitted (GW17-26-03) and in all surface water samples (SW1 and SW2).

It should be noted that the maintenance of ecosystem screening criteria (0.0023 µg/L) is significantly lower than the laboratory detection limit (0.01 µg/L) and a concentration of less than the detection limit does not necessarily mean that there is minimal risk to aquatic ecosystems.

PFAS is present in leachate and has the potential to migrate to groundwater and surface water where there is hydraulic connectivity. Sediment and water samples collected from Dunlop Drain (the closest surface water receptor) suggest that some degree of migration may have historically occurred from the surrounding former landfills as PFAS is present at this location with concentrations in surface water exceeding adopted criteria. No assessment of downstream surface water environments have been undertaken to date.

It is considered that exposure will only occur should the waste mass be disturbed during the construction phase for the road alignment; or if PFAS impacted groundwater and/or leachate is encountered by workers during the construction phase. Should there be a requirement to dispose of the waste mass and/or any shallow groundwater/surface water during the construction phase, it is recommended that testing for PFAS compounds be undertaken and disposed/managed accordingly and in consultation with Melbourne Water and EPA Victoria.

10 CONCLUSIONS

Based on the results of the review of historical information, the project area appears to have been predominantly used for agricultural purposes including nurseries and market gardens until the 1960s to 1970s. Industrial land use has become predominant since that time.

In the Northern Portion of the project area and its surrounds, quarrying, landfilling including industrial waste and liquid waste, various other industrial activities, market gardening and nurseries have operated since the 1960s. The Northern Portion of the project area intersects or adjacent to a number of known former landfills (including the western portion of Din San Landfill, Lot 1 Grange Road Landfill, Barraton Landfill among others).

The large Redwood Gardens Industrial Estate and Woodlands Industrial Estate was developed since the 1990s, which adjoins the Central Portion of the project area to the west. This area was formerly used for agriculture and some industrial uses including the former Braeside Wastewater/Sewage Treatment Plant which intersected the project area. Braeside Park adjoins the Central Portion of the project area to the east and was formerly used for agriculture including market gardening and horse training. Former wetlands and swampy land that has been filled over time is evident in the Central Portion of the project area and surrounds. This includes the Waterways Estate, north of Mordialloc Creek which is currently used for residential purposes. Moorabbin Airport is also located to the west of the Central Portion of the project area. The remainder of the nearby area has predominantly been redeveloped for residential purposes. ASS are anticipated on and within the vicinity of the Central Portion of the project area.

The Southern Portion of the project area has primarily been redeveloped for residential purposes to the west, as well as a some smaller commercial/industrial estates (Chelsea Business Park and Ashley Business Park) immediately adjoining the project area to the west. The majority of the area to the east of the Southern Portion of the project area remains agricultural land with an area used as a horse training ground. ASS are anticipated on and within the vicinity of the Southern Portion of the project area.

Of the above list, it is considered that the key contaminants of concern derived from the surrounding historical/current land uses include landfill gases, inorganics (including ammonia, sulphides, nitrates), pesticides and herbicides (namely: OCPs/OPPs), metals and metalloids, phenolics, petroleum hydrocarbons and volatile and semi-volatile hydrocarbons (chlorinated and non-chlorinated) and ACMs. There is also a potential for presence of aesthetic impacts (e.g. odours) within the vicinity of the project area, where odours emanating from the landfill are not managed appropriately.

Of note, given the ambiguity regarding the type of wastes (i.e. solid and liquid industrial) that have been disposed of within the former Lot 1 Grange Road landfilled area, it is considered possible that solid and/or liquid PFAS-impacted wastes may be present and may have impacted soil and groundwater beneath the property and/or leachates generated from the waste mass. In addition, it is also considered plausible that surrounding landfills (to the Lot 1 Grange Road property) may also contain unknown quantities of solid and/or liquid PFAS-impacted wastes, with a potential to impact soil and groundwater in the area. Moorabbin Airport is also a likely regional source of PFAS.

The anticipated primary transport media for the migration of contaminants identified were:

- Inhalation of dusts from impacted shallow soil and fill
- Dermal contact and ingestion of impacted shallow soil and fill
- Direct contact exposure to impacted shallow groundwater that ingresses into excavations
- Inhalation of vapour sourced from impacted shallow groundwater, which migrates through soil into excavations, underground service trenches or road maintenance chambers/pits
- Inhalation of landfill gas which migrates through soil into excavations, underground service trenches or road maintenance chambers/pits
- Lateral migration of dissolved phase hydrocarbons and other potential contaminants within the leachate which may be present in groundwater, typically in the direction of the local hydraulic gradient expected to be to the south/south-east/south-west (in general) based on the project area's topography and expected regional groundwater flow
- Surface run-off and entry into stormwater drainage system(s) in the event of subsurface spillage

- Migration of landfill gases and/or vapours through soils, underground service trenches and/or pits and beneath building slabs in the event of subsurface leakages
- Odour emissions from the existing landfill located within the proposed road alignment.

Of the potential exposure pathways identified, the migration of fugitive dust emissions is considered to be the primary exposure pathway for contaminants to impact surface soils along the road alignment.

During construction of the road upgrades, potential exposure may occur (should contaminated fill material be present under the existing land area that will house the proposed road extension); via direct contact pathways (including soil ingestion and dermal contact); as well as the inhalation of dust particulates.

In addition, the migration of landfill gases and impacted groundwater from surrounding landfills in the area, into any shallow trench excavations along the road alignment during the construction phase are also considered potential exposure pathways for construction workers.

The results of the intrusive investigation identified the following:

- With respect to the current public open space use of the project area, and future similar use of the project area (i.e. road), the concentration of all analytes were below the relevant adopted assessment criteria except for lead concentrations in one location in the northern portion, within the former landfilled areas. Hence, a health risk to current and/or future users of the road corridor, from exposure to chemical concentrations in soil beneath the project area, are considered to exist in the northern portion and considered unlikely to exist in other areas of the project area.
- A concentration of TRH F2 fractions, TRH F3 fractions and zinc was identified to be above the adopted criteria for ecological health. The presence of the TRH F2 fractions, TRH F3 fractions and zinc was not widespread along the alignment; and was only found to be above the adopted criterion at one location in the northern portion, within the former landfilled areas. Concentrations above adopted guidelines were found in fill material and due to the nature of construction are considered to be of low risk.
- All results for soil samples analysed were below the adopted HSLs for risks to intrusive maintenance workers from soil via vapour inhalation and direct contact exposure pathways. Based on the soil results, there is **not** considered to be a health risk to existing and/or future intrusive maintenance workers at the project area.
- Suspected ACM identified at one location (B17-68327 at 0.8 mBGL in fill) within a rural residential allotment adjacent to Lower Dandenong Road and was subsequently positively identified as asbestos type ‘Ch’ Chrysotile (white asbestos). The sample submitted was described as brown soil with multiple friable asbestos fragments approximately 11 x 7 x 1.5 mm in size and multiple asbestos bundles measured at approximately 6 x 1 x 0.5 mm. Further assessment of the extent of ACM at this location is required. ACM was not observed at any other sample location.
- Soil analytical results are indicative of a mixture of *Category C* and *Fill Material* classifications for off-site disposal within the northern and central portion. Analytical results from the southern portion are indicative of a *Fill Material* classification.
- PASS was identified to be present in the central and southern portions of the project area (from Mills Road to Springvale Road), generally consistent with geological mapping. These areas were defined as a High Risk site classification and will require EPA approval of an appropriate ASS MP (a subset of the CEMP) should disturbance of PASS not be avoidable.
- Elevated sulphate, chloride and TDS concentrations were identified in groundwater samples collected from wells adjacent to the Waterways Estate wetlands which suggests that some degree of CASS disturbance may have historically occurred in this area.
- Based on the preliminary landfill gas assessment works and the LGRA undertaken for the project area, landfill gas (including bulk and trace gases) was identified to be present within the northern portion of proposed road alignment footprint. Based upon the available data and qualitative and quantitative interpretation thereof, WSP consider that the section of the Mordialloc Bypass to be constructed above the former Lot 1 Grange Road Landfill will significantly

impact how gas emits from the waste mass in the landfills west. The main risks identified by the assessment can be summarised as follows:

  - Risk to workers during the construction of the bypass
  - Gas accumulation beneath planned roadways presenting a fire and explosion risk for users and workers
  - Migration of gas into service trenches, voids and conduits increasing the potential for long-distance migration of gas away from site and risk to workers accessing those conduits; and
  - Dissolution of methane and carbon dioxide into groundwater impacting the water quality of Dunlop's Drain and also potentially migrating further downgradient and impacting off-site receptors.

- Monitoring of sub-surface landfill gas concentrations within the planned Bypass footprint outside of the Lot 1 Grange Road site indicates a very low to low risk for development in these areas. As such it is considered that the primary landfill gas risk relating to the development from the adjacent former Din San and Barraton landfills is the migration of gas into service trenches within the alignment.
- PFAS is present in soil, groundwater, sediments and surface water in the targeted areas of potential contamination. PFAS is also present in leachate and has the potential to migrate to groundwater and surface water where there is hydraulic connectivity. It is considered that exposure will only occur should the waste mass be disturbed during the construction phase for the road alignment; or if PFAS impacted groundwater and/or leachate is encountered by workers during the construction phase.
- Leachate was identified within the former Lot 1 Grange Road landfill. Concentrations of benzene, metals (barium, boron, nickel and zinc) were reported above one or more beneficial use criteria for extractive uses and maintenance of ecosystems. Concentrations of benzene and metals were not identified in groundwater monitoring wells to the south of the leachate well.
- Dissolved methane was identified within the leachate bore at the former Lot 1 Grange Road landfill, however potential migration of impacts within groundwater is considered to be of low likelihood based on the analytical results from surrounding groundwater wells.
- The low pH identified in groundwater (4.13-4.8 pH units) adjacent to the former landfill areas may impact on the integrity of future structures (i.e. piling) if they were to come into direct contact with groundwater.
- The groundwater investigation across the wider project area indicated that all beneficial uses of groundwater have been precluded. Extractive uses within the project area, in particular irrigation and domestic use requires confirmation.

11 LIMITATIONS

SCOPE OF SERVICES

This environmental site assessment report (the report) has been prepared in accordance with the scope of services set out in the contract, or as otherwise agreed, between the client and WSP (scope of services). In some circumstances the scope of services may have been limited by a range of factors such as time, budget, access and/or site disturbance constraints.

RELIANCE ON DATA

In preparing the report, WSP has relied upon data, surveys, analyses, designs, plans and other information provided by the client and other individuals and organisations, most of which are referred to in the report (the data). Except as otherwise stated in the report, WSP has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report (conclusions) are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. WSP will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to WSP.

ENVIRONMENTAL CONCLUSIONS

In accordance with the scope of services, WSP has relied upon the data and has conducted environmental field monitoring and/or testing in the preparation of the report. The nature and extent of monitoring and/or testing conducted is described in the report.

On all sites, varying degrees of non-uniformity of the vertical and horizontal soil or groundwater conditions are encountered. Hence no monitoring, common testing or sampling technique can eliminate the possibility that monitoring or testing results/samples are not totally representative of soil and/or groundwater conditions encountered. The conclusions are based upon the data and the environmental field monitoring and/or testing and are therefore merely indicative of the environmental condition of the site at the time of preparing the report, including the presence or otherwise of contaminants or emissions.

Also, it should be recognised that site conditions, including the extent and concentration of contaminants, can change with time.

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

REPORT FOR BENEFIT OF CLIENT

The report has been prepared for the benefit of the client and no other party. WSP assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including without limitation matters arising from any negligent act or omission of WSP or for any loss or damage suffered by any other party in relying upon the matters dealt with or conclusions expressed in the report). Other parties should not rely upon the report or the accuracy or completeness of any conclusions and should make their own enquiries and obtain independent advice in relation to such matters.

OTHER LIMITATIONS

WSP will not be liable to update or revise the report to take into account any events, emergent circumstances or facts occurring or becoming apparent after the date of the report.

The scope of services did not include any assessment of the title to nor ownership of the properties, buildings and structures referred to in the report, nor the application or interpretation of laws in the jurisdiction in which those properties, buildings and structures are located.

12 REFERENCES

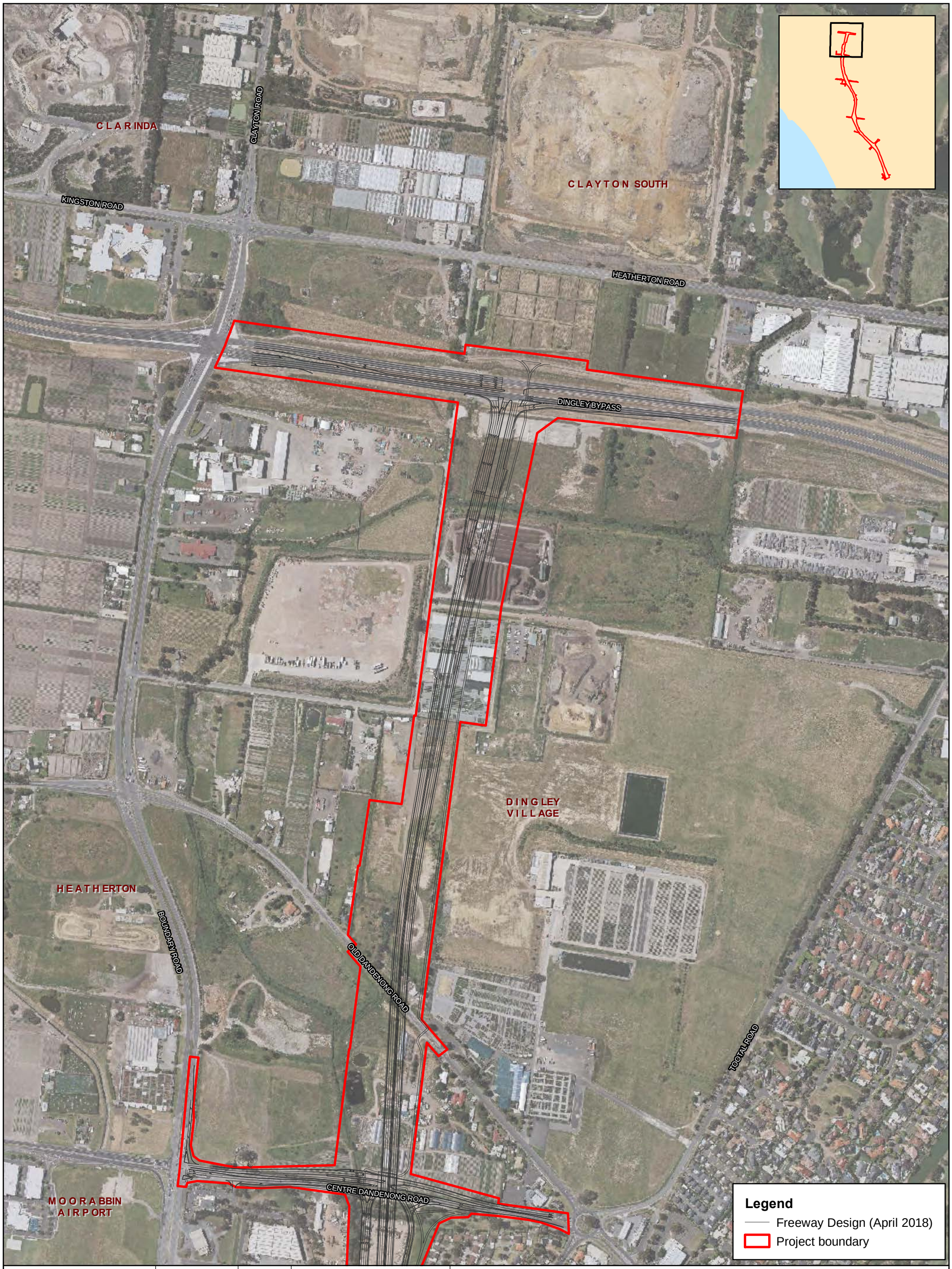
- ADWG 2016, *Australian Drinking Water Quality Management Strategy, Australian drinking Water Guidelines 6,* Australian Government, National Health & Medical Research Council, version 3.3 updated November 2016.
- Ahern et al 2004, *Acid Sulfate Soils Laboratory Method Guidelines Volume* 2.1, published by Queensland Government Department of Natural Resources, Mines and Energy, Indooroopilly, Queensland, Australia, Ahern CR, McElnea AE, Sullivan LA, June 2004.
- ANZECC 2000, *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, Australia & New Zealand Environment & Conservation Council/National Health & Medical Research Council, 2000.
- AS 1999, *Guide to the Sampling and Investigation of Potentially Contaminated Soil, Part 2: Volatile Substances*, Standards Australia, Committee EV/9, Sampling and Analysis of Soils and Biota. Australian Standard 4482.2, 1999.
- AS 2005, *Guide to the Investigation and Sampling of Sites with Potentially Contaminated Soil – Non-volatile and Semi-volatile Compounds*, Australian Standard 4482.1, 2005.
- AS/NZS 1998, *Water Quality – Sampling, Part 1: Guidance on the Design of Sampling Programs, Sampling Techniques and the Preservation and Handling of Samples*, Joint Standards Australia/Standard New Zealand Technical Committee EV-8, Methods for Examination of Waters, Standard 5667.1, 1998.
- CCME 2007, *Water Quality Guidelines for the Protection of Aquatic Life*. Canadian Council of Ministers of the Environment.
- Compass Environmental 2016, *Environmental Monitoring Program Report March 2015-April 2016, Din San landfill, 370-418 Old Dandenong Road, Dingley, Victoria (Ernest Smith Contractors Pty Ltd) (CARMS ID 69419-A),* Compass Environmental Pty, Ltd, 21 July 2016.
- DEDJTR VIC 2017, *Earth Resources – Geovic website*: http://earthresources.vic.gov.au/earth-resources/maps-reports-and-data/geovic, Victorian Government Department of Economic Development, Jobs, Transport and Resources, accessed November 2017.
- DEWLP 2018a, Groundwater bore information online, Department of Environment, Land Water and Planning (http://data.water.vic.gov.au/monitoring.htm accessed April 2018).
- DEWLP 2018b, Groundwater Resource Reports, Department of Environment, Land Water and Planning https://www.water.vic.gov.au/groundwater/groundwater-resource-reports accessed April 2018).
- DTPLI 2016, *Planning Schemes Online*, Department of Transport, Planning and Local Infrastructure, http://planningschemes.dpcd.vic.gov.au/, accessed February 2017 and November 2017.
- DSE VIC 2010, *Victorian Best Practice Guidelines for Assessing and Managing Coastal Acid Sulfate Soils*, Victorian Government Department of Sustainability and Environment, October 2010.
- EPA VIC 2000, *Groundwater Sampling Guidelines, Environment Protection Authority Victori*a, Publication 669, April 2006.
- EPA VIC 2006, *Hydrogeological Assessment (Groundwater Quality) Guidelines*, Environment Protection Authority Victoria, Publication 668, September 2006.
- EPA VIC 2009, *Sampling and Analysis of Waters, Wastewaters, Soils and Wastes*, Industrial Waste Resource Guidelines, Environment Protection Authority Victoria, Publication IWRG701, June 2009.
- EPA VIC 2009a, *Soil Hazard Categorisation and Management, Industrial Waste Resource Guidelines*, Environment Protection Authority Victoria, Publication IWRG621, June 2009.

- EPA VIC 2009b, *Soil Sampling, Industrial Waste Resource Guidelines*, Environment Protection Authority Victoria, Publication IWRG702, June 2009.
- EPA VIC 2009c, *Acid Sulfate Soil and Roc*k, Environment Protection Authority Victoria, Publication 655.1, July 2009.
- EPA VIC 2012, *Closed Landfill Guidelines*, Environment Protection Authority Victoria Publication 1490, 13 December 2012.
- EPA VIC 2015, Bes*t Practice Environmental Management (BPEM) - Siting, design, operation and rehabilitation of landfills (Landfill BPEM*), Environment Protection Authority Victoria Publication 788.3, August 2015.
- Friebel and Nadebaum 2011, *Health Screening Levels for Petroleum Hydrocarbons in Soil and Groundwater*, Part 2: Application Document.
- GoV 1997, *State Environment Protection Policy (Groundwaters of Victoria*), Government of Victoria Gazette No. S 160, 17 December 1997.
- GoV 2002, *State Environment Protection Policy (Prevention and Management of Contamination of Land),* Government of Victoria Gazette S95, 4 June 2002.
- LWBC 2003, *Minimum Construction Requirements for Water Bores in Australia*, Land and Water Biodiversity Committee, September 2003.
- McWorter and Sunada 1977, *Groundwater Hydrology and Hydraulics*, Water Resources Publications, Colorado, USA, David B. McWhorter and Daniel K. Sunada, 1977.
- NEPC 2013, *National Environment Protection Measure (NEPM) Amendment Measure 2013 (No. 1)*, National Environment Protection Council.
- NHMRC 2008, Guidelines for Managing Risk in Recreational Water. National Health and Medical Research Council.
- NHMRC 2011, *Australian Drinking Water Guidelines Paper 6 National Water Quality Management Strategy (Version 3.0 updated October 2017)*. National Health and Medical Research Council and National Resource Management Ministerial Council, Australia.
- PJRA 2014, *Ernest Smith Contractors Pty Ltd Environmental Audit of the Risk of Any Possible harm or Detriment to the environment Pursuant to Part IXD (Section 53V) of the Environment Protection Act 1970*, Din San Landfill, 370-418 Dandenong Road, Dingley Village, Victoria (CARMS ID 69419-2), Peter J Ramsay and Associates, 30 June 2014
- PJRA 2015, *Ernest Smith Contractors Pty Ltd Environmental Audit of the Risk of Any Possible harm or Detriment to the environment Pursuant to Part IXD (Section 53V) of the Environment Protection Act 1970*, Din San Landfill, 370-418 Dandenong Road, Dingley Village, Victoria (CARMS ID 69419-3), Peter J Ramsay and Associates, 30 June 2015.
- PJRA 2016, *Ernest Smith Contractors Pty Ltd Environmental Audit of the Risk of Any Possible harm or Detriment to the environment Pursuant to Part IXD (Section 53V) of the Environment Protection Act 1970*, Din San Landfill, 370-418 Dandenong Road, Dingley Village, Victoria (CARMS ID 69419-4), Peter J Ramsay and Associates, 22 July 2016.
- Safe Work Australia 2013. *Workplace Exposure Standards for Airborne Contaminants*.
- VROM 2009, *Soil Remediation Circular - Groundwater Intervention Values*, Ministry of Housing, Spatial Planning and Environment, Netherlands, 2009.
- VVG 2018, *Visualising Victoria's Groundwater* http://www.vvg.org.au/ accessed April 2018.

- WSP 2017, *Mordialloc Bypass Phase 1 Preliminary Site Assessment Report*, 2135645A-SE-26-CLM-REP-0011 Rev 00, dated 12 July 2017.
- WSP 2017a, *Reverse Brief - Baseline Landfill Investigations and Groundwater Observation Bores*, Reference 2135645A-SE-26-CLM-LET-0001 RevA, dated 7 August 2017.
- WSP 2017b, *Reverse Brief - Mordialloc Bypass: Acid Sulphate Soils Detailed Site Investigation*, 2135645A-SE-PASS-CLM-LET-0002 RevA, dated 18 August 2017.
- WSP 2018, *Mordialloc Bypass, Groundwater Impact Assessment (DRAFT)*, 2135645A-SE-26-ENV-REP-0006 RevA, dated 15 May 2018.
- WSP 2018a, *Task Brief: Mordialloc Bypass Preliminary and Targeted Assessment*, 2135645A-SE-CLM-LET-0002-PMN-RevA, dated 15 March 2018.
- WSP 2018b, *Task Brief: Mordialloc Bypass Landfill Additional Works*, 2135645A-SE-CLM-LET-0004-PMN-RevA dated 10 April 2018.
- WSP 2018c, *Task Brief: Additional Works – Thames Promenade*, 2135645A-SE-CLM-LET-0005-PMN-RevA dated 17 April 2018.
- WSP 2018d, *Design Options Assessment – Contaminated Land. Mordialloc Bypass*, 2135645A-SE-26-ENV-REP-0010A RevA

APPENDIX A

FIGURES



Map: 2135645A_GIS_1010_A	Author: AS		
Date: 2/08/2018	Approved by: ON		

Data source: VicRoads,
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0 60 120 m

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Coordinate system: GDA 1994 MGA Zone 55

Scale ratio correct when printed at A3

Engineering and Technical Services for Mordialloc Bypass Upgrade

Figure 1A - Project area (Northern Portion)

HEATHERTON
MOORABBIN AIRPORT
CENTRE DANDENONG ROAD
OLD DANDENONG ROAD
TOOTAL ROAD
SPRING ROAD
HOWARD ROAD
DINGLEY VILLAGE
ROWAN ROAD
MARCUS ROAD
BOUNDARY ROAD
LOWER DANDENONG ROAD
WOODLANDS DRIVE
MORDIALLOC
BRAESIDE
WHITE STREET
MALCOLM ROAD
GOVERNOR ROAD
HUTTON ROAD
SPRINGVALE ROAD
WATERWAYS
KEYSBOROUGH
ASPENDALE
ASPENDALE GARDENS
WELLS ROAD

Legend

Freeway Design (April 2018)

Project boundary

Map: 2135645A_GIS_1010_A	Author: AS		
Date: 2/08/2018	Approved by: ON		

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Coordinate system: GDA 1994 MGA Zone 55

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vicroads

wsp

Engineering and Technical Services for Mordialloc Bypass Upgrade

Figure 1B - Project area (Central Portion)

Map: 2135645A_GIS_1010_A	Author: AS		
Date: 2/08/2018	Approved by: ON		

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0 100 200 m

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Coordinate system: GDA 1994 MGA Zone 55

Scale ratio correct when printed at A3

Engineering and Technical Services for Mordialloc Bypass Upgrade

Figure 1C - Project area (Southern Portion)

Road Corridor Sections

Mordialloc Bypass

Scale:	Data Sources:	Coordinate System:	Date:
0 200 400 800 1,200 1,600 2,000 Meters	Property Boundaries: State of Victoria - Department of Environment and Primary Industries	GDA 1994 MGA Zone 55	03 May 2018

Map: 2135645A_GIS_1162_A	Author: VD	
Date: 17/09/2018	Approved by: -	

Data source: VicRoads,
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0 50 100 m

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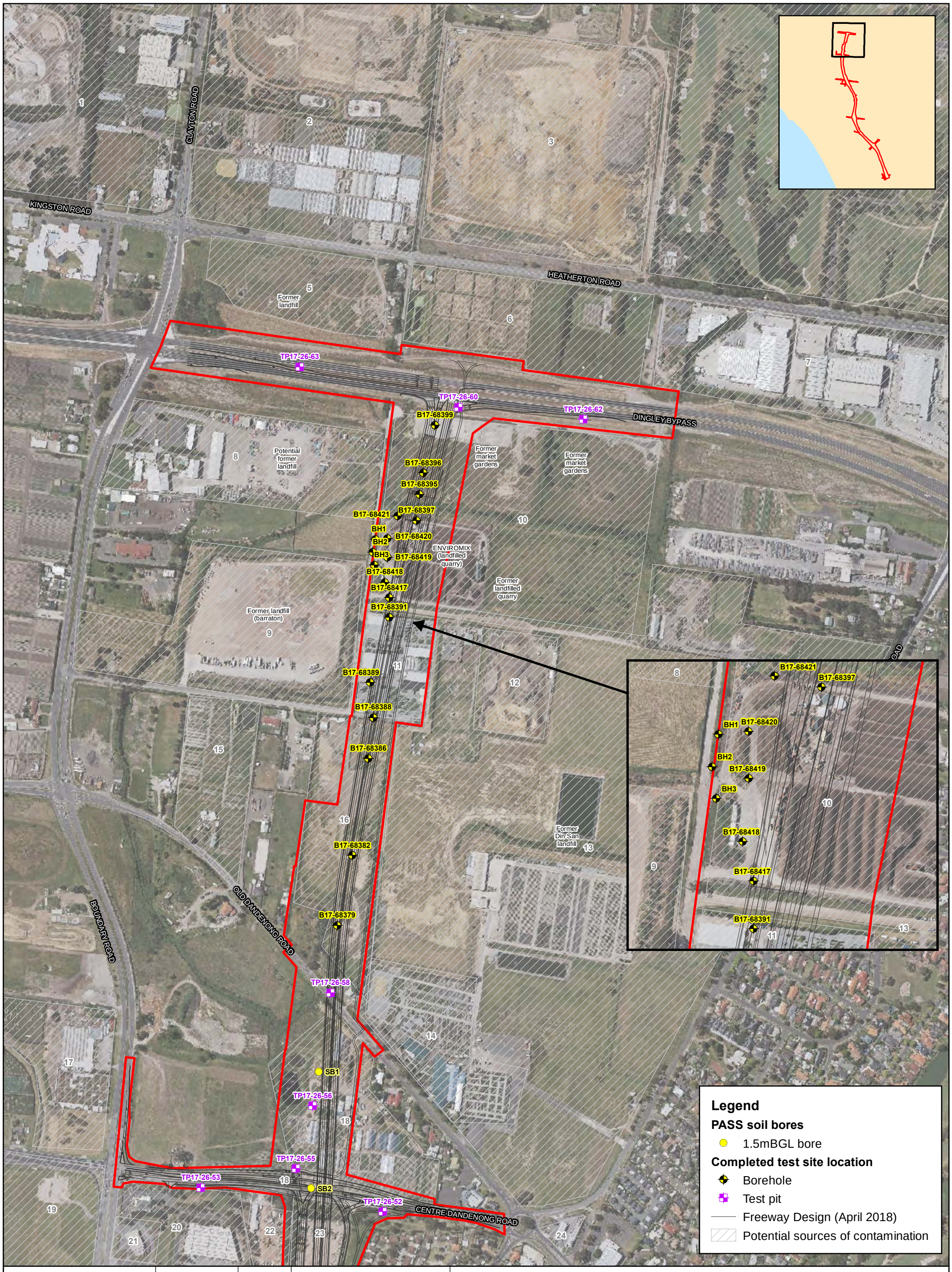
Coordinate system: GDA 1994 MGA Zone 55

Scale ratio correct when printed at A3

Engineering and Technical Services for Mordialloc Freeway Upgrade

Areas of potential contamination (Northern Portion)



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Date: 2/08/2018	Approved by: ON	

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Coordinate system: GDA 1994 MGA Zone 55

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Engineering and Technical Services for Mordialloc Bypass Upgrade

Figure 4A

Soil sampling locations (Northern Portion)

CENTRE DANDENONG ROAD
OLD DANDENONG ROAD
TOOTAL ROAD
SPRING ROAD
HOWARD ROAD
ROWAN ROAD
MARCUS ROAD
BOUNDARY ROAD
LOWER DANDENONG ROAD
WOODLANDS DRIVE
WHITE STREET
MALCOLM ROAD
GOVERNOR ROAD
HUTTON ROAD
SPRINGVALE ROAD
WELLS ROAD

SB1 SB2 SB3 SB4 SB5 SB6 SB7 SB8 SB9 SB10 SB11 SB12 SB13 SB14 SB15 SB16 SB17 SB18 SB19 SB20 SB21 SB22 SB23 SB24 SB25
BH4 BH5 BH6
DB1 DB2 DB3 DB4
TP17-26-56 TP17-26-55 TP17-26-53 TP17-26-52 TP17-26-49 TP17-26-47 TP17-26-45 TP17-26-43 TP17-26-70 TP17-26-41 TP17-26-68 TP17-26-69 TP17-26-37 TP17-26-64 TP17-26-35 TP17-26-33 TP17-26-31 TP17-26-29 TP17-26-27 TP17-26-25 TP17-26-23 TP17-26-24 TP17-26-20
B17-68170 B17-68167

13 14 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 38

Legend

PASS soil bores

- 1.5mBGL bore
- 10mBGL bore
- 20mBGL bore

Completed test site location

- Borehole
- Test pit
- Freeway Design (April 2018)
- Potential sources of contamination

Map: 2135645A_GIS_1011_A	Author: MB	
Date: 2/08/2018	Approved by: ON	

Data source: VicRoads,
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0 150 300 m

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Coordinate system: GDA 1994 MGA Zone 55

Scale ratio correct when printed at A3

Engineering and Technical Services for Mordialloc Bypass Upgrade

Figure 4B

Soil sampling locations (Central Portion)

SB21
SB22
B17-68167
SB23
SB24
SB25
DB4
SB26
TP17-26-18
SB27
SB28
SB29
TP17-26-16
SB30
SB31
SB32
TP17-26-14
SB33
DB5
SB34
TP17-26-10
SB35
TP17-26-07
SB36
SB37
TP17-26-05
SB38
TP17-26-09
TP17-26-03
TP18-26A-01
TP18-26A-02
TP18-26A-09
T1-26A
T2-26A
PD18-26A-04
PD18-26A-10
SPRINGVALE ROAD
PILLARS ROAD
NURTEN PARADE
BRANAGAN DRIVE
WELLS ROAD
EDITH VALE ROAD
MORNINGTON PENINSULA FREEWAY
THAMES PROMENADE
35
36
37
38
39
40
41
42
43
44

Legend

PASS soil bores

- 1.5mBGL bore
- 20mBGL bore

Completed test site location

- Borehole
- Test pit
- Pavement dipping
- Freeway Design (April 2018)
- Potential sources of contamination

Map: 2135645A_GIS_1011_A	Author: MB
Date: 2/08/2018	Approved by: ON

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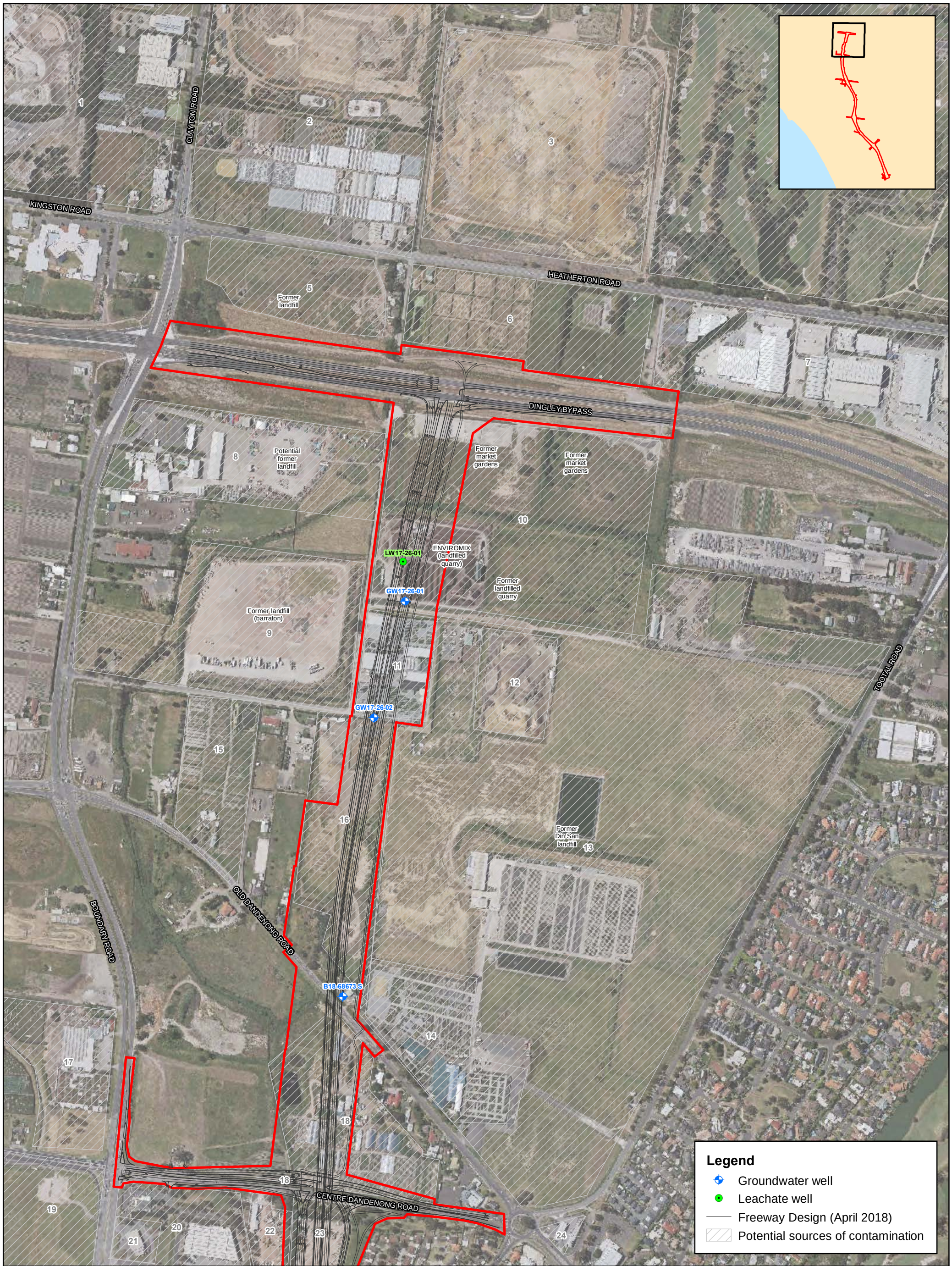
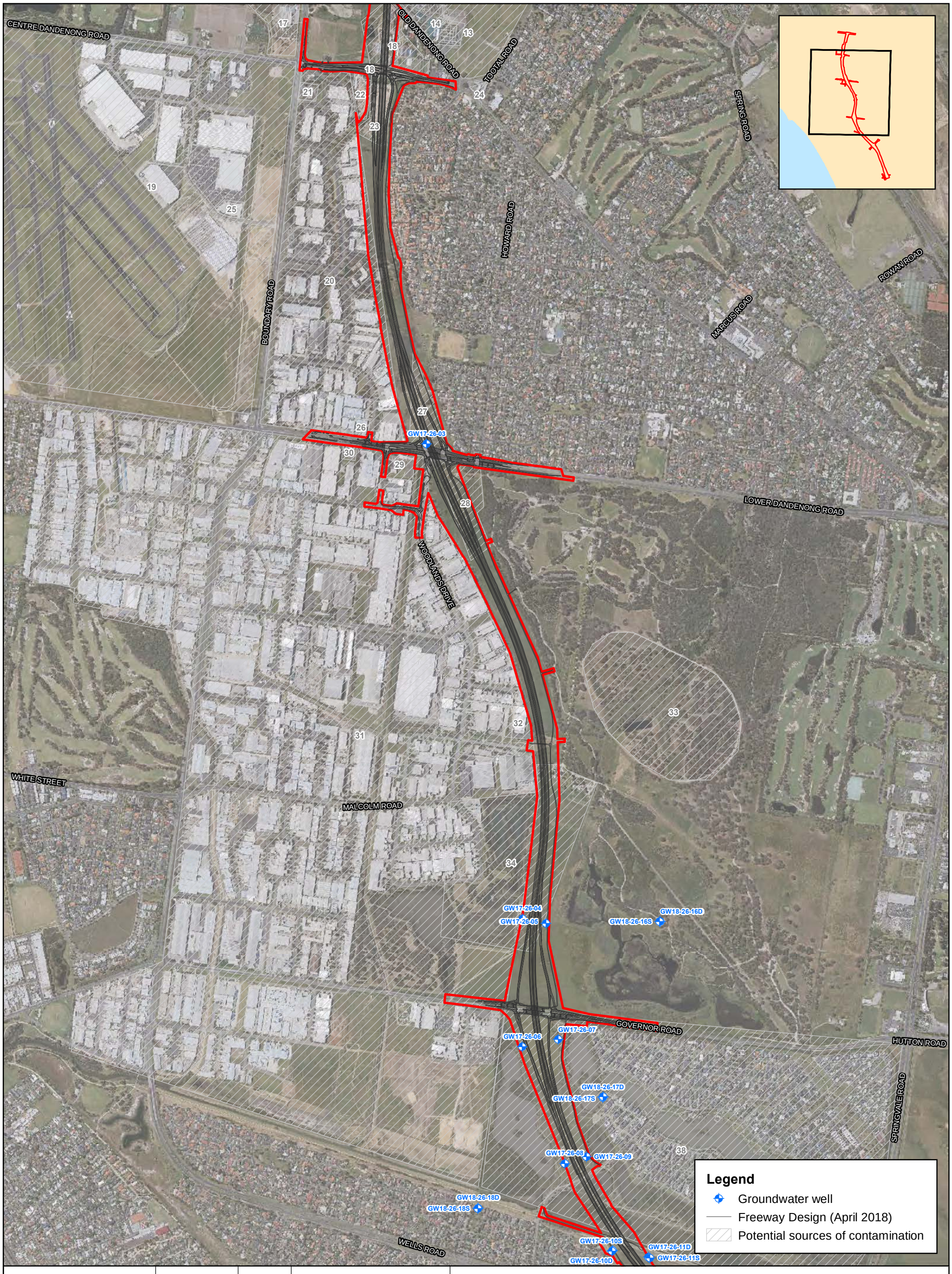
Engineering and Technical Services for Mordialloc Bypass Upgrade

Figure 4C

Soil sampling locations (Southern Portion)



Map: 2135645A_GIS_1012_A	Author: MB	0 60 120 m	**Engineering and Technical Services for Mordialloc Bypass Upgrade**
Date: 2/08/2018	Approved by: ON	1:6,000	Figure 5A
Data source: VicRoads, Copyright © The State of Victoria, Department of Environment, Land, Water & Planning 2018		Coordinate system: GDA 1994 MGA Zone 55 Scale ratio correct when printed at A3	Groundwater and leachate sampling locations (Northern Portion)



Map: 2135645A_GIS_1012_A	Author: MB	
Date: 2/08/2018	Approved by: ON	

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Engineering and Technical Services for Mordialloc Bypass Upgrade

Figure 5B

Groundwater and leachate sampling locations (Central Portion)

GW17-26-08
GW17-26-09
GW17-26-10D
GW17-26-10S
GW17-26-11S
GW17-26-11D
GW18-26-19D
GW18-26-19S
GW18-26-20D
GW18-26-20S
GW17-26-13D
GW17-26-13S
GW17-26-12D
GW17-26-12S
GW17-26-15D
GW17-26-14D
GW17-26-14S
GW18-26-22D
GW18-26-22S
GW18-26-23S
GW18-26-23D
GW18-26-21D

38
35
36
37
39
40
41
42
43
44

SPRINGVALE ROAD
PILLARS ROAD
NURTEN PARADE
BRANAGAN DRIVE
WELLS ROAD
EDITHVALE ROAD
MORNINGTON PENINSULA FREEWAY
THAMES PROMENADE

Legend

- Groundwater well
- Freeway Design (April 2018)
- Potential sources of contamination

Map: 2135645A_GIS_1012_A	Author: MB
Date: 2/08/2018	Approved by: ON

Data source: VicRoads,
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Coordinate system: GDA 1994 MGA Zone 55

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Engineering and Technical Services for Mordialloc Bypass Upgrade

Figure 5C

Groundwater and leachate sampling locations (Southern Portion)

HEATHERTON ROAD
DINGLEY BYPASS
OLD DANDENONG ROAD
BOUNDARY ROAD
Former landfill
Potential former landfill
Former landfill (barraton)
ENVIROMIX (landfilled quarry)
Former landfilled quarry
Former market gardens
Former market gardens
Former Din San landfill
GB17-26-01
GB17-26-02
GB17-26-03
GB17-26-04
GB17-26-05
GB17-26-06
GB17-26-07
GB17-26-08
GB17-26-09
GB17-26-10
GB1
GB2
GB3
GB4
GB29
GB30
GB40
GB41
GB44
2
3
5
6
8
9
10
11
12
13
14
15
16
17
18

Legend

- Existing gas bore
- Gas bore
- Freeway Design (April 2018)
- Potential sources of contamination

Map: 2135645A_GIS_1013_A	Author: MB
Date: 2/08/2018	Approved by: ON

Data source: VicRoads, Compass Environmental,

0 40 80 m

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Coordinate system: GDA 1994 MGA Zone 55

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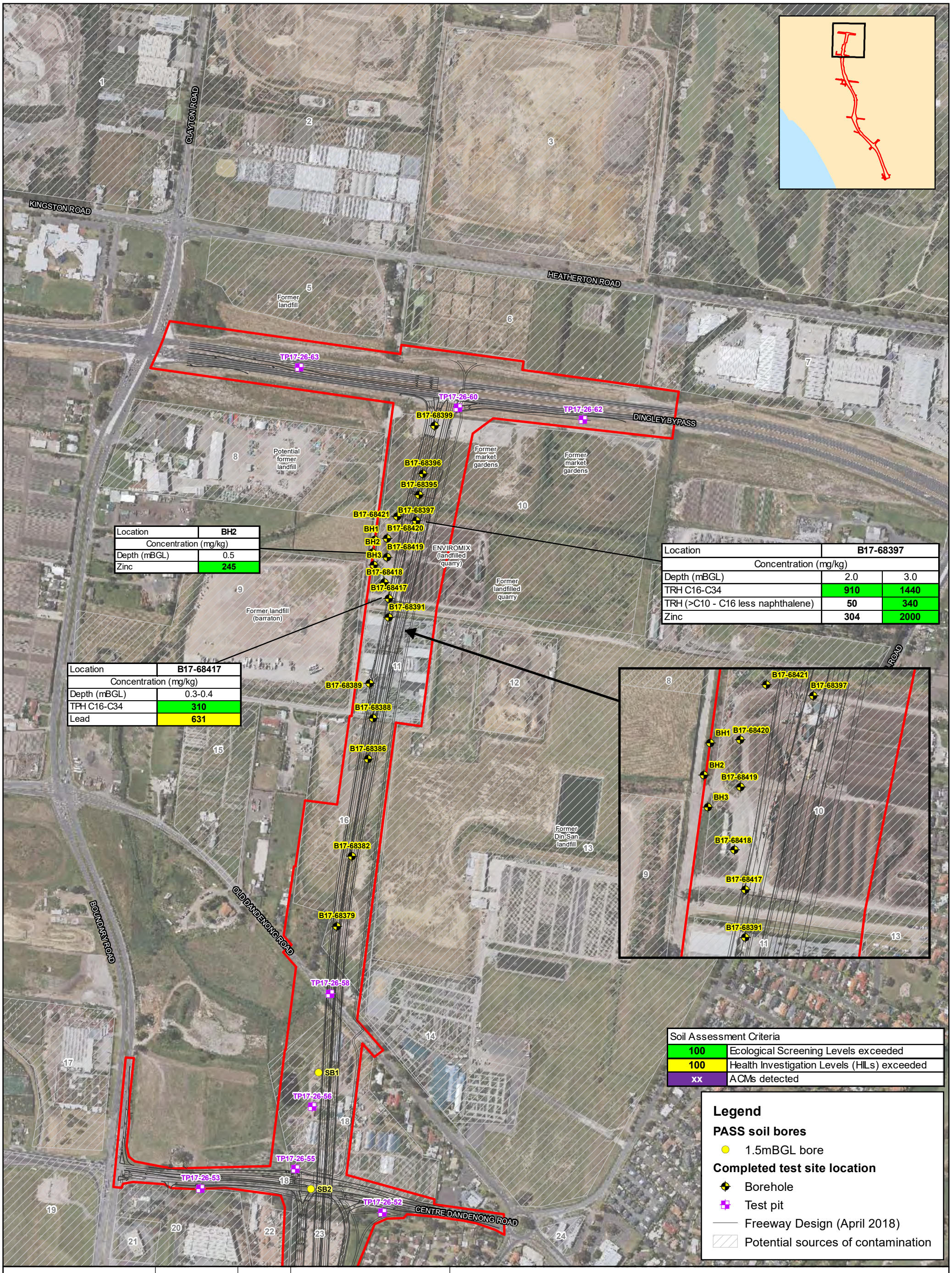
Engineering and Technical Services for Mordialloc Bypass Upgrade

Figure 6

Gas bore locations



Location	BH2
Concentration (mg/kg)	
Depth (mBGL)	0.5
Zinc	245

Location	B17-68397	
Concentration (mg/kg)		
Depth (mBGL)	2.0	3.0
TRH C16-C34	910	1440
TRH (>C10 - C16 less naphthalene)	50	340
Zinc	304	2000

Location	B17-68417
Concentration (mg/kg)	
Depth (mBGL)	0.3-0.4
TPH C16-C34	310
Lead	631

Soil Assessment Criteria	
100	Ecological Screening Levels exceeded
100	Health Investigation Levels (HILs) exceeded
xx	ACMs detected

Legend

PASS soil bores

- 1.5mBGL bore

Completed test site location

- Borehole
- Test pit
- Freeway Design (April 2018)
- Potential sources of contamination

Map: 2135645A_GIS_1014_A2	Author: MB
Date: 2/08/2018	Approved by: ON

Data source: VicRoads,
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0 60 120 m

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Coordinate system: GDA 1994 MGA Zone 55

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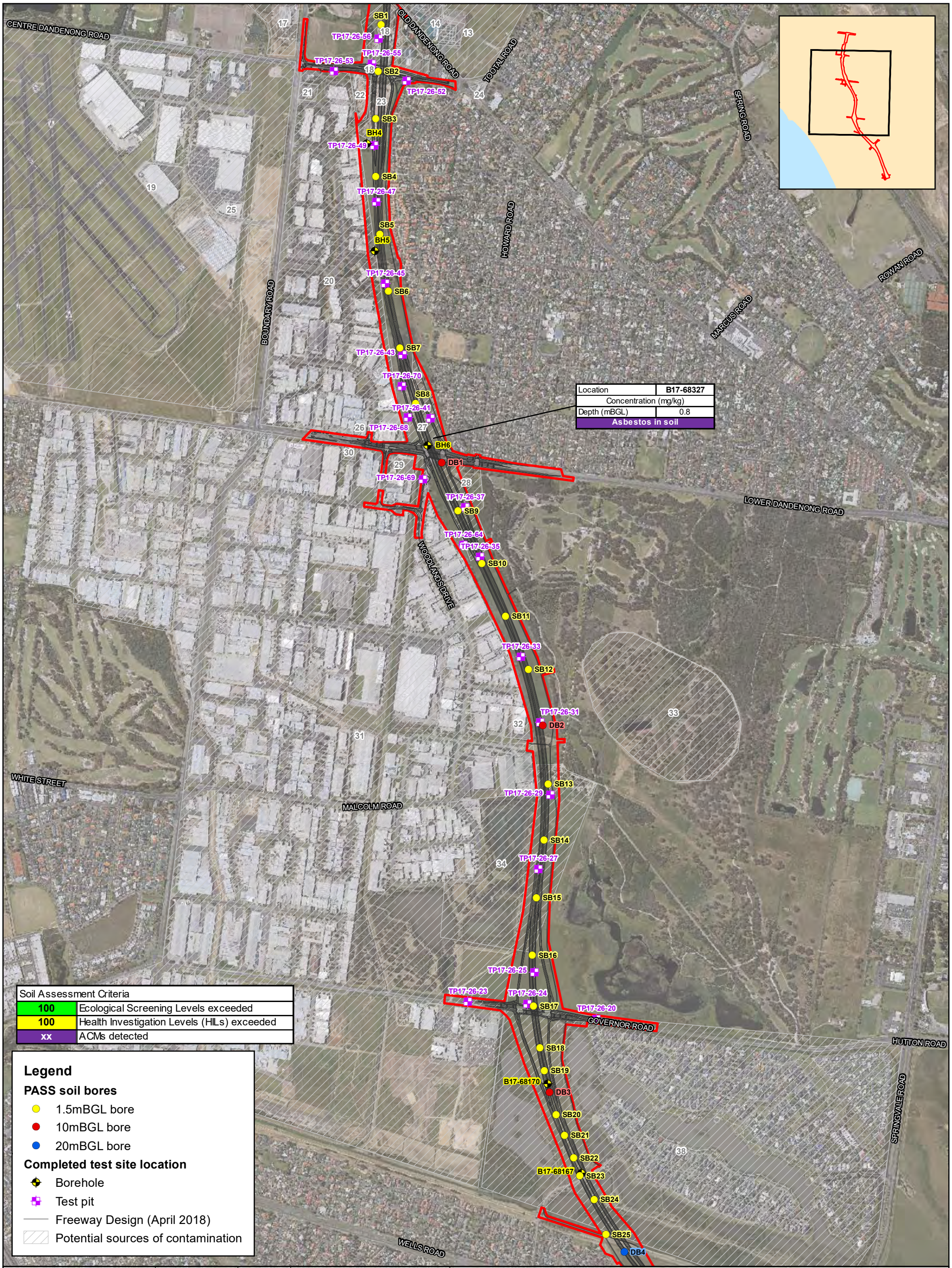
Engineering and Technical Services for Mordialloc Bypass Upgrade

Figure 7A

Soil impact plan assessed against beneficial uses (Northern Portion)



Map: 2135645A_GIS_1014_A2 | Author: MB

Date: 2/08/2018 | Approved by: ON

0 150 300 m

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Coordinate system: GDA 1994 MGA Zone 55

Scale ratio correct when printed at A3

Data source: VicRoads,
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Engineering and Technical Services for Mordialloc Bypass Upgrade

Figure 7B

Soil impact plan assessed against beneficial uses (Central Portion)

SB21
SB22
B17-68167
SB23
SB24
SB25
DB4
SB26
TP17-26-18
SB27
SB28
SB29
TP17-26-16
SB30
SB31
SB32
TP17-26-14
TP17-26-09
SB33
DB5
SB34
TP17-26-10
SB35
TP17-26-07
SB36
SB37
TP17-26-05
SB38
TP17-26-03
TP18-26A-01
TP18-26A-02
TP18-26A-09
T1-26A
T2-26A
PD18-26A-04
PD18-26A-10
SPRINGVALE ROAD
NURTEN PARADE
BRANAGAN DRIVE
WELLS ROAD
EDITHVALE ROAD
PILLARS ROAD
MORNINGTON PENINSULA FREEWAY
THAMES PROMENADE
35
36
37
38
39
40
41
42
43
44

Soil Assessment Criteria	
100	Ecological Screening Levels exceeded
100	Health Investigation Levels (HILs) exceeded
xx	ACMs detected

Legend

PASS soil bores
- 1.5mBGL bore
- 20mBGL bore

Completed test site location
- Borehole
- Test pit
- Pavement dipping
- Freeway Design (April 2018)
- Potential sources of contamination

Map: 2135645A_GIS_1014_A2	Author: MB
Date: 2/08/2018	Approved by: ON

Data source: VicRoads,
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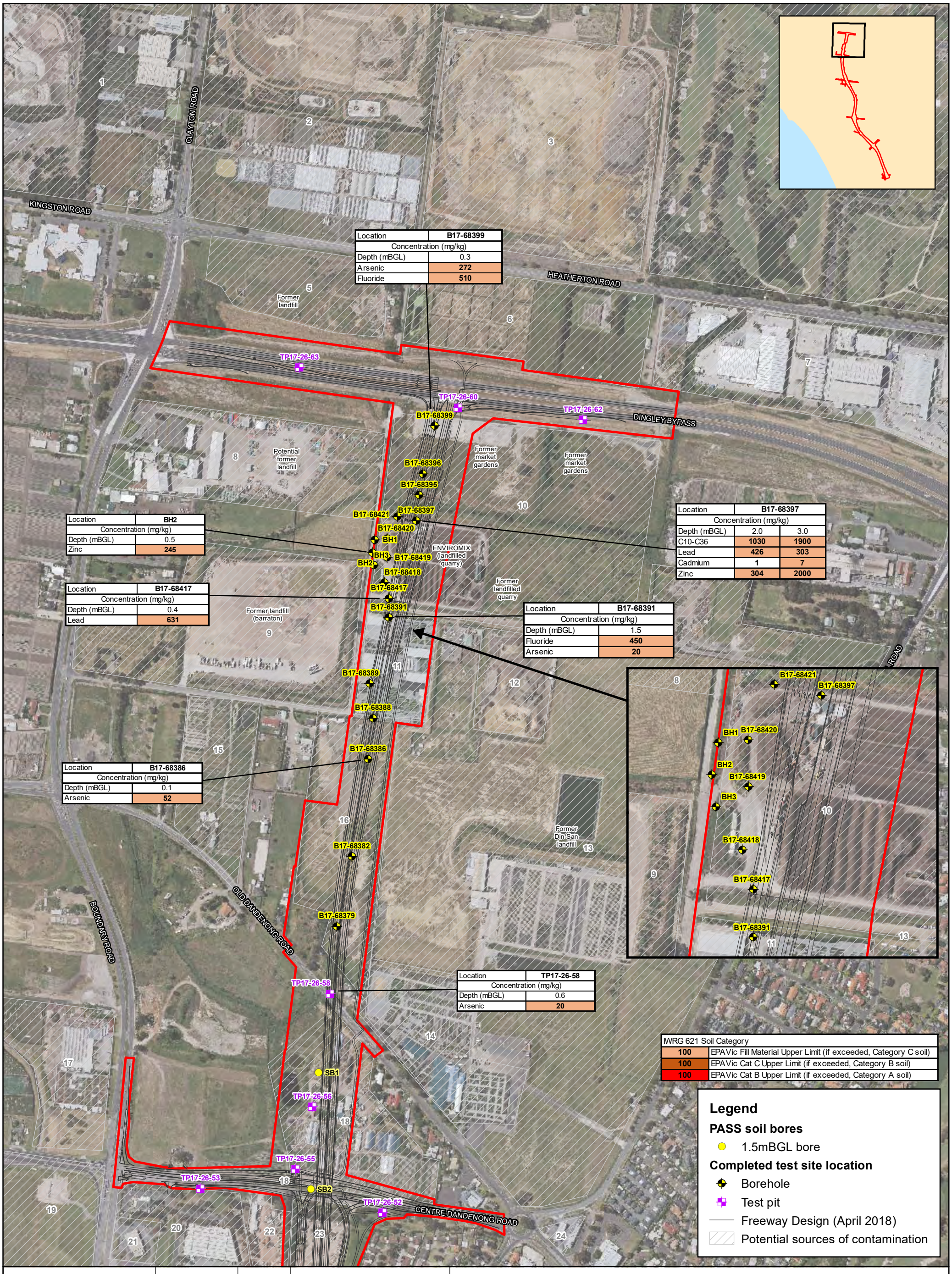
0 100 200 m
1:10,000
Coordinate system: GDA 1994 MGA Zone 55
Scale ratio correct when printed at A3

Engineering and Technical Services for Mordialloc Bypass Upgrade
Figure 7C
Soil impact plan assessed against beneficial uses (Southern Portion)



Location	B17-68399
Concentration (mg/kg)	
Depth (mBGL)	0.3
Arsenic	272
Fluoride	510

Location	BH2
Concentration (mg/kg)	
Depth (mBGL)	0.5
Zinc	245

Location	B17-68397	
Concentration (mg/kg)		
Depth (mBGL)	2.0	3.0
C10-C36	1030	1900
Lead	426	303
Cadmium	1	7
Zinc	304	2000

Location	B17-68417
Concentration (mg/kg)	
Depth (mBGL)	0.4
Lead	631

Location	B17-68391
Concentration (mg/kg)	
Depth (mBGL)	1.5
Fluoride	450
Arsenic	20

Location	B17-68386
Concentration (mg/kg)	
Depth (mBGL)	0.1
Arsenic	52

Location	TP17-26-58
Concentration (mg/kg)	
Depth (mBGL)	0.6
Arsenic	20

IWRG 621 Soil Category	
100	EPA Vic Fill Material Upper Limit (if exceeded, Category C soil)
100	EPA Vic Cat C Upper Limit (if exceeded, Category B soil)
100	EPA Vic Cat B Upper Limit (if exceeded, Category A soil)

Legend

PASS soil bores

- 1.5mBGL bore

Completed test site location

- Borehole
- Test pit
- Freeway Design (April 2018)
- Potential sources of contamination

Map: 2135645A_GIS_1015_A	Author: MB	
Date: 2/08/2018	Approved by: ON	

Data source: VicRoads,
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0 60 120 m

1:6,000

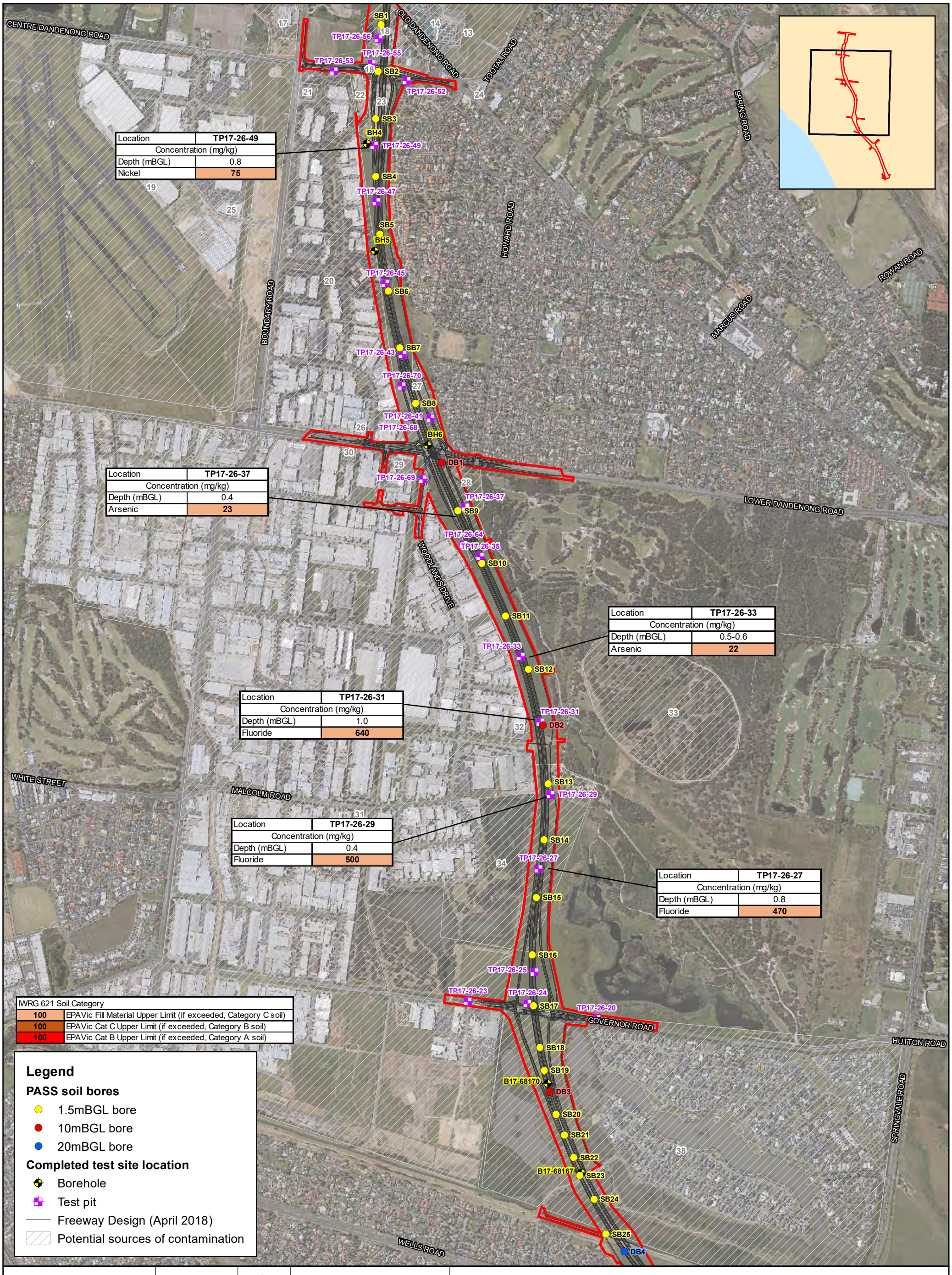
Coordinate system: GDA 1994 MGA Zone 55

Scale ratio correct when printed at A3

Engineering and Technical Services for Mordialloc Bypass Upgrade

Figure 8A

Soil impact plan assessed against IWRG criteria (Northern Portion)



Map: 2135645A_GIS_1015_A	Author: MB
Date: 2/08/2018	Approved by: ON

0 150 300 m

1:15,000

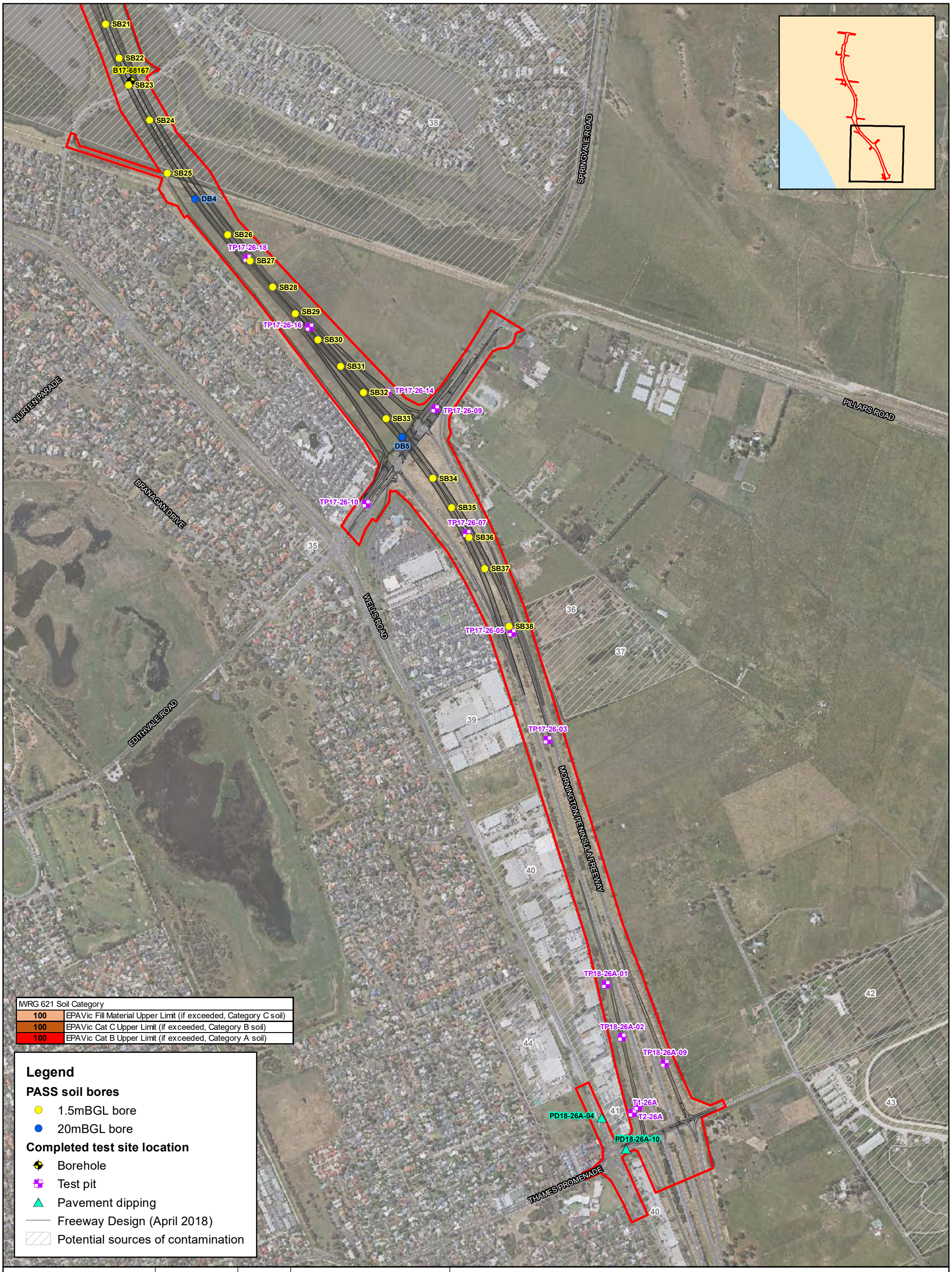
Coordinate system: GDA 1994 MGA Zone 55

Scale ratio correct when printed at A3

Engineering and Technical Services for Mordialloc Bypass Upgrade

Figure 8B

Soil impact plan assessed against IWRG criteria (Central Portion)



IWRG 621 Soil Category	
100	EPAVic Fill Material Upper Limit (if exceeded, Category C soil)
100	EPAVic Cat C Upper Limit (if exceeded, Category B soil)
100	EPAVic Cat B Upper Limit (if exceeded, Category A soil)

Legend

PASS soil bores

- 1.5mBGL bore
- 20mBGL bore

Completed test site location

- Borehole
- Test pit
- Pavement dipping
- Freeway Design (April 2018)
- Potential sources of contamination

Map: 2135645A_GIS_1015_A	Author: MB
Date: 2/08/2018	Approved by: ON

Data source: VicRoads,
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0 100 200 m

1:10,000

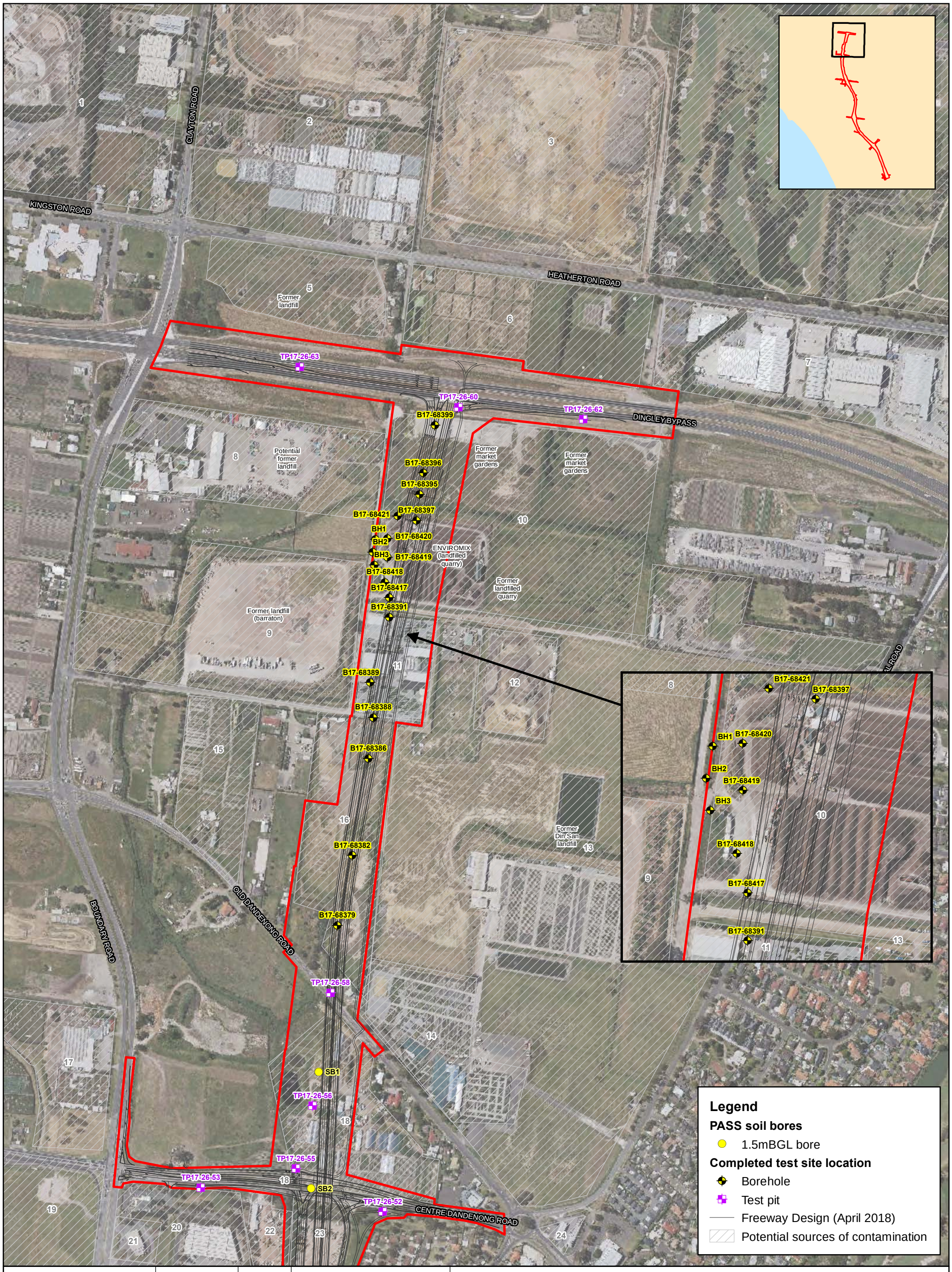
Coordinate system: GDA 1994 MGA Zone 55

Scale ratio correct when printed at A3

Engineering and Technical Services for Mordialloc Bypass Upgrade

Figure 8C

Soil impact plan assessed against IWRG criteria (Southern Portion)



Map: 2135645A_GIS_1018_A	Author: MB	
Date: 2/08/2018	Approved by: ON	

Data source: VicRoads,
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0 60 120 m

1:6,000

Coordinate system: GDA 1994 MGA Zone 55

Scale ratio correct when printed at A3

Engineering and Technical Services for Mordialloc Bypass Upgrade

Figure 9A

Soil impact plan assessed

PASS action levels (Northern Portion)

CENTRE DANDENONG ROAD
OLD DANDENONG ROAD
TOOTAL ROAD
SPRING ROAD
HOWARD ROAD
ROWAN ROAD
MARCUS ROAD
BOUNDARY ROAD
WOODLANDS DRIVE
LOWER DANDENONG ROAD
WHITE STREET
MALCOLM ROAD
GOVERNOR ROAD
HUTTON ROAD
SPRINGVALE ROAD
WELLS ROAD

SB1 SB2 SB3 SB4 SB5 SB6 SB7 SB8 SB9 SB10 SB11 SB12 SB13 SB14 SB15 SB16 SB17 SB18 SB19 SB20 SB21 SB22 SB23 SB24 SB25
BH4 BH5 BH6 B17-68170 B17-68167
DB1 DB2 DB3 DB4
TP17-26-56 TP17-26-55 TP17-26-53 TP17-26-52 TP17-26-49 TP17-26-47 TP17-26-45 TP17-26-43 TP17-26-70 TP17-26-41 TP17-26-68 TP17-26-69 TP17-26-37 TP17-26-64 TP17-26-35 TP17-26-33 TP17-26-31 TP17-26-29 TP17-26-27 TP17-26-25 TP17-26-23 TP17-26-24 TP17-26-20

17 18 13 14 21 22 23 24 19 25 20 26 27 28 29 30 31 32 33 34 38

Legend

PASS soil bores

- 1.5mBGL bore
- 1.5mBGL bore - Exceeded adopted action level for PASS
- 10mBGL bore
- 20mBGL bore - Exceeded adopted action level for PASS

Completed test site location

- Borehole
- Test pit
- Freeway Design (April 2018)
- Potential sources of contamination
- Prospective coastal acid sulfate soil

Map: 2135645A_GIS_1018_A	Author: MB
Date: 2/08/2018	Approved by: ON

Data source: VicRoads,
Copyright © The State of Victoria,
Department of Environment, Land, Water & Planning 2018

0 150 300 m

1:15,000

Coordinate system: GDA 1994 MGA Zone 55

Scale ratio correct when printed at A3

Engineering and Technical Services for Mordialloc Bypass Upgrade
Figure 9B
Soil impact plan assessed
PASS action levels (Central Portion)

SB21
SB22
B17-68167
SB23
SB24
SB25
DB4
SB26
TP17-26-18
SB27
SB28
SB29
TP17-26-16
SB30
SB31
SB32
TP17-26-14
SB33
TP17-26-09
DB5
SB34
TP17-26-10
SB35
TP17-26-07
SB36
SB37
TP17-26-05
SB38
TP17-26-03

SPRINGVALE ROAD
PILLARS ROAD
NURTEN PARADE
BRANAGAN DRIVE
WELLS ROAD
EDITH VALE ROAD
MORNINGTON PENINSULA FREEWAY
THAMES PROMENADE

35
36
37
38
39
40
41
42
43
44

Legend

PASS soil bores

- 1.5mBGL bore
- 1.5mBGL bore - Exceeded adopted action level for PASS
- 20mBGL bore - Exceeded adopted action level for PASS

Completed test site location

- Borehole
- Test pit
- Freeway Design (April 2018)
- Potential sources of contamination
- Prospective coastal acid sulfate soil

Map: 2135645A_GIS_1018_A	Author: MB
Date: 2/08/2018	Approved by: ON

Data source: VicRoads,

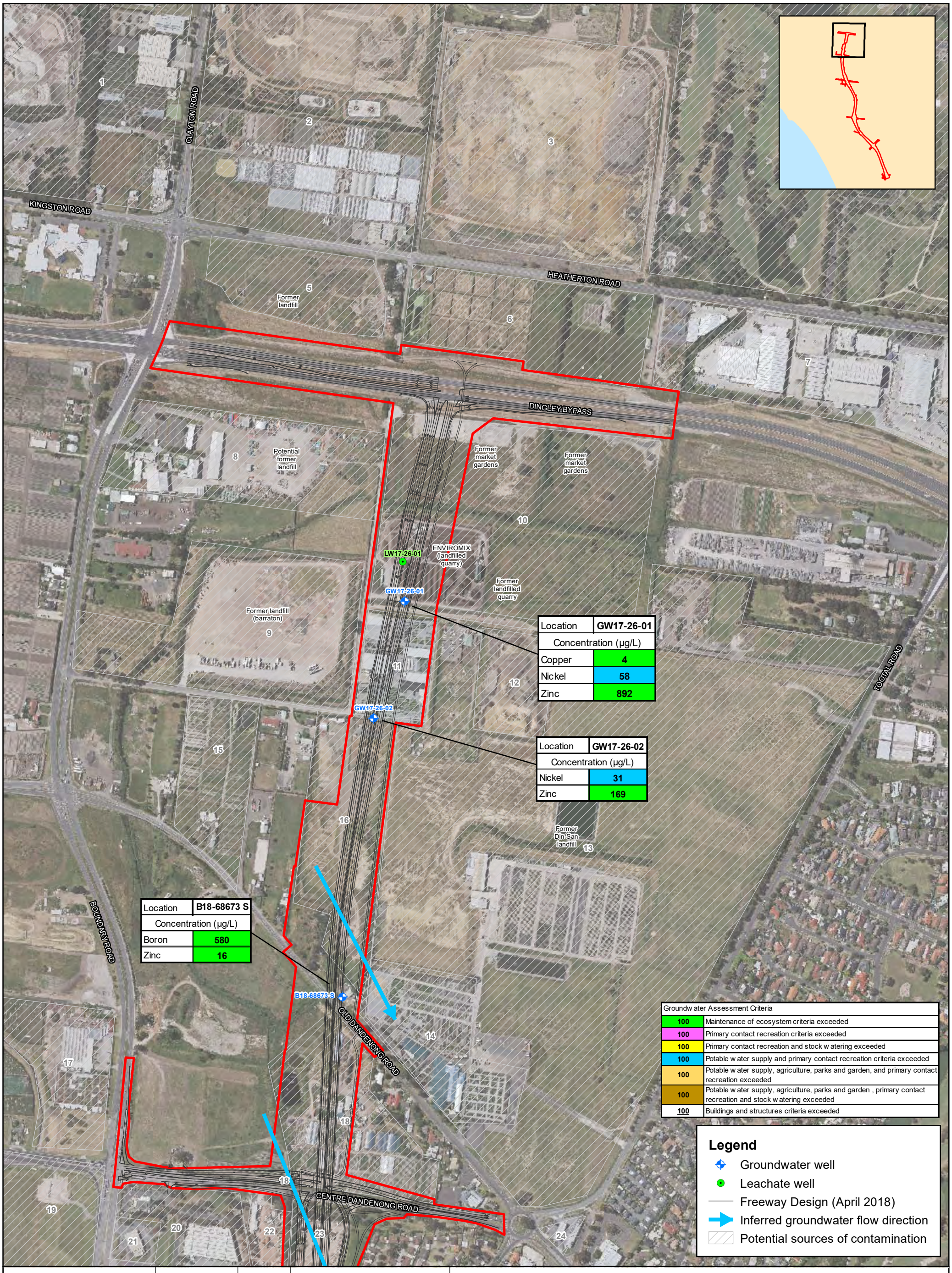
0 100 200 m

1:10,000

Coordinate system: GDA 1994 MGA Zone 55

Scale ratio correct when printed at A3

Engineering and Technical Services for Mordialloc Bypass Upgrade
Figure 9C
Soil impact plan assessed
PASS action levels (Southern Portion)



Map: 2135645A_GIS_1019_A1	Author: MB	
Date: 2/08/2018	Approved by: ON	

Data source: VicRoads,
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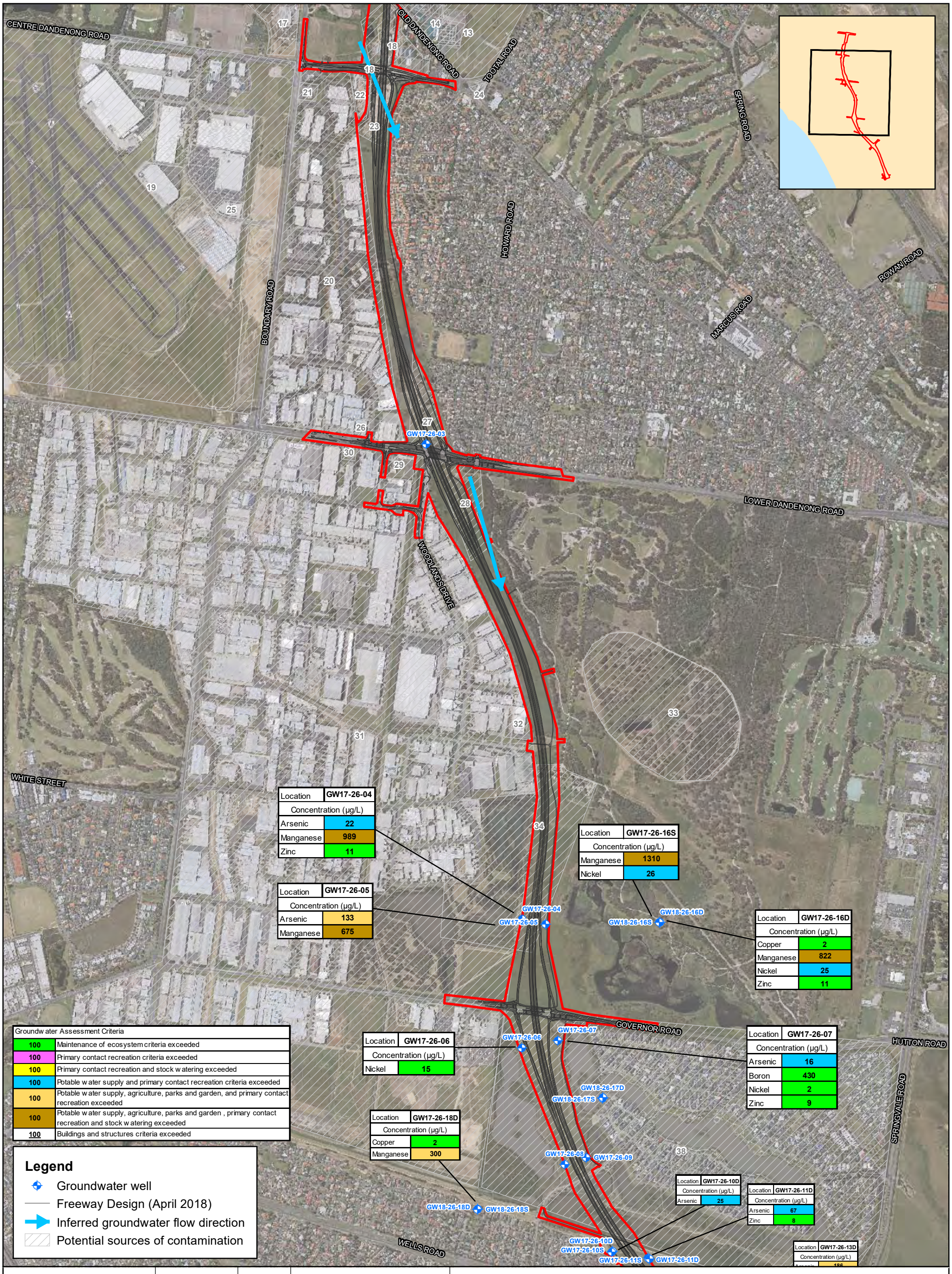
0 60 120 m

1:6,000

Coordinate system: GDA 1994 MGA Zone 55

Scale ratio correct when printed at A3

Engineering and Technical Services for Mordialloc Bypass Upgrade
Figure 10A
Groundwater Impact Plan (UTAF)
(Northern Portion)



Map: 2135645A_GIS_1019_A1 | Author: MB

Date: 2/08/2018 | Approved by: ON

0 150 300 m

1:15,000

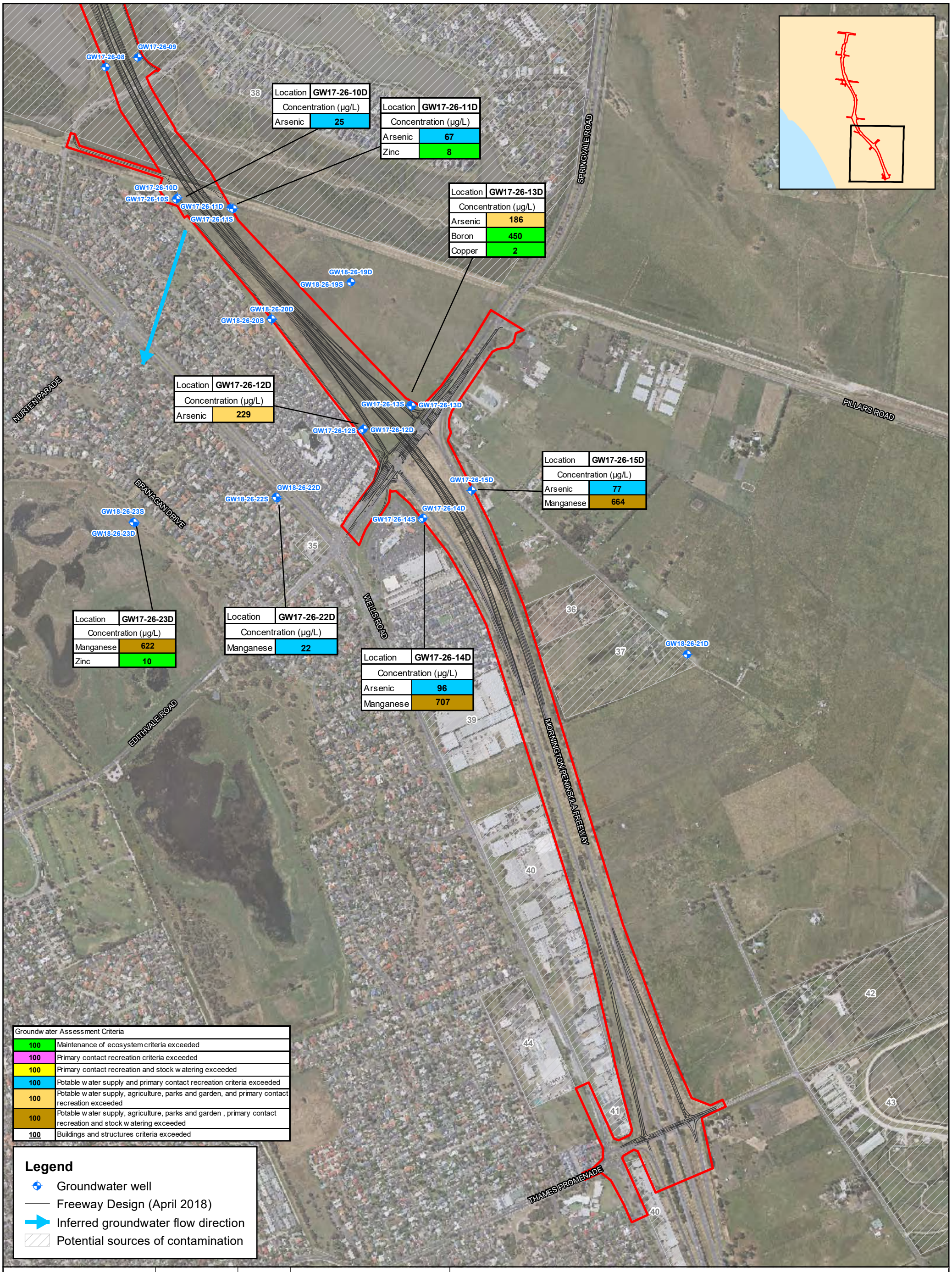
Coordinate system: GDA 1994 MGA Zone 55

Scale ratio correct when printed at A3

Engineering and Technical Services for Mordialloc Bypass Upgrade

Figure 10B

Groundwater Impact Plan (UTAF) (Central Portion)



Location	GW17-26-10D
Concentration (µg/L)	
Arsenic	25

Location	GW17-26-11D
Concentration (µg/L)	
Arsenic	67
Zinc	8

Location	GW17-26-13D
Concentration (µg/L)	
Arsenic	186
Boron	450
Copper	2

Location	GW17-26-12D
Concentration (µg/L)	
Arsenic	229

Location	GW17-26-15D
Concentration (µg/L)	
Arsenic	77
Manganese	664

Location	GW17-26-23D
Concentration (µg/L)	
Manganese	622
Zinc	10

Location	GW17-26-22D
Concentration (µg/L)	
Manganese	22

Location	GW17-26-14D
Concentration (µg/L)	
Arsenic	96
Manganese	707

Groundwater Assessment Criteria	
100	Maintenance of ecosystem criteria exceeded
100	Primary contact recreation criteria exceeded
100	Primary contact recreation and stock watering exceeded
100	Potable water supply and primary contact recreation criteria exceeded
100	Potable water supply, agriculture, parks and garden, and primary contact recreation exceeded
100	Potable water supply, agriculture, parks and garden , primary contact recreation and stock watering exceeded
100	Buildings and structures criteria exceeded

Legend

- Groundwater well
- Freeway Design (April 2018)
- Inferred groundwater flow direction
- Potential sources of contamination

Map: 2135645A_GIS_1019_A1	Author: MB
Date: 2/08/2018	Approved by: ON

Data source: VicRoads,
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Department of Environment, Land, Water & Planning 2018

0 100 200 m

1:10,000

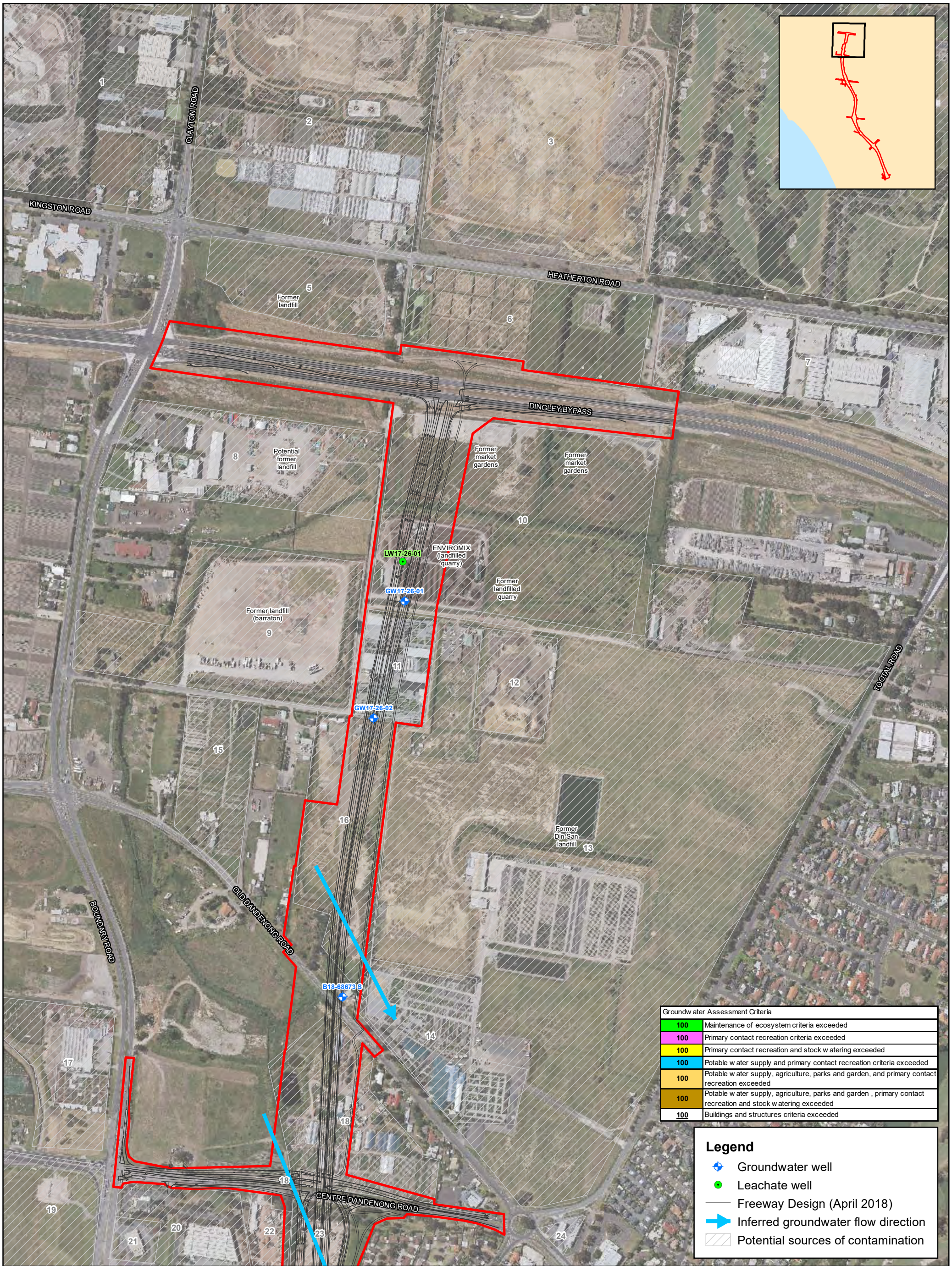
Coordinate system: GDA 1994 MGA Zone 55

Scale ratio correct when printed at A3

Engineering and Technical Services for Mordialloc Bypass Upgrade

Figure 10C

Groundwater Impact Plan (UTAF) (Southern Portion)



Map: 2135645A_GIS_1020_A1	Author: MB
Date: 2/08/2018	Approved by: ON

0 60 120 m

1:6,000

Coordinate system: GDA 1994 MGA Zone 55

Scale ratio correct when printed at A3

Engineering and Technical Services for Mordialloc Bypass Upgrade

Figure 11A

Groundwater Impact Plan (QA)

(Northern Portion)

CENTRE DANDENONG ROAD
OLD DANDENONG ROAD
TOOTAL ROAD
SPRING ROAD
HOWARD ROAD
ROWAN ROAD
MARCUS ROAD
BOUNDARY ROAD
LOWER DANDENONG ROAD
WOODLANDS DRIVE
WHITE STREET
MALCOLM ROAD
GOVERNOR ROAD
HUTTON ROAD
SPRINGVALE ROAD
WELLS ROAD

17 14 13 18 18 21 22 24 23 19 25 20 26 27 30 29 28 33 32 31 34 38

GW17-26-03
GW17-26-04
GW17-26-05
GW18-26-16D
GW18-26-16S
GW17-26-06
GW17-26-07
GW18-26-17D
GW18-26-17S
GW17-26-08
GW17-26-09
GW18-26-18D
GW18-26-18S
GW17-26-10D
GW17-26-10S
GW17-26-11S
GW17-26-11D

Groundw ater Assessment Criteria	
100	Maintenance of ecosystem criteria exceeded
100	Primary contact recreation criteria exceeded
100	Primary contact recreation and stock w atering exceeded
100	Potable w ater supply and primary contact recreation criteria exceeded
100	Potable w ater supply, agriculture, parks and garden, and primary contact recreation exceeded
100	Potable w ater supply, agriculture, parks and garden , primary contact recreation and stock w atering exceeded
100	Buildings and structures criteria exceeded

Location	GW17-26-18S
Concentration (µg/L)	
Arsenic	14
Copper	3

Location	GW17-26-09
Concentration (µg/L)	
Nickel	14

Legend

- Groundwater well
- Freeway Design (April 2018)
- Inferred groundwater flow direction
- Potential sources of contamination

Map: 2135645A_GIS_1020_A1 | Author: MB
Date: 2/08/2018 | Approved by: ON

0 150 300 m
1:15,000

Coordinate system: GDA 1994 MGA Zone 55
Scale ratio correct when printed at A3

Engineering and Technical Services for Mordialloc Bypass Upgrade
Figure 11B
Groundwater Impact Plan (QA)
(Central Portion)

Location	GW17-26-09
Concentration (µg/L)	
Nickel	14

Location	GW17-26-08
Concentration (µg/L)	
Aluminium	2540
Arsenic	147
Cadmium	1
Manganese	8140
Nickel	1540
Zinc	178

Location	GW17-26-23S
Concentration (µg/L)	
Aluminium	1300
Arsenic	14
Copper	3
Zinc	14

Location	GW17-26-22S
Concentration (µg/L)	
Aluminium	60
Arsenic	11
Copper	5
Zinc	18

Location	GW17-26-14S
Concentration (µg/L)	
Aluminium	260
Arsenic	21
Zinc	10

Groundw ater Assessment Criteria	
100	Maintenance of ecosystem criteria exceeded
100	Primary contact recreation criteria exceeded
100	Primary contact recreation and stock w atering exceeded
100	Potable w ater supply and primary contact recreation criteria exceeded
100	Potable w ater supply, agriculture, parks and garden, and primary contact recreation exceeded
100	Potable w ater supply, agriculture, parks and garden , primary contact recreation and stock w atering exceeded
100	Buildings and structures criteria exceeded

Legend

- Groundwater well
- Freeway Design (April 2018)
- Inferred groundwater flow direction
- Potential sources of contamination

Map: 2135645A_GIS_1020_A1	Author: MB
Date: 2/08/2018	Approved by: ON

Data source: VicRoads,
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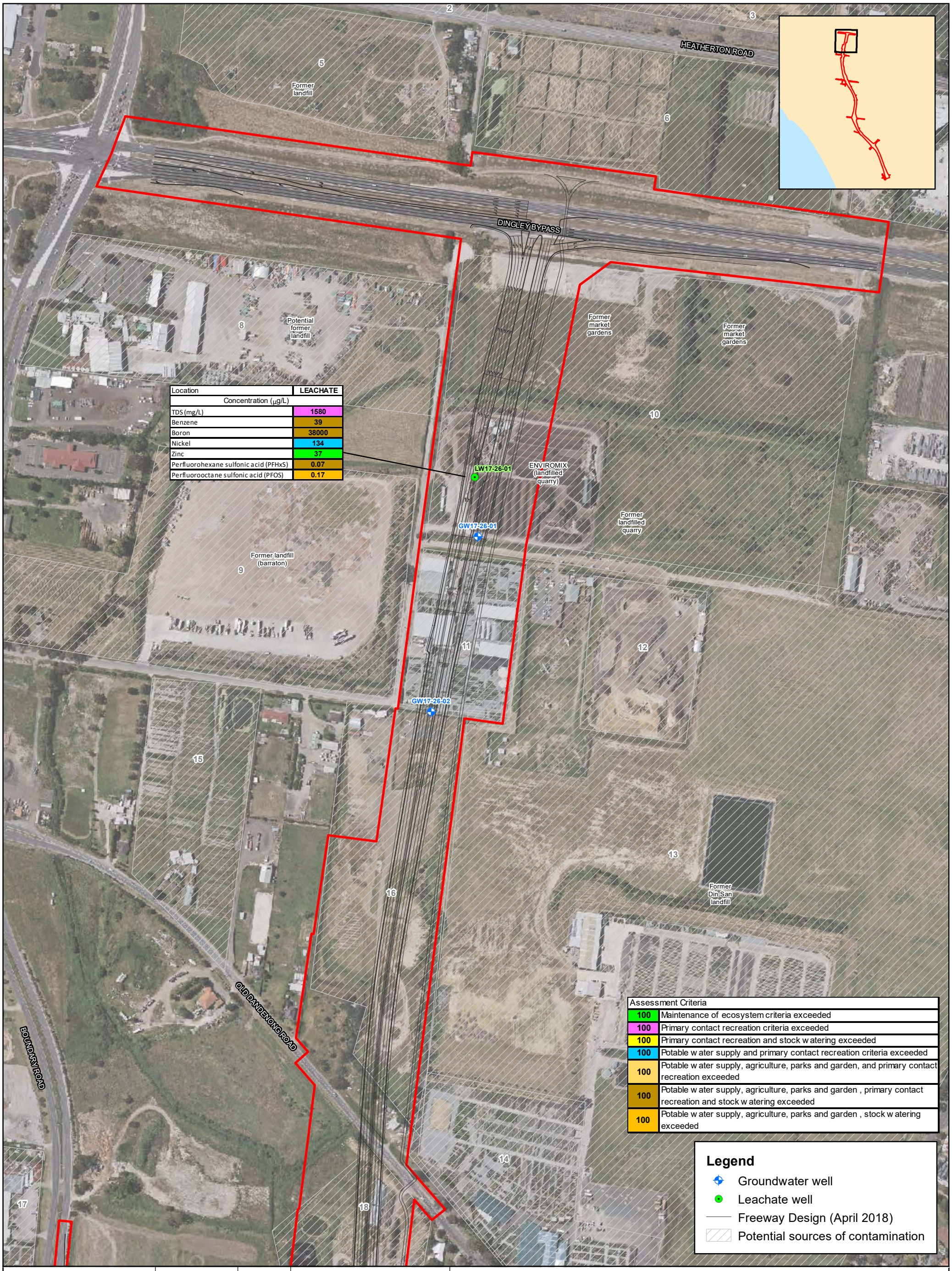
0 100 200 m

1:10,000

Coordinate system: GDA 1994 MGA Zone 55

Scale ratio correct when printed at A3

Engineering and Technical Services for Mordialloc Bypass Upgrade
Figure 11C
Groundwater Impact Plan (QA)
(Southern Portion)



Location	LEACHATE
Concentration (µg/L)	
TDS (mg/L)	1580
Benzene	39
Boron	38000
Nickel	134
Zinc	37
Perfluorohexane sulfonic acid (PFHxS)	0.07
Perfluorooctane sulfonic acid (PFOS)	0.17

Assessment Criteria	
100	Maintenance of ecosystem criteria exceeded
100	Primary contact recreation criteria exceeded
100	Primary contact recreation and stock watering exceeded
100	Potable water supply and primary contact recreation criteria exceeded
100	Potable water supply, agriculture, parks and garden, and primary contact recreation exceeded
100	Potable water supply, agriculture, parks and garden , primary contact recreation and stock watering exceeded
100	Potable water supply, agriculture, parks and garden , stock watering exceeded

Legend

- Groundwater well
- Leachate well
- Freeway Design (April 2018)
- Potential sources of contamination

Map: 2135645A_GIS_1022_A | Author: MB

Date: 2/08/2018 | Approved by: ON

Data source: VicRoads, Compass Environmental,
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0 40 80 m

1:4,000

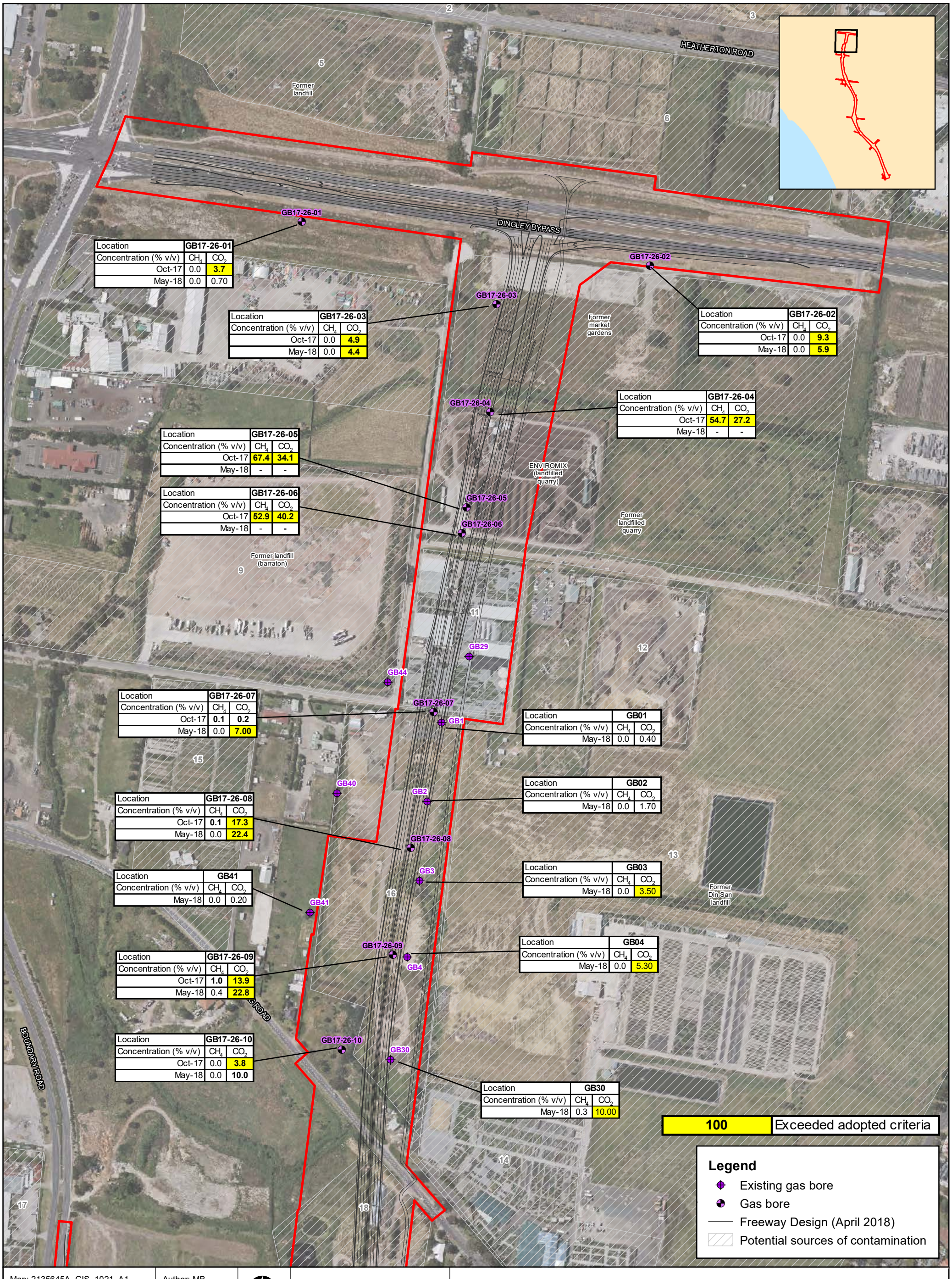
Coordinate system: GDA 1994 MGA Zone 55

Scale ratio correct when printed at A3

Engineering and Technical Services for Mordialloc Bypass Upgrade

Figure 12

Leachate impact plan



Location	GB17-26-01	
Concentration (% v/v)	CH_4	CO_2
Oct-17	0.0	**3.7**
May-18	0.0	0.70

Location	GB17-26-02	
Concentration (% v/v)	CH_4	CO_2
Oct-17	0.0	**9.3**
May-18	0.0	**5.9**

Location	GB17-26-03	
Concentration (% v/v)	CH_4	CO_2
Oct-17	0.0	**4.9**
May-18	0.0	**4.4**

Location	GB17-26-04	
Concentration (% v/v)	CH_4	CO_2
Oct-17	**54.7**	**27.2**
May-18	-	-

Location	GB17-26-05	
Concentration (% v/v)	CH_4	CO_2
Oct-17	**67.4**	**34.1**
May-18	-	-

Location	GB17-26-06	
Concentration (% v/v)	CH_4	CO_2
Oct-17	**52.9**	**40.2**
May-18	-	-

Location	GB17-26-07	
Concentration (% v/v)	CH_4	CO_2
Oct-17	**0.1**	**0.2**
May-18	0.0	**7.00**

Location	GB01	
Concentration (% v/v)	CH_4	CO_2
May-18	0.0	0.40

Location	GB17-26-08	
Concentration (% v/v)	CH_4	CO_2
Oct-17	**0.1**	**17.3**
May-18	0.0	**22.4**

Location	GB02	
Concentration (% v/v)	CH_4	CO_2
May-18	0.0	1.70

Location	GB41	
Concentration (% v/v)	CH_4	CO_2
May-18	0.0	0.20

Location	GB03	
Concentration (% v/v)	CH_4	CO_2
May-18	0.0	3.50

Location	GB17-26-09	
Concentration (% v/v)	CH_4	CO_2
Oct-17	**1.0**	**13.9**
May-18	0.4	**22.8**

Location	GB04	
Concentration (% v/v)	CH_4	CO_2
May-18	0.0	5.30

Location	GB17-26-10	
Concentration (% v/v)	CH_4	CO_2
Oct-17	0.0	**3.8**
May-18	0.0	**10.0**

Location	GB30	
Concentration (% v/v)	CH_4	CO_2
May-18	0.3	10.00

100	Exceeded adopted criteria

Legend

- Existing gas bore
- Gas bore
- Freeway Design (April 2018)
- Potential sources of contamination

Map: 2135645A_GIS_1021_A1	Author: MB
Date: 2/08/2018	Approved by: ON

Data source: VicRoads, Compass Environmental,
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Department of Environment, Land, Water & Planning 2018

0 40 80 m

1:4,000

Coordinate system: GDA 1994 MGA Zone 55
Scale ratio correct when printed at A3

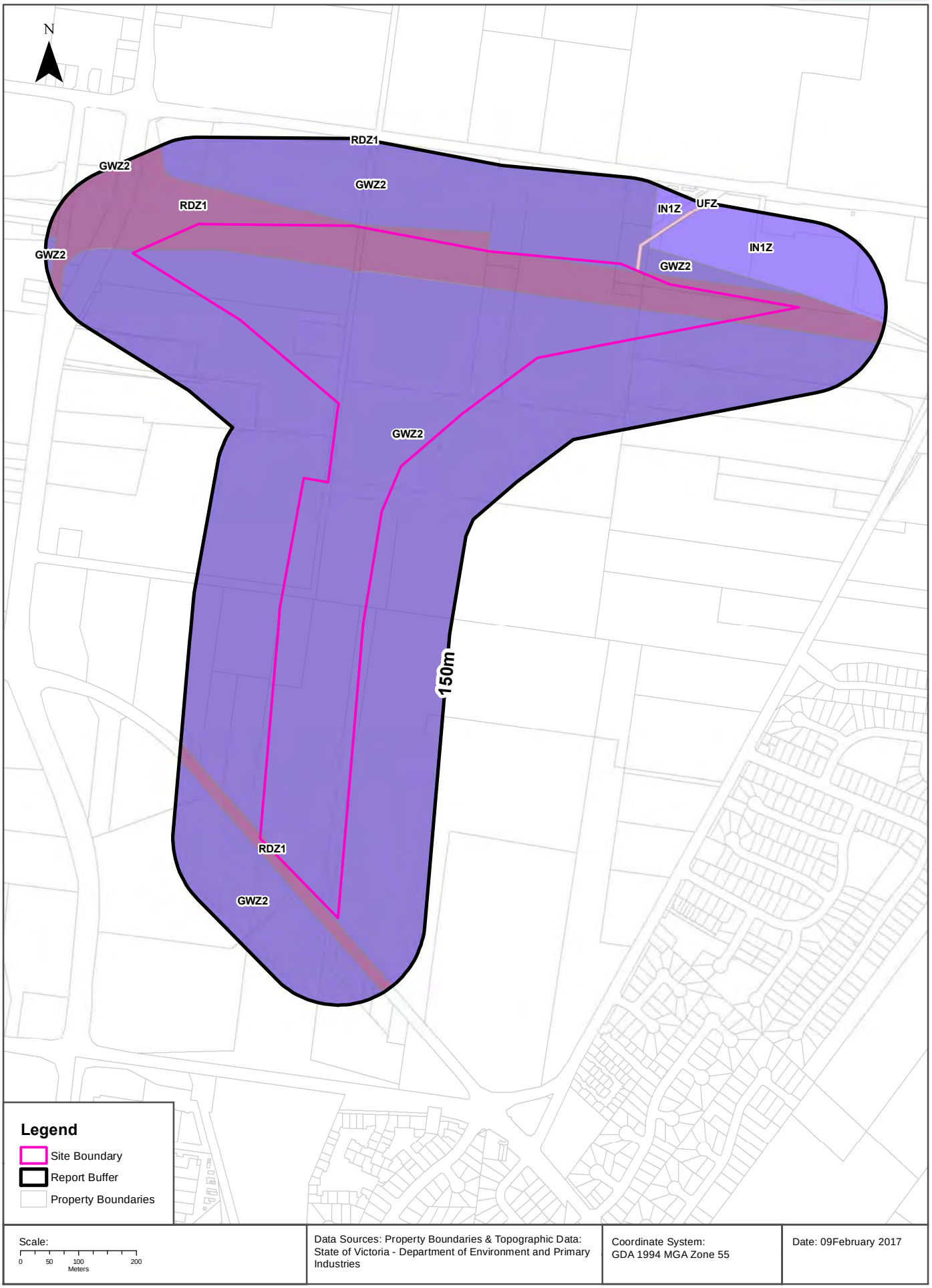
Engineering and Technical Services for Mordialloc Bypass Upgrade
Figure 13
Bulk gas impact plan

APPENDIX B

PLANNING ZONES

Planning Zones

OSAR Proposed Road Alignments - Site 26 (Section 1)



Planning Zones

OSAR Proposed Road Alignments - Site 26 (Section 1)

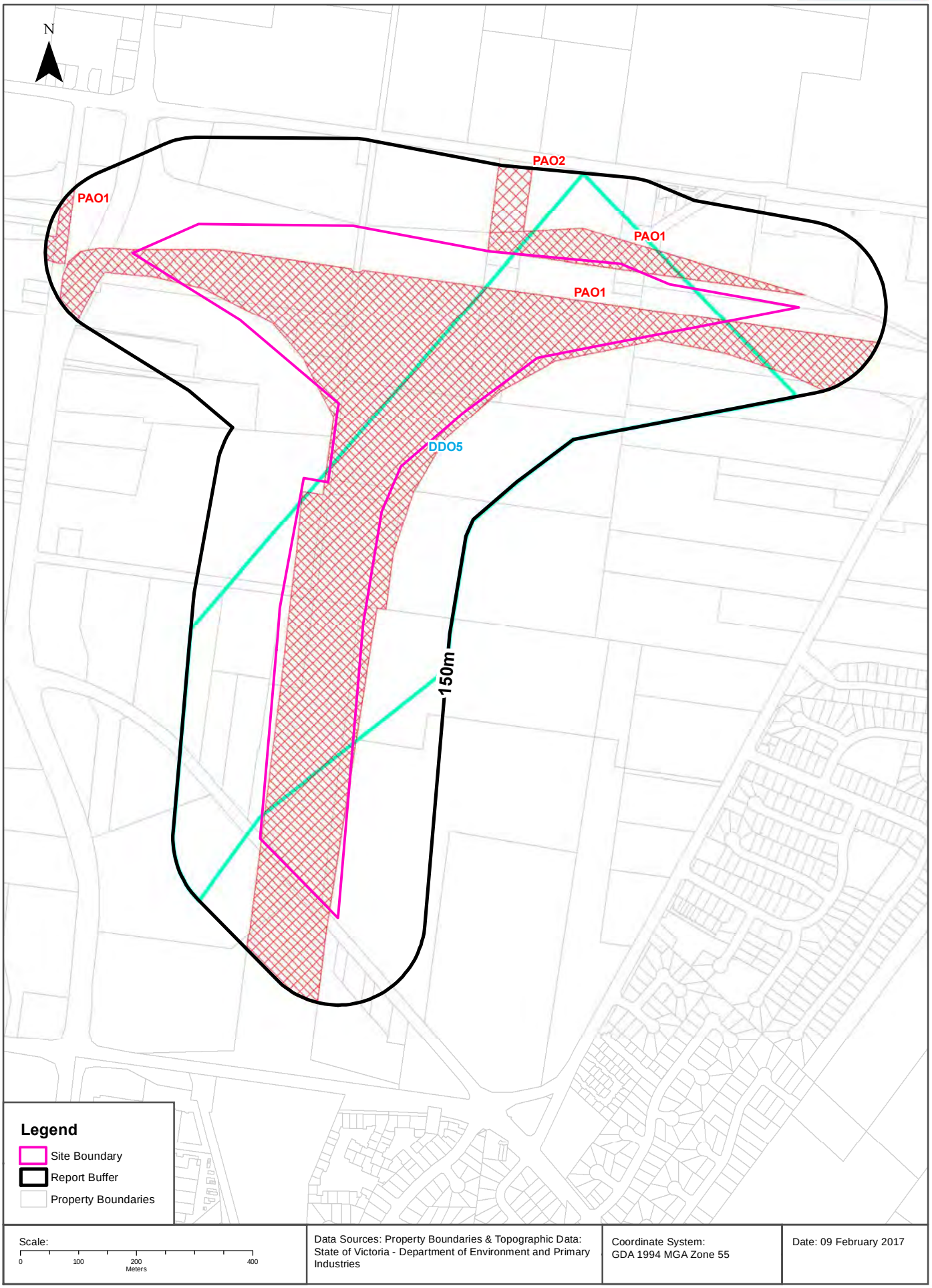
Planning Zones

Planning zones within the report buffer:

Zone Code	Description	Distance	Direction
GWZ2	GREEN WEDGE ZONE - SCHEDULE 2	0m	Onsite
RDZ1	ROAD ZONE - CATEGORY 1	0m	Onsite
UFZ	URBAN FLOODWAY ZONE	0m	North East
GWZ2	GREEN WEDGE ZONE - SCHEDULE 2	15m	South
IN1Z	INDUSTRIAL 1 ZONE	24m	East
IN1Z	INDUSTRIAL 1 ZONE	61m	North East
GWZ2	GREEN WEDGE ZONE - SCHEDULE 2	134m	West
GWZ2	GREEN WEDGE ZONE - SCHEDULE 2	145m	North West

Planning Overlays

OSAR Proposed Road Alignments - Site 26 (Section 1)



Planning Overlays

OSAR Proposed Road Alignments - Site 26 (Section 1)

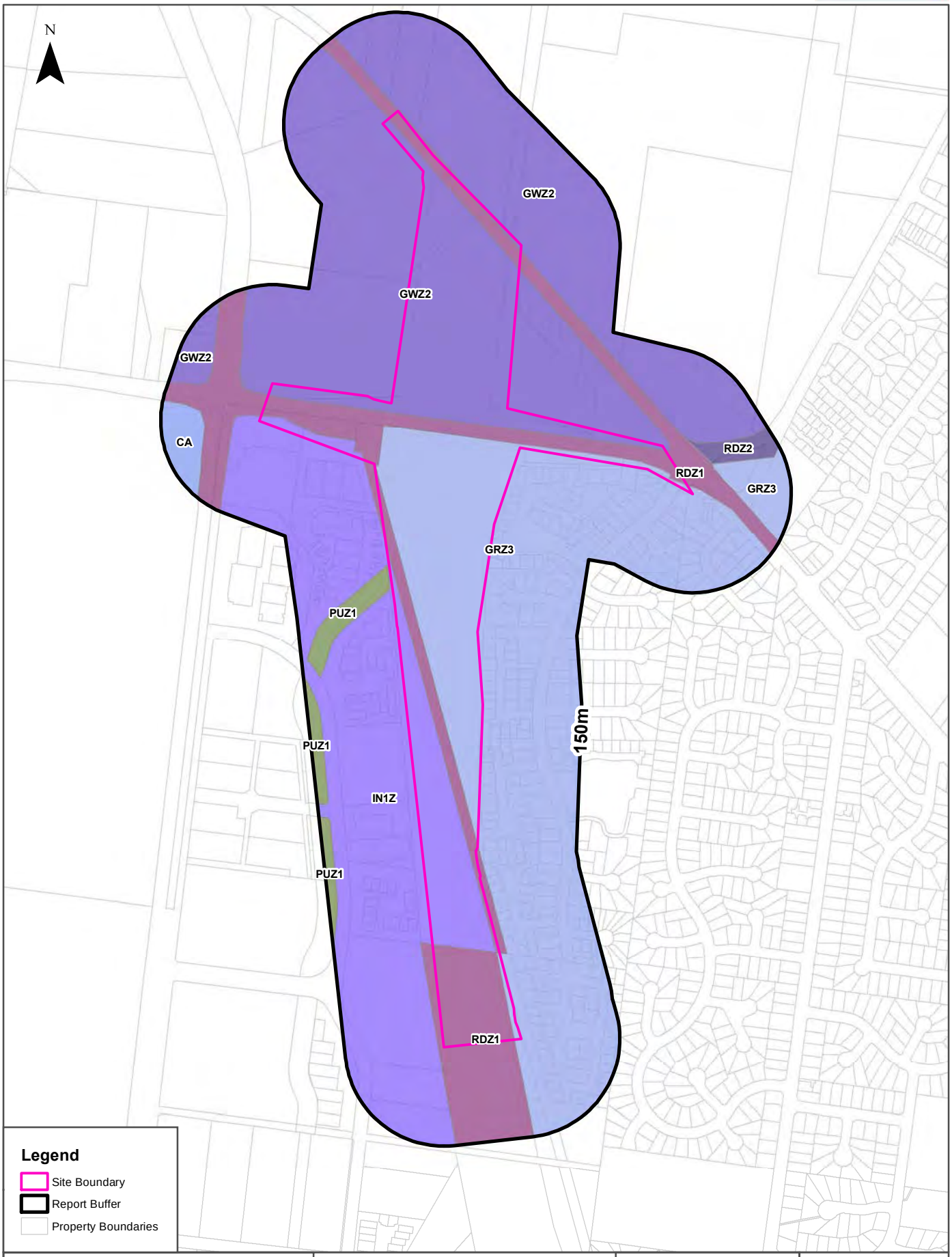
Planning Overlays

Planning overlays within the report buffer:

Zone Code	Description	Distance	Direction
PAO1	PUBLIC ACQUISITION OVERLAY 1	0m	Onsite
DDO5	DESIGN AND DEVELOPMENT OVERLAY - SCHEDULE 5	0m	Onsite
PAO2	PUBLIC ACQUISITION OVERLAY 2	31m	North East
PAO1	PUBLIC ACQUISITION OVERLAY 1	114m	North West

Planning Zones

OSAR Proposed Road Alignments - Site 26 (Section 2)



Planning Zones

OSAR Proposed Road Alignments - Site 26 (Section 2)

Planning Zones

Planning zones within the report buffer:

Zone Code	Description	Distance	Direction
GRZ3	GENERAL RESIDENTIAL ZONE - SCHEDULE 3	0m	Onsite
GWZ2	GREEN WEDGE ZONE - SCHEDULE 2	0m	Onsite
RDZ1	ROAD ZONE - CATEGORY 1	0m	Onsite
IN1Z	INDUSTRIAL 1 ZONE	0m	Onsite
PUZ1	PUBLIC USE ZONE - SERVICE AND UTILITY	3m	South West
RDZ2	ROAD ZONE - CATEGORY 2	33m	North East
GRZ3	GENERAL RESIDENTIAL ZONE - SCHEDULE 3	46m	North East
CA	COMMONWEALTH LAND NOT CONTROLLED BY PLANNING SCHEME	84m	West
GWZ2	GREEN WEDGE ZONE - SCHEDULE 2	93m	North West
PUZ1	PUBLIC USE ZONE - SERVICE AND UTILITY	131m	South West
PUZ1	PUBLIC USE ZONE - SERVICE AND UTILITY	134m	South

Planning Overlays

OSAR Proposed Road Alignments - Site 26 (Section 2)

Planning Overlays

OSAR Proposed Road Alignments - Site 26 (Section 2)

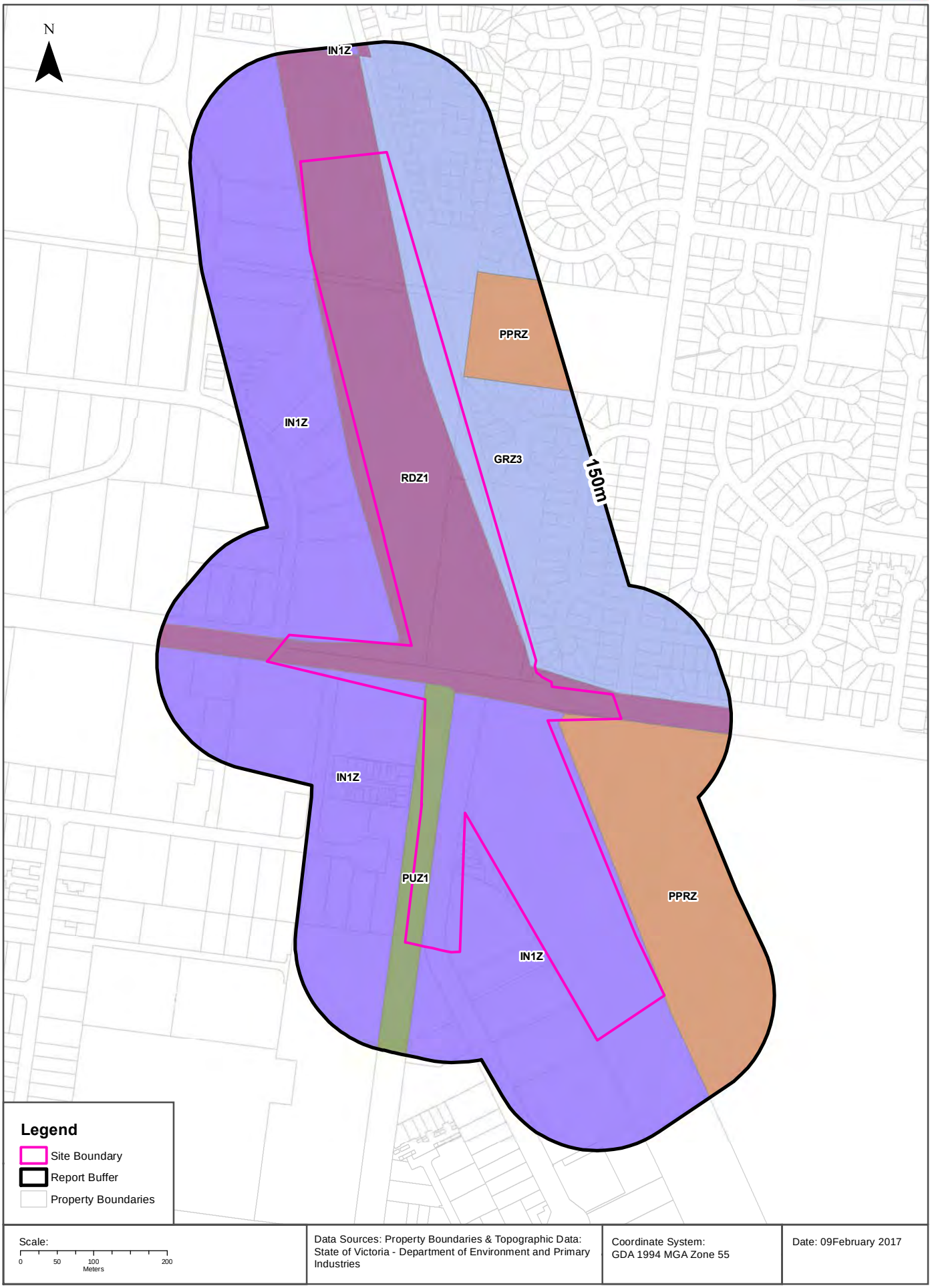
Planning Overlays

Planning overlays within the report buffer:

Zone Code	Description	Distance	Direction
PAO1	PUBLIC ACQUISITION OVERLAY 1	0m	Onsite
SBO	SPECIAL BUILDING OVERLAY	0m	Onsite
DDO5	DESIGN AND DEVELOPMENT OVERLAY - SCHEDULE 5	0m	Onsite
HO3	HERITAGE OVERLAY (HO3)	0m	Onsite
DDO4	DESIGN AND DEVELOPMENT OVERLAY - SCHEDULE 4	42m	South West
SBO	SPECIAL BUILDING OVERLAY	50m	East
AEO1	AIRPORT ENVIRONS OVERLAY (AEO1)	67m	West
LSIO	LAND SUBJECT TO INUNDATION OVERLAY	69m	North West
SBO	SPECIAL BUILDING OVERLAY	133m	South West

Planning Zones

OSAR Proposed Road Alignments - Site 26 (Section 3)



Planning Zones

OSAR Proposed Road Alignments - Site 26 (Section 3)

Planning Zones

Planning zones within the report buffer:

Zone Code	Description	Distance	Direction
RDZ1	ROAD ZONE - CATEGORY 1	0m	Onsite
IN1Z	INDUSTRIAL 1 ZONE	0m	Onsite
GRZ3	GENERAL RESIDENTIAL ZONE - SCHEDULE 3	0m	Onsite
PUZ1	PUBLIC USE ZONE - SERVICE AND UTILITY	0m	Onsite
PPRZ	PUBLIC PARK AND RECREATION ZONE	0m	South East
PPRZ	PUBLIC PARK AND RECREATION ZONE	14m	North

Planning Overlays

OSAR Proposed Road Alignments - Site 26 (Section 3)

Planning Overlays

OSAR Proposed Road Alignments - Site 26 (Section 3)

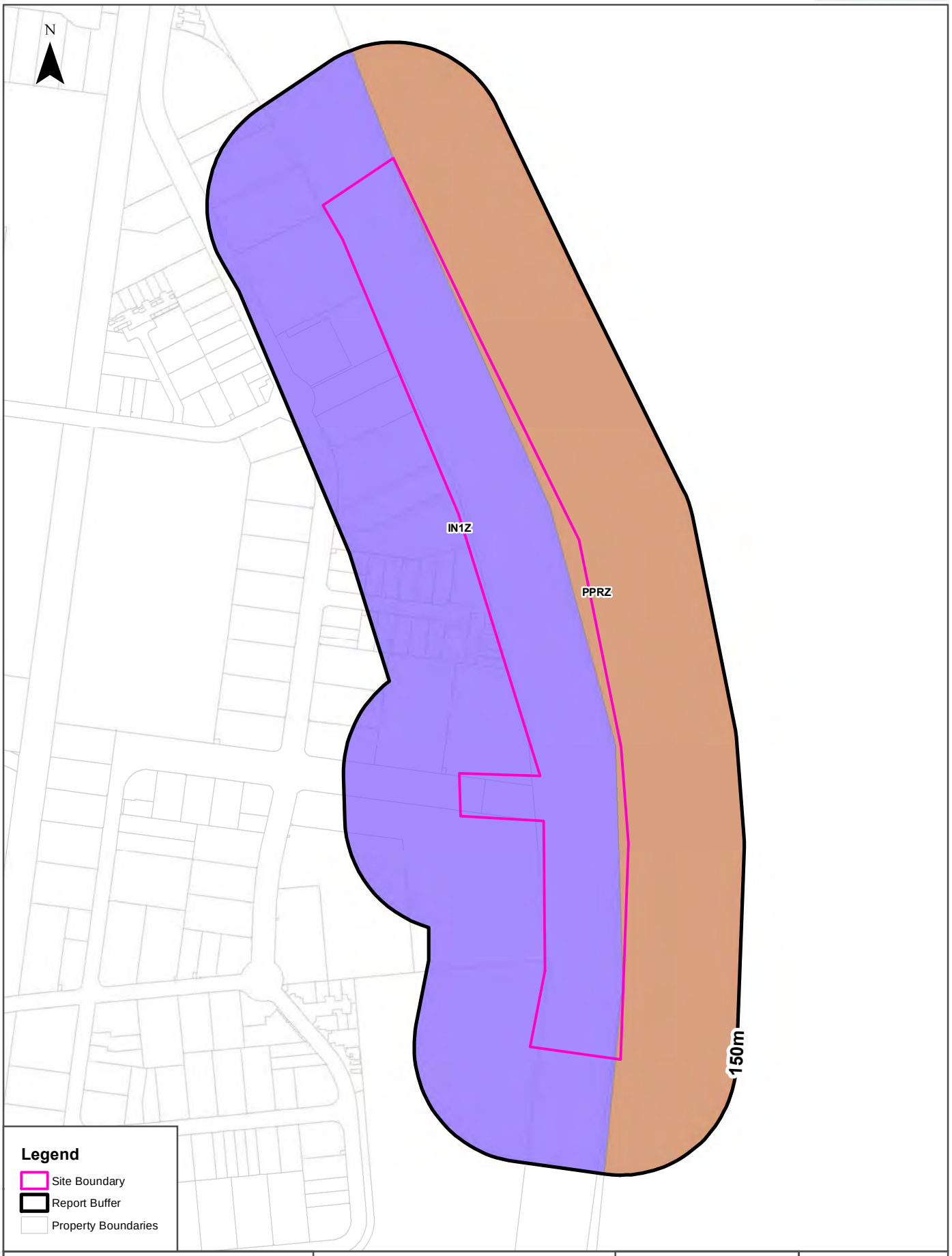
Planning Overlays

Planning overlays within the report buffer:

Zone Code	Description	Distance	Direction
SBO	SPECIAL BUILDING OVERLAY	0m	Onsite
PAO1	PUBLIC ACQUISITION OVERLAY 1	0m	Onsite
DDO5	DESIGN AND DEVELOPMENT OVERLAY - SCHEDULE 5	0m	Onsite
LSIO	LAND SUBJECT TO INUNDATION OVERLAY	0m	Onsite
DDO4	DESIGN AND DEVELOPMENT OVERLAY - SCHEDULE 4	0m	Onsite
AEO1	AIRPORT ENVIRONS OVERLAY (AEO1)	23m	North West
SBO	SPECIAL BUILDING OVERLAY	45m	West
PAO1	PUBLIC ACQUISITION OVERLAY 1	135m	North

Planning Zones

OSAR Proposed Road Alignments - Site 26 (Section 4)



Planning Zones

OSAR Proposed Road Alignments - Site 26 (Section 4)

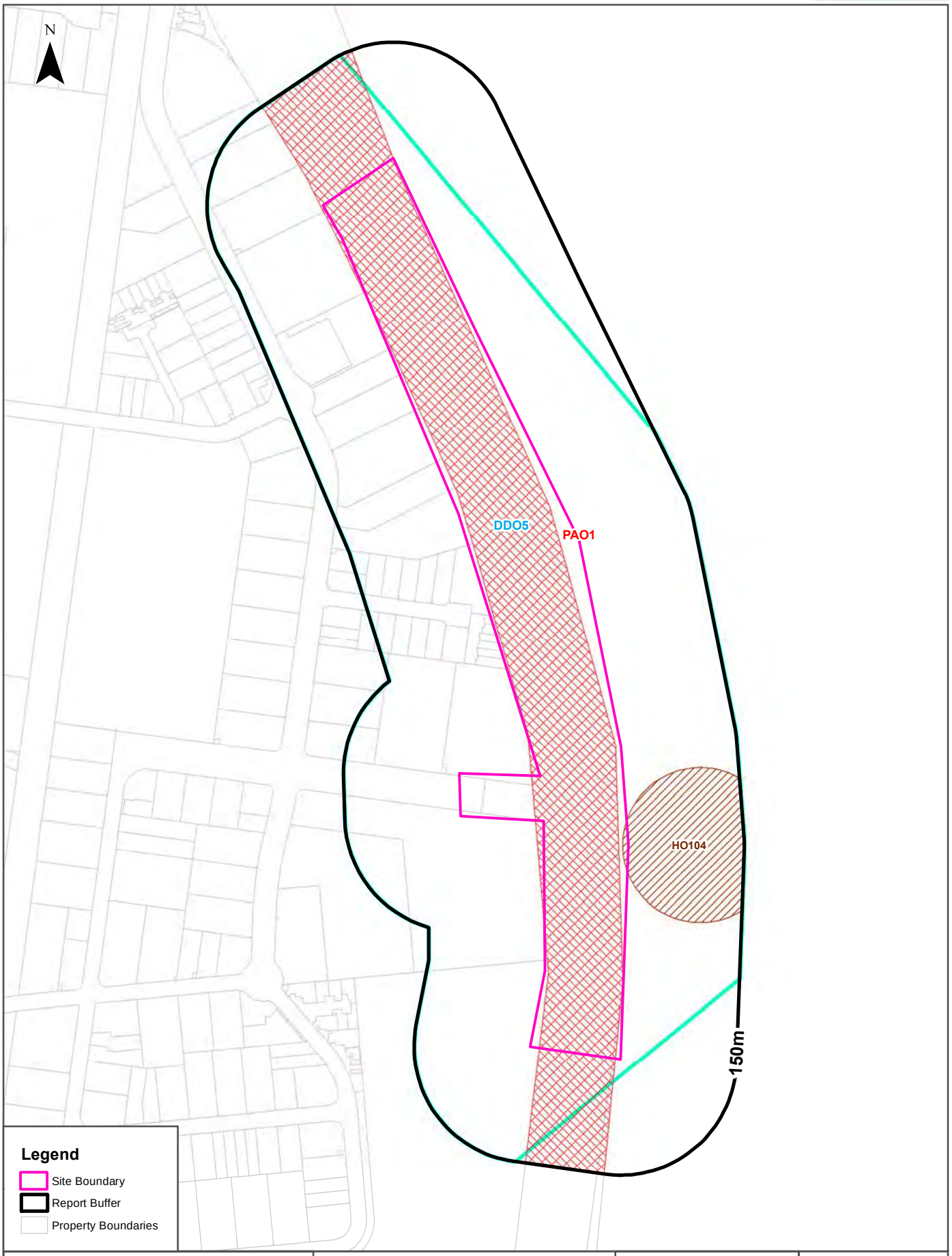
Planning Zones

Planning zones within the report buffer:

Zone Code	Description	Distance	Direction
IN1Z	INDUSTRIAL 1 ZONE	0m	Onsite
PPRZ	PUBLIC PARK AND RECREATION ZONE	0m	Onsite

Planning Overlays

OSAR Proposed Road Alignments - Site 26 (Section 4)



Planning Overlays

OSAR Proposed Road Alignments - Site 26 (Section 4)

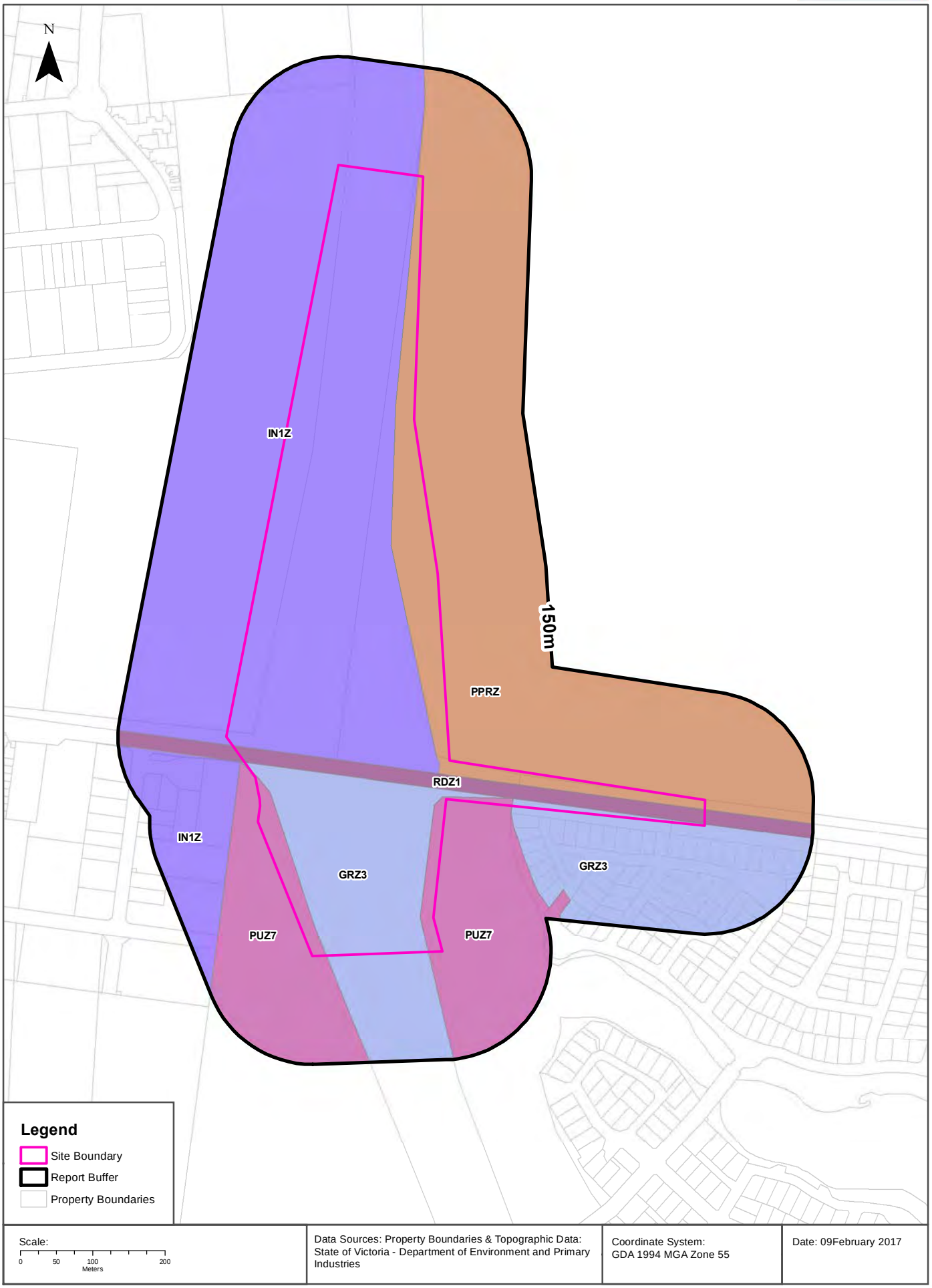
Planning Overlays

Planning overlays within the report buffer:

Zone Code	Description	Distance	Direction
DDO5	DESIGN AND DEVELOPMENT OVERLAY - SCHEDULE 5	0m	Onsite
PAO1	PUBLIC ACQUISITION OVERLAY 1	0m	Onsite
HO104	HERITAGE OVERLAY (HO104)	0m	Onsite

Planning Zones

OSAR Proposed Road Alignments - Site 26 (Section 5)



Planning Zones

OSAR Proposed Road Alignments - Site 26 (Section 5)

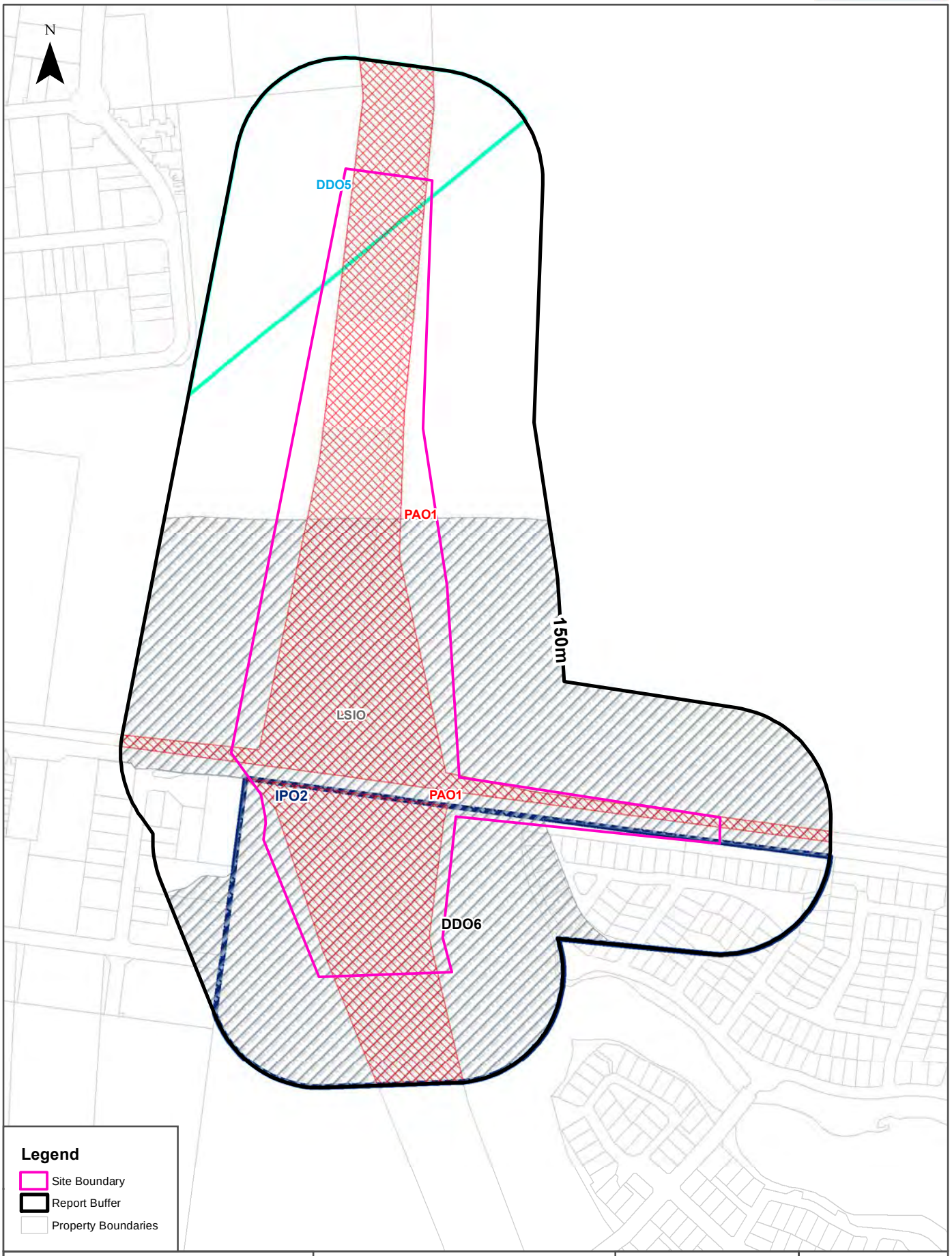
Planning Zones

Planning zones within the report buffer:

Zone Code	Description	Distance	Direction
IN1Z	INDUSTRIAL 1 ZONE	0m	Onsite
GRZ3	GENERAL RESIDENTIAL ZONE - SCHEDULE 3	0m	Onsite
PPRZ	PUBLIC PARK AND RECREATION ZONE	0m	Onsite
RDZ1	ROAD ZONE - CATEGORY 1	0m	Onsite
PUZ7	PUBLIC USE ZONE - OTHER PUBLIC USE	0m	Onsite
IN1Z	INDUSTRIAL 1 ZONE	5m	South West

Planning Overlays

OSAR Proposed Road Alignments - Site 26 (Section 5)



Planning Overlays

OSAR Proposed Road Alignments - Site 26 (Section 5)

Planning Overlays

Planning overlays within the report buffer:

Zone Code	Description	Distance	Direction
LSIO	LAND SUBJECT TO INUNDATION OVERLAY	0m	Onsite
PAO1	PUBLIC ACQUISITION OVERLAY 1	0m	Onsite
DDO6	DESIGN AND DEVELOPMENT OVERLAY - SCHEDULE 6	0m	Onsite
IPO2	INCORPORATED PLAN OVERLAY - SCHEDULE 2	0m	Onsite
DDO5	DESIGN AND DEVELOPMENT OVERLAY - SCHEDULE 5	0m	Onsite

Planning Zones

OSAR Proposed Road Alignments - Site 26 (Section 6)

Planning Zones

OSAR Proposed Road Alignments - Site 26 (Section 6)

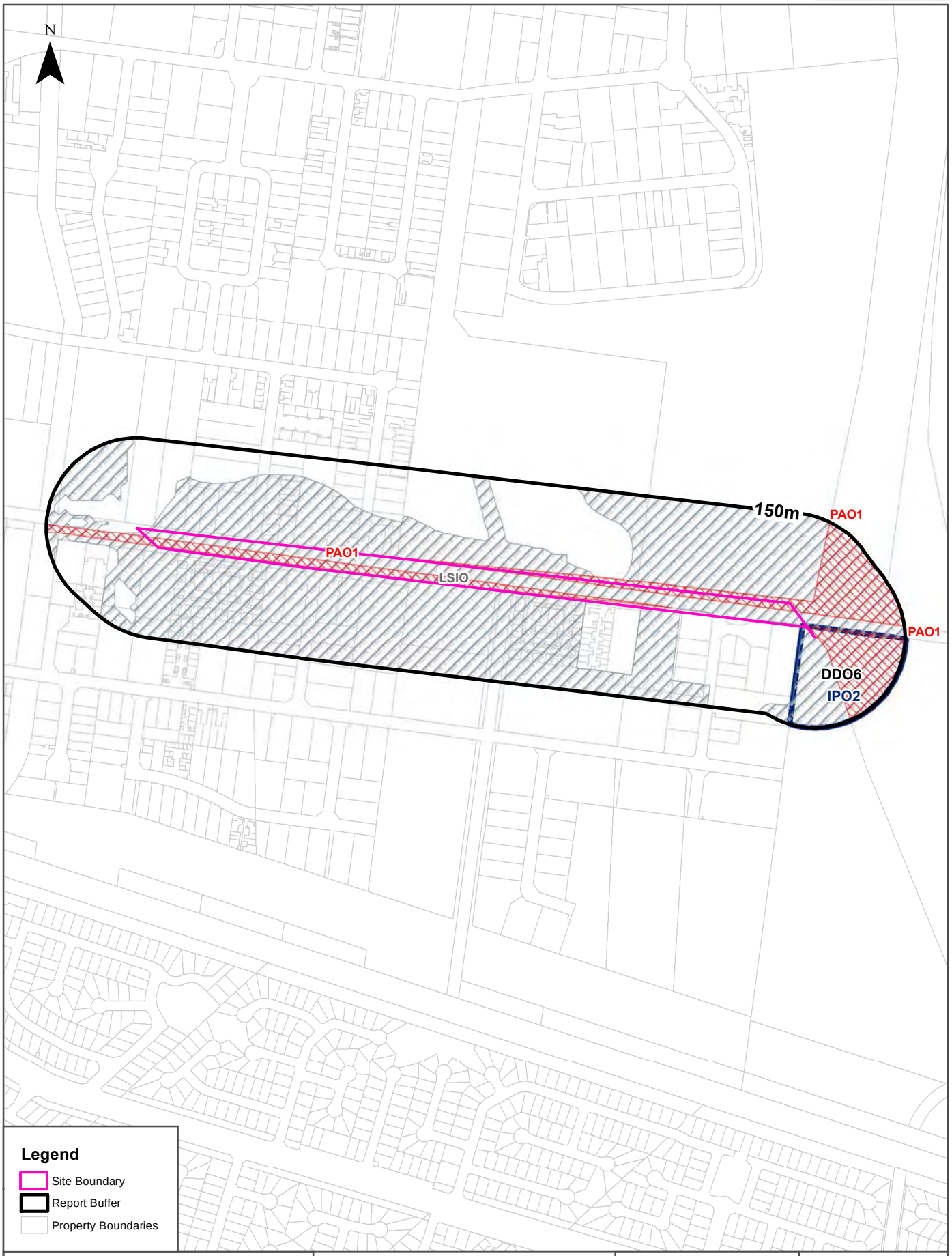
Planning Zones

Planning zones within the report buffer:

Zone Code	Description	Distance	Direction
RDZ1	ROAD ZONE - CATEGORY 1	0m	Onsite
IN1Z	INDUSTRIAL 1 ZONE	0m	Onsite
PPRZ	PUBLIC PARK AND RECREATION ZONE	0m	Onsite
GRZ3	GENERAL RESIDENTIAL ZONE - SCHEDULE 3	0m	South East
PUZ7	PUBLIC USE ZONE - OTHER PUBLIC USE	0m	South East
UFZ	URBAN FLOODWAY ZONE	128m	West
UFZ	URBAN FLOODWAY ZONE	134m	North West

Planning Overlays

OSAR Proposed Road Alignments - Site 26 (Section 6)



Planning Overlays

OSAR Proposed Road Alignments - Site 26 (Section 6)

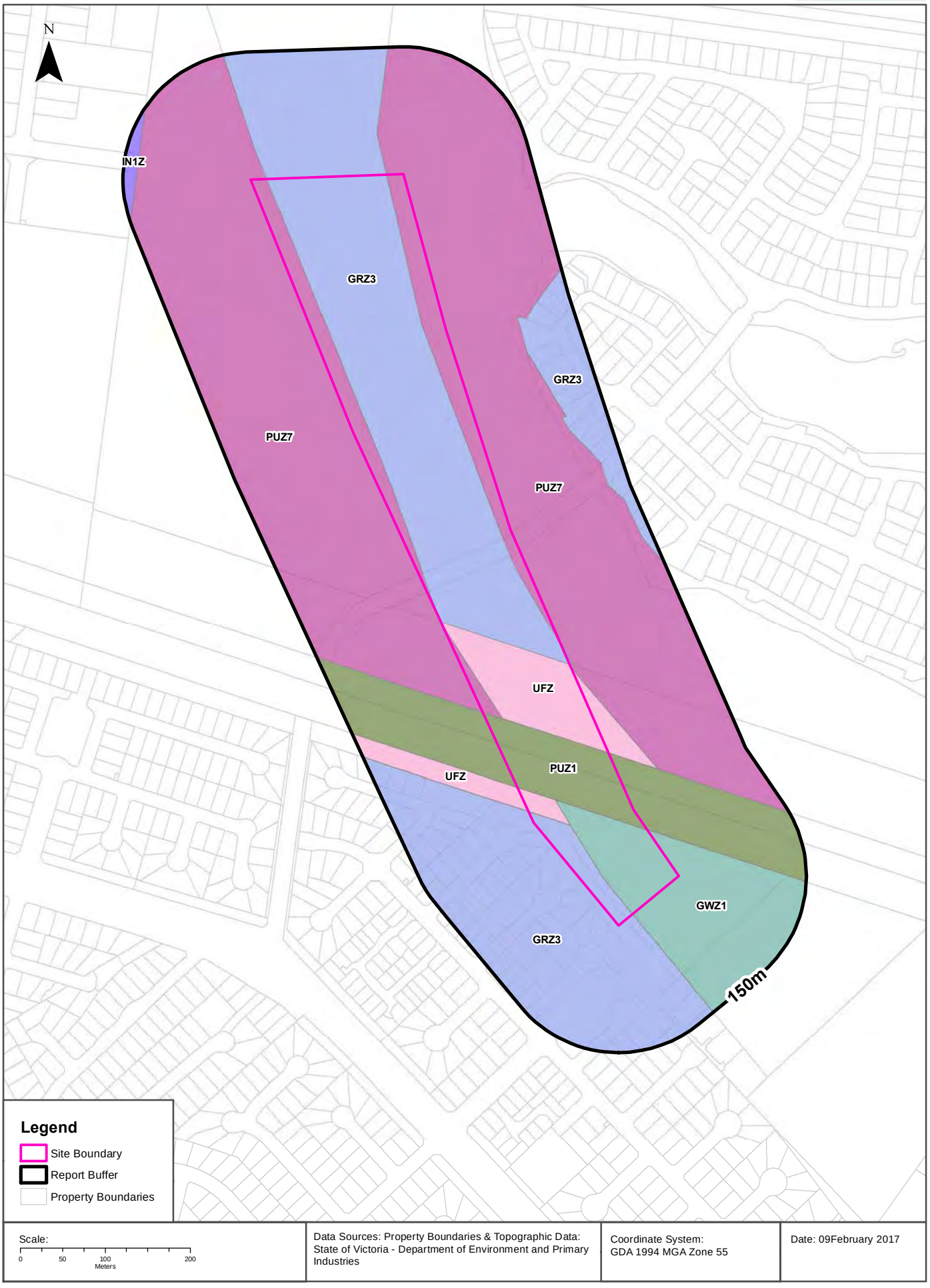
Planning Overlays

Planning overlays within the report buffer:

Zone Code	Description	Distance	Direction
LSIO	LAND SUBJECT TO INUNDATION OVERLAY	0m	Onsite
PAO1	PUBLIC ACQUISITION OVERLAY 1	0m	Onsite
DDO6	DESIGN AND DEVELOPMENT OVERLAY - SCHEDULE 6	0m	Onsite
IPO2	INCORPORATED PLAN OVERLAY - SCHEDULE 2	0m	Onsite

Planning Zones

OSAR Proposed Road Alignments - Site 26 (Section 7)



Planning Zones

OSAR Proposed Road Alignments - Site 26 (Section 7)

Planning Zones

Planning zones within the report buffer:

Zone Code	Description	Distance	Direction
GRZ3	GENERAL RESIDENTIAL ZONE - SCHEDULE 3	0m	Onsite
PUZ7	PUBLIC USE ZONE - OTHER PUBLIC USE	0m	Onsite
UFZ	URBAN FLOODWAY ZONE	0m	Onsite
PUZ1	PUBLIC USE ZONE - SERVICE AND UTILITY	0m	Onsite
GWZ1	GREEN WEDGE ZONE - SCHEDULE 1	0m	Onsite
GRZ3	GENERAL RESIDENTIAL ZONE - SCHEDULE 3	82m	East
IN1Z	INDUSTRIAL 1 ZONE	134m	North West

Planning Overlays

OSAR Proposed Road Alignments - Site 26 (Section 7)

Planning Overlays

OSAR Proposed Road Alignments - Site 26 (Section 7)

Planning Overlays

Planning overlays within the report buffer:

Zone Code	Description	Distance	Direction
LSIO	LAND SUBJECT TO INUNDATION OVERLAY	0m	Onsite
DDO6	DESIGN AND DEVELOPMENT OVERLAY - SCHEDULE 6	0m	Onsite
IPO2	INCORPORATED PLAN OVERLAY - SCHEDULE 2	0m	Onsite
PAO1	PUBLIC ACQUISITION OVERLAY 1	0m	Onsite
IPO3	INCORPORATED PLAN OVERLAY - SCHEDULE 3	0m	Onsite

Planning Zones

OSAR Proposed Road Alignments - Site 26 (Section 8)

Planning Zones

OSAR Proposed Road Alignments - Site 26 (Section 8)

Planning Zones

Planning zones within the report buffer:

Zone Code	Description	Distance	Direction
GWZ1	GREEN WEDGE ZONE - SCHEDULE 1	0m	Onsite
GRZ3	GENERAL RESIDENTIAL ZONE - SCHEDULE 3	0m	Onsite
RDZ1	ROAD ZONE - CATEGORY 1	0m	North West
PUZ1	PUBLIC USE ZONE - SERVICE AND UTILITY	40m	North
RDZ1	ROAD ZONE - CATEGORY 1	43m	North East
C2Z	COMMERCIAL 2 ZONE	68m	South East
PUZ7	PUBLIC USE ZONE - OTHER PUBLIC USE	112m	North
UFZ	URBAN FLOODWAY ZONE	128m	North West
GWZ	GREEN WEDGE ZONE	147m	South East

Planning Overlays

OSAR Proposed Road Alignments - Site 26 (Section 8)

Planning Overlays

OSAR Proposed Road Alignments - Site 26 (Section 8)

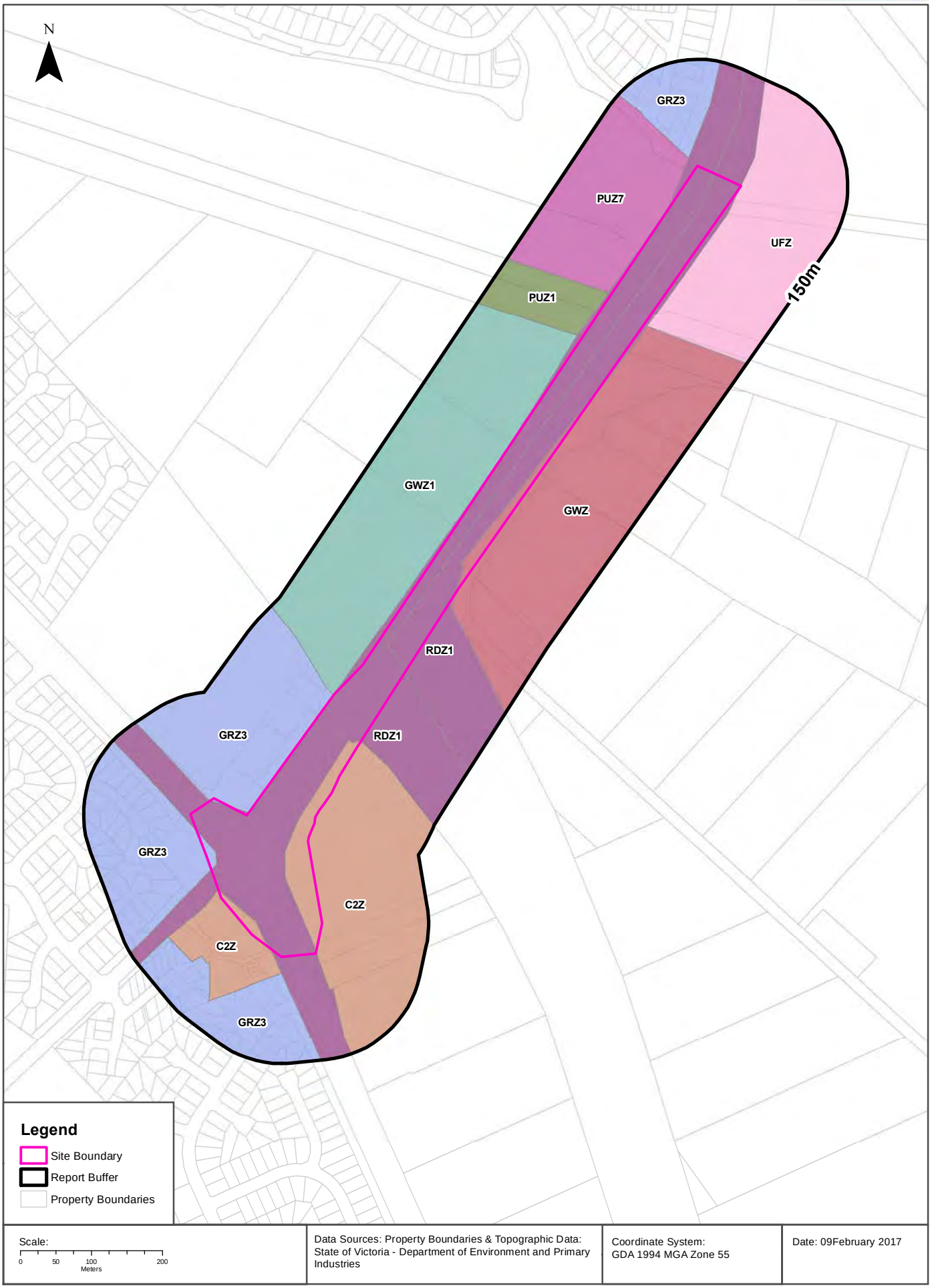
Planning Overlays

Planning overlays within the report buffer:

Zone Code	Description	Distance	Direction
LSIO	LAND SUBJECT TO INUNDATION OVERLAY	0m	Onsite
PAO1	PUBLIC ACQUISITION OVERLAY 1	0m	Onsite
IPO3	INCORPORATED PLAN OVERLAY - SCHEDULE 3	0m	Onsite
DDO6	DESIGN AND DEVELOPMENT OVERLAY - SCHEDULE 6	112m	North
IPO2	INCORPORATED PLAN OVERLAY - SCHEDULE 2	112m	North

Planning Zones

OSAR Proposed Road Alignments - Site 26 (Section 9)



Planning Zones

OSAR Proposed Road Alignments - Site 26 (Section 9)

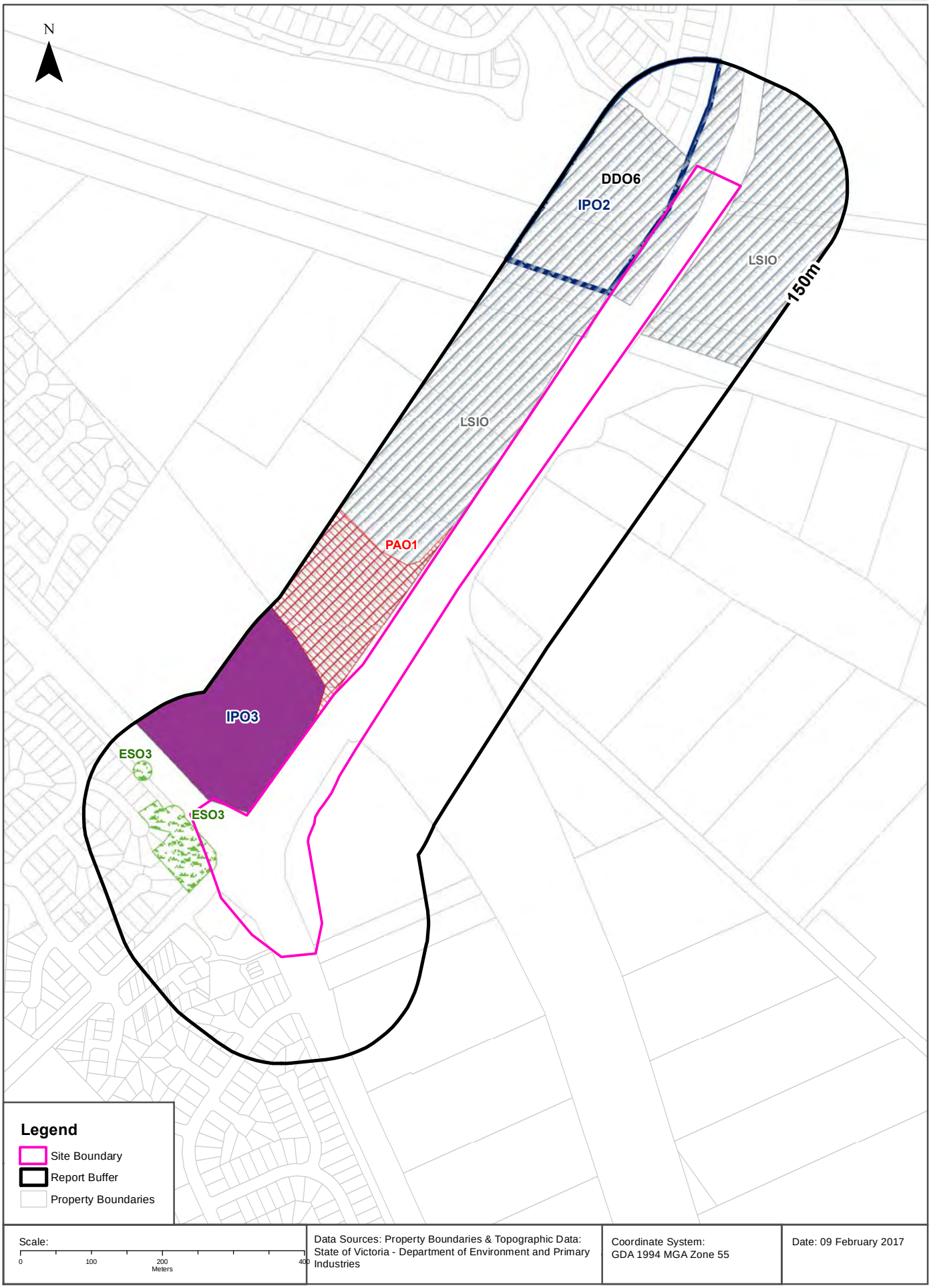
Planning Zones

Planning zones within the report buffer:

Zone Code	Description	Distance	Direction
RDZ1	ROAD ZONE - CATEGORY 1	0m	Onsite
C2Z	COMMERCIAL 2 ZONE	0m	Onsite
GWZ	GREEN WEDGE ZONE	0m	Onsite
GRZ3	GENERAL RESIDENTIAL ZONE - SCHEDULE 3	0m	North West
PUZ7	PUBLIC USE ZONE - OTHER PUBLIC USE	0m	North
UFZ	URBAN FLOODWAY ZONE	0m	East
GWZ1	GREEN WEDGE ZONE - SCHEDULE 1	1m	North West
PUZ1	PUBLIC USE ZONE - SERVICE AND UTILITY	5m	North West
GRZ3	GENERAL RESIDENTIAL ZONE - SCHEDULE 3	17m	North
GRZ3	GENERAL RESIDENTIAL ZONE - SCHEDULE 3	23m	South

Planning Overlays

OSAR Proposed Road Alignments - Site 26 (Section 9)



Planning Overlays

OSAR Proposed Road Alignments - Site 26 (Section 9)

Planning Overlays

Planning overlays within the report buffer:

Zone Code	Description	Distance	Direction
LSIO	LAND SUBJECT TO INUNDATION OVERLAY	0m	Onsite
ESO3	ENVIRONMENTAL SIGNIFICANCE OVERLAY - SCHEDULE 3	0m	Onsite
IPO3	INCORPORATED PLAN OVERLAY - SCHEDULE 3	0m	Onsite
PAO1	PUBLIC ACQUISITION OVERLAY 1	0m	North West
DDO6	DESIGN AND DEVELOPMENT OVERLAY - SCHEDULE 6	0m	North
IPO2	INCORPORATED PLAN OVERLAY - SCHEDULE 2	0m	North
ESO3	ENVIRONMENTAL SIGNIFICANCE OVERLAY - SCHEDULE 3	77m	South West

Planning Zones

OSAR Proposed Road Alignments - Site 26 (Section 10)

Data Sources: Property Boundaries & Topographic Data: State of Victoria - Department of Environment and Primary Industries

Coordinate System: GDA 1994 MGA Zone 55

Date: 09February 2017

Planning Zones

OSAR Proposed Road Alignments - Site 26 (Section 10)

Planning Zones

Planning zones within the report buffer:

Zone Code	Description	Distance	Direction
RDZ1	ROAD ZONE - CATEGORY 1	0m	Onsite
C2Z	COMMERCIAL 2 ZONE	0m	South
GWZ	GREEN WEDGE ZONE	0m	East
GWZ1	GREEN WEDGE ZONE - SCHEDULE 1	57m	North West
GRZ3	GENERAL RESIDENTIAL ZONE - SCHEDULE 3	68m	North West

Planning Overlays

OSAR Proposed Road Alignments - Site 26 (Section 10)

Planning Overlays

OSAR Proposed Road Alignments - Site 26 (Section 10)

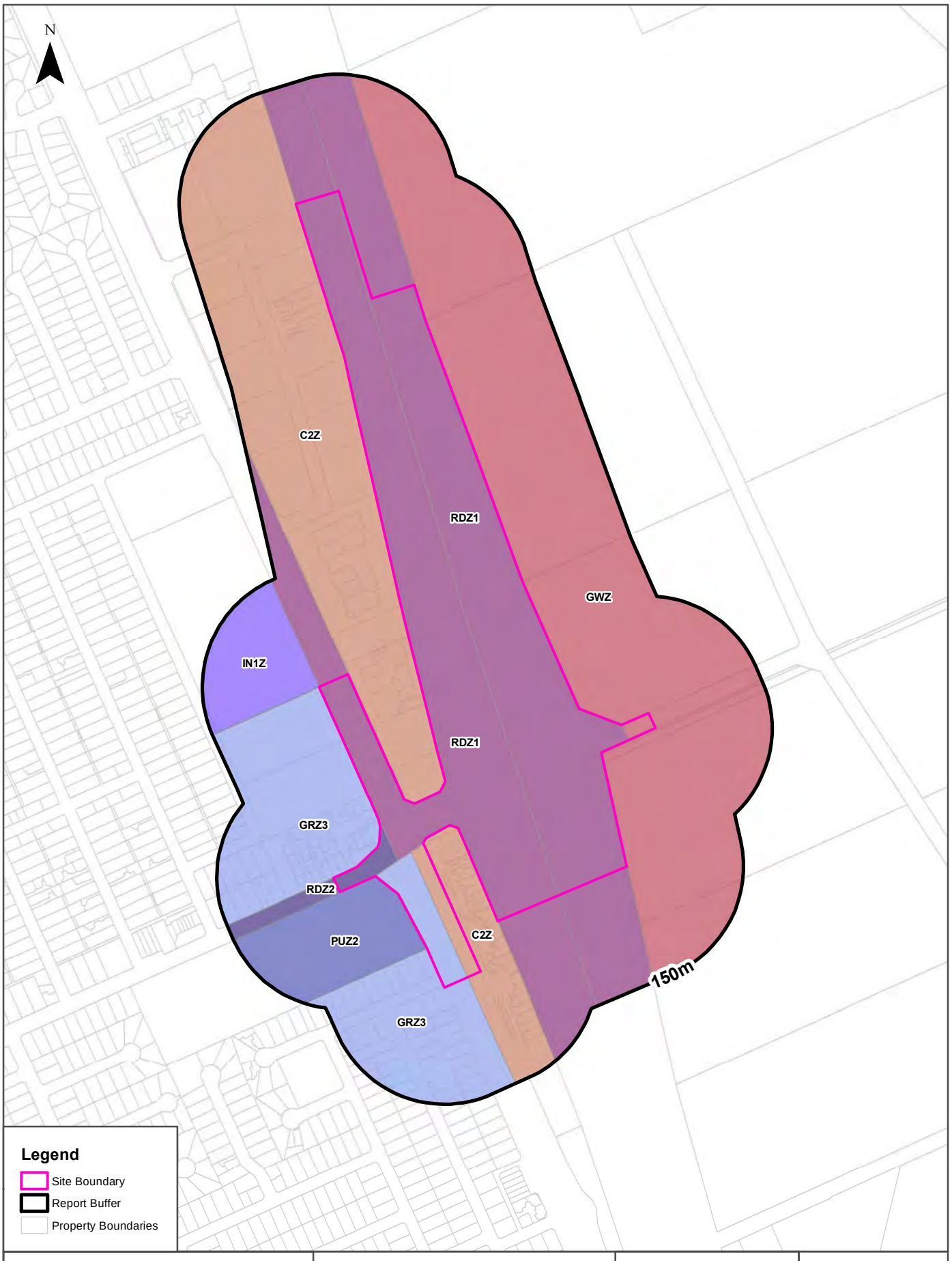
Planning Overlays

Planning overlays within the report buffer:

Zone Code	Description	Distance	Direction
LSIO	LAND SUBJECT TO INUNDATION OVERLAY	57m	West
PAO1	PUBLIC ACQUISITION OVERLAY 1	57m	North West
IPO3	INCORPORATED PLAN OVERLAY - SCHEDULE 3	71m	North West

Planning Zones

Section 11 (Thames Promenade) - Mordialloc Bypass



Planning Zones

Section 11 (Thames Promenade) - Mordialloc Bypass

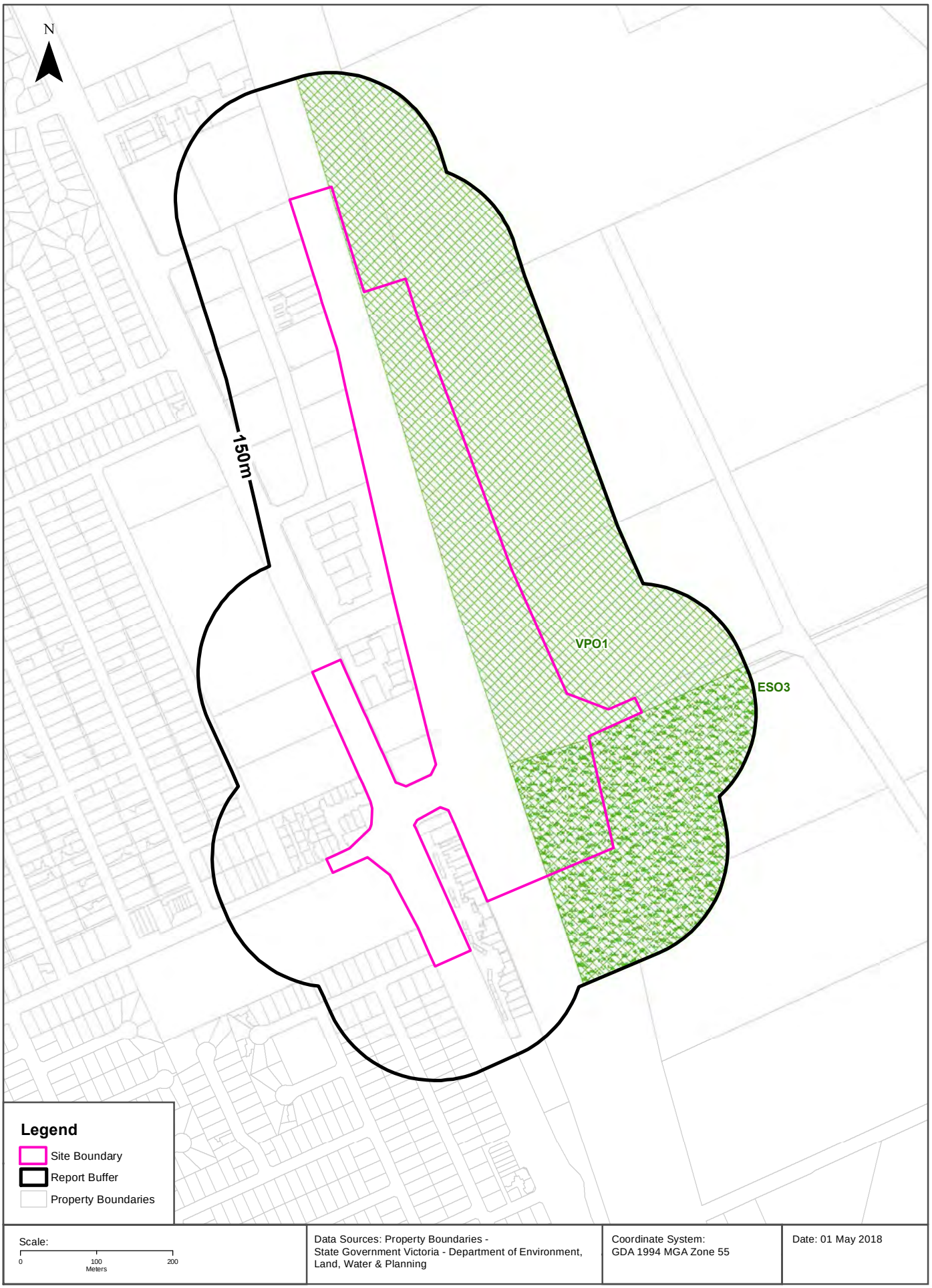
Planning Zones

Planning zones within the dataset buffer:

Zone Code	Description	Distance	Direction
RDZ1	ROAD ZONE - CATEGORY 1	0m	Onsite
GRZ3	GENERAL RESIDENTIAL ZONE - SCHEDULE 3	0m	Onsite
C2Z	COMMERCIAL 2 ZONE	0m	Onsite
RDZ2	ROAD ZONE - CATEGORY 2	0m	Onsite
GWZ	GREEN WEDGE ZONE	0m	North East
IN1Z	INDUSTRIAL 1 ZONE	0m	West
PUZ2	PUBLIC USE ZONE - EDUCATION	0m	South West

Planning Overlays

Section 11 (Thames Promenade) - Mordialloc Bypass



Planning Overlays

Section 11 (Thames Promenade) - Mordialloc Bypass

Planning Overlays

Planning overlays within the dataset buffer:

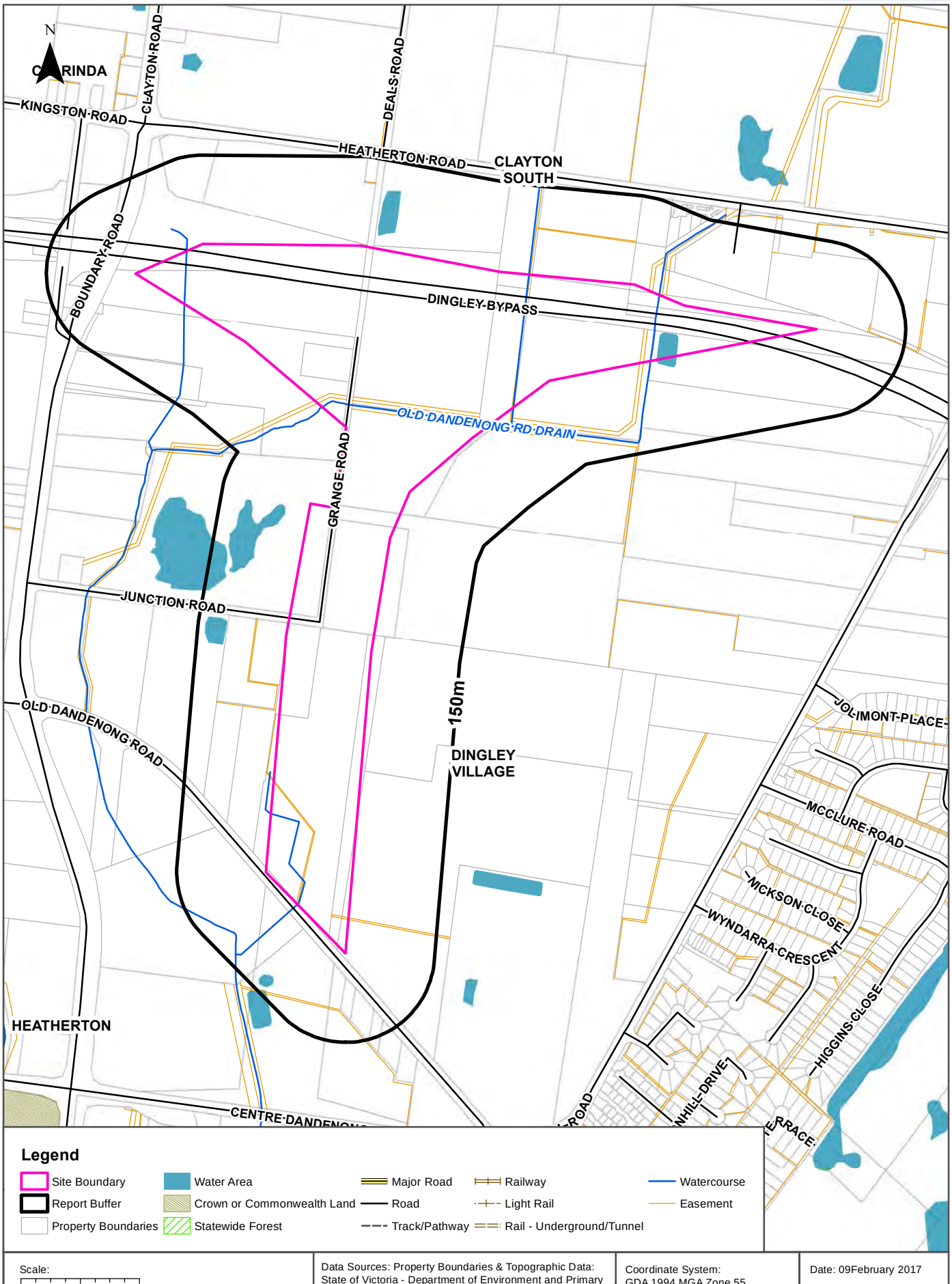
Zone Code	Description	Distance	Direction
VPO1	VEGETATION PROTECTION OVERLAY - SCHEDULE 1	0m	Onsite
ESO3	ENVIRONMENTAL SIGNIFICANCE OVERLAY - SCHEDULE 3	0m	Onsite

APPENDIX C

TOPOGRAPHIC DATA

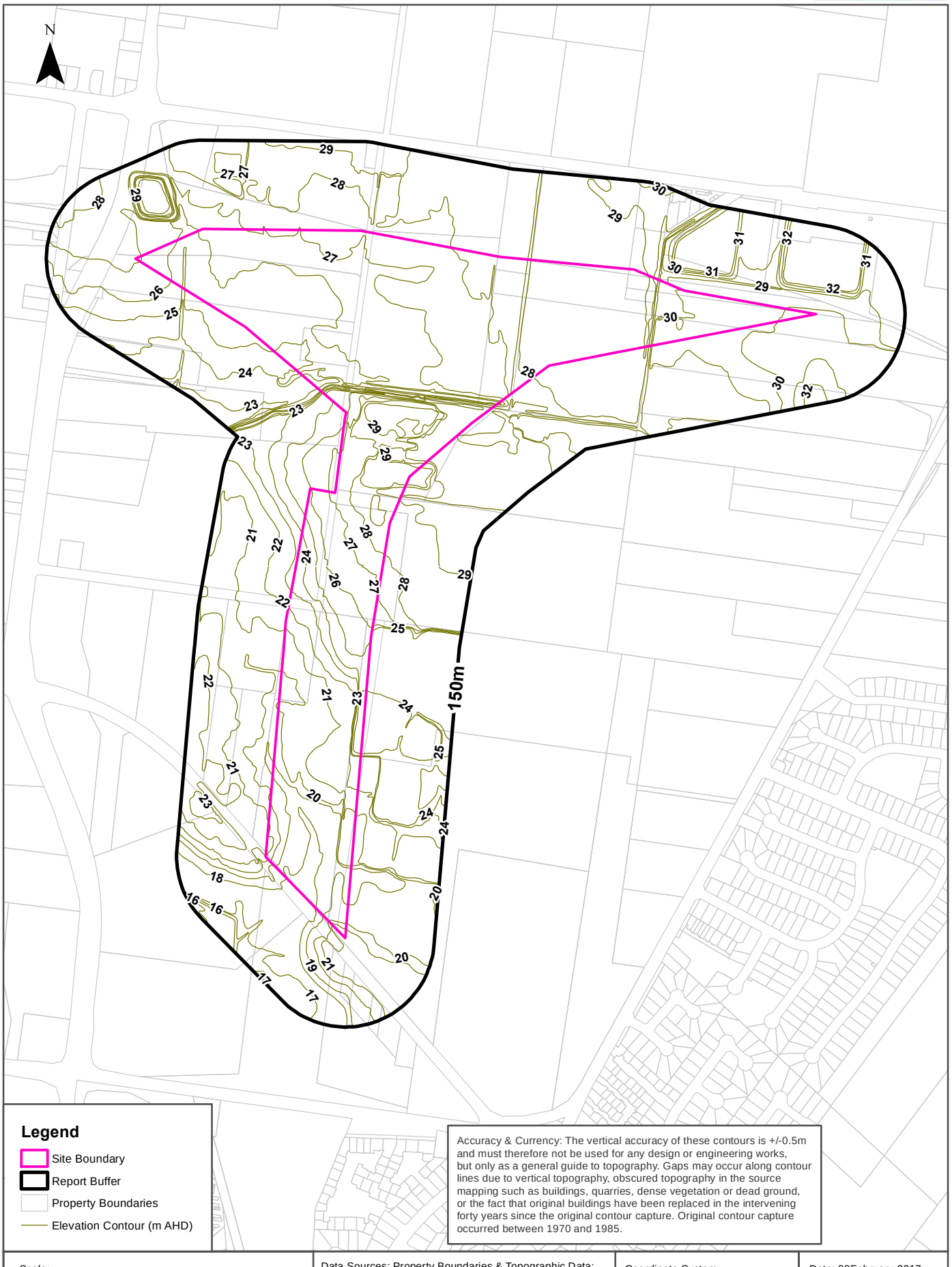
Topographic Data

OSAR Proposed Road Alignments - Site 26 (Section 1)



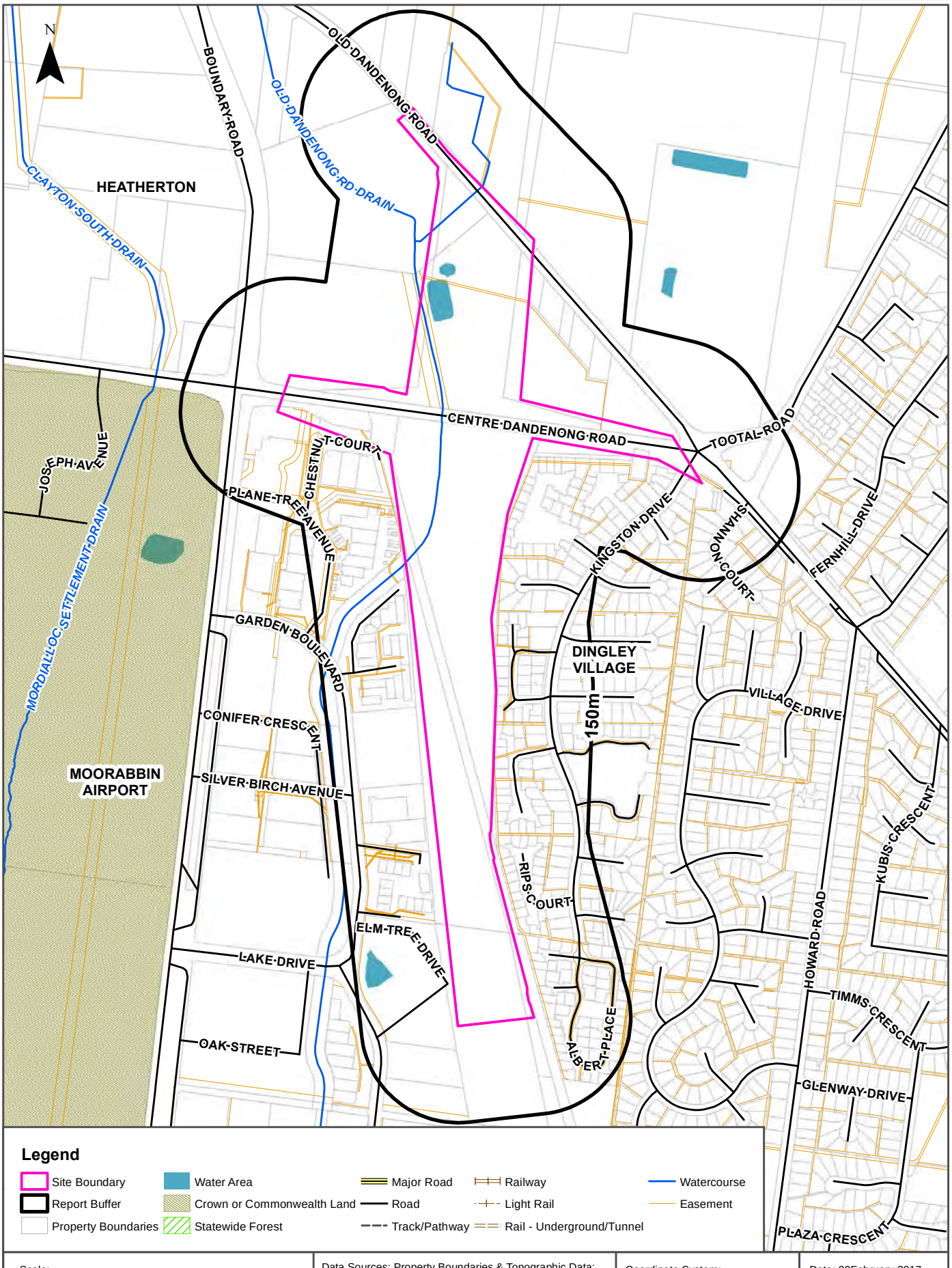
Elevation Contours (m AHD)

OSAR Proposed Road Alignments - Site 26 (Section 1)



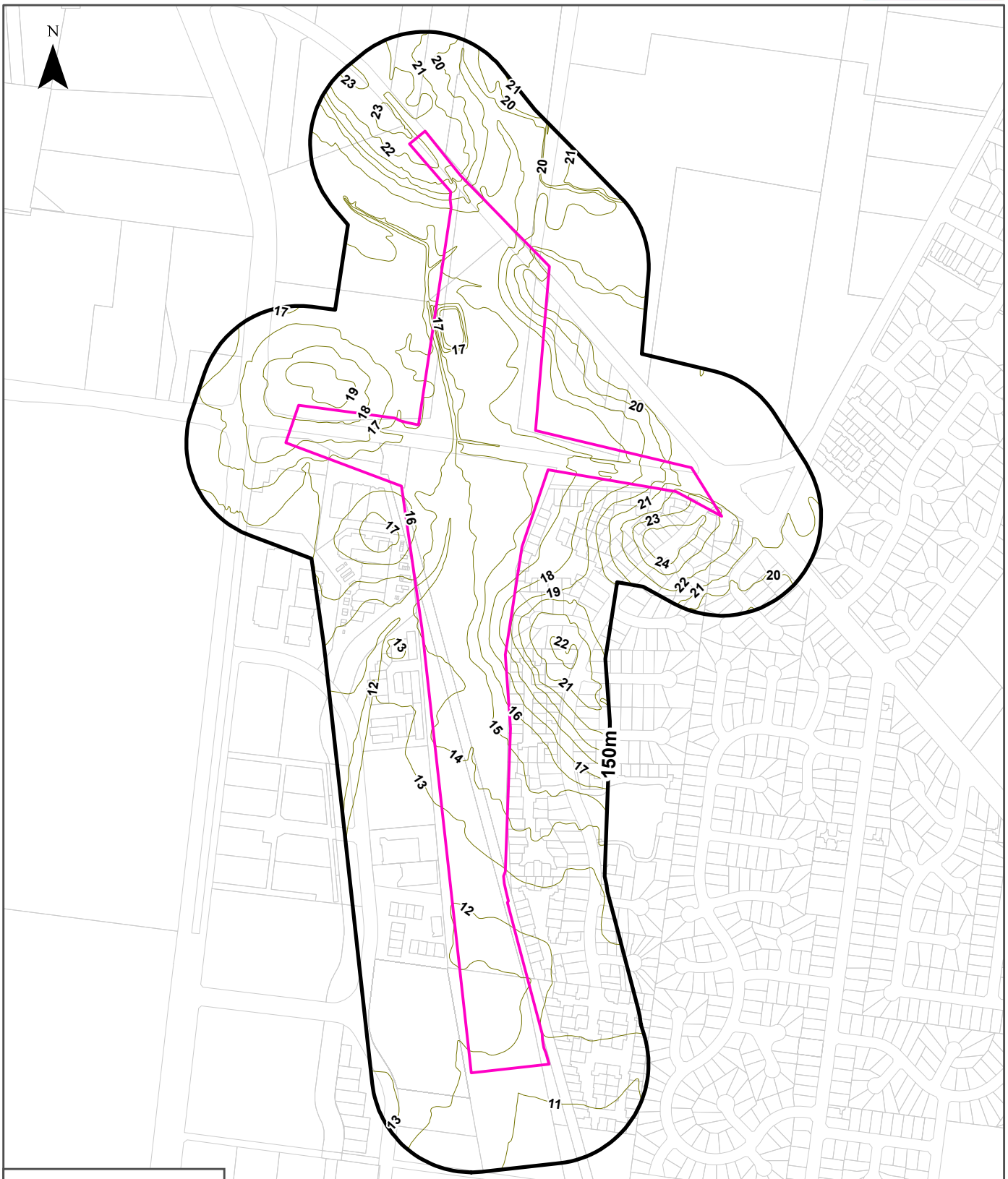
Topographic Data

OSAR Proposed Road Alignments - Site 26 (Section 2)



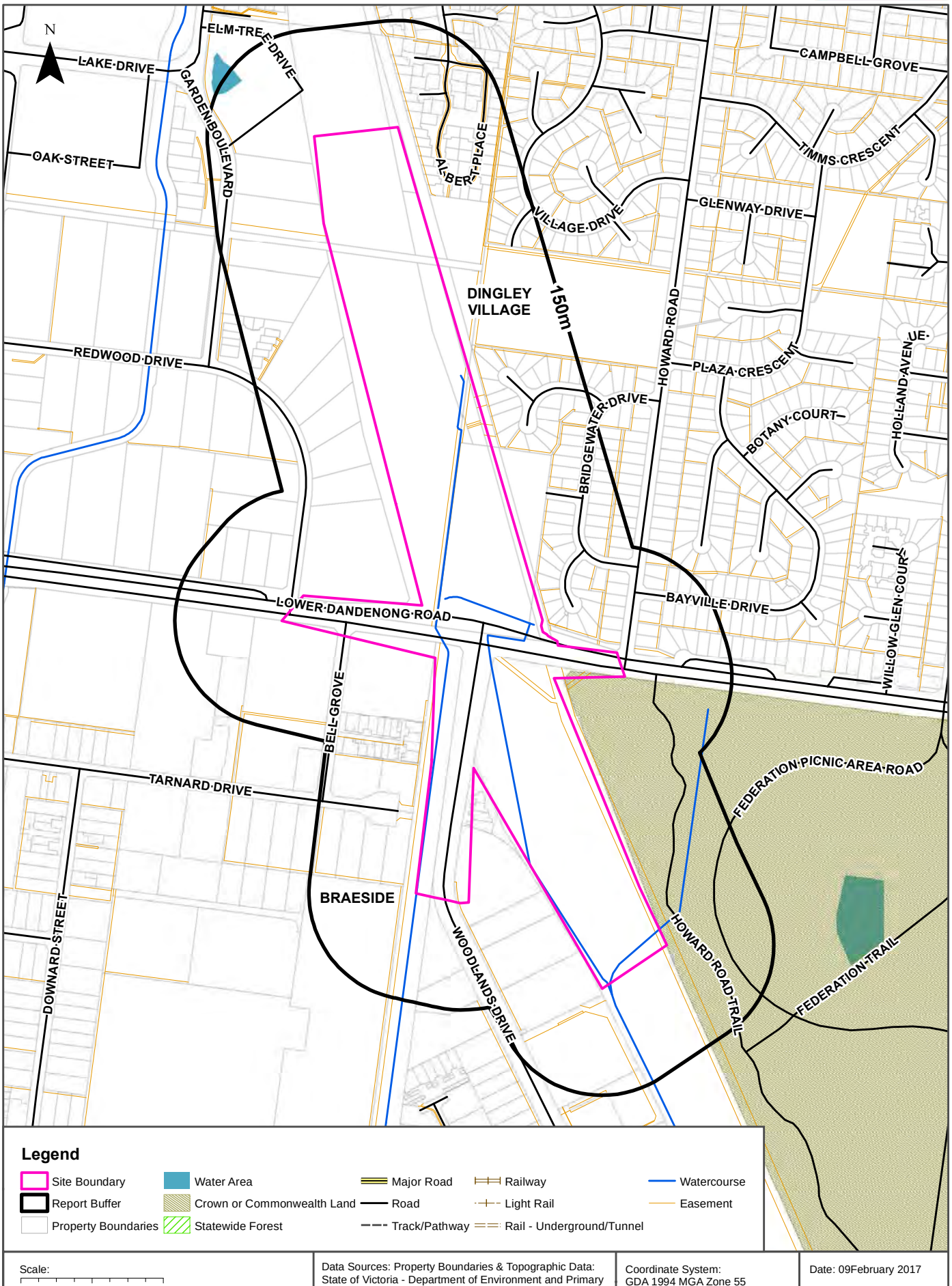
Elevation Contours (m AHD)

OSAR Proposed Road Alignments - Site 26 (Section 2)



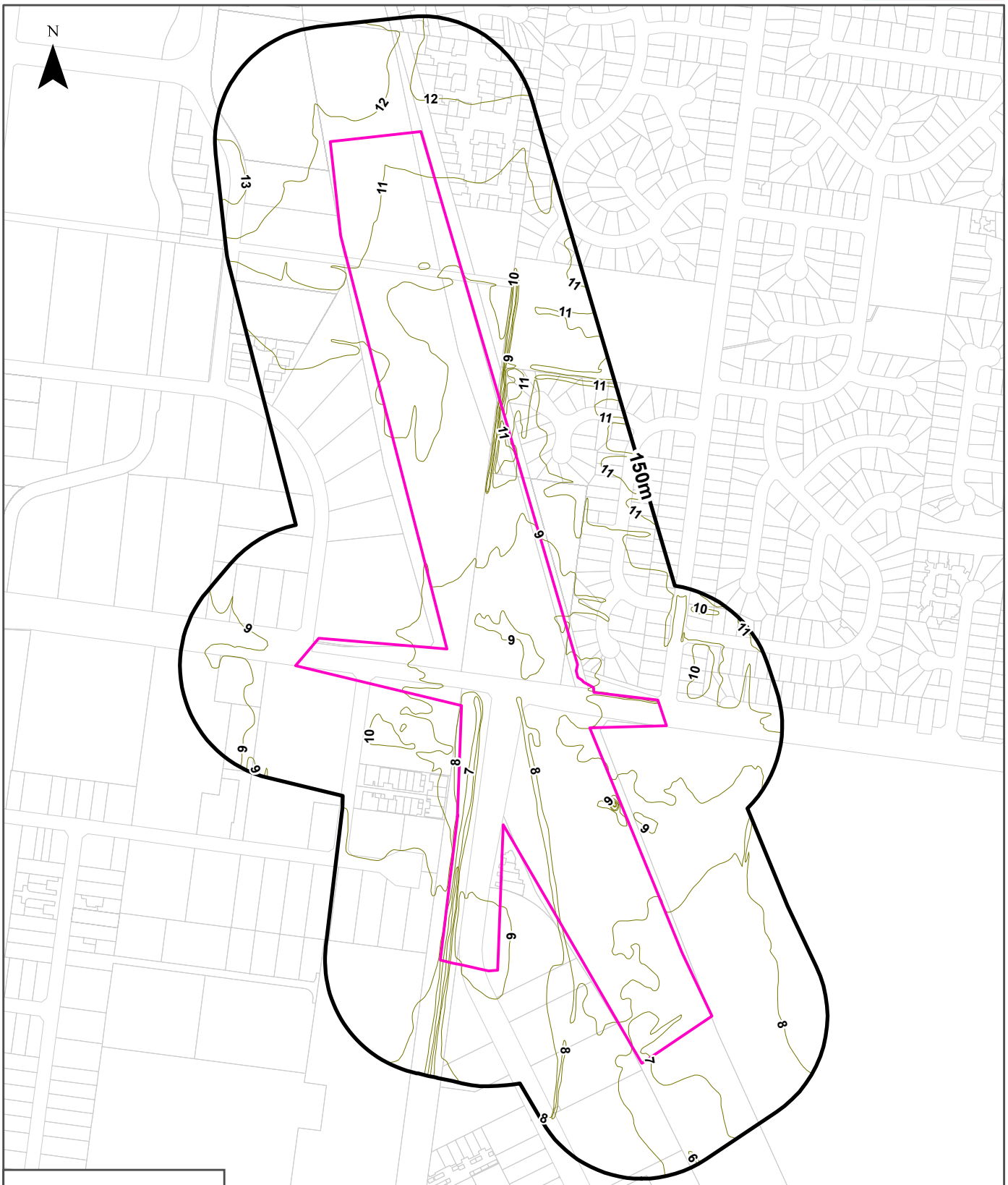
Topographic Data

OSAR Proposed Road Alignments - Site 26 (Section 3)



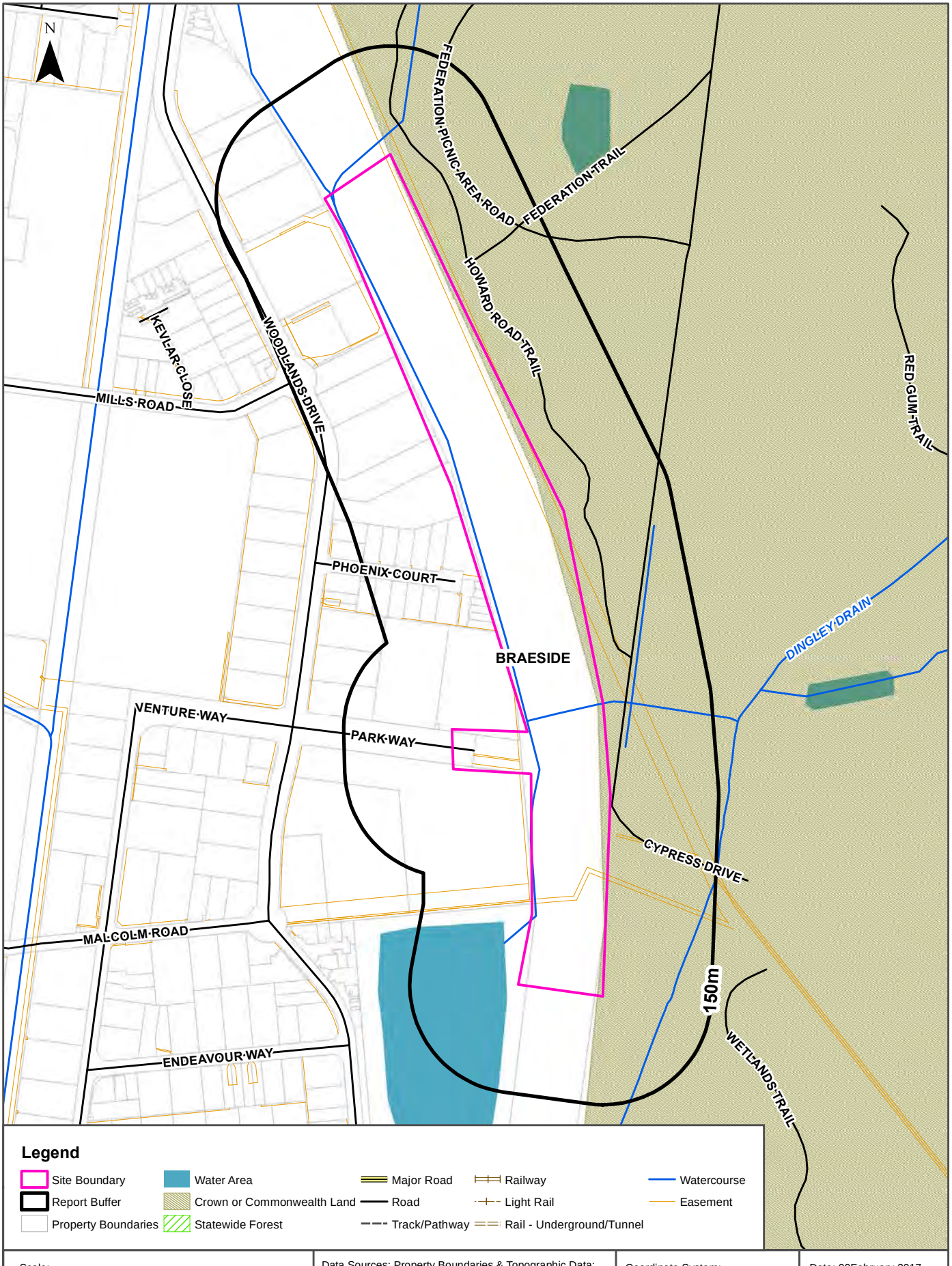
Elevation Contours (m AHD)

OSAR Proposed Road Alignments - Site 26 (Section 3)



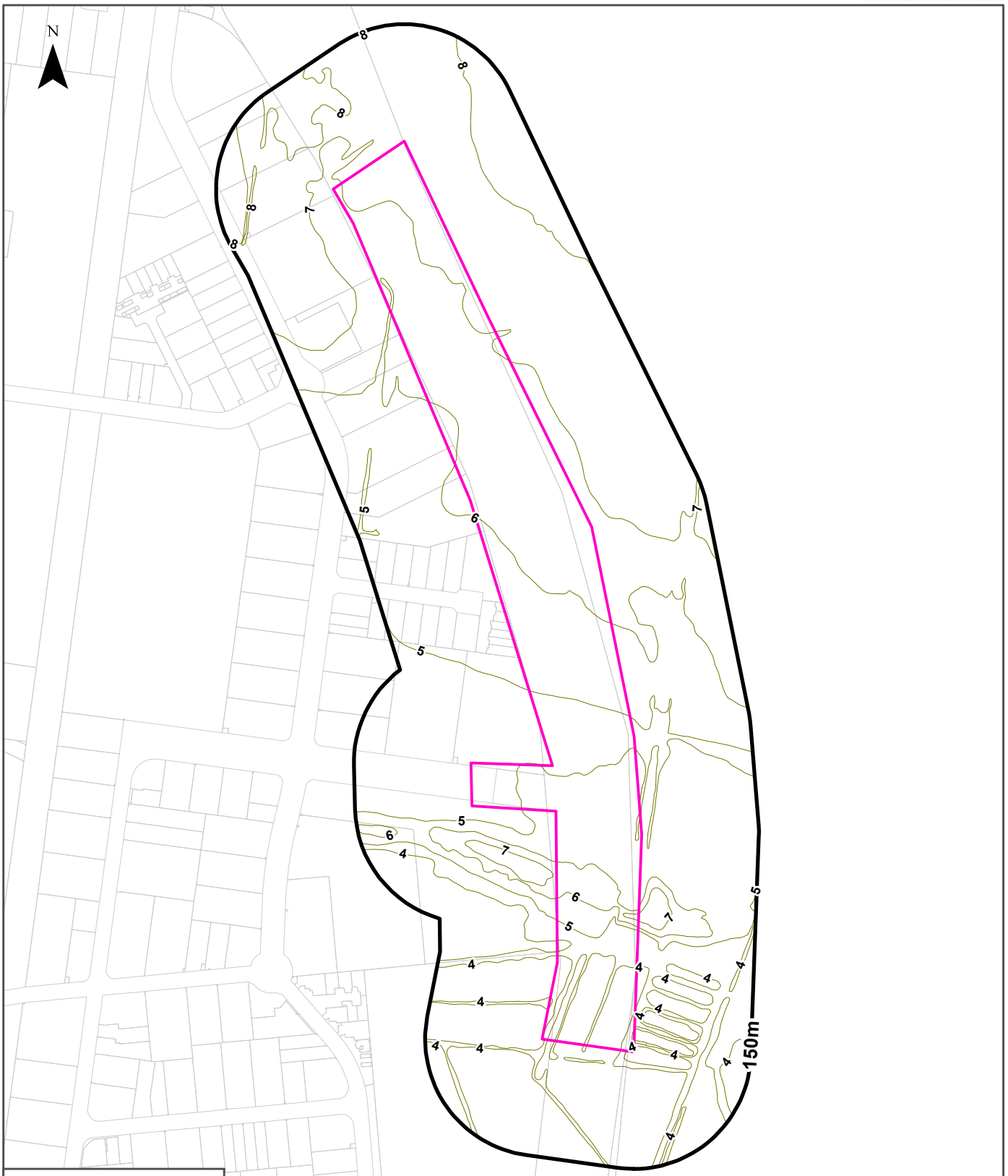
Topographic Data

OSAR Proposed Road Alignments - Site 26 (Section 4)



Elevation Contours (m AHD)

OSAR Proposed Road Alignments - Site 26 (Section 4)

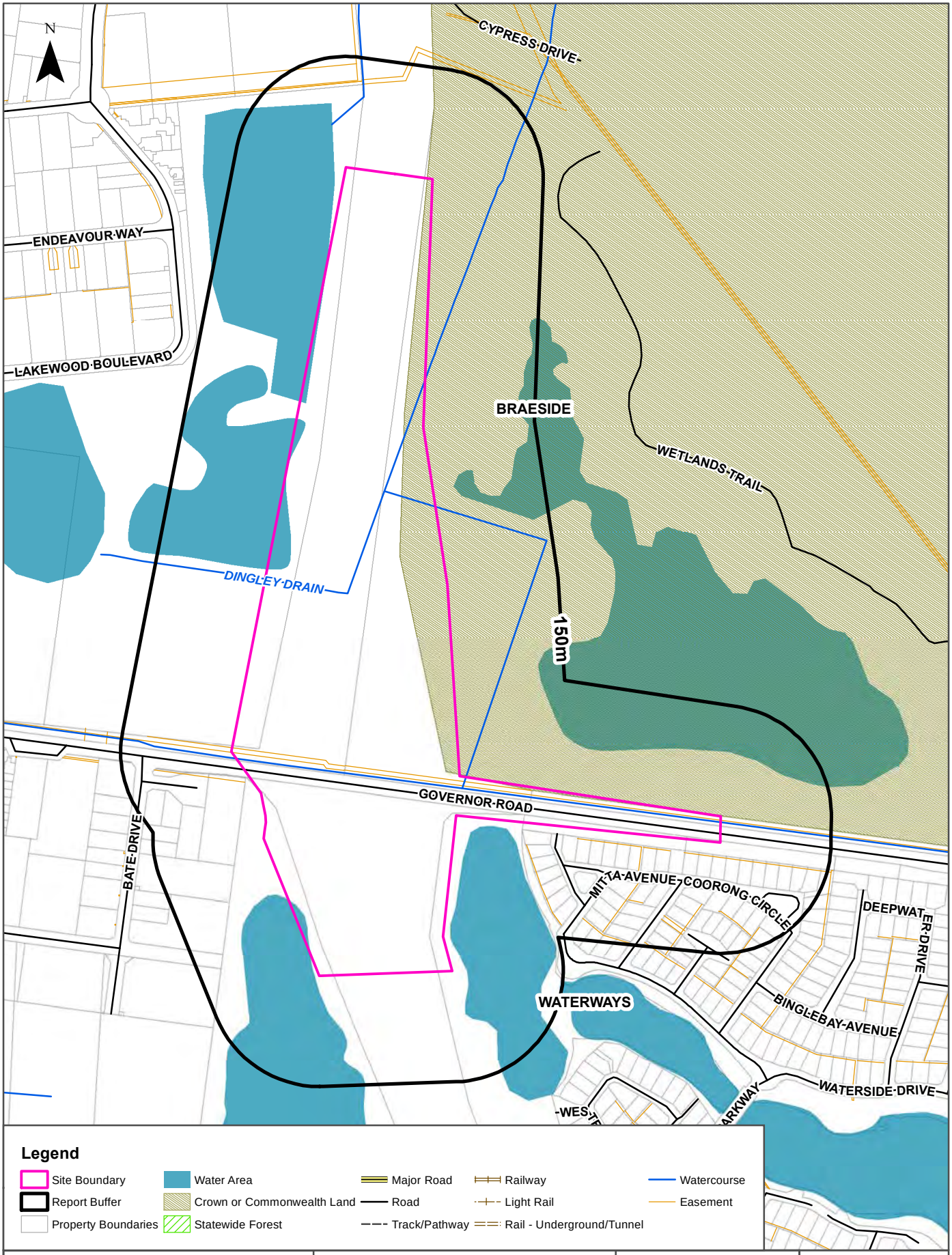


Accuracy & Currency: The vertical accuracy of these contours is +/-0.5m and must therefore not be used for any design or engineering works, but only as a general guide to topography. Gaps may occur along contour lines due to vertical topography, obscured topography in the source mapping such as buildings, quarries, dense vegetation or dead ground, or the fact that original buildings have been replaced in the intervening forty years since the original contour capture. Original contour capture occurred between 1970 and 1985.

Scale: 0 50 100 200 Meters	Data Sources: Property Boundaries & Topographic Data: State of Victoria - Department of Environment and Primary Industries	Coordinate System: GDA 1994 MGA Zone 55	Date: 09February 2017

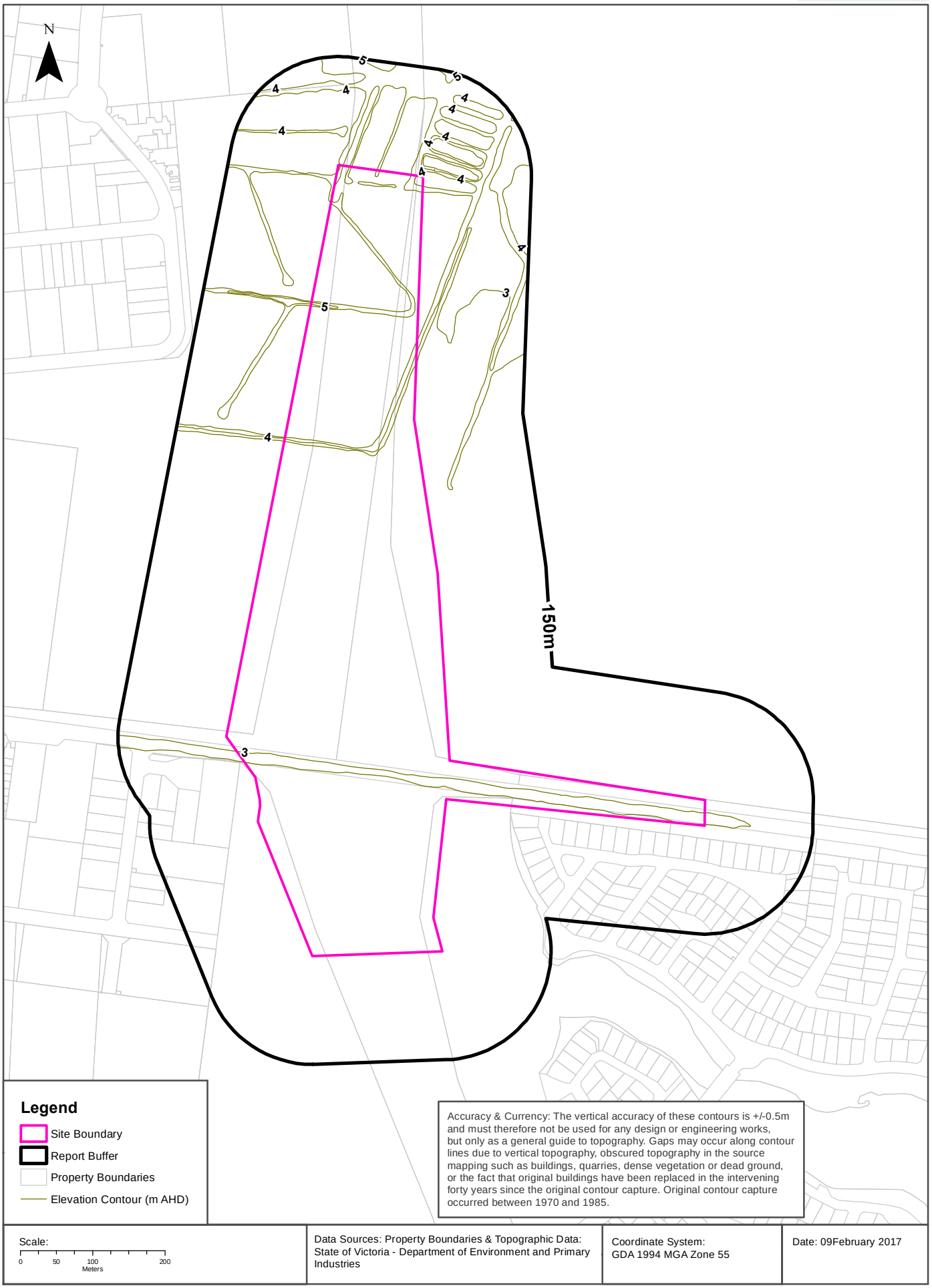
Topographic Data

OSAR Proposed Road Alignments - Site 26 (Section 5)



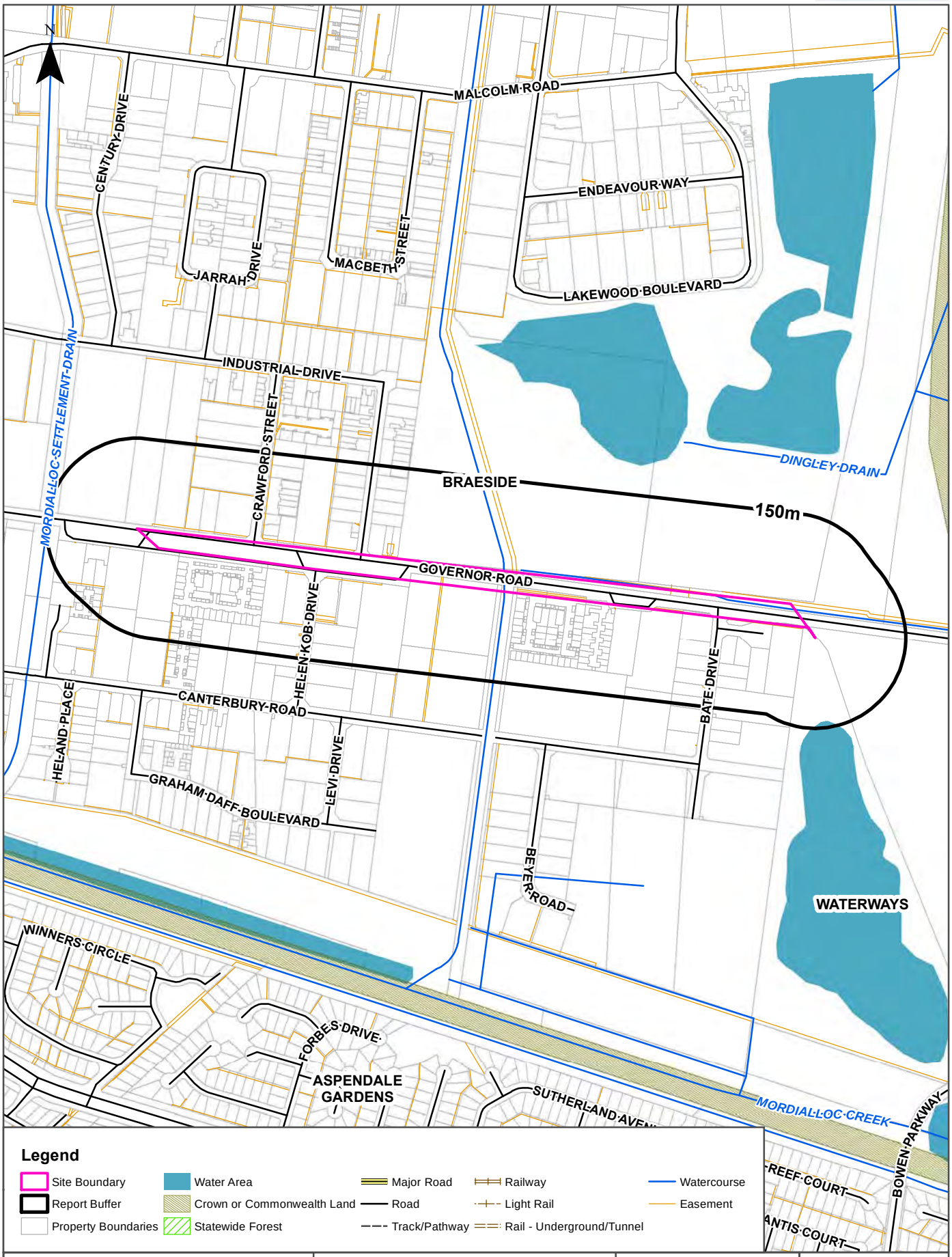
Elevation Contours (m AHD)

OSAR Proposed Road Alignments - Site 26 (Section 5)



Topographic Data

OSAR Proposed Road Alignments - Site 26 (Section 6)

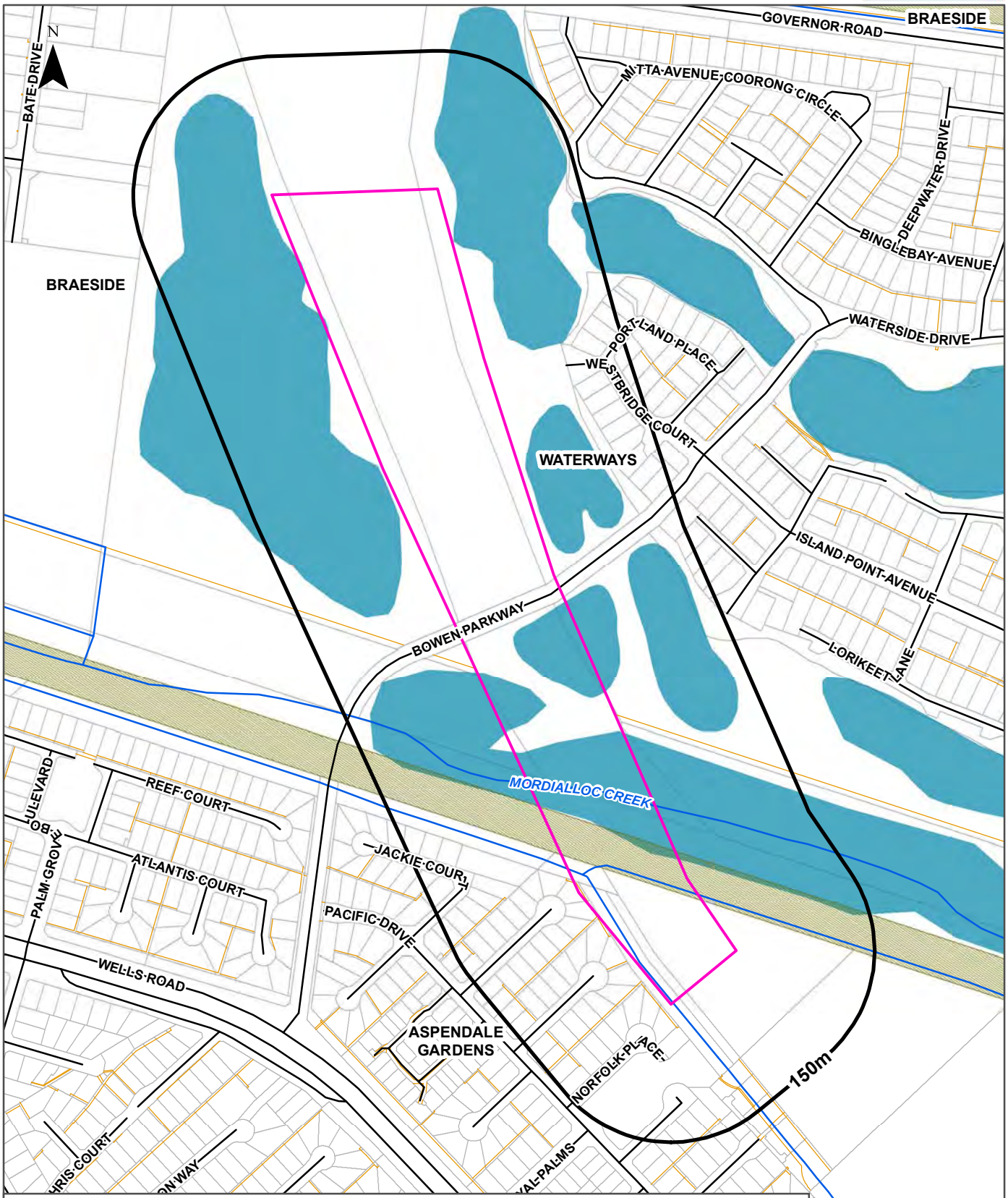


Elevation Contours (m AHD)

OSAR Proposed Road Alignments - Site 26 (Section 6)

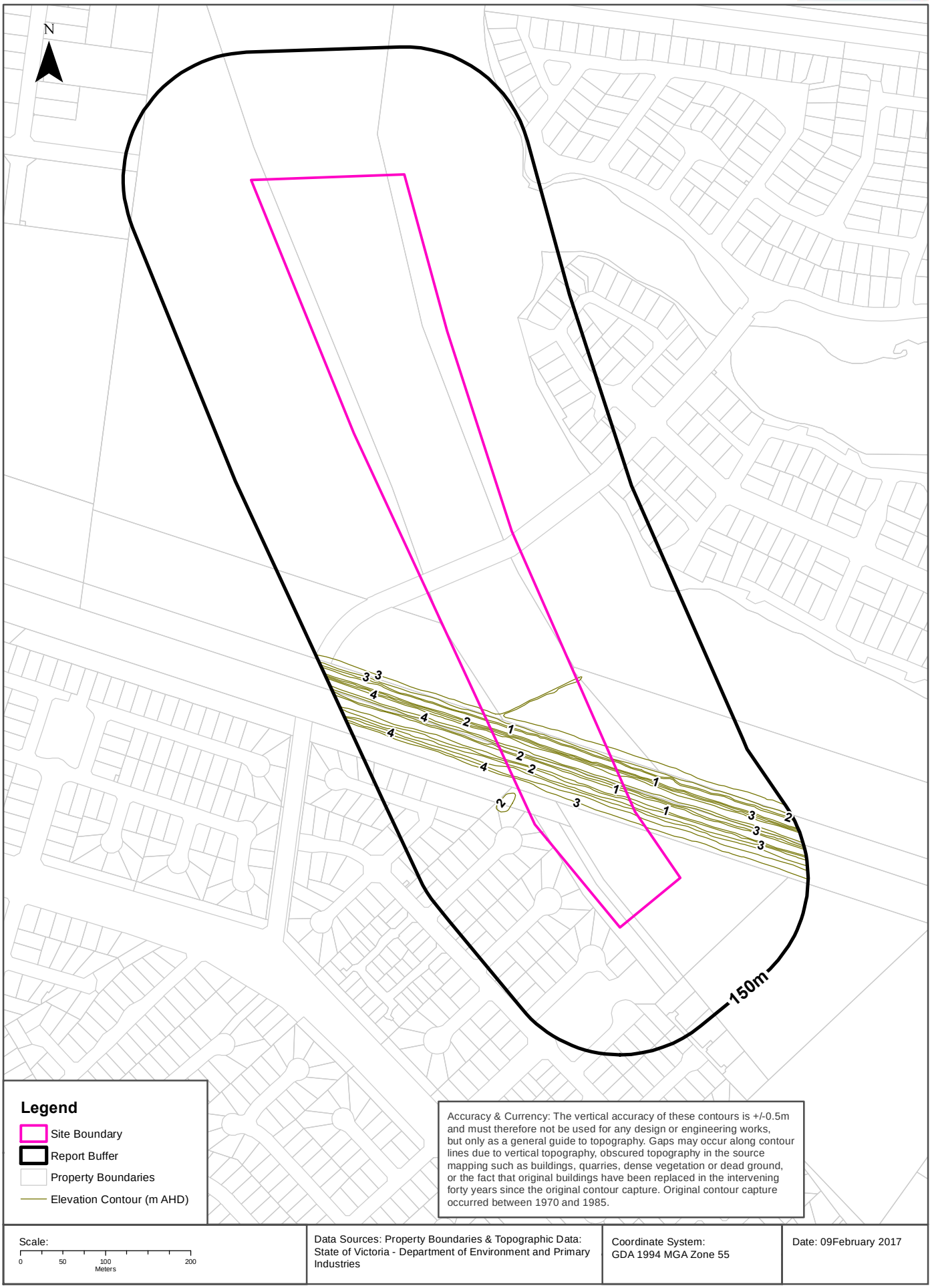
Topographic Data

OSAR Proposed Road Alignments - Site 26 (Section 7)



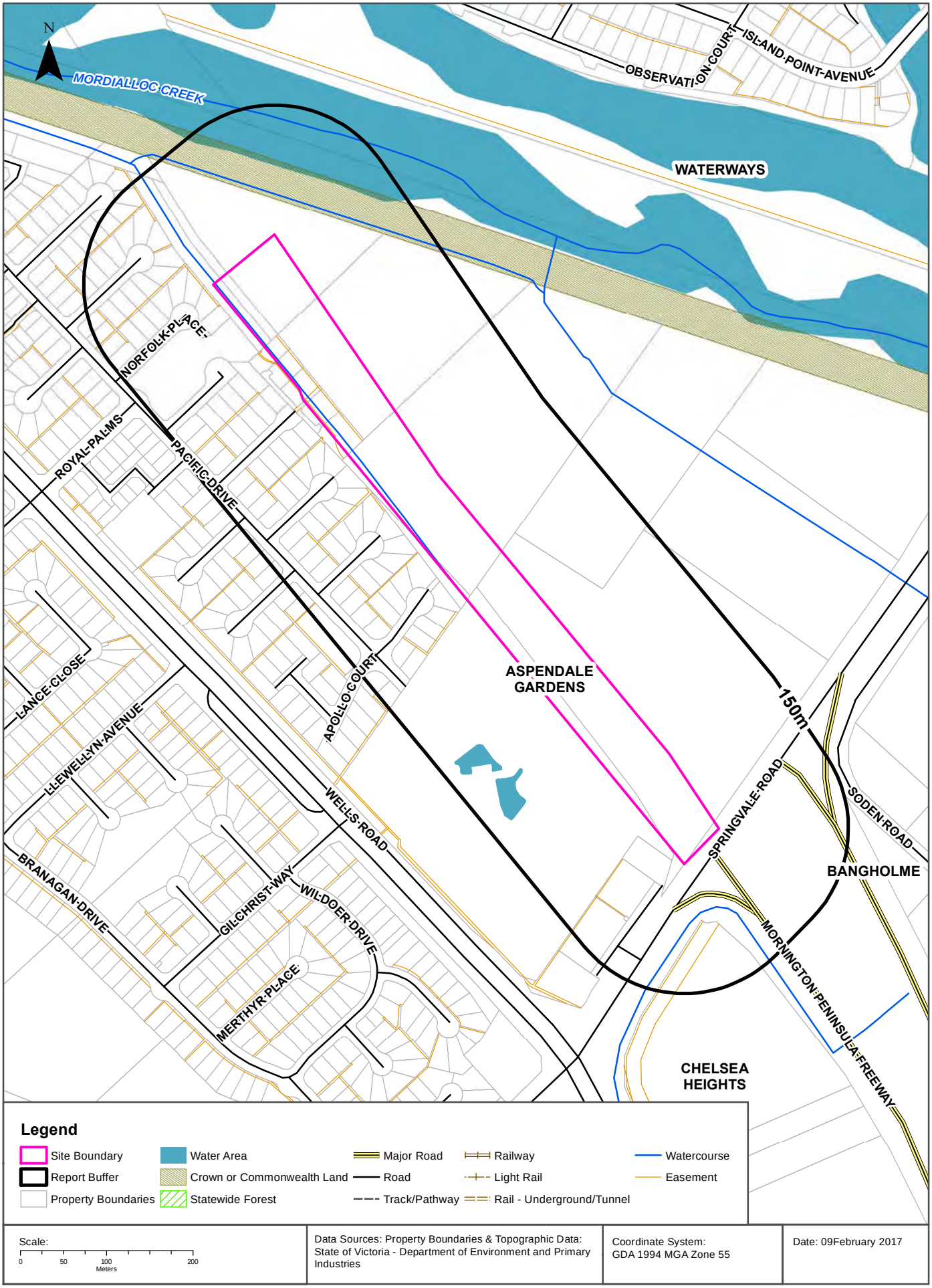
Elevation Contours (m AHD)

OSAR Proposed Road Alignments - Site 26 (Section 7)



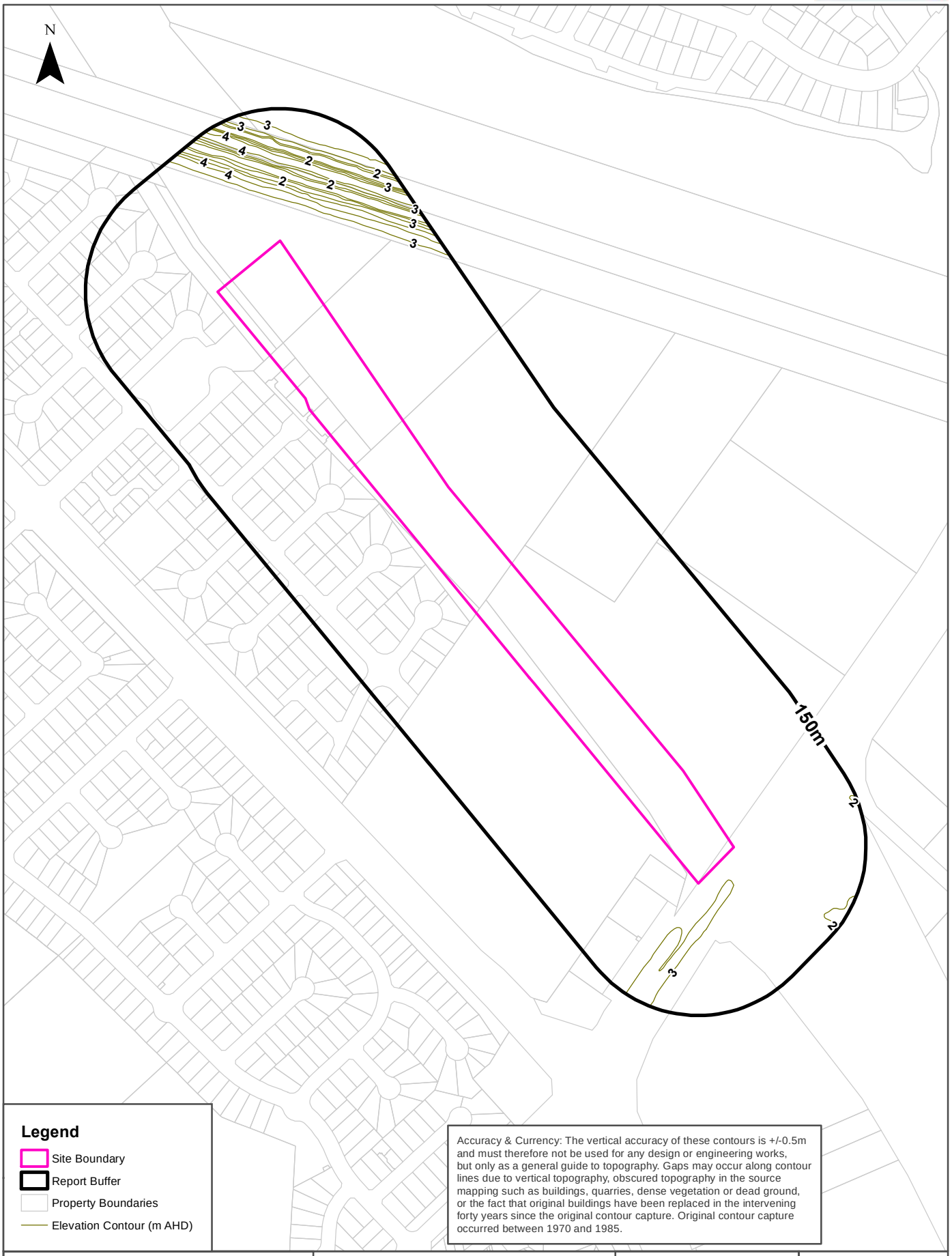
Topographic Data

OSAR Proposed Road Alignments - Site 26 (Section 8)



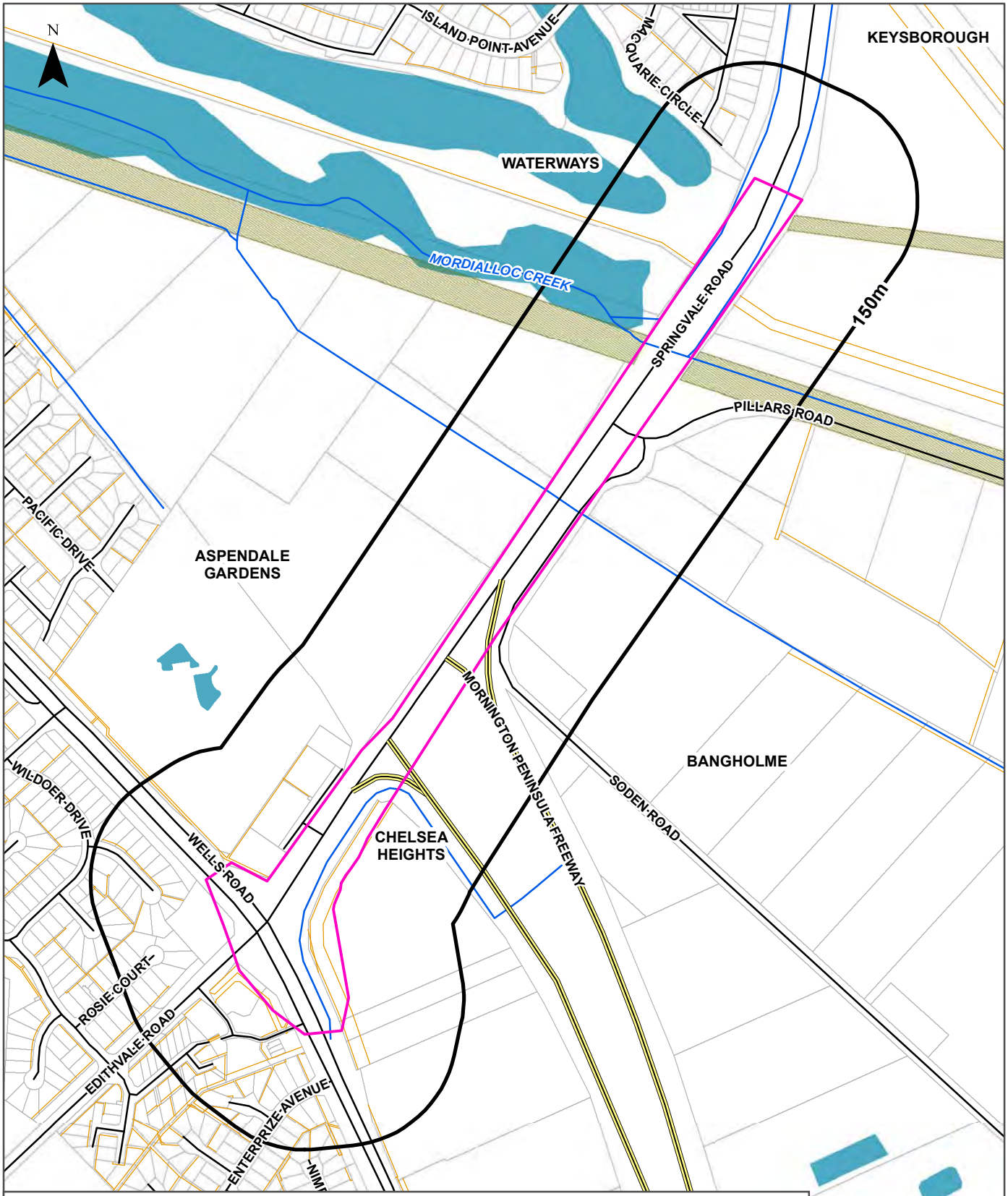
Elevation Contours (m AHD)

OSAR Proposed Road Alignments - Site 26 (Section 8)



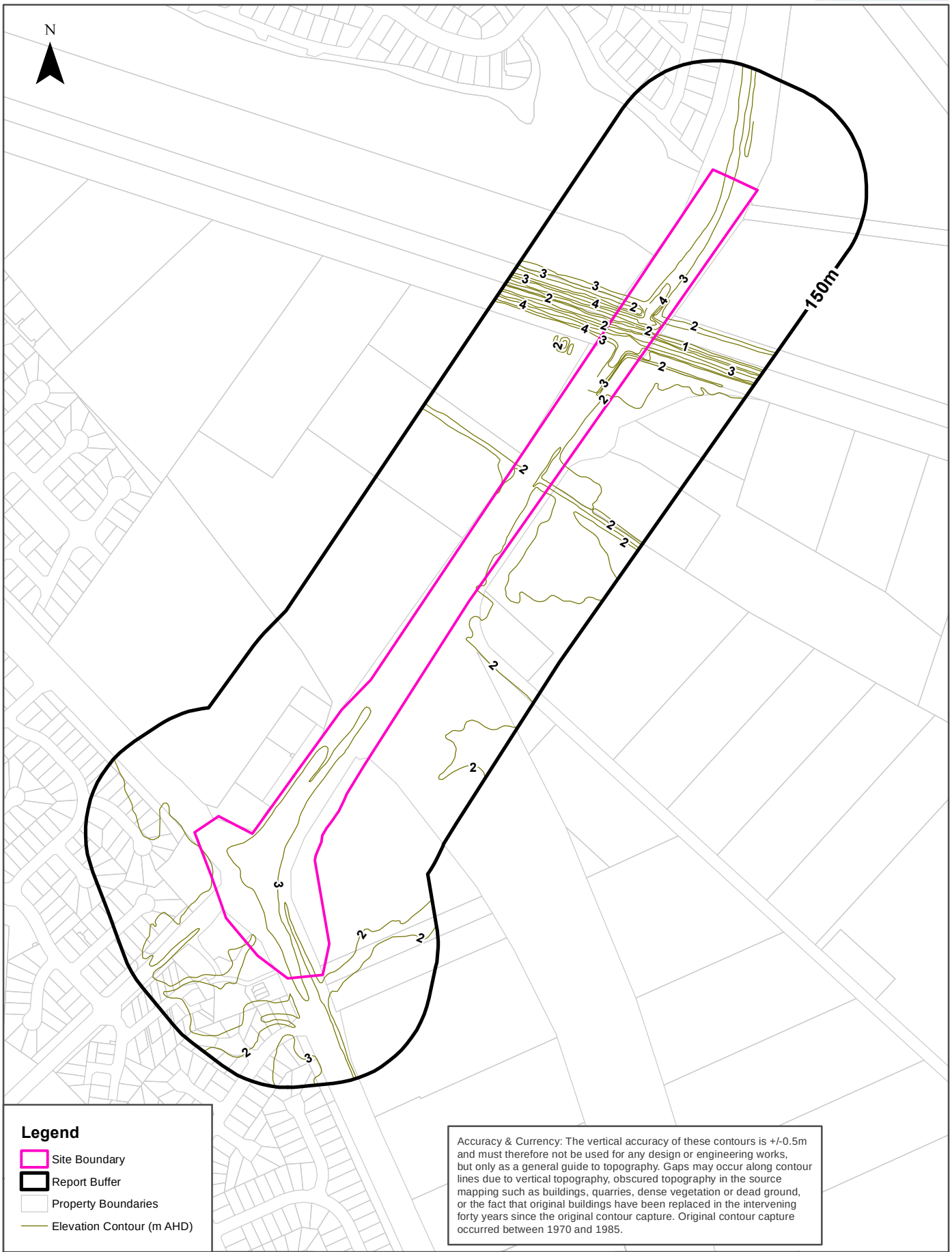
Topographic Data

OSAR Proposed Road Alignments - Site 26 (Section 9)



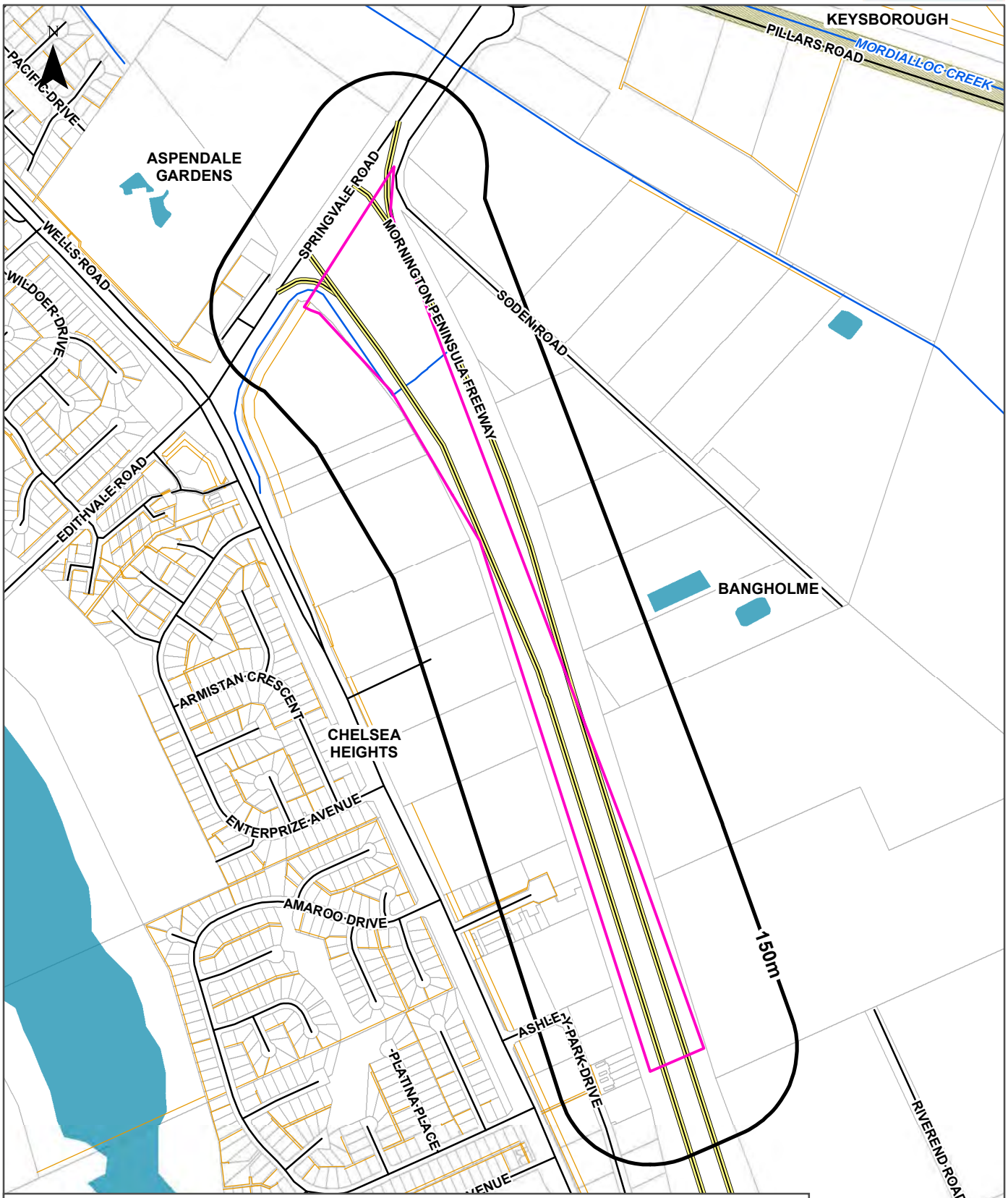
Elevation Contours (m AHD)

OSAR Proposed Road Alignments - Site 26 (Section 9)



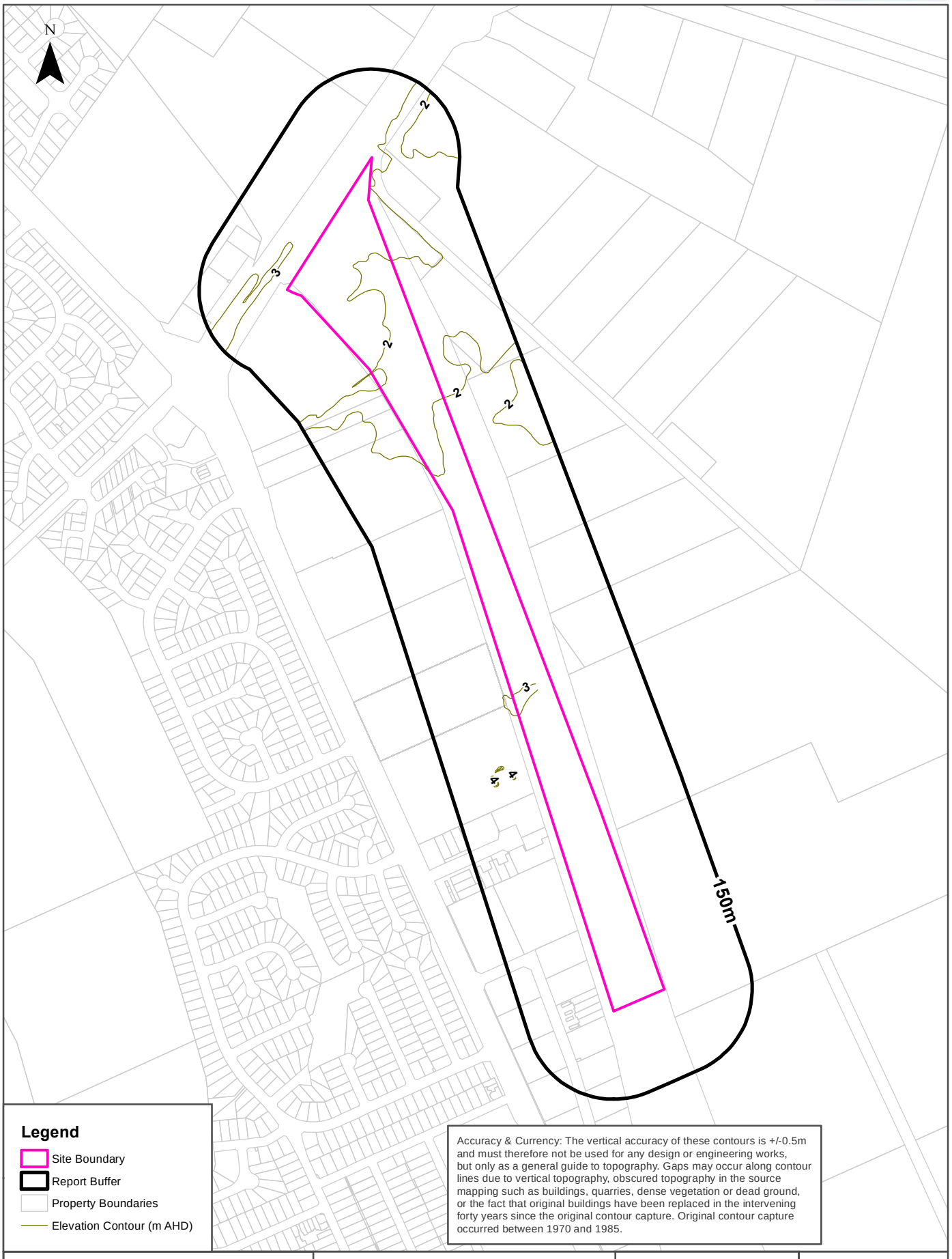
Topographic Data

OSAR Proposed Road Alignments - Site 26 (Section 10)



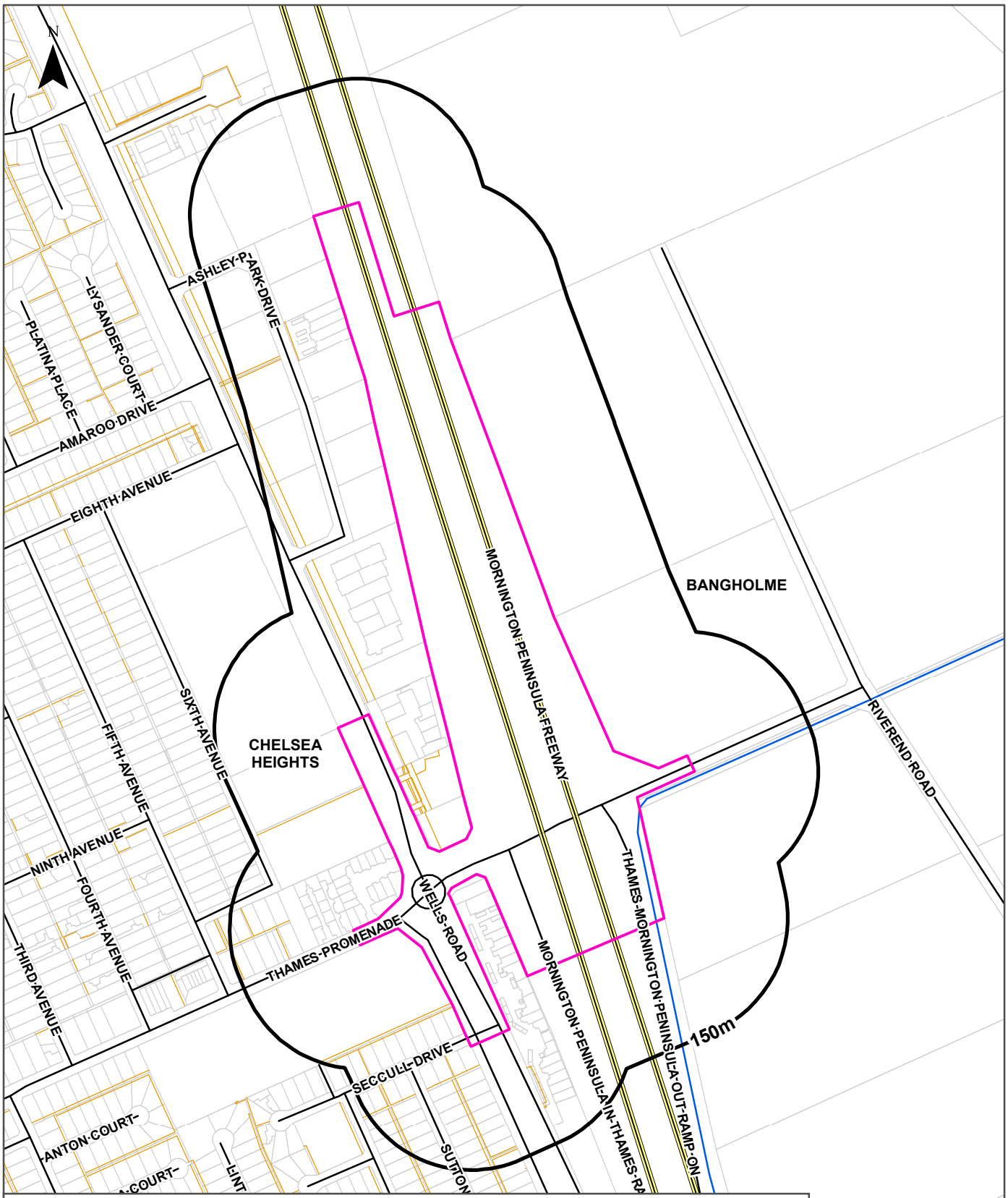
Elevation Contours (m AHD)

OSAR Proposed Road Alignments - Site 26 (Section 10)



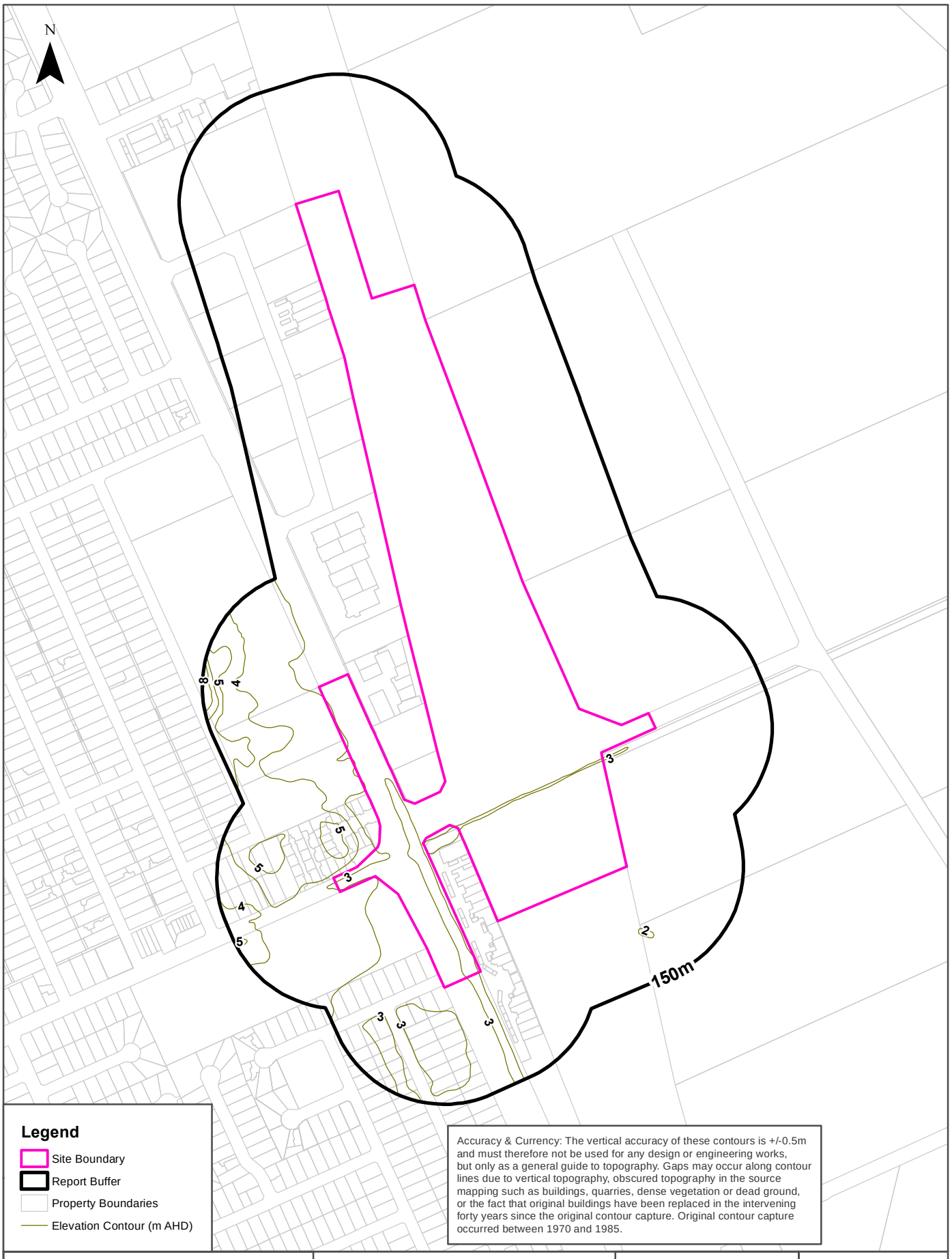
Topographic Data

Section 11 (Thames Promenade) - Mordialloc Bypass



Elevation Contours (m AHD)

Section 11 (Thames Promenade) - Mordialloc Bypass



APPENDIX D

ACID SULFATE SOIL

Coastal Acid Sulfate Soils

OSAR Proposed Road Alignments - Site 26 (Section 1)

Coastal Acid Sulfate Soils

What are the on-site Coastal Acid Sulfate Soil types?

Coastal Acid Sulfate Soil Types
There are no Acid Sulfate areas onsite

What are the Coastal Acid Sulfate Soil types within the report buffer?

Coastal Acid Sulfate Soil Types	Distance	Direction
There are no Acid Sulfate areas within the report buffer		

Coastal Acid Sulfate Soils

OSAR Proposed Road Alignments - Site 26 (Section 2)

Coastal Acid Sulfate Soils

What are the on-site Coastal Acid Sulfate Soil types?

Coastal Acid Sulfate Soil Types
There are no Acid Sulfate areas onsite

What are the Coastal Acid Sulfate Soil types within the report buffer?

Coastal Acid Sulfate Soil Types	Distance	Direction
There are no Acid Sulfate areas within the report buffer		

Coastal Acid Sulfate Soils

OSAR Proposed Road Alignments - Site 26 (Section 3)

Coastal Acid Sulfate Soils

What are the on-site Coastal Acid Sulfate Soil types?

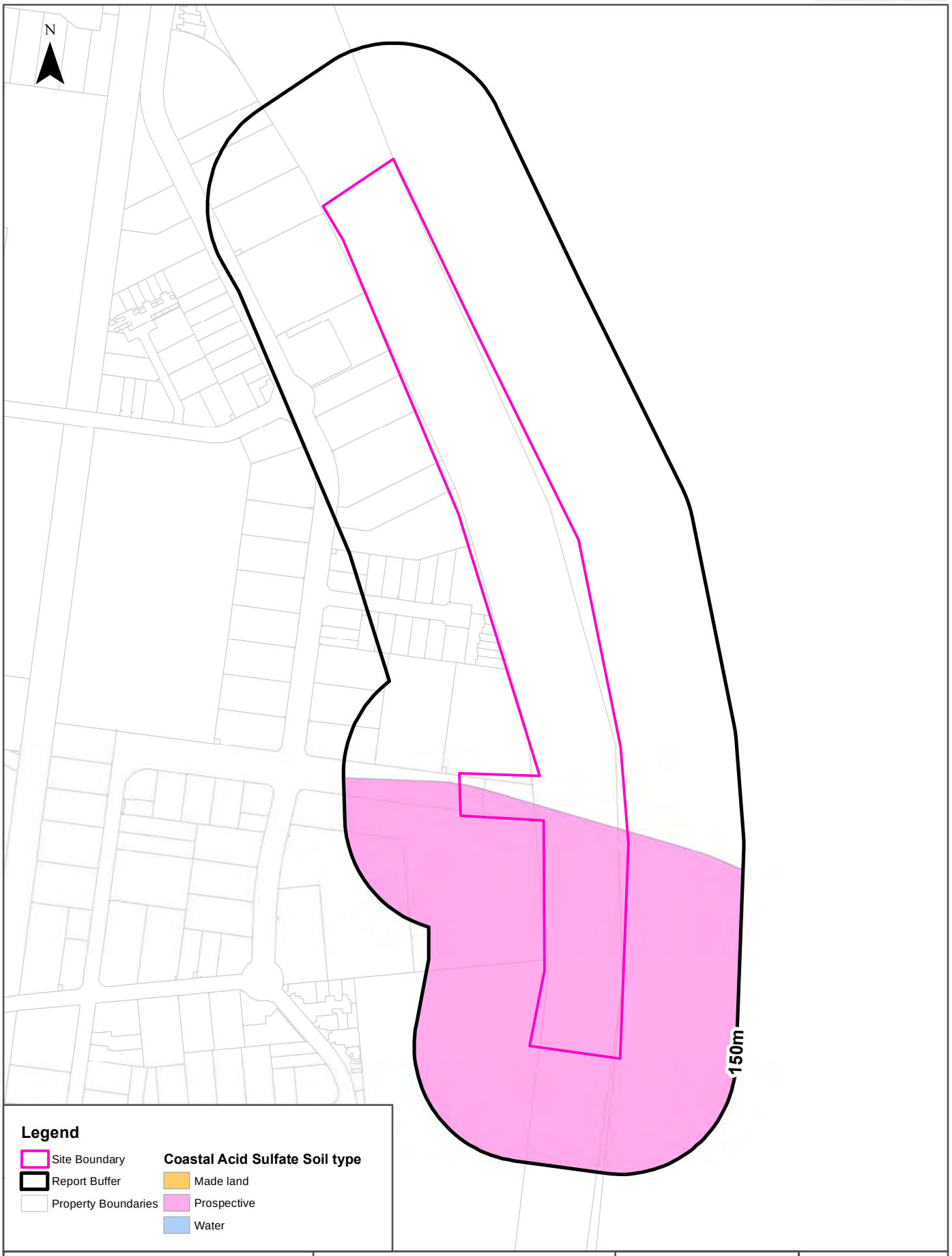
Coastal Acid Sulfate Soil Types
There are no Acid Sulfate areas onsite

What are the Coastal Acid Sulfate Soil types within the report buffer?

Coastal Acid Sulfate Soil Types	Distance	Direction
There are no Acid Sulfate areas within the report buffer		

Coastal Acid Sulfate Soils

OSAR Proposed Road Alignments - Site 26 (Section 4)



Data Sources: Property Boundaries & Topographic Data: State of Victoria - Department of Environment and Primary Industries

Coordinate System: GDA 1994 MGA Zone 55

Date: 09February 2017

Coastal Acid Sulfate Soils

OSAR Proposed Road Alignments - Site 26 (Section 4)

Coastal Acid Sulfate Soils

What are the on-site Coastal Acid Sulfate Soil types?

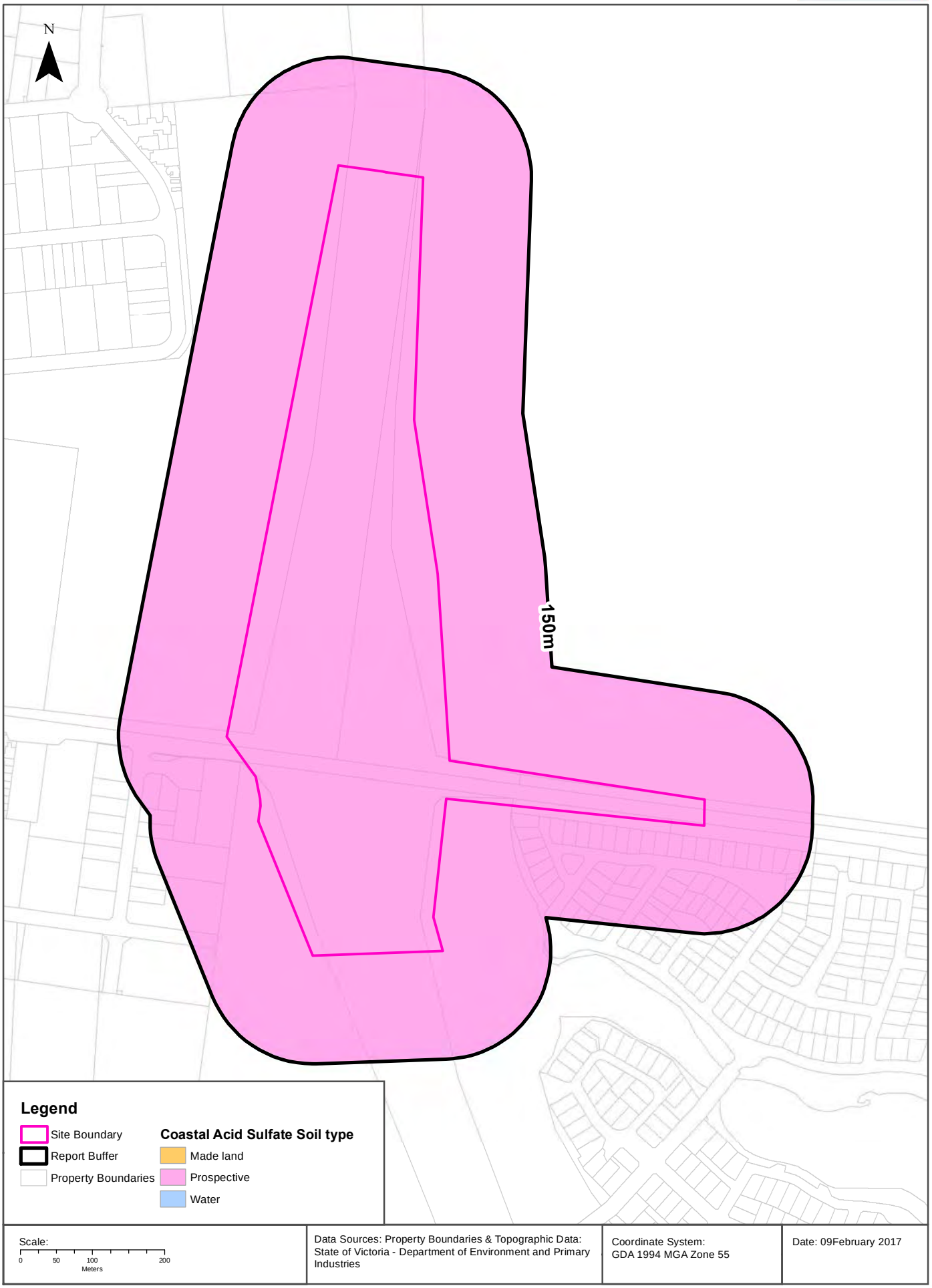
Coastal Acid Sulfate Soil Types
Prospective

What are the Coastal Acid Sulfate Soil types within the report buffer?

Coastal Acid Sulfate Soil Types	Distance	Direction
Prospective	0m	Onsite

Coastal Acid Sulfate Soils

OSAR Proposed Road Alignments - Site 26 (Section 5)



Coastal Acid Sulfate Soils

OSAR Proposed Road Alignments - Site 26 (Section 5)

Coastal Acid Sulfate Soils

What are the on-site Coastal Acid Sulfate Soil types?

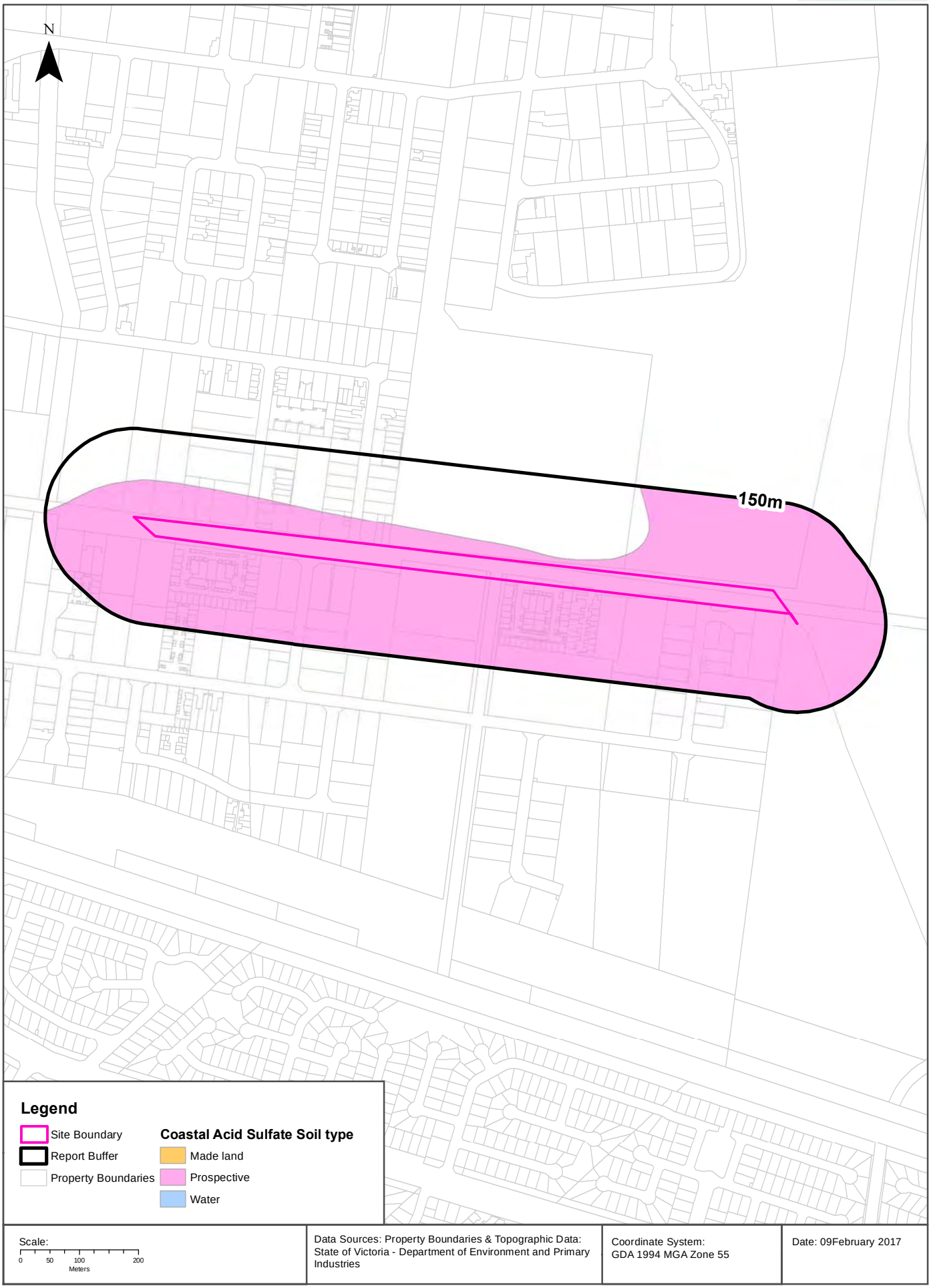
Coastal Acid Sulfate Soil Types
Prospective

What are the Coastal Acid Sulfate Soil types within the report buffer?

Coastal Acid Sulfate Soil Types	Distance	Direction
Prospective	0m	Onsite

Coastal Acid Sulfate Soils

OSAR Proposed Road Alignments - Site 26 (Section 6)



Coastal Acid Sulfate Soils

OSAR Proposed Road Alignments - Site 26 (Section 6)

Coastal Acid Sulfate Soils

What are the on-site Coastal Acid Sulfate Soil types?

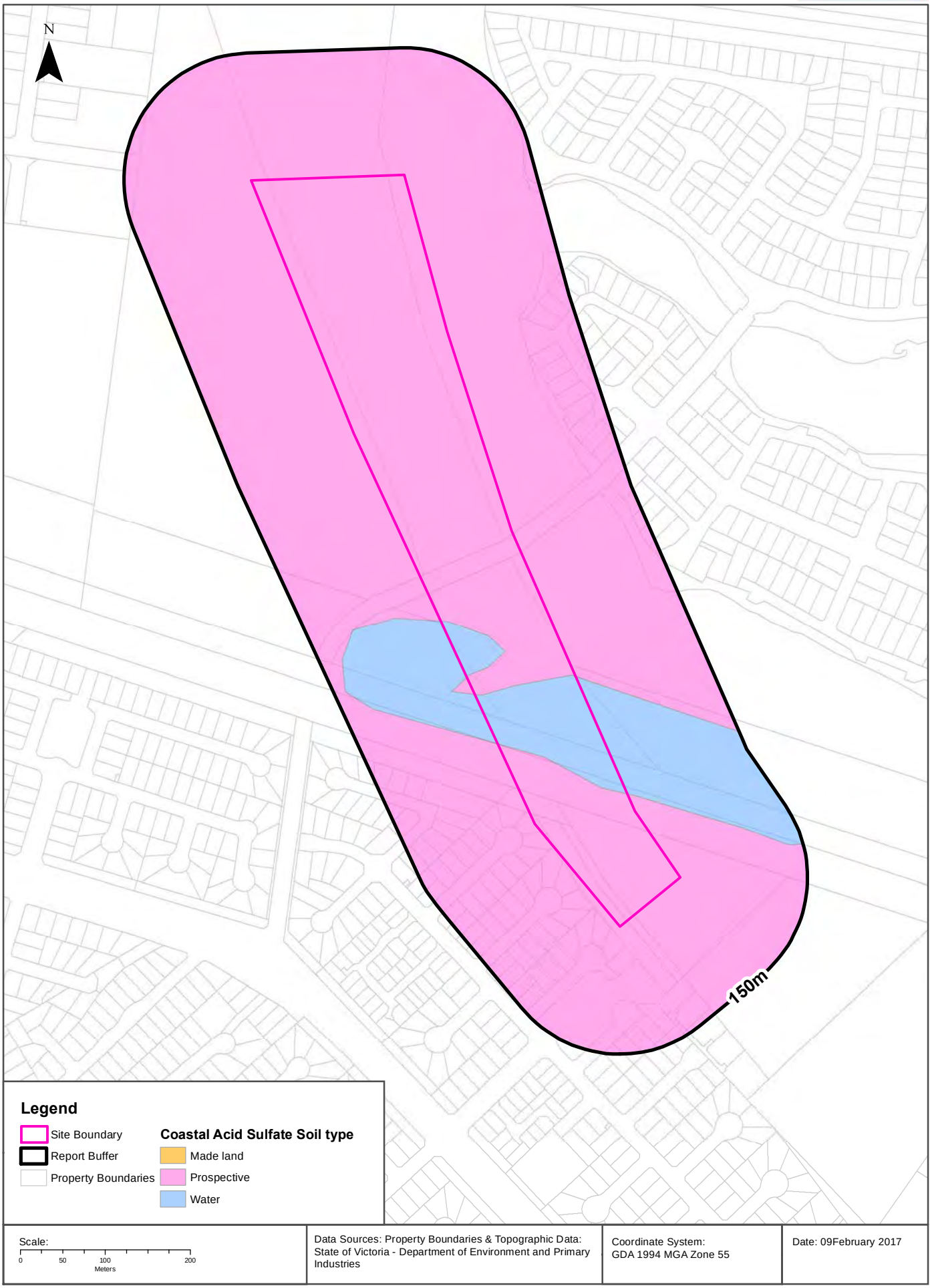
Coastal Acid Sulfate Soil Types
Prospective

What are the Coastal Acid Sulfate Soil types within the report buffer?

Coastal Acid Sulfate Soil Types	Distance	Direction
Prospective	0m	Onsite

Coastal Acid Sulfate Soils

OSAR Proposed Road Alignments - Site 26 (Section 7)



Coastal Acid Sulfate Soils

OSAR Proposed Road Alignments - Site 26 (Section 7)

Coastal Acid Sulfate Soils

What are the on-site Coastal Acid Sulfate Soil types?

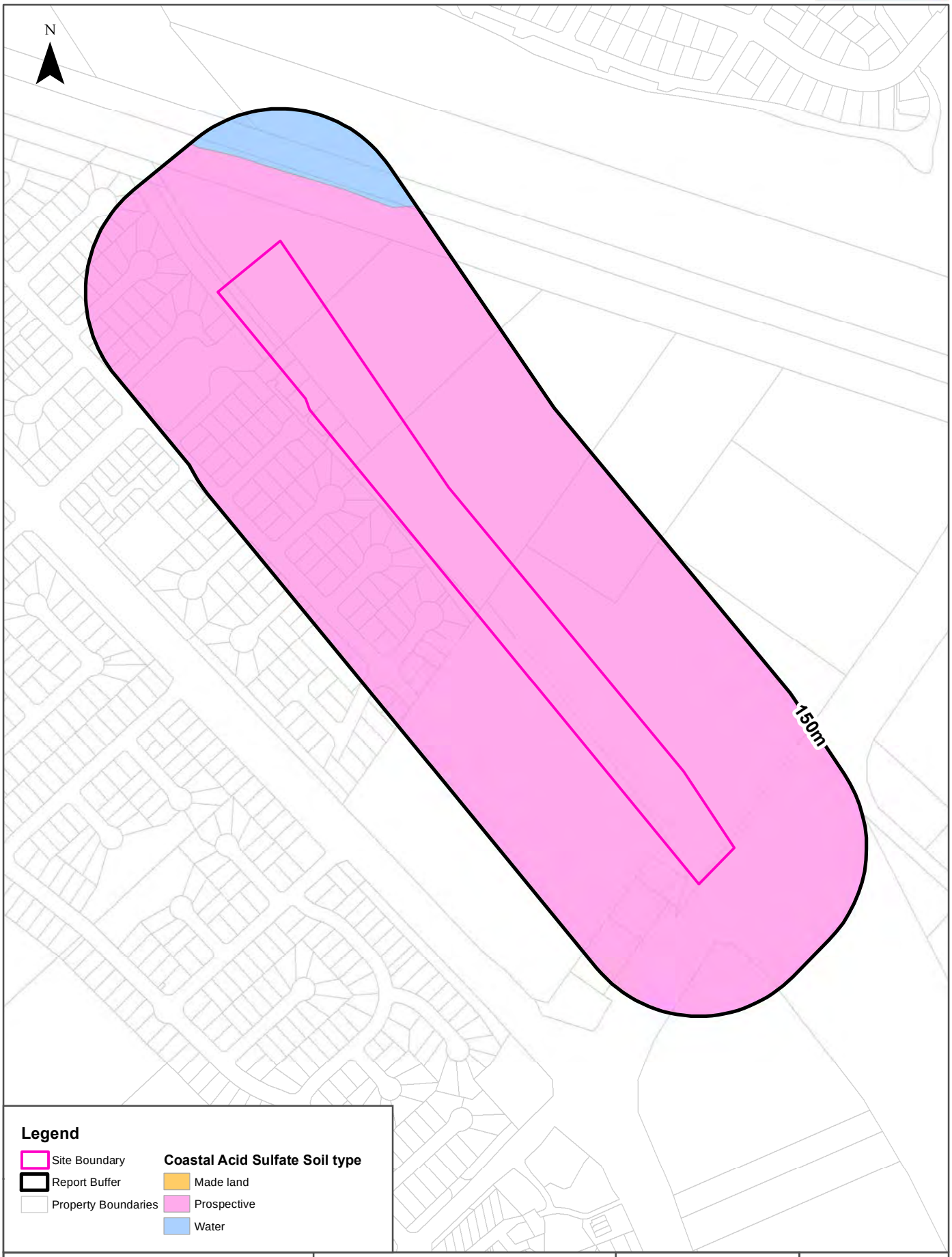
Coastal Acid Sulfate Soil Types
Prospective
Water

What are the Coastal Acid Sulfate Soil types within the report buffer?

Coastal Acid Sulfate Soil Types	Distance	Direction
Prospective	0m	Onsite
Water	0m	Onsite

Coastal Acid Sulfate Soils

OSAR Proposed Road Alignments - Site 26 (Section 8)



Data Sources: Property Boundaries & Topographic Data: State of Victoria - Department of Environment and Primary Industries

Coordinate System: GDA 1994 MGA Zone 55

Date: 09February 2017

Coastal Acid Sulfate Soils

OSAR Proposed Road Alignments - Site 26 (Section 8)

Coastal Acid Sulfate Soils

What are the on-site Coastal Acid Sulfate Soil types?

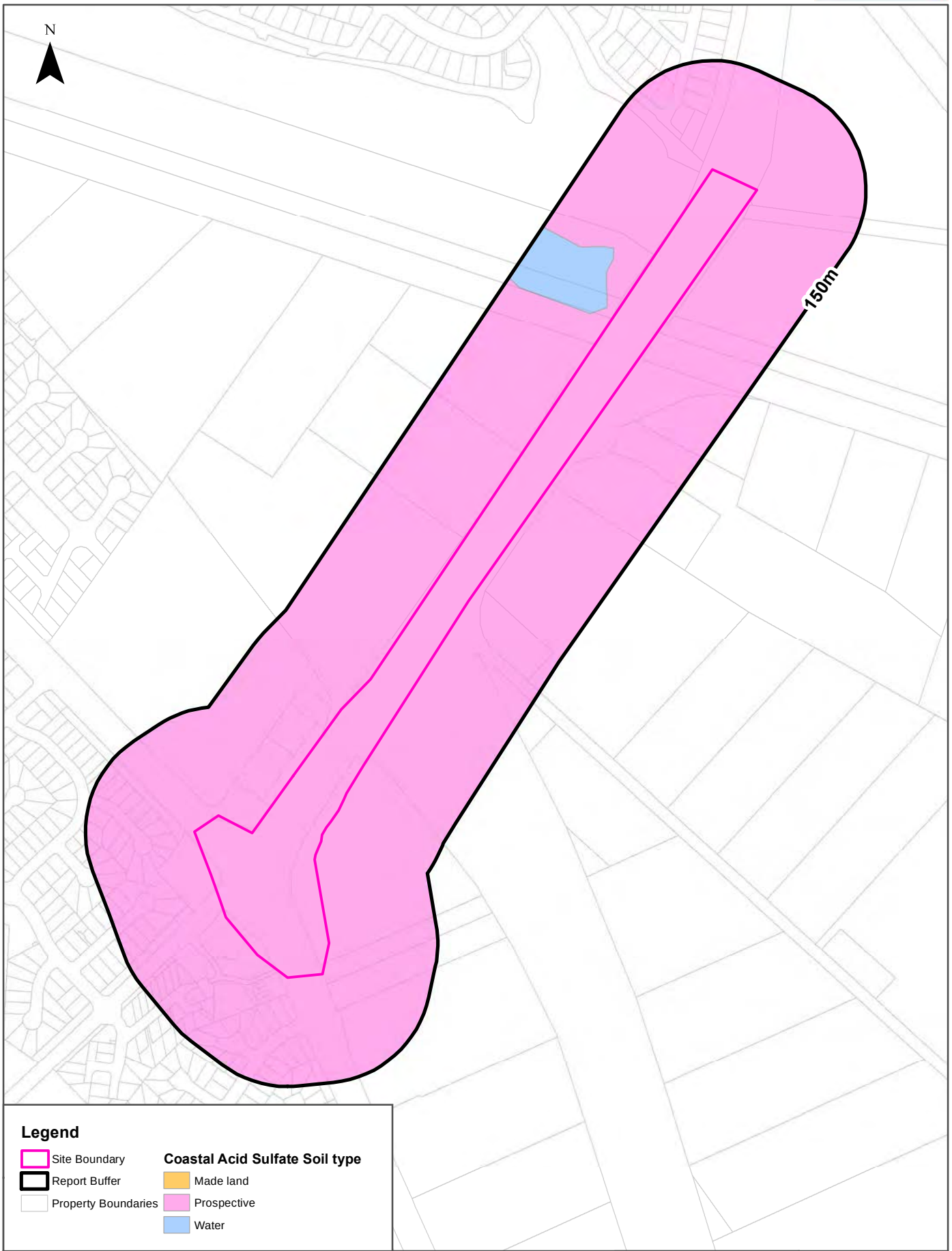
Coastal Acid Sulfate Soil Types
Prospective

What are the Coastal Acid Sulfate Soil types within the report buffer?

Coastal Acid Sulfate Soil Types	Distance	Direction
Prospective	0m	Onsite
Water	77m	North

Coastal Acid Sulfate Soils

OSAR Proposed Road Alignments - Site 26 (Section 9)



Data Sources: Property Boundaries & Topographic Data: State of Victoria - Department of Environment and Primary Industries

Coordinate System: GDA 1994 MGA Zone 55

Date: 09February 2017

Coastal Acid Sulfate Soils

OSAR Proposed Road Alignments - Site 26 (Section 9)

Coastal Acid Sulfate Soils

What are the on-site Coastal Acid Sulfate Soil types?

Coastal Acid Sulfate Soil Types
Prospective

What are the Coastal Acid Sulfate Soil types within the report buffer?

Coastal Acid Sulfate Soil Types	Distance	Direction
Prospective	0m	Onsite
Water	16m	North West

Planning Zones

OSAR Proposed Road Alignments - Site 26 (Section 10)

Data Sources: Property Boundaries & Topographic Data: State of Victoria - Department of Environment and Primary Industries

Coordinate System: GDA 1994 MGA Zone 55

Date: 09February 2017

Planning Zones

OSAR Proposed Road Alignments - Site 26 (Section 10)

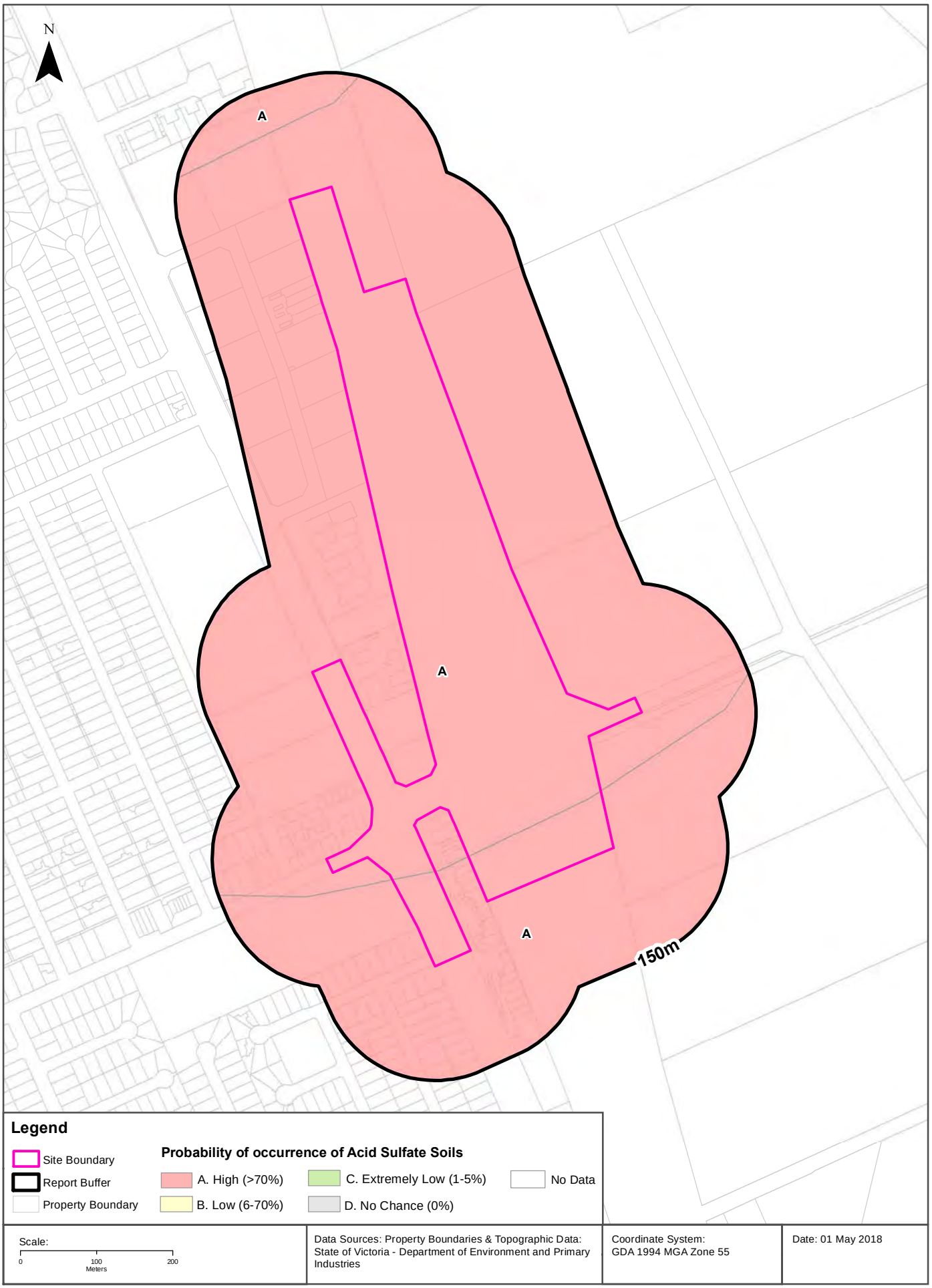
Planning Zones

Planning zones within the report buffer:

Zone Code	Description	Distance	Direction
RDZ1	ROAD ZONE - CATEGORY 1	0m	Onsite
C2Z	COMMERCIAL 2 ZONE	0m	South
GWZ	GREEN WEDGE ZONE	0m	East
GWZ1	GREEN WEDGE ZONE - SCHEDULE 1	57m	North West
GRZ3	GENERAL RESIDENTIAL ZONE - SCHEDULE 3	68m	North West

Atlas of Australian Acid Sulfate Soils

Section 11 (Thames Promenade) - Mordialloc Bypass



Acid Sulfate Soils

Section 11 (Thames Promenade) - Mordialloc Bypass

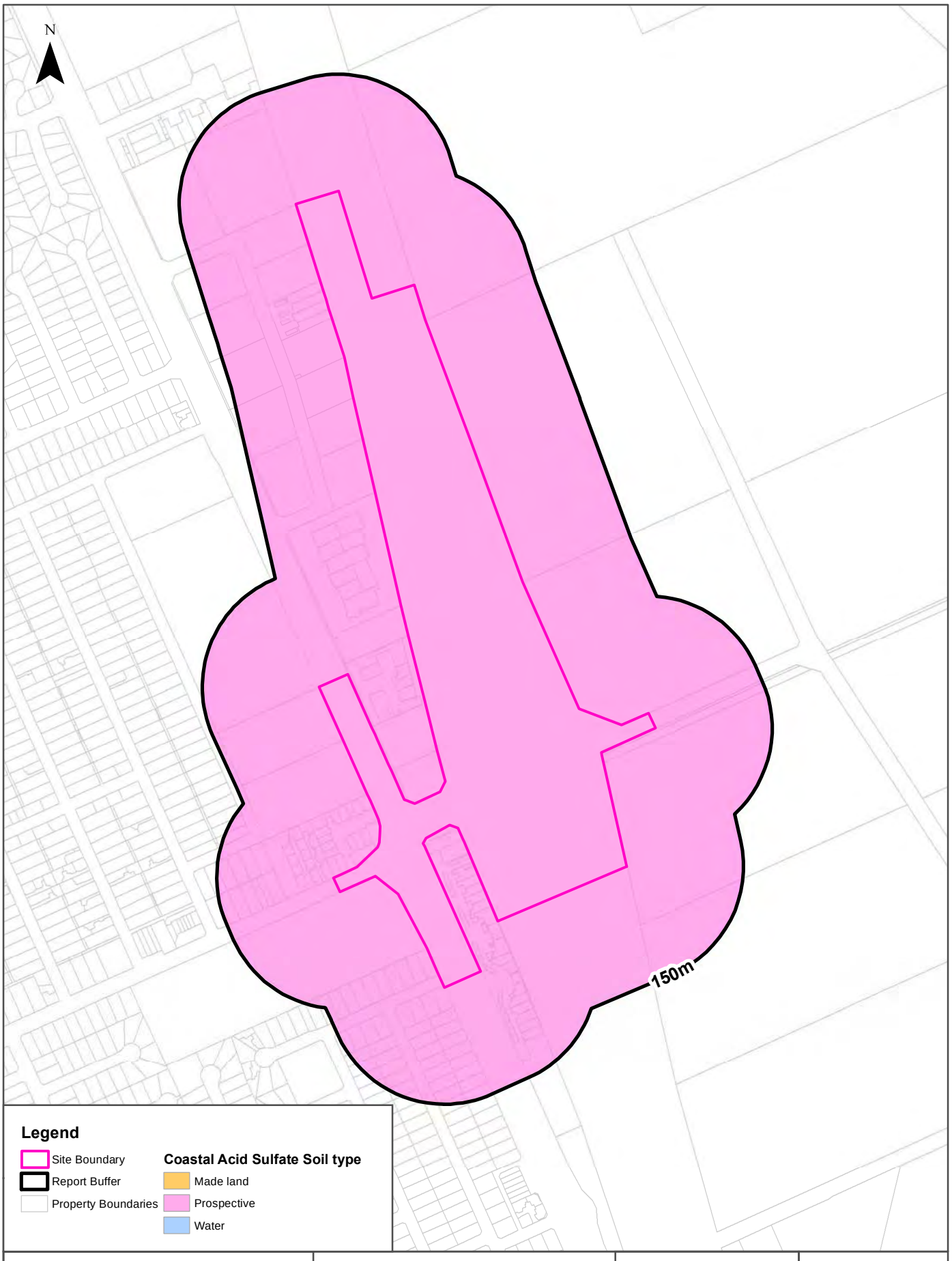
Atlas of Australian Acid Sulfate Soils

Atlas of Australian Acid Sulfate Soil categories within the dataset buffer:

PROBCLASS	Description	Distance
A	High Probability of occurrence. >70% chance of occurrence.	0m

Coastal Acid Sulfate Soils

Section 11 (Thames Promenade) - Mordialloc Bypass



Coastal Acid Sulfate Soils

Section 11 (Thames Promenade) - Mordialloc Bypass

Coastal Acid Sulfate Soils

What are the on-site Coastal Acid Sulfate Soil types?

Coastal Acid Sulfate Soil Types
Prospective

What are the Coastal Acid Sulfate Soil types within the dataset buffer?

Coastal Acid Sulfate Soil Types	Distance	Direction
Prospective	0m	Onsite

APPENDIX E

GROUNDWATER DATABASE SEARCH

Station	UseType	DrillersLog	Stratigraphy	Geology	Levels	Construction	CompleteDate	Distance	Direction	Latitude	Longitude
WRK043346								0	Onsite	-38.02747904	145.1312397
WRK966394								0	Onsite	-37.97116857	145.1157311
WRK039072	Domestic, Irrigation, Stock	0.00m-3.00m BLACK CLAY 3.00m-9.00m YELLOW CLAY 9.00m-18.00m SANDY CLAY 18.00m-22.00m SAND (MEDIUM) 22.00m-24.38m CLAY (IRONSTONE BANDS)		18.29m-21.34m Sand		0.00m-18.29m INNER LINING - CASING = Pvc18.29m-21.34m INNER LINING - SCREEN = Pvc21.34m-24.38m INNER LINING - CASING = Pvc	09/01/1986	0	Onsite	-38.02666967	145.1348058
81673	Not Known	0.00m-0.30m SURFACE SOIL 0.30m-1.22m SAND 1.22m-6.10m CLAYEY SAND 6.10m-6.40m SAND 6.40m-10.67m CLAY 10.67m-14.02m STICKY MARINE CLAY SAND 14.02m-18.29m SANDSTONE PIECES MARINE SILT SAND 18.29m-37.19m MARINE SILT CLAY 37.19m-38.71m DARK MARINE SHELL 38.71m-42.30m DARK MARINE SHELL LITTLE LIMESTONE					06/01/1970	0	Onsite	-37.96894555	145.1159021
81419	Observation, State Observation Network	0.00m-1.50m TOP SOIL SAND 1.50m-4.60m CLAY AND SAND 4.60m-6.10m ORANGE CLAY SAND 6.10m-10.70m SANDY DARK CLAY 10.70m-22.90m GREEN CLAY SAND 22.90m-23.00m GRAVEL 23.00m-23.20m HARD BAR 23.20m-26.20m GREEN CLAY GRAVEL 26.20m-27.40m GREY CLAY 27.40m-39.60m GREEN SILTY CLAY WITH SHELLS 39.60m-42.98m CLAY MUD STONE			Date/time: 1982-07-26 0000 Quality: 43 WLMP: 6.58m DBNS: 6.55m RWL: 20.12mAHD	0.00m-42.98m INNER LINING - CASING = Pvc	27/11/1971	0	Onsite	-37.96096549	145.1173469
127483	Groundwater Investigation, Observation, State Observation Network	0.00m-1.00m FINE GREY SAND 1.00m-2.00m LIGHT ORANGE CLAY 2.00m-4.00m YELLOW AND GREY SANDY CLAY 4.00m-10.00m LIGHT BROWN SANDY CLAY 10.00m-12.00m ORANGE CLAYEY SAND 12.00m-15.00m GREY SAILTY CLAY			Date/time: 2016-05-24 0908 Quality: 43 WLMP: 5.40m DBNS: 5.45m RWL: 12.35mAHD	0.00m-12.00m INNER LINING - CASING = Pvc12.00m-14.00m INNER LINING - SCREEN = Pvc14.00m-15.00m INNER LINING - CASING = Pvc 11.00m-12.00m OUTER LINING - GRAVEL = Bentonite 12.00m-15.00m OUTER LINING - GRAVEL = Gravel	18/04/1996	7	North	-37.97229497	145.1124769
WRK982650								19	North	-37.97332574	145.119818
76479	Domestic	0.00m-3.00m BLACK CLAY 3.00m-9.00m YELLOW CLAY 9.00m-12.00m SANDY CLAY 12.00m-19.00m SAND (MEDIUM) 19.00m-24.38m CLAY IRONSTONE BANDS		12.19m-18.29m Sand		0.00m-12.19m INNER LINING - CASING = Pvc Class 912.19m-18.29m INNER LINING - SCREEN = Pvc Class 918.29m-24.38m INNER LINING - CASING = Pvc Class 9	11/01/1986	20	South	-38.02531866	145.1348398
WRK069052	Observation	0.00m-0.40m FILL 0.40m-9.50m CLAY		9.00m-9.50m Clay		0.00m-6.00m INNER LINING - CASING = Pvc6.00m-9.00m INNER LINING - SCREEN = Pvc9.00m-9.50m INNER LINING - CASING = Pvc 0.00m-5.00m OUTER LINING - GRAVEL = Cement 5.00m-6.00m OUTER LINING - GRAVEL = Bentonite 6.00m-9.00m OUTER LINING - GRAVEL = Gravel	17/08/2012	23	North	-37.97370034	145.1201386
WRK989236								47	North West	-37.98755551	145.1142057
WRK055858	Irrigation							61	South	-38.02670117	145.13596
WRK991278	Groundwater Investigation	0.00m-0.30m topsoil 0.30m-1.50m sand 1.50m-3.60m sandstone 3.60m-8.20m sand				0.00m-4.20m INNER LINING - CASING = Pvc4.20m-8.20m INNER LINING - SCREEN = Pvc 0.00m-2.50m OUTER LINING - GRAVEL = Cement 2.50m-3.70m OUTER LINING - GRAVEL = Bentonite 3.70m-8.20m OUTER LINING - GRAVEL = Gravel	08/05/2009	64	North	-37.97371699	145.1206163
WRK989237								73	North West	-37.98731583	145.1138702
81729	Domestic	0.00m-3.05m CLAY 3.05m-12.19m SANDY CLAY BROWN 12.19m-21.34m SAND BROWN 21.34m-36.58m SAND GREY 36.58m-49.38m SAND BLACK		36.58m-38.10m Sand 42.98m-45.72m Sand		0.00m-36.58m INNER LINING - CASING = Pvc36.58m-38.10m INNER LINING - SCREEN = Pvc38.10m-44.50m INNER LINING - CASING = Pvc42.98m-45.72m INNER LINING - SCREEN = Pvc	23/12/1982	87	North West	-37.98731268	145.1137125
136919	Groundwater Investigation	0.00m-0.90m SILTY SAND, BROWN, MOIST FILL 0.90m-7.50m CLAYEY SAND RED BROWN, YELLOW BROWN AND PAIL GREY, MEDIUM GR				0.00m-4.00m INNER LINING - CASING = Pvc Class 184.00m-7.50m INNER LINING - SCREEN = Pvc Class 18 0.00m-0.20m OUTER LINING - GRAVEL = Cement 2.30m-3.00m OUTER LINING - GRAVEL = Bentonite 3.00m-7.50m OUTER LINING - GRAVEL = Gravel	06/10/1998	89	North	-37.97363952	145.1208931
142770	Groundwater Investigation	0.00m-4.00m CLAYEY SAND 4.00m-5.00m SILTY SAND 5.00m-11.00m CLAYEY SAND		6.50m-11.00m Sand		0.00m-6.50m INNER LINING - CASING = Pvc6.50m-11.00m INNER LINING - SCREEN = Pvc 0.00m-5.50m OUTER LINING - GRAVEL = Cement 5.50m-6.00m OUTER LINING - GRAVEL = Bentonite 6.00m-11.00m OUTER LINING - GRAVEL = Gravel	12/08/1998	89	North	-37.97363952	145.1208931
142771	Groundwater Investigation					0.00m-3.00m INNER LINING - CASING = Pvc3.00m-6.00m INNER LINING - SCREEN = Pvc 1.50m-2.00m OUTER LINING - GRAVEL = Bentonite 2.00m-0.00m OUTER LINING - GRAVEL = Seal	22/10/1998	89	North	-37.97363952	145.1208931
136918	Groundwater Investigation	0.00m-0.80m SANDY SILT, BROWN, DENSE, MOIST FILL 0.80m-7.50m CLAYEY SAND, FINE AND MEDIUM SAND, RED BROWN, YELLOW BROWN,				0.00m-4.00m INNER LINING - CASING = Pvc Class 184.00m-7.50m INNER LINING - SCREEN = Pvc Class 18 0.00m-0.20m OUTER LINING - GRAVEL = Cement 2.40m-3.00m OUTER LINING - GRAVEL = Bentonite 3.00m-7.50m OUTER LINING - GRAVEL = Gravel	06/10/1998	89	North	-37.97363952	145.1208931
142768	Groundwater Investigation	0.00m-4.00m CLAYEY SAND 4.00m-5.00m SILTY SAND 5.00m-11.00m CLAYEY SAND		6.50m-11.00m Sand		0.00m-6.50m INNER LINING - CASING = Pvc6.50m-11.00m INNER LINING - SCREEN = Pvc 0.00m-5.50m OUTER LINING - GRAVEL = Cement 5.50m-6.00m OUTER LINING - GRAVEL = Bentonite 6.00m-11.00m OUTER LINING - GRAVEL = Gravel	12/08/1998	89	North	-37.97363952	145.1208931
142774	Groundwater Investigation					0.00m-3.00m INNER LINING - CASING = Pvc3.00m-6.00m INNER LINING - SCREEN = Pvc 1.50m-2.00m OUTER LINING - GRAVEL = Bentonite 2.00m-0.00m OUTER LINING - GRAVEL = Seal	22/10/1998	89	North	-37.97363952	145.1208931
142772	Groundwater Investigation					0.00m-3.00m INNER LINING - CASING = Pvc3.00m-6.00m INNER LINING - SCREEN = Pvc	22/10/1998	89	North	-37.97363952	145.1208931
142769	Groundwater Investigation	0.00m-4.00m CLAYEY SAND 4.00m-5.00m SILTY SAND 5.00m-11.00m CLAYEY SAND		6.50m-11.00m Sand		0.00m-6.50m INNER LINING - CASING = Pvc6.50m-11.00m INNER LINING - SCREEN = Pvc 0.00m-5.50m OUTER LINING - GRAVEL = Cement 5.50m-6.00m OUTER LINING - GRAVEL = Bentonite 6.00m-11.00m OUTER LINING - GRAVEL = Gravel	12/08/1998	89	North	-37.97363952	145.1208931
142775	Groundwater Investigation					0.00m-3.00m INNER LINING - CASING = Pvc3.00m-7.00m INNER LINING - SCREEN = Pvc 1.50m-2.00m OUTER LINING - GRAVEL = Bentonite 2.00m-0.00m OUTER LINING - GRAVEL = Seal	22/10/1998	89	North	-37.97363952	145.1208931
136917	Groundwater Investigation	0.00m-0.80m SANDY SILT, BROWN, MOIST FILL 0.80m-1.00m SAND CLAY, ORANGE BROWN, PAIL BROWN, YELLOW BROWN, STIFF, MO 1.00m-7.50m CLAYEY SAND FINE AND MEDIUM SAND, RED BROWN, YELLOW BROWN AN				0.00m-3.50m INNER LINING - CASING = Pvc Class 183.50m-7.50m INNER LINING - SCREEN = Pvc Class 18 0.00m-0.20m OUTER LINING - GRAVEL = Cement 2.30m-3.00m OUTER LINING - GRAVEL = Bentonite 3.00m-7.50m OUTER LINING - GRAVEL = Gravel	06/10/1998	89	North	-37.97363952	145.1208931
142773	Groundwater Investigation					0.00m-3.00m INNER LINING - CASING = Pvc3.00m-6.00m INNER LINING - SCREEN = Pvc 1.50m-2.00m OUTER LINING - GRAVEL = Bentonite 2.00m-0.00m OUTER LINING - GRAVEL = Seal	22/10/1998	89	North	-37.97363952	145.1208931
WRK989238								96	North West	-37.98738369	145.1136066
WRK989239								101	North West	-37.9875815	145.1135787
WRK051930	Observation	0.00m-6.00m clay		0.00m-3.00m Clay 3.00m-6.00m Clay		0.00m-3.00m INNER LINING - CASING = Pvc3.00m-6.00m INNER LINING - SCREEN = Pvc 0.00m-1.00m OUTER LINING - GRAVEL = Cement 1.00m-2.00m OUTER LINING - GRAVEL = Bentonite 2.00m-6.00m OUTER LINING - GRAVEL = Gravel	21/10/2009	125	North	-37.97165797	145.1113453
76306	Domestic	0.00m-3.00m BLACK CLAY 3.00m-11.00m YELLOW CLAY 11.00m-18.00m SANDY CLAY 18.00m-24.38m SAND (MEDIUM)		18.29m-24.38m Sand		0.00m-18.29m INNER LINING - CASING = Pvc18.29m-24.38m INNER LINING - SCREEN = Pvc	13/01/1986	136	South	-38.02906265	145.1379348

Station	UseType	DrillersLog	Stratigraphy	Geology	Levels	Construction	CompleteDate	Distance	Direction	Latitude	Longitude
WRK986516								138	North	-37.97203118	145.111017
WRK987293	Groundwater Investigation	0.00m-0.16m 0.16M CONCRETE 0.16m-0.30m FILL: SANDY GRAVEL 0.30m-0.80m FILL: SILTY SAND FINE GRAINED 0.80m-4.20m SILTY CLAY (CH) STIFF 4.20m-5.00m SANDY CLAY					14/07/2008	149	North	-37.96048615	145.1278627
81737	Domestic	0.00m-3.00m TOP SOIL WITH GREY SAND 3.00m-5.00m GREY SANDY CLAY 5.00m-11.00m GREY CLAY WITH SAND 11.00m-17.00m BROWN SANDY CLAY 17.00m-59.00m BLACK CLAY 59.00m-60.00m WEATHERED MUDSTONE 60.00m-86.00m MUDSTONE		59.20m-86.00m Mudstone		0.00m-59.20m INNER LINING - CASING = Mild Steel59.20m-86.00m INNER LINING - SCREEN = Mild Steel	02/12/1983	152	North West	-37.97964764	145.1134533
142871	Groundwater Investigation	0.00m-12.50m SANDY CLAY				0.00m-5.00m INNER LINING - CASING = Pvc5.00m-12.00m INNER LINING - SCREEN = Pvc 0.00m-4.00m OUTER LINING - GRAVEL = Cement 4.00m-4.50m OUTER LINING - GRAVEL = Bentonite 4.50m-12.50m OUTER LINING - GRAVEL = Gravel	18/10/1999	158	South West	-38.00121468	145.1208736
142869	Groundwater Investigation	0.00m-14.40m SANDY CLAY				0.00m-11.40m INNER LINING - CASING = Pvc11.40m-14.40m INNER LINING - SCREEN = Pvc 10.40m-10.90m OUTER LINING - GRAVEL = Bentonite 10.90m-14.40m OUTER LINING - GRAVEL = Gravel	03/11/1999	158	South West	-38.00121468	145.1208736
142870	Groundwater Investigation	0.00m-12.50m SANDY CLAY				0.00m-5.00m INNER LINING - CASING = Pvc5.00m-12.50m INNER LINING - SCREEN = Pvc 0.00m-4.00m OUTER LINING - GRAVEL = Cement 4.00m-4.50m OUTER LINING - GRAVEL = Bentonite 4.50m-12.50m OUTER LINING - GRAVEL = Gravel	18/10/1999	158	South West	-38.00121468	145.1208736
WRK967873	Groundwater Investigation	0.00m-1.20m CLAY 1.20m-4.20m SIILTY SANDY CLAY, BLACK 4.20m-5.20m SANDY CLAY, DARK BROWN 5.20m-6.20m SILTY CLAY				0.00m-2.60m INNER LINING - CASING = Pvc Class 182.60m-6.20m INNER LINING - SLOT = Pvc Class 18 0.00m-0.50m OUTER LINING - GRAVEL = Cement 0.50m-1.20m OUTER LINING - GRAVEL = Seal 1.20m-2.10m OUTER LINING - GRAVEL = Bentonite 2.10m-6.20m OUTER LINING - GRAVEL = Gravel	10/12/2004	181	South	-38.03455401	145.1409497
WRK967872	Groundwater Investigation	0.00m-0.20m ORGANIC MATTER 0.20m-0.50m SAND - BROWN 0.50m-9.00m SANDY CLAY, GREY				0.00m-4.50m INNER LINING - CASING = Pvc Class 184.50m-9.00m INNER LINING - SLOT = Pvc Class 18 0.00m-0.50m OUTER LINING - GRAVEL = Cement 0.50m-4.00m OUTER LINING - GRAVEL = Seal 4.00m-5.00m OUTER LINING - GRAVEL = Bentonite 5.00m-9.00m OUTER LINING - GRAVEL = Gravel	26/11/2004	181	South	-38.03455401	145.1409497
WRK967871	Groundwater Investigation	0.00m-0.20m ORGANIC MATTER 0.20m-0.40m CLAYEY SAND 0.40m-7.50m SANDY CLAY, GREY				0.00m-4.50m INNER LINING - CASING = Pvc Class 184.50m-7.50m INNER LINING - SLOT = Pvc Class 18 0.00m-0.50m OUTER LINING - GRAVEL = Cement 0.50m-3.50m OUTER LINING - GRAVEL = Seal 3.50m-4.00m OUTER LINING - GRAVEL = Bentonite 4.00m-7.50m OUTER LINING - GRAVEL = Gravel	26/11/2004	181	South	-38.03455401	145.1409497
127114	Groundwater Investigation	0.00m-4.00m FINE GREY SAND 4.00m-7.00m YELLOW AND GREY CLAY 7.00m-9.50m GREY SANDY CLAY			Date/time: 1996-10-08 0000 Quality: 47 WLMP: 4.61m DBNS: 3.82m RWL: 26.95mAHD	0.20m-6.00m INNER LINING - CASING = Pvc6.00m-8.00m INNER LINING - SCREEN = Pvc8.00m-9.00m INNER LINING - CASING = Pvc 4.50m-5.50m OUTER LINING - GRAVEL = Bentonite 5.50m-9.00m OUTER LINING - GRAVEL = Gravel	07/12/1995	187	North	-37.95853842	145.1227808
81421	Observation, State Observation Network	0.00m-1.20m SAND 1.20m-6.40m SANDY CLAY YELLOW 6.40m-7.90m SANDS DARK GREY 7.90m-14.90m GREEN MARL SANDY GRAVEL 14.90m-15.20m HARD STONE BAR 15.20m-21.30m GRAVEL CLAY SOME HARD BARS 21.30m-30.50m SILTY MARL GREEN 30.50m-32.00m SILTY MARL SAND GREYT MICA 32.00m-38.40m SILTY MARL SAND GREY 38.40m-39.90m DARKER SILTY CLAY 39.90m-42.10m GREEN MARL FIRM SHELLS 42.10m-44.20m HARD BAR STONE 44.20m-50.29m GREY CLAY TURNED TO STONE (BEDROCK)		30.50m-42.70m Marl	Date/time: 1991-12-04 0000 Quality: 43 WLMP: 4.21m DBNS: 3.34m RWL: 18.36mAHD	0.00m-30.50m INNER LINING - CASING = Pvc30.50m-42.70m INNER LINING - SCREEN = Pvc42.70m-50.29m INNER LINING - CASING = Pvc 0.00m-1.00m OUTER LINING - GRAVEL = Cement 25.90m-50.29m OUTER LINING - GRAVEL = Gravel	21/02/1973	187	North	-37.96820851	145.119438
81437	Not Known						20/09/1985	187	North	-37.96820851	145.119438
81438	Not Known						20/09/1985	187	North	-37.96820851	145.119438
127113	Groundwater Investigation	0.00m-4.00m FINE GREY SAND 4.00m-7.00m YELLOW AND GREY CLAY 7.00m-9.50m GREY SANDY CLAY 9.50m-16.00m FINE GREY SAND 16.00m-19.00m FINE DARK GREY SAND 19.00m-20.00m LIGHNIOUS CLAY			Date/time: 1996-10-08 0000 Quality: 47 WLMP: 9.46m DBNS: 8.56m RWL: 22.21mAHD	0.30m-17.00m INNER LINING - CASING = Pvc17.00m-19.00m INNER LINING - SCREEN = Pvc19.00m-20.00m INNER LINING - CASING = Pvc 15.50m-16.50m OUTER LINING - GRAVEL = Bentonite 16.50m-20.00m OUTER LINING - GRAVEL = Gravel	06/12/1995	188	North	-37.95852942	145.1227808
WRK990436								190	North	-37.95797678	145.1185705
WRK980809								190	South	-38.0250636	145.1289543
WRK987292	Groundwater Investigation	0.00m-0.30m CONCRETE				0.00m-0.40m OUTER LINING - GRAVEL = Cement 0.40m-1.00m OUTER LINING - GRAVEL = Bentonite 1.00m-6.00m OUTER LINING - GRAVEL = Gravel	15/07/2008	191	North	-37.9604943	145.1283747
127117	Groundwater Investigation	0.00m-1.00m GREY SAND 1.00m-2.50m YELLOW AND GREY CLAYEY SAND 2.50m-4.00m YELLOW AND GREY CLAY 4.00m-6.00m YELLOW AND GREY SANDY CLAY 6.00m-9.50m FINE SAND 9.50m-11.00m BROWN COAL 11.00m-15.50m MEDIUM SAND 15.50m-22.00m GREY SILTY CLAY 22.00m-30.00m MARL CLAY			Date/time: 1996-10-08 0000 Quality: 47 WLMP: 6.39m DBNS: 6.45m RWL: 22.81mAHD	0.00m-25.00m INNER LINING - CASING = Pvc25.00m-27.00m INNER LINING - SCREEN = Pvc27.00m-28.00m INNER LINING - CASING = Pvc 23.50m-24.50m OUTER LINING - GRAVEL = Bentonite 24.50m-28.00m OUTER LINING - GRAVEL = Gravel	13/12/1995	194	North	-37.9577515	145.1152439
127118	Groundwater Investigation	0.00m-1.00m GREY SAND 1.00m-2.50m YELLOW AND GREY CLAYEY SAND 2.50m-4.00m YELLOW AND GREY CLAY 4.00m-6.00m YELLOW AND GREY SANDY CLAY 6.00m-9.50m FINE SAND 9.50m-10.50m BROWN COAL 10.50m-15.00m MEDIUM SAND 15.00m-16.00m GREY SILTY CLAY			Date/time: 1996-10-07 0000 Quality: 47 WLMP: 1.40m DBNS: 1.44m RWL: 27.82mAHD	0.00m-12.00m INNER LINING - CASING = Pvc12.00m-14.00m INNER LINING - SCREEN = Pvc14.00m-15.00m INNER LINING - CASING = Pvc 10.50m-11.50m OUTER LINING - GRAVEL = Bentonite 11.50m-15.00m OUTER LINING - GRAVEL = Gravel	14/12/1995	195	North	-37.9577505	145.1152319
WRK046838							10/08/2006	197	North	-37.96807685	145.1195649
WRK963363								214	North West	-37.97283364	145.1099852
WRK963364								214	North West	-37.97283364	145.1099852
WRK962790	Groundwater Investigation	0.00m-2.50m DARK BROWN SAND 2.50m-4.00m DARK ORANGE SAND 4.00m-7.00m WET SAND				0.00m-7.00m INNER LINING - CASING = Pvc	29/09/2003	216	North	-37.95754867	145.1143474
WRK962792	Groundwater Investigation	0.00m-2.50m LIGHT ORANGE SAND 2.50m-3.50m PALR GREY SAND 3.50m-7.00m GREY SILTY SAND 7.00m-10.00m FINE CLAYEY SAND 10.00m-11.70m FINE PALE GREY QUARTZ GRAVEL				0.00m-11.70m INNER LINING - CASING = Pvc	29/09/2003	220	North	-37.95756594	145.1171127
WRK962791	Groundwater Investigation	0.00m-0.10m FILL, DARK GREY PEBBLY SAND 0.10m-1.00m LIGHT GREY SAND 1.00m-4.50m DARK GREY SAND 4.50m-5.00m FINE ORANGE SAND 5.00m-7.50m FINE PALE GREY SAND 7.50m-10.00m CLAYEY SAND 10.00m-12.00m LIGHT GREY/BROWN SAND 12.00m-15.00m CLAYEY SAND 15.00m-19.00m SILTY SAND 19.00m-24.50m FINE BROWN/GREY GRAVEL 24.50m-28.00m SILTY CLAY 28.00m-31.00m FINE SANDY GRAVEL 31.00m-33.00m CLAYEY SAND 33.00m-36.00m GRAVEL 36.00m-38.00m GRAVELLY SAND				30.00m-32.00m INNER LINING - CASING = Pvc32.00m-38.00m INNER LINING - SCREEN = Pvc	29/09/2003	224	North	-37.95753028	145.1171364
76456	Domestic, Stock	0.00m-3.00m BLACK CLAY 3.00m-9.00m YELLOW CLAY 9.00m-12.00m SANDY CLAY 12.00m-18.00m SAND (MEDIUM) 18.00m-22.25m CLAY WITH IRONSTONE BANDS		12.19m-18.29m Sand		0.00m-12.19m INNER LINING - CASING = Pvc12.19m-18.29m INNER LINING - SCREEN = Pvc18.29m-22.25m INNER LINING - CASING = Pvc	23/11/1983	226	South East	-38.02653764	145.1378848
127486	Groundwater Investigation, Observation, State Observation Network	0.00m-1.00m FINE GREY SAND 1.00m-7.00m LIGHT BROWN CLAYEY SAND 7.00m-15.00m BROWN CLAYEY SAND 15.00m-30.00m SANDY MARL			Date/time: 2017-11-01 1303 Quality: 43 WLMP: 4.12m DBNS: 4.19m RWL: 6.93mAHD	0.00m-27.00m INNER LINING - CASING = Pvc27.00m-29.00m INNER LINING - SCREEN = Pvc29.00m-30.00m INNER LINING - CASING = Pvc 26.00m-27.00m OUTER LINING - GRAVEL = Bentonite 27.00m-30.00m OUTER LINING - GRAVEL = Gravel	18/04/1996	232	North	-37.98309836	145.1201406

Station	UseType	DrillersLog	Stratigraphy	Geology	Levels	Construction	CompleteDate	Distance	Direction	Latitude	Longitude
127484	Groundwater Investigation, Observation, State Observation Network	0.00m-1.00m DARK GREY SANDY SOIL 1.00m-2.00m ORANGY BROWN SANDY CLAY 2.00m-3.00m BROWNY ORANGE SANDY CLAY 3.00m-5.00m ORANGE GRAVELY CLAY 5.00m-13.00m ORANGE & GREY GRAVELY CLAY 13.00m-15.00m GREY SILTY SAND			Date/time: 2016-05-24 1220 Quality: 43 WLMP: 4.25m DBNS: 4.27m RWL: 6.88mAHD	0.00m-12.00m INNER LINING - CASING = Pvc12.00m-14.00m INNER LINING - SCREEN = Pvc14.00m-15.00m INNER LINING - CASING = Pvc 10.00m-11.00m OUTER LINING - GRAVEL = Bentonite 11.00m-15.00m OUTER LINING - GRAVEL = Gravel	12/04/1996	233	North	-37.98299094	145.1201065
81725	Not Known	0.00m-0.30m SURFACE SOIL 0.30m-3.00m SAND 3.00m-9.10m SANDY CLAY 9.10m-15.20m CLAYEY SAND AND LIGNITE 15.20m-16.80m CONSOLIDATED LIGNITE AND SAND 16.80m-17.10m COARSE SAND AND LIGNITE 17.10m-17.40m FINE SAND AND LIGNITE 17.40m-18.90m MEDIUM COARSE SAND AND LIGNITE 18.90m-22.30m SILT WITH LAYERS OF GREY CLAY 22.30m-23.50m MARINE CLAY 23.50m-24.40m COARSE SAND 24.40m-39.60m MARINE SILT 39.60m-43.90m GREY AND GREEN SANDSTONE					28/04/1983	235	North	-37.95817941	145.1234498
WRK080503	Observation	0.00m-3.00m CLAY 3.00m-12.00m SAND		9.00m-12.00m Sand		0.00m-7.50m OUTER LINING - GRAVEL = Cement 7.50m-8.50m OUTER LINING - GRAVEL = Bentonite 8.50m-12.00m OUTER LINING - GRAVEL = Gravel	17/07/2014	235	North	-37.95858517	145.1248447
81768	Not Known	0.00m-0.50m DARK BROWN SAND 0.50m-1.60m STIFF BROWN CLAY 1.60m-2.00m FIRM YELLOW-BROWN CLAY 2.00m-5.50m STIFF YELLOW-ORANGE CLAY AND FINE SAND 5.50m-8.50m GREY FINE TO COURSE SAND WITH DARK GREY CLAY LENSES		7.80m-8.50m Sand		0.00m-7.80m INNER LINING - CASING = Pvc7.80m-8.50m INNER LINING - SCREEN = Pvc 0.20m-8.50m OUTER LINING - GRAVEL = Gravel	24/09/1985	240	North	-37.95876538	145.1262808
81716	Domestic	0.00m-2.00m TOP SOIL 2.00m-6.00m CLAY 6.00m-7.00m LIGHT CLAY AND SAND 7.00m-8.00m LIGHT SAND 8.00m-10.00m COARSE SAND		7.00m-10.00m Clay		0.00m-7.00m INNER LINING - CASING = Pvc7.00m-10.00m INNER LINING - SCREEN = Pvc	12/06/1983	241	North	-37.97973958	145.1191442
WRK987290	Groundwater Investigation	0.00m-0.70m FILL - GRAVEL 0.70m-1.20m BROWN SAND 1.20m-5.90m CLAYEY SAND 5.90m-7.00m SAND				0.00m-0.40m OUTER LINING - GRAVEL = Cement 0.40m-0.80m OUTER LINING - GRAVEL = Bentonite	16/07/2008	245	North	-37.96156722	145.1289735
81726	Not Known	0.00m-0.30m SURFACE SOIL 0.30m-5.80m SANDY CLAY 5.80m-17.10m CLAYEY SAND 17.10m-17.70m GREY CLAY 17.70m-19.50m SLOPPY GREY SANDY CLAY 19.50m-21.30m STICKY MARINE CLAY 21.30m-21.90m FINE MARINE CLAYEY SAND 21.90m-22.60m FINE MARINE SAND 22.60m-23.80m MARINE SILT					09/05/1983	247	North	-37.9580914	145.1235668
81710	Irrigation	0.00m-1.00m FIRM CLAYEY SAND 1.00m-6.10m VEREY STIFF SANDY CLAY 6.10m-15.20m SOFT CLAYEY SAND 15.20m-26.00m COARSE & FINE SAND 26.00m-29.00m BLUE SILT LIMESTONE PIECES & COARSE SAND 29.00m-30.50m HARD LIMESTONE BROKEN & SOME SAND 30.50m-33.50m MEDIUM HARD BLUE SHALE (CLAYEY) 33.50m-82.50m MEDIUM HARD BLUE SHALE WITH HARD LAYERS OF SANDSTONE 82.50m-152.50m HARD SANDSTONE				0.00m-34.00m INNER LINING - CASING = Steel0.00m-76.50m INNER LINING - CASING = Steel76.50m-152.50m INNER LINING - SCREEN = Steel	12/01/1979	251	North	-37.96050436	145.1290817
WRK093091	Investigation	0.00m-2.20m CLAY 2.20m-4.00m SANDY CLAY				0.00m-1.00m INNER LINING - CASING = Pvc1.00m-4.00m INNER LINING - SCREEN = Pvc 0.00m-0.30m OUTER LINING - GRAVEL = Cement 0.30m-0.70m OUTER LINING - GRAVEL = Bentonite 0.70m-4.00m OUTER LINING - GRAVEL = Gravel	24/03/2016	257	North	-37.95863776	145.1264482
81690	Not Known	0.00m-16.76m GREENY GREY CLAYEY SAND				0.00m-16.76m INNER LINING - CASING = Not Known10.67m-16.76m INNER LINING - SCREEN = Not Known	11/02/1973	274	North	-37.96251055	145.112527
76514	Domestic	0.00m-3.00m STILL BLACK CLAY 3.00m-6.00m YELLOW BROWN SANDY CLAY 6.00m-9.50m YELLOW BROWN LOOSE SAND 9.50m-14.00m YELLOW BROWN SANDY CLAY 14.00m-20.00m YELLOW BROWN LOOSE SAND		12.50m-18.30m Sand		0.00m-12.50m INNER LINING - CASING = Not Known12.50m-18.30m INNER LINING - SCREEN = Not Known40.00m-0.00m OUTER LINING - GRAVEL = Not Known	27/02/1990	275	South East	-38.03126763	145.1406128
WRK955491							10/02/2006	279	North	-37.95699986	145.1158707
81699	Not Known	0.00m-0.30m SURFACE SOIL 0.30m-2.74m SAND 2.74m-9.75m SANDY CLAY 9.75m-23.47m SAND WITH LAYER CLAY 23.47m-47.24m MARINE SILT LITTLE SHELL					05/11/1973	287	North	-37.95701346	145.1181308
WRK992204	Groundwater Investigation	0.00m-0.50m fill 0.50m-5.00m brighton group sands				0.00m-2.00m INNER LINING - CASING = Pvc2.00m-5.00m INNER LINING - SCREEN = Pvc 0.00m-0.20m OUTER LINING - GRAVEL = Cement 0.20m-1.50m OUTER LINING - GRAVEL = Bentonite 1.50m-5.00m OUTER LINING - GRAVEL = Gravel	10/08/2009	291	North West	-37.98273846	145.1122226
WRK071605	Irrigation						02/10/2012	306	North West	-37.97482189	145.1102738
80676	Not Known						01/01/1988	306	North West	-37.97482065	145.1102763
WRK987291	Groundwater Investigation	0.00m-0.30m FILL - GRAVEL 0.30m-4.60m SANDY CLAY 4.60m-6.00m CLAYEY SAND 6.00m-6.50m SAND				0.00m-0.70m OUTER LINING - GRAVEL = Cement 0.70m-1.50m OUTER LINING - GRAVEL = Bentonite 1.50m-6.50m OUTER LINING - GRAVEL = Gravel	14/07/2008	309	North	-37.96047999	145.1297409
WRK039215	Irrigation	0.00m-5.60m STIFF YELLOW/BROWN CLAY 5.60m-10.70m GREY FINE TO MEDIUM GRAINED SAND 10.70m-29.70m YELLOW/GREY FIRM CLAYEY SAND 29.70m-40.02m YELLOW/WHITE VERY LOOSE COARSE GRAINED SAND &		30.00m-39.50m Sand		0.00m-30.00m INNER LINING - CASING = Pvc30.00m-39.50m INNER LINING - SCREEN = Pvc39.50m-40.02m INNER LINING - CASING = Pvc 39.00m-40.02m OUTER LINING - GRAVEL = Gravel	20/02/1990	319	North West	-37.97057463	145.1095882
WRK093090	Investigation	0.00m-2.70m CLAY 2.70m-4.50m SANDY CLAY				0.00m-1.50m INNER LINING - CASING = Pvc1.50m-4.50m INNER LINING - SCREEN = Pvc 0.00m-0.30m OUTER LINING - GRAVEL = Cement 0.30m-1.00m OUTER LINING - GRAVEL = Bentonite 1.00m-4.50m OUTER LINING - GRAVEL = Gravel	24/03/2016	325	North	-37.95800665	145.1264301
WRK967337								336	North West	-37.99393569	145.1165035
WRK967338								336	North West	-37.99393569	145.1165035
WRK967339								336	North West	-37.99393569	145.1165035
WRK981683								353	North	-37.95978133	145.1300091
81736	Domestic	0.00m-0.30m TOP SOIL 0.30m-0.91m WHITE SAND 0.91m-3.61m CLAY 3.61m-7.01m CLAY AND FINE SAND 7.01m-9.71m SHELL GRIT AND SHALE WITH COARSE PARTS 9.71m-11.84m COARSE WATER BEARING CLAY 11.84m-16.15m CLAY SHELL GRIT AND SHALE 16.15m-24.38m SHELL, GRIT AND SHALE		22.86m-24.38m Clay		0.00m-22.86m INNER LINING - CASING = Pvc22.86m-24.38m INNER LINING - SCREEN = Pvc	10/08/1983	363	North	-37.99200758	145.1255494
81781	Not Known	0.00m-3.40m NO RETURNS 3.40m-4.90m SAND FINE/MEDIUM 4.90m-6.40m NO RETURNES 6.40m-11.00m SAND FINE/CLAYEY 11.00m-12.50m SAND FINE/MEDIUM 12.50m-26.20m SAND MEDIUM/COARSE LIGNEOUS 26.20m-32.30m SAND FINE/COARSE GRAVEL 32.30m-33.10m CLAY SANDY 33.10m-36.40m SAND GRAVEL CALCARESUS NODULES 36.40m-36.90m CLAY SILTY 36.90m-41.50m SAND FINE SILTY 41.50m-42.20m SAND MED/COARSE 42.20m-46.00m SAND FINE SILTY CLAYEY 46.00m-47.60m SAND FINE LIMESTONE FRAGMENTS CALCARESUS BANDS		3.00m-33.00m Sand		0.00m-3.00m INNER LINING - CASING = Pvc3.00m-33.00m INNER LINING - SCREEN = Pvc33.00m-47.60m INNER LINING - CASING = Pvc	03/02/1990	363	North	-37.95627047	145.1167838
81811	Not Known						01/01/1988	366	North	-37.96081434	145.1304407
WRK963362	Domestic & Stock						07/11/2005	370	North West	-37.97257152	145.1081913
WRK986702	Domestic & Stock	0.00m-0.10m TOP SOIL 0.10m-7.50m SANDY CLAYS				0.00m-8.00m INNER LINING - CASING = Pvc Class 18 0.00m-5.50m OUTER LINING - GRAVEL = Cement 5.50m-7.50m OUTER LINING - GRAVEL = Bentonite	17/06/2008	371	North	-37.95953037	145.1300951
76558	Not Known						01/01/1988	383	South East	-38.02340158	145.1412907
76462	Agro Industries, Domestic, Stock	0.00m-2.44m BLACK TOPSOIL 2.44m-3.00m GREY CLAY 3.00m-12.19m RED CLAY 12.19m-18.29m GREY SANDY CLAY 18.29m-21.34m COARSE SAND		18.29m-21.34m Sand		0.00m-18.29m INNER LINING - CASING = Pvc18.29m-21.34m INNER LINING - SCREEN = Pvc	27/12/1982	392	South East	-38.02355458	145.1412637
76497	Domestic	0.00m-3.00m SAND		2.20m-3.00m Sand		0.00m-2.20m INNER LINING - CASING = Galvanised Iron2.20m-3.00m INNER LINING - SCREEN = Galvanised Iron	31/12/1984	396	South	-38.04760177	145.1363822
WRK984375								398	North West	-37.97354201	145.1080184
76473	Domestic	0.00m-0.91m BLACK TOP SOIL 0.91m-3.00m YELLOW FINE SAND 3.00m-6.10m COARSE SAND CLEAN		5.44m-6.10m Sand		0.00m-5.44m INNER LINING - CASING = Not Known5.44m-6.10m INNER LINING - SCREEN = Not Known	07/08/1983	403	South	-38.04134676	145.1340911

Station	UseType	DrillersLog	Stratigraphy	Geology	Levels	Construction	CompleteDate	Distance	Direction	Latitude	Longitude
WRK093093	Investigation	0.00m-2.70m CLAY 2.70m-5.00m SANDY CLAY				0.00m-2.00m INNER LINING - CASING = Pvc2.00m-5.00m INNER LINING - SCREEN = Pvc 0.00m-0.30m OUTER LINING - GRAVEL = Cement 0.30m-1.50m OUTER LINING - GRAVEL = Bentonite 1.50m-5.00m OUTER LINING - GRAVEL = Gravel	24/03/2016	407	North	-37.95737939	145.12722
WRK093094	Investigation	0.00m-2.70m CLAY 2.70m-5.00m SANDY CLAY				0.00m-2.00m INNER LINING - CASING = Pvc2.00m-5.00m INNER LINING - SCREEN = Pvc 0.00m-0.30m OUTER LINING - GRAVEL = Cement 0.30m-1.50m OUTER LINING - GRAVEL = Bentonite 1.50m-5.00m OUTER LINING - GRAVEL = Gravel	24/03/2016	412	North	-37.95733417	145.1272097
WRK979611								427	North West	-37.98723311	145.1098415
81662	Domestic						31/12/1970	431	North	-37.95566946	145.1175278
81779	Not Known	0.00m-0.70m SANDY LOAM 0.70m-3.00m GREY CLAYEY SAND 3.00m-10.00m ORANGE SANDS 10.00m-14.00m GREY SANDS 14.00m-17.50m BLACK SANDS		10.50m-16.50m Sand		0.00m-10.50m INNER LINING - CASING = Pvc10.50m-16.50m INNER LINING - SCREEN = Pvc16.50m-17.50m INNER LINING - CASING = Pvc 8.50m-17.50m OUTER LINING - GRAVEL = Not Known	08/12/1988	433	South East	-38.01725052	145.1432455
WRK068226	Observation	0.00m-9.00m CLAY		3.00m-9.00m Clay		0.00m-3.00m INNER LINING - CASING = Pvc3.00m-9.00m INNER LINING - SCREEN = Pvc 0.00m-1.50m OUTER LINING - GRAVEL = Cement 1.50m-2.50m OUTER LINING - GRAVEL = Bentonite 3.50m-9.00m OUTER LINING - GRAVEL = Gravel	02/02/2012	434	North	-37.95769209	145.1289694
WRK980362								434	North	-37.95997831	145.1310626
114432	Groundwater Investigation	0.00m-12.00m SAND GREY / BROWN MEDIUM 12.00m-23.50m COARSE SAND SOME GRAVEL GREY		8.00m-23.50m Sand		-0.50m-8.00m INNER LINING - CASING = Pvc8.00m-23.50m INNER LINING - SCREEN = Pvc 0.00m-6.00m OUTER LINING - GRAVEL = Cement 6.00m-7.00m OUTER LINING - GRAVEL = Bentonite 7.00m-23.00m OUTER LINING - GRAVEL = Gravel	04/08/1992	449	North	-37.9561904	145.1230458
WRK057334	Domestic & Stock	67.00m-68.00m siltstone		61.50m-67.50m Siltstone		0.00m-61.50m INNER LINING - CASING = Pvc61.50m-67.50m INNER LINING - SCREEN = Pvc67.50m-68.00m INNER LINING - CASING = Pvc 45.00m-48.00m OUTER LINING - GRAVEL = Cement 58.00m-60.00m OUTER LINING - GRAVEL = Bentonite 60.00m-61.00m OUTER LINING - GRAVEL = Seal	02/06/2010	457	North	-37.95931117	145.1310454
WRK981217								460	North	-37.95930252	145.1310683
133632	Groundwater Investigation	0.00m-0.90m FILL CLAYEY SILT 0.90m-3.50m SANDY CLAY 3.50m-6.00m CLAYEY SAND					21/01/1998	461	North West	-37.99481471	145.1151146
WRK962793	Groundwater Investigation	0.00m-2.00m DARK BROWN/GREY SAND 2.00m-4.00m ORANGE/BROWN SAND 4.00m-7.00m FINE GREY SAND 7.00m-7.50m COARSE SAND 7.50m-8.50m PALE GREY SANDY SILT 8.50m-12.50m SILTY SAND 12.50m-13.00m BLACK SILTY SAND				0.00m-13.00m INNER LINING - CASING = Pvc	29/09/2003	481	North	-37.95532844	145.1130156
WRK032660	Irrigation	0.00m-0.30m TOPSOIL 0.30m-1.80m DARK GREY CLAY 1.80m-3.50m YELLOW CLAY 3.50m-19.00m YELLOW & GREY CLAY 19.00m-22.00m BLACK SILT 22.00m-25.60m DECOMPOSED BASALT 25.60m-51.00m COROL SHELL & LAYERS OF SANDSTONE 51.00m-56.00m BASALT & HONEYCOMB				-0.50m-26.00m INNER LINING - CASING = Pvc26.00m-51.00m INNER LINING - CASING = Pvc51.00m-56.00m INNER LINING - SCREEN = Pvc	08/07/1998	483	South East	-38.04580663	145.148222
81660	Not Known						31/12/1970	484	North	-37.97012947	145.123442
133633	Groundwater Investigation	0.00m-1.30m FILL SAND & SANDY CLAY 1.30m-6.00m SANDY CLAY					21/01/1998	496	North West	-37.99535871	145.1153286
124426	Groundwater Investigation				Date/time: 1996-09-26 0000 Quality: 47 WLMP: 3.76m DBNS: 2.75m RWL: 27.60mAHD		07/04/1995	510	North	-37.96564242	145.1263219
127109	Groundwater Investigation	0.00m-9.00m BACK FILL FROM TIP 9.00m-16.00m GREY CLAYEY SAND 16.00m-19.00m GREY SILTY CLAY 19.00m-20.00m MUDSTONE 20.00m-30.00m SANDY MARL				0.30m-27.00m INNER LINING - CASING = Pvc27.00m-29.00m INNER LINING - SCREEN = Pvc29.00m-30.00m INNER LINING - CASING = Pvc 25.50m-26.50m OUTER LINING - GRAVEL = Bentonite 26.50m-30.00m OUTER LINING - GRAVEL = Gravel	24/11/1995	513	North	-37.96566942	145.1263329
133634	Groundwater Investigation	0.00m-1.00m FILL FRAVEL & SANDY CLAY 1.00m-5.50m SANDY CLAY 5.50m-6.00m CLAYEY SAND					21/01/1998	519	North West	-37.99516372	145.1144226
81750	Domestic	0.00m-0.50m GREY SANDY LOAM 0.50m-3.00m YELLOW CLAY 3.00m-3.15m SANDY LAYER MEDIUM 3.15m-5.00m WHITE GREY CLAY 5.00m-5.07m THIN ROCK LAYER 5.07m-5.45m COARSE SAND WITH SOME FINE CLAY 5.45m-6.00m GREY CLAY		5.00m-5.45m Sand 5.45m-6.00m Clay		0.00m-5.00m INNER LINING - CASING = Pvc5.00m-5.45m INNER LINING - SCREEN = Pvc5.45m-6.00m INNER LINING - SCREEN = Slotted Pvc	04/06/1984	550	North	-37.97880154	145.1224702
WRK042431	Irrigation	0.00m-4.60m MEDIUM GRAINED SAND 4.60m-5.60m GREY CLAY 5.60m-12.00m ORANGE/BROWN, VERY FINE SANDSTONE 12.00m-47.50m GREY SILT/SOME SHELLS AT DEPTH 47.50m-48.50m GREY SANDSTONE 48.50m-50.00m DARK GREY/SANDY LIMESTONE 50.00m-51.00m LIGHT GREY HARD LIMESTONE 51.00m-53.50m BROWN CLAY 53.50m-54.00m QUARTZ SAND 54.00m-55.00m BROWN CLAY 55.00m-57.00m COARSE SAND CEMENTED PYRITE 57.00m-59.00m LIGHT GREY CLAY 59.00m-59.50m LIGHT GREY SANDSTONE 59.50m-62.00m LIGHT GREY BASALT 62.00m-66.00m COARSE SAND/WOODY 66.00m-67.00m GREY CLAY		59.60m-62.00m Basalt		0.00m-59.60m INNER LINING - CASING = Abs Plastic59.60m-62.00m INNER LINING - SCREEN = Abs Plastic0.00m-41.00m OUTER LINING - GRAVEL = Cement 41.00m-56.30m OUTER LINING - GRAVEL = Bentonite 56.30m-65.70m OUTER LINING - GRAVEL = Gravel	25/11/1997	556	North West	-37.98747073	145.1083666
WRK979015								589	North	-37.96561985	145.1090869
WRK070261	Observation						05/07/2012	589	North West	-37.97713122	145.1081767
WRK070260	Observation						04/07/2012	591	North West	-37.97714887	145.1081535
WRK070259	Observation						03/07/2012	592	North West	-37.9771577	145.1081419
WRK069756	Observation						02/08/2012	593	North	-37.95417826	145.1137849
WRK069757	Observation						02/08/2012	593	North	-37.95418654	145.1137391
WRK070258	Observation						02/07/2012	593	North West	-37.97716652	145.1081302
WRK069758	Observation						03/08/2012	593	North	-37.95417826	145.1137849
WRK069754	Observation	0.00m-5.00m CLAY		2.00m-5.00m Clay		0.00m-2.00m INNER LINING - CASING = Pvc2.00m-5.00m INNER LINING - SCREEN = Pvc 0.00m-1.50m OUTER LINING - GRAVEL = Bentonite 1.50m-5.00m OUTER LINING - GRAVEL = Gravel	02/08/2012	594	North	-37.95417753	145.1137394
WRK069755	Observation						02/08/2012	595	North	-37.95416834	145.1137282
133635	Groundwater Investigation	0.00m-1.50m FILL SANDY LOAM 1.50m-2.00m CLAY 2.00m-6.50m SANDY CLAY					21/01/1998	601	West	-37.99588073	145.1141766
WRK983290								604	West	-38.00432501	145.1029223
133627	Groundwater Investigation	0.00m-0.50m CLAY 0.50m-1.40m FILL CRUSEHD ROCK & SILTSTONE 1.40m-4.00m CLAY		1.00m-4.00m Clay		1.00m-4.00m INNER LINING - SCREEN = Not Known	21/04/1998	611	West	-38.00559492	145.101855
76444	Domestic	0.00m-0.61m BLACK LOAM SAND TOP SOIL 0.61m-2.40m BLACK GREY SAND 2.40m-3.61m GREY COARSE SAND		2.74m-3.61m Sand		0.00m-2.74m INNER LINING - CASING = Pvc2.74m-3.61m INNER LINING - SCREEN = Pvc	09/11/1983	614	South	-38.04464381	145.1317282
WRK047009								616	North West	-37.96792214	145.1076732
WRK080508	Observation	0.00m-1.00m CLAY 1.00m-15.00m FILL 15.00m-20.00m SAND		17.00m-20.00m Sand		0.00m-15.50m OUTER LINING - GRAVEL = Cement 15.50m-16.50m OUTER LINING - GRAVEL = Bentonite 16.50m-20.00m OUTER LINING - GRAVEL = Gravel	17/07/2014	629	North	-37.95625613	145.1302532
WRK980205	Domestic & Stock					0.00m-6.50m INNER LINING - CASING = Pvc6.50m-11.00m INNER LINING - SLOT = Pvc 0.00m-5.00m OUTER LINING - GRAVEL = Cement 5.00m-6.00m OUTER LINING - GRAVEL = Bentonite 6.00m-11.00m OUTER LINING - GRAVEL = Gravel	02/04/2007	632	North	-37.95379577	145.1146596

Station	UseType	DrillersLog	Stratigraphy	Geology	Levels	Construction	CompleteDate	Distance	Direction	Latitude	Longitude
WRK980209	Domestic & Stock					0.00m-23.00m INNER LINING - CASING = Pvc23.00m-26.00m INNER LINING - SLOT = Pvc 0.00m-21.00m OUTER LINING - GRAVEL = Cement 21.00m-22.00m OUTER LINING - GRAVEL = Bentonite 22.00m-26.00m OUTER LINING - GRAVEL = Gravel	05/04/2007	632	North	-37.95379577	145.1146596
WRK980213	Domestic & Stock					0.00m-23.00m INNER LINING - CASING = Pvc23.00m-26.00m INNER LINING - SLOT = Pvc 0.00m-21.00m OUTER LINING - GRAVEL = Cement 21.00m-22.00m OUTER LINING - GRAVEL = Bentonite 22.00m-26.00m OUTER LINING - GRAVEL = Gravel	05/04/2007	632	North	-37.95379577	145.1146596
WRK980210	Domestic & Stock					0.00m-14.00m INNER LINING - CASING = Pvc14.00m-18.00m INNER LINING - SLOT = Pvc 0.00m-11.50m OUTER LINING - GRAVEL = Cement 11.50m-13.00m OUTER LINING - GRAVEL = Bentonite 13.00m-18.00m OUTER LINING - GRAVEL = Gravel	03/04/2007	632	North	-37.95379577	145.1146596
WRK980212	Domestic & Stock					0.00m-14.00m INNER LINING - CASING = Pvc14.00m-18.00m INNER LINING - SLOT = Pvc 0.00m-11.50m OUTER LINING - GRAVEL = Cement 11.50m-13.00m OUTER LINING - GRAVEL = Bentonite 13.00m-18.00m OUTER LINING - GRAVEL = Gravel	03/04/2007	632	North	-37.95379577	145.1146596
WRK980211	Domestic & Stock					0.00m-7.00m INNER LINING - CASING = Pvc7.00m-11.50m INNER LINING - SLOT = Pvc 0.00m-5.50m OUTER LINING - GRAVEL = Cement 5.50m-6.50m OUTER LINING - GRAVEL = Bentonite 6.50m-11.50m OUTER LINING - GRAVEL = Gravel	02/04/2007	632	North	-37.95379577	145.1146596
WRK980208	Domestic & Stock					0.00m-7.00m INNER LINING - CASING = Pvc7.00m-11.50m INNER LINING - SLOT = Pvc 0.00m-5.50m OUTER LINING - GRAVEL = Cement 5.50m-6.50m OUTER LINING - GRAVEL = Bentonite 6.50m-11.50m OUTER LINING - GRAVEL = Gravel	02/04/2007	632	North	-37.95379577	145.1146596
WRK039209	Irrigation	0.00m-0.60m TOP SOIL 0.60m-3.00m SANDY CLAY RED 3.00m-27.40m COARSE SAND AND CLAY 27.40m-36.50m CLAY 36.50m-38.40m PEAT 38.40m-60.96m SANDSTONE		38.40m-60.96m Sandstone		0.00m-38.40m INNER LINING - CASING = Steel38.40m-60.96m INNER LINING - SCREEN = Steel	22/02/1983	632	North	-37.96301833	145.1330027
WRK962789	Groundwater Investigation	0.00m-0.10m GARDEN BED, GRASS & MULCH 0.10m-2.00m FINE BLACK/GREY SAND 2.00m-4.00m FINE SAND 4.00m-5.00m DARK BROWN SAND 5.00m-8.00m PALE SAND 8.00m-11.50m CLAYEY SAND 11.50m-14.00m BROWN SAND				0.00m-14.00m INNER LINING - CASING = Pvc	29/09/2003	633	North	-37.95387297	145.1132919
WRK093092	Investigation	0.00m-2.20m CLAY 2.20m-4.00m SANDY CLAY				0.00m-1.00m INNER LINING - CASING = Pvc1.00m-4.00m INNER LINING - SCREEN = Pvc 0.00m-0.30m OUTER LINING - GRAVEL = Cement 0.30m-0.70m OUTER LINING - GRAVEL = Bentonite 0.70m-4.00m OUTER LINING - GRAVEL = Gravel	24/03/2016	643	North	-37.95537607	145.1281814
WRK041780	Dairy							655	North	-37.96714883	145.1250024
WRK985144								664	North	-37.97469862	145.1273536
WRK981666								672	North	-37.96527283	145.1082421
81722	Domestic	0.00m-1.20m TOP SOIL 1.20m-8.00m CLAY 8.00m-9.00m RIVER SAND 9.00m-0.00m ROCK (SANDSTONE)		6.00m-9.00m Sand		0.00m-6.00m INNER LINING - CASING = Pvc6.00m-9.00m INNER LINING - SCREEN = Pvc 0.00m-1.00m OUTER LINING - GRAVEL = Cement 0.30m-0.00m OUTER LINING - GRAVEL = Seal	28/02/1983	683	North	-37.98181552	145.1250112
WRK080507	Observation	0.00m-3.00m CLAY 3.00m-10.00m CLAY/SAND		7.00m-10.00m Sand		0.00m-5.50m OUTER LINING - GRAVEL = Cement 5.50m-6.50m OUTER LINING - GRAVEL = Bentonite 6.50m-10.00m OUTER LINING - GRAVEL = Gravel	17/07/2014	691	North	-37.95488546	145.127932
81799	Domestic, Stock						01/01/1988	694	North	-37.96740843	145.1257199
WRK055245	Observation					0.00m-2.00m INNER LINING - CASING = Pvc2.00m-8.00m INNER LINING - SCREEN = Pvc 0.00m-1.50m OUTER LINING - GRAVEL = Bentonite 1.50m-8.00m OUTER LINING - GRAVEL = Gravel	23/02/2010	698	West	-38.0009326	145.1138744
81754	Not Known	0.00m-2.00m FINE BLACK SAND 2.00m-8.00m FINE/MED MUDDY ORANGE SAND 8.00m-8.10m LIGNITE 8.10m-30.00m FINE MUDDY GREY SAND					10/05/1983	702	North	-37.96692039	145.1290329
WRK080502	Observation	0.00m-4.00m CLAY 4.00m-35.00m CLAY/SAND 35.00m-42.00m SILTSTONE		39.00m-42.00m Siltstone		0.00m-39.00m INNER LINING - CASING = Pvc Class 90.00m-37.00m OUTER LINING - GRAVEL = Cement 37.00m-38.00m OUTER LINING - GRAVEL = Bentonite 38.00m-42.00m OUTER LINING - GRAVEL = Gravel	17/07/2014	705	North	-37.95474944	145.1278786
WRK032549	Irrigation	0.00m-4.00m TOP SOIL AND CLAY 4.00m-43.00m SAND 43.00m-50.00m SANDSTONE AND SLATE 50.00m-55.00m SANDSTONE 55.00m-73.00m GRAVEL AND COAL AND SEA SHELLS 73.00m-85.00m SANDSTONE				0.00m-43.00m INNER LINING - CASING = Steel0.00m-74.00m INNER LINING - CASING = Steel60.00m-85.00m INNER LINING - SCREEN = Steel	03/10/1997	711	North	-37.97312189	145.1279402
WRK987217								718	North	-37.97121193	145.1274081
81791	Not Known	0.00m-0.50m SANDY LOAM 0.50m-1.50m FINE WHITE SAND 1.50m-2.00m DARK BROWN SANDY CLAY 2.00m-15.50m LIGHT GREY & YELLOW SANDY CLAY 15.50m-19.00m DIRTY DRIFT SAND 19.00m-36.00m GREEN MARINE SILT 36.00m-37.00m BROWN COAL 37.00m-44.00m GREEN SILT & SHELL 44.00m-45.00m LIGNIOUS CLAY 45.00m-59.00m SOFT MUDSTONE					05/09/1990	719	North	-37.97348344	145.12807
WRK039213	Miscellaneous	0.00m-0.30m TOP SOIL 0.30m-2.40m GREY CLAY & FINE SAND 2.40m-3.60m YELLOW CLAY 3.60m-6.60m CLAY & FINE SAND 6.60m-12.10m COARSE SAND & PET 12.10m-24.00m FINE WHITE SAND 24.00m-33.40m SAND & CLAY 33.40m-40.00m FINE SAND 40.00m-43.50m GREY SANDSTONE 43.50m-76.00m BLUE/GREY SAND,STONE WITH FRACTURES				0.00m-41.00m INNER LINING - CASING = Mild Steel42.50m-68.00m INNER LINING - SCREEN = Mild Steel	23/10/1989	760	North	-37.95389535	145.1260627
127482	Groundwater Investigation, Observation, State Observation Network	0.00m-1.00m YELLOW AND GREY CLAY 1.00m-8.00m YELLOW SANDY CLAY 8.00m-15.00m SANDY MARL			Date/time: 2016-05-24 0928 Quality: 43 WLMP: 7.58m DBNS: 7.60m RWL: 11.04mAHD	0.00m-12.00m INNER LINING - CASING = Pvc12.00m-14.00m INNER LINING - SCREEN = Pvc14.00m-15.00m INNER LINING - CASING = Pvc 11.00m-12.00m OUTER LINING - GRAVEL = Bentonite 12.00m-15.00m OUTER LINING - GRAVEL = Gravel	16/04/1996	771	North West	-37.96761846	145.1059501
WRK057581	Irrigation	0.00m-2.50m Sand 2.50m-3.20m sandy Clay 3.20m-6.50m Grey Clay 6.50m-13.30m Brown Sandy Clay 13.30m-18.50m Blue Clay 18.50m-20.50m Fine Sand 20.50m-29.50m Blue Clay 29.50m-32.00m Sand 32.00m-33.00m Blue Clay					23/09/2010	790	North	-37.98761409	145.1291546
WRK962788	Groundwater Investigation	0.00m-4.00m FINE GRAIN SAND 4.00m-5.50m FINE LIGHT GREY SAND 5.50m-6.00m LIGHT GREY CLAYEY SAND 6.00m-11.00m FINE PALE GREY SAND 11.00m-13.00m GREY SAND 13.00m-16.00m GRAVEL					25/09/2003	792	North	-37.95240767	145.1168917
81755	Domestic	0.00m-0.30m TOP SOIL 0.30m-7.62m CLAY 7.62m-12.80m SAND AND CLAY		11.58m-12.80m Sand		0.00m-11.58m INNER LINING - CASING = Pvc11.58m-12.80m INNER LINING - SCREEN = Pvc	01/06/1983	792	North	-37.97466744	145.128837
81782	Not Known	0.00m-1.80m NO RETURNS 1.80m-4.90m SAND FINE SILTY ORANGE 4.90m-6.40m NO RETURNS 6.40m-10.20m SAND COARSE WHITE SILTY 10.20m-20.70m SAND MED TO COARSE BROWN 20.70m-20.80m SAND MED TO COARSE GRAVEL GREY 20.80m-26.80m SAND GINE SILTY GREY 26.80m-27.30m GRAVEL GREY 27.30m-28.20m SAND MED SILTY GREY/GREEN 28.20m-28.80m GRAVEL/SAND MED TO COARSE 28.80m-29.30m CLAY SILTY GREEN 29.30m-30.80m SAND FINE TO COARSE GREEN 30.80m-31.40m SAND MED CLAYEY GREEN 31.40m-33.80m SAND COARSE MINOR GRAVEL 33.80m-41.50m SILT SAND CLAY CALCASEOUS BANDS CLAY NODULES		8.00m-33.00m Sand		0.00m-8.00m INNER LINING - CASING = Pvc8.00m-33.00m INNER LINING - SCREEN = Pvc33.00m-41.50m INNER LINING - CASING = Pvc	06/02/1990	796	North	-37.95252742	145.1193827
81808	Not Known						01/01/1988	800	North	-37.98420451	145.1279112

Station	UseType	DrillersLog	Stratigraphy	Geology	Levels	Construction	CompleteDate	Distance	Direction	Latitude	Longitude
81738	Domestic	0.00m-1.50m GREY LOAM AND SAND 1.50m-3.00m GREY FIRM SAND 3.00m-4.52m GREY FINE SAND AND CLAY 4.52m-6.10m GREY SAND MEDIUM COARSE 6.10m-7.62m GREY COARSE SAND 7.62m-9.10m YELLOW CLAY SOME GRIT 9.10m-10.62m FINE SAND AND CLAY 10.62m-11.30m MEDIUM FINE SAND 11.30m-12.70m GREY MEDIUM COARSE SAND 12.70m-13.70m GREY MEDIUM CORASE SAND SOME CLAY 13.70m-15.20m COARSE GREY SAND WITH CLAY 15.20m-16.70m YELLOW CLAY FINE SAND 16.70m-19.81m COARSE GREY SAND		7.62m-18.50m Clay 18.50m-19.81m Sand		0.00m-7.62m INNER LINING - CASING = Pvc7.62m-18.50m INNER LINING - SCREEN = Pvc18.50m-19.81m INNER LINING - SCREEN = Slotted Pvc	14/09/1983	804	North	-37.97655146	145.128333
WRK080505	Observation	0.00m-4.50m CLAY 4.50m-6.70m CLAY/SAND 6.70m-10.00m SAND		7.00m-10.00m Sand		0.00m-0.30m OUTER LINING - GRAVEL = Cement 0.30m-5.50m OUTER LINING - GRAVEL = Bentonite 5.50m-10.00m OUTER LINING - GRAVEL = Gravel	03/07/2014	807	North	-37.95481992	145.1311774
WRK080504	Observation	0.00m-4.50m CLAY 4.50m-6.70m CLAY/SAND 6.70m-10.00m SAND		7.00m-10.00m Sand		0.00m-0.30m OUTER LINING - GRAVEL = Cement 0.30m-4.50m OUTER LINING - GRAVEL = Bentonite 4.50m-5.50m OUTER LINING - GRAVEL = Bentonite 5.50m-10.00m OUTER LINING - GRAVEL = Gravel	03/07/2014	807	North	-37.95481992	145.1311774
WRK072970	OBIN	0.00m-3.00m SILTY SAND 3.00m-6.00m SAND M=C GRAINED LIGHT GREY SOME QUARTZ WATER INFLOW 6.00m-17.00m SAND GREY SOME DARK BROWN SILTS				0.00m-13.00m INNER LINING - CASING = Pvc13.00m-17.00m INNER LINING - SCREEN = Pvc 0.50m-10.50m OUTER LINING - GRAVEL = Cement 10.50m-12.50m OUTER LINING - GRAVEL = Bentonite 12.50m-17.00m OUTER LINING - GRAVEL = Gravel	08/04/2013	810	North	-37.95306459	145.124507
WRK981862								817	North	-37.97802569	145.1274626
WRK039206	Irrigation						31/12/1970	820	North	-37.97868149	145.1268561
WRK042465	Irrigation						31/12/1970	837	North	-37.95204649	145.1129768
81674	Not Known	0.00m-0.30m SURFACE SOIL 0.30m-1.52m CLAY 1.52m-3.35m SANDY CLAY 3.35m-6.10m SLOPPY CLAYEY SAND 6.10m-7.62m CLAY MOTTLEY 7.62m-10.67m BROWN CLAYEY SAND 10.67m-11.28m BLACK CLAY 11.28m-17.07m MARINE STICKY SAND CLAY 17.07m-27.32m MARINE SAND CLAY SILT 27.32m-29.26m BROWN COAL CLAY 29.26m-38.71m DARK MARINE CLAY LITTLE SHELL 38.71m-39.32m SHELL MARINE CLAY WITH FEW PEBBLES 39.32m-40.23m SILT BROWN CLAY MUDSTONE WITH THIS LAYERS SANDSTONE 40.23m-50.90m SANDSTONE					06/01/1970	842	North	-37.96784238	145.1303759
81733	Not Known	0.00m-0.35m TOP SANDY LOAM 0.35m-12.19m GREEN AND YELLOW CLAY 12.19m-13.00m BROWN WATER BEARING SANDY CLAY 13.00m-21.34m SOFT SANDY CLAY 21.34m-24.60m WATER BEARING GREY SANDY CLAY 24.60m-39.49m MEDIUM HARD SANDY CLAY		24.38m-39.49m Clay		0.00m-24.38m INNER LINING - CASING = Galvanised Iron24.38m-39.49m INNER LINING - SCREEN = Galvanised Iron	20/02/1983	848	North West	-37.96183165	145.1038931
81717	Domestic, Stock	0.00m-1.00m SAND BROWN 1.00m-1.80m SAND GREY 1.80m-3.00m CEMENTED FERRIGINOUS PIECES 3.00m-7.00m CLAYEY SAND 7.00m-8.00m GRAVEL 8.00m-10.00m SANDY CLAY 10.00m-11.00m COFFEE ROCK 11.00m-15.00m SILT GRAVEL AND BLACK SAND 15.00m-15.50m CLAYEY SAND 15.50m-16.20m GRAVEL 16.20m-0.00m ROCK		12.00m-16.20m Silt		0.00m-12.00m INNER LINING - CASING = Pvc12.00m-16.20m INNER LINING - SCREEN = Pvc 0.00m-2.00m OUTER LINING - GRAVEL = Cement	13/08/1981	848	North	-37.97413743	145.129533
WRK096850	Irrigation	0.00m-1.00m BROWN TOP SOIL 1.00m-9.00m YELLOW SAND 9.00m-11.00m LIGNITE 11.00m-12.00m SAND 12.00m-27.00m BROWN SAND 27.00m-30.00m CLAYED SAND 30.00m-40.00m MARINE SILTS		15.00m-27.00m Sand		0.00m-15.00m INNER LINING - CASING = Pvc15.00m-27.00m INNER LINING - SLOT = Pvc 0.00m-5.00m OUTER LINING - GRAVEL = Cement 13.00m-14.00m OUTER LINING - GRAVEL = Bentonite 14.00m-27.00m OUTER LINING - GRAVEL = Gravel 27.00m-40.00m OUTER LINING - GRAVEL = Packer	13/12/2016	852	North	-37.95191603	145.1129846
80524	Not Known	0.00m-1.00m TOP SOIL 1.00m-8.00m GREY AND ORANGE CLAY 8.00m-9.00m BROWN MED COARSE SAND 9.00m-14.00m BROWN FINE/MED/COARSE SAND AND LIGNETIC SAND 14.00m-20.00m SANDY GREY AND ORANGE CLAY 20.00m-45.00m GREEN SILT AND LIMESTONE LAYERS 45.00m-46.00m DARK GREY SILTY CLAY 46.00m-51.00m GREEN SILT 51.00m-57.00m BROWN AND GREY CLAY AND WOOD 57.00m-59.00m COAL 59.00m-63.50m GREEN SILT AND GREY CLAY 63.50m-64.20m GRANODORITE					29/09/1983	862	North	-37.9519605	145.1121138
81731	Not Known	0.00m-7.62m FINE BLUE CLAY 7.62m-11.27m FINE ORANGE CLAY 11.27m-44.80m MED/COARSE SILTY SAND 44.80m-52.70m SILTY SILURIAN CLAY 52.70m-122.00m HARD SANDSTONE		54.00m-122.00m Sandstone		0.00m-54.00m INNER LINING - CASING = Steel54.00m-122.00m INNER LINING - SCREEN = Steel	16/02/1983	862	West	-38.00093687	145.1035698
WRK042486	Irrigation	0.00m-0.30m TOP SOIL 0.30m-6.00m CLAY 6.00m-14.00m SANDY CLAY 14.00m-26.00m MARL 26.00m-39.00m LIMESTONE AND CLAY 39.00m-43.00m MARL 43.00m-80.00m SHALE 80.00m-181.00m VERY HARD SHALE		110.00m-181.00m Shale		0.00m-63.00m INNER LINING - CASING = Pvc63.00m-110.00m INNER LINING - CASING = Pvc10.00m-15.00m OUTER LINING - GRAVEL = Cement 15.00m-62.50m OUTER LINING - GRAVEL = Bentonite 62.50m-63.00m OUTER LINING - GRAVEL = Seal	06/03/2004	873	North West	-37.96402716	145.1047567
81780	Not Known	0.00m-6.10m NO RETURNS 6.10m-9.10m CLAY 9.10m-11.40m SAND 11.40m-15.20m SAND LIGNEOUS NODULES 15.20m-16.80m SAND MINOR GRAVEL 16.80m-18.30m NO RETURNS 18.30m-22.10m SAND MINOR GRAVEL 22.10m-22.90m SAND 22.90m-24.40m NO RETURNS 24.40m-29.70m SAND MINOR GRAVEL 29.70m-30.50m CLAY 30.50m-36.60m SAND 36.60m-41.20m SAND CLAYEY/SILTY		7.70m-28.70m Sand		0.00m-7.70m INNER LINING - CASING = Pvc7.70m-28.70m INNER LINING - SCREEN = Pvc28.70m-41.20m INNER LINING - CASING = Pvc	31/01/1990	901	North	-37.95137047	145.1146328
WRK963468	Domestic & Stock	0.00m-4.50m CLAY 4.50m-9.50m VERY FINE SAND, CLAY & SLIME				-0.30m-2.00m INNER LINING - CASING = Pvc2.00m-9.50m INNER LINING - SCREEN = Stainless Steel	05/03/2004	902	West	-38.00554913	145.0983693
127111	Groundwater Investigation	0.00m-2.00m FINE GREY SAND 2.00m-4.20m BROWN AND GREY CLAY 4.20m-7.20m YELLOW AND GREY SANDY CLAY 7.20m-10.20m FINE GREY SAND 10.20m-10.50m DARK GREY CLAY			Date/time: 1996-10-07 0000 Quality: 47 WLMP: 5.47m DBNS: 5.54m RWL: 27.40mAHD	0.00m-7.50m INNER LINING - CASING = Pvc7.50m-9.50m INNER LINING - SCREEN = Pvc9.50m-10.50m INNER LINING - CASING = Pvc 6.00m-7.00m OUTER LINING - GRAVEL = Bentonite 7.00m-10.50m OUTER LINING - GRAVEL = Gravel	30/11/1995	905	North	-37.95220353	145.1098309
127110	Groundwater Investigation	0.00m-2.00m FINE GREY SAND 2.00m-4.00m BROWN AND GREY SAND 4.00m-7.00m YELLOW AND GREY SANDY CLAY 7.00m-10.20m FINE GREY SAND 10.20m-11.00m DARK GREY CLAY 11.00m-19.00m FINE SAND 19.00m-23.00m FINE SAND AND GRAVEL 23.00m-25.00m FINE CLAYEY SAND 25.00m-30.00m SANDY CLAY			Date/time: 1996-10-07 0000 Quality: 47 WLMP: 8.31m DBNS: 8.35m RWL: 24.59mAHD	0.00m-17.00m INNER LINING - CASING = Pvc17.00m-19.00m INNER LINING - SCREEN = Pvc19.00m-20.00m INNER LINING - CASING = Pvc 15.50m-16.50m OUTER LINING - GRAVEL = Bentonite 16.50m-20.00m OUTER LINING - GRAVEL = Gravel	30/11/1995	908	North	-37.95219353	145.1097859
WRK962895								919	West	-38.00625297	145.097966
144513	Groundwater Investigation	0.00m-0.30m FILL & SAND 0.30m-1.00m SAND WITH CLAY 1.00m-9.00m SILTY SAND WITH CLAY 9.00m-18.50m SAND WITH ORANGE BROWN CLAY 18.50m-23.00m SILTY SAND MEDIUM TO COARSE SAND 23.00m-29.00m SANDY SILT, FINE SAND, DARK GREY SILT, CLEAR QUARTZ SAND 29.00m-35.00m SILTY SAND MEDIUM TO COARSE 35.00m-43.60m SANDY SILT, FINE SAND, GREY TO GREEN CLAY 43.60m-51.60m SILTSTONE MEDIUM STRENGTH				0.00m-45.60m INNER LINING - CASING = Pvc Class 1845.60m-51.60m INNER LINING - SCREEN = Pvc Class 18	13/02/1996	925	North	-37.95208535	145.1249827
81721	Stock	0.00m-0.35m TOP SANDY LOAM 0.35m-3.00m GREY CLAY 3.00m-7.00m BROWN SOFT CLAY 7.00m-9.50m GREEN CLAY 9.50m-16.20m HARD BROWN SANDY COAL CLAY 16.20m-21.00m WATER BEARING HARD AND MEDIUM HARD SANDSTONE 21.00m-27.00m SOFT SANDSTONE 27.00m-30.00m VERY SOFT GREEN SANDY CLAY 30.00m-33.00m WATER BEARING GRAVELY SOFT CLAY		29.50m-31.20m Sandstone		0.00m-29.50m INNER LINING - CASING = Not Known29.50m-31.20m INNER LINING - SCREEN = Not Known	05/01/1983	929	North West	-37.96036965	145.1026791
144515	Groundwater Investigation	0.00m-0.30m SILTY SAND, FINE TO MEDIUM SAND 0.30m-1.60m SANDY CLAY FINE TO COARSE SAND 1.60m-4.80m SILTY SAND WITH CLAY, FINE TO COARSE SAND, PALE GREY 4.80m-18.00m SAND FINE TO COARSE 18.00m-20.50m SILTY SAND, COARSE SAND, DARK GREY BROWN SILT, CLEAR TO PALE				0.00m-14.50m INNER LINING - CASING = Pvc Class 1814.50m-20.50m INNER LINING - SCREEN = Pvc Class 18	12/02/1996	948	North	-37.95233133	145.1268766

Station	UseType	DrillersLog	Stratigraphy	Geology	Levels	Construction	CompleteDate	Distance	Direction	Latitude	Longitude
144514	Groundwater Investigation	0.00m-2.00m CLAYEY SAND 2.00m-5.00m SILTY SAND FINE TO COARSE SAND 5.00m-21.00m SAND WITH SILT MEDIUM TO COARSE 21.00m-23.00m SILTY SAND FINE TO MEDIUM SAND, DARK GREY SILT 23.00m-26.00m SANDY SILT DARK GREY 26.00m-38.00m SILTY SAND FINE TO COARSE SAND				0.00m-32.00m INNER LINING - CASING = Pvc Class 1832.00m-38.00m INNER LINING - SCREEN = Pvc Class 18	07/02/1996	956	North	-37.95252832	145.1284536
81763	Domestic	0.00m-0.25m TOP SOIL 0.25m-0.75m ORANGE SAND 0.75m-6.00m ORANGE CLAY 6.00m-7.00m GREY CLAY 7.00m-8.00m ORANGE SANDY CLAY 8.00m-9.15m IRON STONE		8.95m-9.15m Ironstone		0.00m-8.95m INNER LINING - CASING = Galvanised Iron8.95m-9.15m INNER LINING - SCREEN = Galvanised Iron	12/11/1982	964	North	-37.97890047	145.1287291
WRK056513	Observation	0.00m-0.30m topsoil 0.30m-6.00m sand		0.00m-3.00m Sand 3.00m-6.00m Sand		0.00m-3.00m INNER LINING - CASING = Pvc3.00m-6.00m INNER LINING - SCREEN = Pvc 0.00m-1.00m OUTER LINING - GRAVEL = Cement 1.00m-2.50m OUTER LINING - GRAVEL = Bentonite 2.50m-6.00m OUTER LINING - GRAVEL = Gravel	29/04/2010	964	South	-38.05154594	145.1321663
81797	Groundwater Investigation	0.00m-38.00m BROWN & GREY SAND 38.00m-40.00m GREY SILTSTONE			Date/time: 1996-10-04 0000 Quality: 47 WLMP: 6.15m DBNS: RWL:	0.00m-3.00m INNER LINING - CASING = Pvc3.00m-40.00m INNER LINING - SCREEN = Pvc	19/09/1990	965	North	-37.95249632	145.1287166
116136	Groundwater Investigation	0.00m-1.70m FILL 1.70m-7.00m SAND 7.00m-8.00m SILTY SAND				0.00m-2.50m INNER LINING - CASING = Pvc2.50m-8.00m INNER LINING - SCREEN = Pvc 2.30m-3.00m OUTER LINING - GRAVEL = Bentonite 3.00m-8.00m OUTER LINING - GRAVEL = Gravel	22/02/1991	970	South	-38.05163484	145.1321773
81772	Not Known					0.00m-95.80m INNER LINING - CASING = Galvanised Iron96.00m-107.20m INNER LINING - SCREEN = Galvanised Iron	27/03/1987	974	West	-38.00178292	145.1001309
133612	Irrigation	0.00m-52.00m SILTY SANDS & CLAYEY MARLS SOME FILLING ENCOUNTERED AT 5-9 M 52.00m-150.00m FRIM GREY MUDSTONES		52.00m-150.00m Mudstone		0.30m-52.00m INNER LINING - CASING = Steel52.00m-150.00m INNER LINING - SCREEN = Steel 0.00m-52.00m OUTER LINING - GRAVEL = Cement	24/11/1997	980	North West	-37.96606767	145.1039552
81661	Domestic						31/12/1970	985	North	-37.95068748	145.1130798
81783	Not Known	0.00m-6.40m NO RETURNS 6.40m-9.50m SILT SANDY 9.50m-14.00m SAND FINE/MEDIUM 14.00m-14.90m SAND FINE/COARSE 14.90m-22.40m SAND FINE/COARSE 22.40m-23.60m SAND COARSE MINOR GRAVEL 23.60m-33.90m SAND FINE/COARSE MIN GRAVEL 33.90m-44.50m SAND FINE/MED 44.50m-47.60m SILT CLAY CALCAREOUS BANDS		3.00m-36.00m Sand		0.00m-3.00m INNER LINING - CASING = Pvc3.00m-36.00m INNER LINING - SCREEN = Pvc36.00m-47.60m INNER LINING - CASING = Pvc	09/02/1990	986	North	-37.95071342	145.1186327
81794	Groundwater Investigation	0.00m-33.00m GREY & BROWN SAND 33.00m-34.10m GREY SILTSTONE				0.00m-3.00m INNER LINING - CASING = Pvc3.00m-34.10m INNER LINING - SCREEN = Pvc	20/08/1990	995	North	-37.95134236	145.1241937
WRK095031	Investigation	0.00m-0.90m CONCRETE AND SANDY CLAY 0.90m-2.70m SILTY SANDY CLAY 2.70m-4.00m CLAYEY SAND AND SOME GRAVEL BANDS		1.50m-4.00m Sand		0.00m-1.50m INNER LINING - CASING = Pvc1.50m-4.00m INNER LINING - SCREEN = Pvc 0.00m-0.30m OUTER LINING - GRAVEL = Cement 0.30m-1.00m OUTER LINING - GRAVEL = Bentonite 1.00m-4.00m OUTER LINING - GRAVEL = Gravel	12/07/2016	1000	West	-38.00059039	145.1013628
WRK987435								1003	West	-38.00060382	145.1012872
WRK095027	Investigation	0.00m-0.90m CONCRETE AND SANDY CLAY 0.90m-2.70m SILTY SANDY CLAY 2.70m-4.00m CLAYEYE SAND AND SOME GRAVEL BANDS		1.50m-4.00m Sand		0.00m-1.50m INNER LINING - CASING = Pvc1.50m-4.00m INNER LINING - SCREEN = Pvc 0.00m-0.30m OUTER LINING - GRAVEL = Cement 0.30m-1.00m OUTER LINING - GRAVEL = Bentonite 1.00m-4.00m OUTER LINING - GRAVEL = Gravel	12/07/2016	1007	West	-38.00063212	145.1011567
WRK095028	Investigation	0.00m-0.90m CONCRETE AND SANDY CLAY 0.90m-2.70m SILTY SANDY CLAY 2.70m-4.00m CLAYEY SAND AND SOME GRAVEL BANDS		1.50m-4.00m Sand		0.00m-1.50m INNER LINING - CASING = Pvc1.50m-4.00m INNER LINING - SCREEN = Pvc 0.00m-0.30m OUTER LINING - GRAVEL = Cement 0.30m-1.00m OUTER LINING - GRAVEL = Bentonite 1.00m-4.00m OUTER LINING - GRAVEL = Gravel	12/07/2016	1011	West	-38.00058708	145.1011579
WRK081288	Observation	0.00m-0.30m Top soil 0.30m-20.50m SANDS& clay 20.50m-47.00m MARL& coal 47.00m-50.00m volcanic 50.00m-63.00m BASALT				0.00m-51.00m INNER LINING - CASING = Pvc 0.00m-51.00m OUTER LINING - GRAVEL = Cement	12/10/2015	1016	South East	-38.05150208	145.1502716
81420	Observation	0.00m-1.50m SAND 1.50m-4.60m SANDY CLAY 4.60m-9.10m SAND 9.10m-10.70m DARK CLAY COAL 10.70m-13.70m SANDY CLAY 13.70m-14.30m BAND BLACK COAL 14.30m-18.30m SAND SOME COARSE GRAVEL 18.30m-25.30m GREEN SILTY CLAY 25.30m-27.40m COURSE GRAVEL CLAY 27.40m-29.60m SILTY SAND 29.60m-33.20m HARD BAND STONE 33.20m-44.80m FINE SILTY SANDS 44.80m-45.40m BAND HARD STONE 45.40m-47.20m GREEN DIRTY MARL SAND 47.20m-48.80m SILTY CLAY 48.80m-49.40m BAND OF HARD STONE 49.40m-50.00m GREEN CLAY 50.00m-50.60m STONE 50.60m-56.40m BROWN CLAY 56.40m-58.20m DECOM CLAY COAL 58.20m-60.96m MUDSTONE			Date/time: 1975-10-22 0000 Quality: 47 WLMP: 6.33m DBNS: 6.30m RWL: 27.34mAHD	0.00m-60.96m INNER LINING - CASING = Pvc	31/01/1973	1019	North	-37.95171454	145.1080229
WRK095029	Investigation	0.00m-0.90m CONCRETE AND SANDY CLAY 0.90m-2.70m SILTY SANDY CLAY 2.70m-4.00m CLAYEY SAND AND SOME GRAVEL BANDS		1.50m-4.00m Sand		0.00m-1.50m INNER LINING - CASING = Pvc1.50m-4.00m INNER LINING - SCREEN = Pvc 0.00m-0.30m OUTER LINING - GRAVEL = Cement 0.30m-1.00m OUTER LINING - GRAVEL = Bentonite 1.00m-4.00m OUTER LINING - GRAVEL = Gravel	12/07/2016	1020	West	-38.00040894	145.1012877
81806	Not Known						01/01/1988	1022	North	-37.95281328	145.1316676
WRK095026	Investigation	0.00m-0.90m CONCRETE AND SANDY CLAY 0.90m-2.70m SILTY SANDY CLAY 2.70m-4.00m CLAYEY SAND AND SOME GRAVEL BANDS		1.50m-4.00m Sand		0.00m-1.50m INNER LINING - CASING = Pvc1.50m-4.00m INNER LINING - SCREEN = Pvc 0.00m-0.30m OUTER LINING - GRAVEL = Cement 0.30m-1.00m OUTER LINING - GRAVEL = Bentonite 1.00m-4.00m OUTER LINING - GRAVEL = Gravel	12/07/2016	1025	West	-38.00059186	145.1008958
81767	Domestic	0.00m-0.30m SURFACE SOIL 0.30m-0.60m GREY SAND 0.60m-4.20m CLAY 4.20m-14.00m SANDY CLAY 14.00m-15.80m SLOPPY CLAYEY SAND 15.80m-17.90m CLAYEY SAND WITH PIECES OF IRONSTONE		15.80m-17.90m Sand		0.00m-15.80m INNER LINING - CASING = Pvc15.80m-17.90m INNER LINING - SCREEN = Pvc 4.50m-17.90m OUTER LINING - GRAVEL = Gravel	01/09/1983	1025	North	-37.98224448	145.1293271
133628	Groundwater Investigation	0.00m-0.80m SILT 0.80m-2.00m SILTY CLAY 2.00m-4.00m SILTY SANDY CLAY		1.00m-4.00m Clay		1.00m-4.00m INNER LINING - SCREEN = Not Known	21/04/1998	1028	West	-38.00444096	145.097329
81739	Domestic	0.00m-1.50m GREY SANDY LOAM 1.50m-4.52m YELLOW CLAY 4.52m-9.10m YELLOW ORANGE CLAY 9.10m-10.60m MEDIUM SAND AND MEDIUM COARSE GRAVEL 10.60m-12.10m YELLOW CLAY 12.10m-15.20m YELLOW CLAY, COARSE GRAVEL 15.20m-18.29m GREEN CLAY, SOME GRAVEL 18.29m-19.51m GREEN CLAY - GRAVEL		6.40m-18.00m Clay 18.50m-19.51m Clay		0.00m-6.40m INNER LINING - CASING = Pvc6.40m-18.00m INNER LINING - SCREEN = Pvc18.00m-18.50m INNER LINING - CASING = Pvc18.50m-19.51m INNER LINING - SCREEN = Pvc	13/12/1983	1029	North	-37.97435041	145.131577
WRK982968								1033	South East	-38.01012637	145.1400065
WRK095030	Investigation	0.00m-0.90m CONCRETE AND SANDY CLAY 0.90m-2.70m SILTY SANDY CLAY 2.70m-4.00m CLAYEY SAND AND SOME GRAVEL BANDS		1.50m-4.00m Sand		0.00m-1.50m INNER LINING - CASING = Pvc1.50m-4.00m INNER LINING - SCREEN = Pvc 0.00m-0.30m OUTER LINING - GRAVEL = Cement 0.30m-1.00m OUTER LINING - GRAVEL = Bentonite 1.00m-4.00m OUTER LINING - GRAVEL = Gravel	12/07/2016	1038	West	-38.0003685	145.1010155
81761	Domestic, Stock	0.00m-1.00m FILL BRICK RUBBLE 1.00m-3.00m SAND YELLOW 3.00m-6.00m SANDY CLAY 6.00m-9.00m CLAY 9.00m-13.50m SAND 13.50m-0.00m BEDROCK		12.00m-13.50m Sand		0.00m-12.00m INNER LINING - CASING = Pvc12.00m-13.50m INNER LINING - SCREEN = Pvc	31/12/1983	1053	North	-37.98243347	145.1298921
WRK072380	Observation	0.00m-0.40m FILLbuilding ruble/clay 0.40m-0.80m DArk peaty clay 0.80m-3.00m Mottled silty clay 3.00m-5.00m SANDy clay/silt 5.00m-6.00m wet sand & yellow clay		1.50m-6.00m Clay		0.00m-1.50m INNER LINING - CASING = Pvc1.50m-6.00m INNER LINING - SCREEN = Pvc 0.00m-0.50m OUTER LINING - GRAVEL = Cement 0.50m-1.40m OUTER LINING - GRAVEL = Bentonite 1.40m-6.00m OUTER LINING - GRAVEL = Gravel	27/05/2013	1055	West	-38.00064516	145.1002909
WRK072379	Observation	0.00m-0.40m Rubble 0.40m-0.70m Black silt 0.70m-2.50m CLAY 2.50m-4.20m CLAYey sand/silt		1.20m-4.20m Clay		0.00m-1.20m INNER LINING - CASING = Pvc1.20m-4.20m INNER LINING - SLOT = Pvc 0.00m-0.80m OUTER LINING - GRAVEL = Cement 0.80m-1.00m OUTER LINING - GRAVEL = Bentonite 1.00m-4.20m OUTER LINING - GRAVEL = Gravel	28/05/2013	1055	West	-38.000522	145.1004763
WRK981643								1058	East	-37.99662258	145.1357584

Station	UseType	DrillersLog	Stratigraphy	Geology	Levels	Construction	CompleteDate	Distance	Direction	Latitude	Longitude
112414	Groundwater Investigation	0.00m-0.30m SILTY TOP SOIL 0.30m-0.80m TIP FILL 0.80m-3.00m SILTY SAND 3.00m-12.00m YELLOW SILTY CLAY SAND 12.00m-12.50m GREY SANDY CLAY 12.50m-15.40m LIGNIOUS SANDY CLAY 15.40m-21.00m FINE LIGNIOUS SAND OPEN HOLE 21.00m-26.00m FINE LIGNIOUS SAND		19.25m-25.00m Sand		-0.10m-19.25m INNER LINING - CASING = Pvc19.25m-25.00m INNER LINING - SCREEN = Pvc 0.20m-1.50m OUTER LINING - GRAVEL = Cement 18.00m-25.00m OUTER LINING - GRAVEL = Gravel	09/01/1992	1061	North	-37.94993645	145.1151248
WRK072382	Observation	0.00m-0.30m GRAss/topsoil 0.30m-0.50m FILL/rubblegritty material 0.50m-0.70m Ddark silty clay 0.70m-2.00m Stiff clay/yellow mottled 2.00m-4.00m CLAYey sand		1.00m-4.00m Clay		0.00m-1.00m INNER LINING - CASING = Pvc1.00m-4.00m INNER LINING - SCREEN = Pvc 0.00m-0.60m OUTER LINING - GRAVEL = Cement 0.60m-0.90m OUTER LINING - GRAVEL = Bentonite 0.90m-4.00m OUTER LINING - GRAVEL = Gravel	27/05/2013	1066	West	-38.00032529	145.1005724
WRK989785								1071	North	-37.96898622	145.1330881
WRK072384	Observation	0.00m-0.40m CLAY& some srubble bricks concretesome rocks 0.40m-0.80m SIsturbed clay 2.50m-3.00m SILTy clay & sand 3.00m-4.50m wet yellow clayey sand		1.50m-4.50m Clay		0.00m-1.50m INNER LINING - CASING = Pvc1.50m-4.50m INNER LINING - SCREEN = Pvc 0.00m-1.00m OUTER LINING - GRAVEL = Cement 1.00m-1.20m OUTER LINING - GRAVEL = Bentonite 1.20m-4.50m OUTER LINING - GRAVEL = Gravel	28/05/2013	1072	West	-38.00047309	145.1002384
WRK072381	Observation	0.00m-0.30m FILL/disturbed clay some rubble 0.30m-0.70m CLAYey silt/black 0.70m-1.50m SANDy clay/dense 1.50m-2.50m SANDy clay/silty 2.50m-4.20m LIGhter clayey sand/wet		1.20m-4.20m Clay		0.00m-1.20m INNER LINING - CASING = Pvc1.20m-4.20m INNER LINING - SCREEN = Pvc 0.00m-0.60m OUTER LINING - GRAVEL = Cement 0.60m-0.90m OUTER LINING - GRAVEL = Bentonite 0.90m-4.20m OUTER LINING - GRAVEL = Gravel	27/05/2013	1074	West	-38.00040232	145.1003199
133626	Groundwater Investigation	0.00m-1.00m CLAY SAND 1.00m-3.50m CLAY SAND FINE				0.50m-3.50m INNER LINING - SCREEN = Not Known	21/04/1998	1081	West	-38.00228994	145.098068
133613	Irrigation	0.00m-50.00m SILTY SANDS & CLAYEY MARLS 50.00m-150.00m SOFT GREY MUDSTONE		50.00m-150.00m Mudstone		-0.30m-50.00m INNER LINING - CASING = Steel50.00m-150.00m INNER LINING - SCREEN = Steel 0.00m-50.00m OUTER LINING - GRAVEL = Cement	22/11/1997	1084	North West	-37.96260168	145.1013692
80581	Stock	0.00m-8.00m CLAYEY SAND 8.00m-10.00m FINE WHITE SAND 10.00m-17.00m BLACK SAND 17.00m-29.00m FINE BLACK SILTY SAND 29.00m-55.00m BLACK SAND LAYERS SANDSTONE 55.00m-58.00m BROWN CLAY AND INFERIOR COAL 58.00m-80.00m WEATHERED GRANITE		68.00m-80.00m Granite		0.00m-68.00m INNER LINING - CASING = Steel68.00m-80.00m INNER LINING - SCREEN = Steel	17/02/1984	1085	North	-37.95142955	145.1071199
WRK043124	Not Known						01/01/1988	1086	East	-37.99583185	145.1359037
WRK072979	Observation	0.00m-0.00m NULL				0.00m-0.00m OUTER LINING - GRAVEL = Not Known	12/01/2013	1090	North	-37.95148456	145.1068842
WRK071464	Observation						11/10/2012	1095	South	-38.03620108	145.1226776
WRK071463	Observation						11/10/2012	1101	South	-38.03622719	145.12262
WRK071461	Observation	0.00m-0.60m SOIL 0.60m-7.30m SAND		3.00m-7.50m Sand		0.00m-3.00m INNER LINING - CASING = Pvc3.00m-7.50m INNER LINING - SCREEN = Pvc 0.00m-0.10m OUTER LINING - GRAVEL = Cement 0.10m-3.00m OUTER LINING - GRAVEL = Bentonite 3.00m-7.50m OUTER LINING - GRAVEL = Gravel	11/10/2012	1102	South	-38.03622701	145.1226086
WRK071462	Observation						11/10/2012	1102	South	-38.03622701	145.1226086
WRK986210								1144	West	-37.99647772	145.1058349
WRK058438	Irrigation	0.00m-42.00m SAND 42.00m-55.00m MUD STONE 55.00m-68.00m BASALT 68.00m-87.00m SAND 87.00m-95.00m CLAY 95.00m-108.00m SANDSTONE		0.00m-42.50m Mudstone 45.50m-84.50m Basalt		0.00m-42.50m INNER LINING - CASING = Steel45.50m-84.50m INNER LINING - SLOT = Steel 0.00m-42.50m OUTER LINING - GRAVEL = Cement	21/09/2009	1146	North West	-37.96311671	145.1008304
WRK080506	Observation	0.00m-1.50m CLAY 1.50m-7.30m CLAY/SAND 7.30m-13.10m SAND		10.10m-13.10m Sand		0.00m-0.30m OUTER LINING - GRAVEL = Cement 0.30m-8.50m OUTER LINING - GRAVEL = Bentonite 8.50m-13.10m OUTER LINING - GRAVEL = Gravel	03/07/2014	1156	North	-37.95124818	145.1309834
WRK992071								1162	South	-38.02638351	145.1162409
WRK043168	Irrigation						01/01/1982	1168	East	-38.00080443	145.1372764
WRK039208	Irrigation					0.00m-60.35m INNER LINING - CASING = Not Known56.08m-60.35m INNER LINING - SCREEN = Not Known	31/12/1963	1178	West	-37.99996492	145.0991529
WRK047138	Irrigation	0.00m-1.00m FILL/TOP SOIL 1.00m-29.00m BRIGHTON GROUP - SANDY CLAY AND CLAYEY SAND 29.00m-35.00m COURSE SAND 35.00m-36.00m SANDY CLAY				0.50m-30.00m INNER LINING - CASING = Pvc30.00m-33.00m INNER LINING - SCREEN = Stainless Steel33.00m-36.00m INNER LINING - CASING = Pvc 0.00m-26.00m OUTER LINING - GRAVEL = Cement 26.00m-36.00m OUTER LINING - GRAVEL = Gravel	24/11/2008	1185	South	-38.05219479	145.1293349
81732	Domestic, Stock	0.00m-3.00m SANDY LOAM 3.00m-10.60m MOTTLED CLAY FIRM SANDY 10.60m-39.30m SAND, SILTY FIRM (FINE) 39.30m-42.60m SANDSTONE PIECES AND FINE SAND		39.30m-42.60m Sandstone		0.00m-39.30m INNER LINING - CASING = Steel39.30m-42.60m INNER LINING - SCREEN = Steel	12/11/1982	1187	North	-37.96882433	145.1354738
76562	Domestic						01/01/1988	1195	South	-38.05198888	145.1289204
WRK984897								1198	North West	-37.96330625	145.1002905
81742	Not Known	0.00m-2.00m SANDY CLAY GREY 2.00m-3.00m SANDY CLAY WHITE 3.00m-5.00m SANDY CLAY GREY 5.00m-9.00m COARSE GRAVEL 9.00m-10.00m SANDY CLAY GREY 10.00m-23.00m SANDY CLAY BLACK 23.00m-50.00m CLAY SANDY GREY WITH PLEATS OF MICA 50.00m-60.00m CLAY GREY WITH BANDS OF SAND STONE 60.00m-69.00m CLAY BLUE GREEN 69.00m-84.00m BLUE GREEN CLAY WITH HARD BANDS					03/02/1983	1212	West	-38.00137295	145.097067
81741	Not Known	0.00m-1.00m TOP SOIL AND SAND 1.00m-6.00m SANDY CLAY GREY 6.00m-18.00m SANDY CLAY BANDS SANDSTONE 18.00m-23.00m GREY CLAY WITH CHIPS OF SANDSTONE 23.00m-58.00m GREY SANDY CLAY WITH BROWN CAOL 58.00m-59.00m HARD BAND BASALT 59.00m-62.00m BLUE GREEN CLAY WITH CHIPS OF BASALT 62.00m-68.00m BLUE GREEN CLAY WITH BROWN COAL					03/02/1983	1212	West	-38.00137295	145.097067
81740	Not Known	0.00m-1.00m TOP SOIL AND SAND 1.00m-4.00m SANDY CLAY 4.00m-11.00m SAND GRAVEL AND CLAY 11.00m-18.00m SANDY CLAY GREY 18.00m-24.00m CLAY WITH BANDS OF SAND STONE 24.00m-68.00m GREEN BLUE CLAY MARINE					04/02/1983	1212	West	-38.00137295	145.097067
81743	Irrigation	0.00m-4.00m OLD TIP-FILLED 4.00m-49.00m SILTY CLAY 49.00m-51.00m HARD BAND 51.00m-57.50m WEATHERED BASALT 57.50m-63.00m BASALT 63.00m-65.00m WOODY CLAY/COAL 65.00m-67.50m GREY CLAY/MUDSTONE				0.00m-58.00m INNER LINING - CASING = Steel58.00m-67.50m INNER LINING - SCREEN = Steel	03/11/1983	1217	West	-38.00128295	145.0970689
76447	Domestic	0.00m-1.83m BLACK CLAY BUILT UP GROWN 1.83m-2.44m COARSE WHITE SAND TO BLACK MARL		1.83m-2.44m Sand		0.00m-1.83m INNER LINING - CASING = Not Known1.83m-2.44m INNER LINING - SCREEN = Not Known	14/09/1983	1222	South	-38.04417288	145.1247893
WRK984494								1223	North	-37.95899317	145.139977
81697	Domestic, Stock	0.00m-1.52m TOP AND SUB SOILS 1.52m-3.05m YELLOW SANDY CLAY 3.05m-3.66m GREY/WHITE CLAY 3.66m-4.88m ORANGE SANDY CLAY 4.88m-7.31m PURE WHITE FINE SAND				0.00m-7.31m INNER LINING - CASING = Not Known1.52m-7.31m INNER LINING - SCREEN = Not Known	06/01/1973	1225	North	-37.95526022	145.1382065
115902	Groundwater Investigation	0.00m-15.00m BROWN & GREY SILTY SANDS				0.00m-13.00m INNER LINING - CASING = Pvc13.00m-15.00m INNER LINING - SCREEN = Pvc 10.00m-12.70m OUTER LINING - GRAVEL = Gravel 12.70m-12.90m OUTER LINING - GRAVEL = Bentonite 12.90m-15.00m OUTER LINING - GRAVEL = Gravel	07/06/1993	1232	North	-37.94839045	145.1142537
115903	Groundwater Investigation	0.00m-15.00m BROWN & GREY SILTY SANDS				0.00m-13.00m INNER LINING - CASING = Pvc13.00m-15.00m INNER LINING - SCREEN = Pvc 10.00m-12.70m OUTER LINING - GRAVEL = Gravel 12.70m-12.90m OUTER LINING - GRAVEL = Bentonite 12.90m-15.00m OUTER LINING - GRAVEL = Gravel	07/06/1993	1241	North	-37.94830945	145.1148247
129983	Groundwater Investigation, Observation	0.00m-7.00m CLAY 7.00m-11.00m SAND 11.00m-15.00m MUDSTONE 15.00m-33.00m SAND 33.00m-45.00m MUDSTONE 45.00m-54.00m GREEN MUDSTONE 54.00m-58.00m COAL 58.00m-87.00m MUDSTONE 87.00m-90.00m FRACTURED MUDSTONE & BASALT 90.00m-150.00m WEATHERED BASALT				-0.30m-4.20m INNER LINING - CASING = Not Known-0.30m-91.00m INNER LINING - CASING = Not Known61.00m-91.00m INNER LINING - SCREEN = Not Known	07/02/1997	1249	North West	-37.97084376	145.0983684

Station	UseType	DrillersLog	Stratigraphy	Geology	Levels	Construction	CompleteDate	Distance	Direction	Latitude	Longitude
WRK972024								1249	South East	-38.01332047	145.1511112
WRK039214	Irrigation	0.00m-6.50m GREY STICKY SILTY SAND 6.50m-26.00m BLACK MED GRAINED SAND 26.00m-28.90m BLACK-GREY COARSE SAND AND GRAVEL 28.90m-35.60m YELLOW/BROWN CLAYEY SAND 35.60m-40.50m GREY/BROWN MED GRAINED SAND 40.50m-52.50m VERY LOOSE MED GRAINED GREY/WHITE SAND 52.50m-54.38m SOFT TO HARD GREY/BROWN WEATHERED ROCK				0.00m-54.38m INNER LINING - CASESCRN = Not Known	29/07/1990	1260	North West	-37.95563966	145.0999551
WRK964690								1261	South East	-38.01338641	145.1513394
76564	Domestic	0.00m-3.00m NO DETAILS AVAILABLE				0.00m-3.00m INNER LINING - CASING = Pvc	17/03/1983	1262	South	-38.04434589	145.1243293
125269	Groundwater Investigation, State Observation Network	0.00m-2.00m DRY SAND 2.00m-8.00m SANDY CLAY 8.00m-11.00m GRAVEL SILT & CLAY 11.00m-17.00m YELLOW SILTY CLAY 17.00m-28.00m GREY SILTY CLAY			Date/time: 2016-05-24 1335 Quality: 43 WLMP: 6.52m DBNS: 6.52m RWL: 20.69mAHD	0.00m-8.50m INNER LINING - CASING = Pvc8.50m-10.50m INNER LINING - SCREEN = Pvc10.50m-13.50m INNER LINING - CASING = Pvc 8.50m-13.50m OUTER LINING - GRAVEL = Gravel 13.50m-14.50m OUTER LINING - GRAVEL = Bentonite	13/01/1995	1267	North	-37.97753211	145.1334986
WRK081287	Commercial, Observation	0.00m-0.30m Top soil 0.30m-10.30m BRighton Group 10.30m-52.70m MARLcoal & sand 52.70m-58.00m BASALT				0.00m-53.30m INNER LINING - CASING = Pvc 3.00m-53.00m OUTER LINING - GRAVEL = Cement	06/03/2015	1288	South East	-38.05292279	145.1529368
81753	Domestic	0.00m-1.50m GREY BLACK LOAM 1.50m-3.00m BROWN SAND 3.00m-5.00m SAND GREY SILT, SOME GRAVEL 5.00m-7.00m SAND AND FINE GRAVEL 7.00m-9.00m SANDY CLAY 9.00m-13.70m COARSE GRAVEL AND SAND		12.00m-12.40m Gravel 12.40m-13.70m Gravel		0.00m-12.00m INNER LINING - CASING = Pvc12.00m-12.40m INNER LINING - SCREEN = Pvc12.40m-13.70m INNER LINING - SCREEN = Slotted Pvc	01/04/1985	1288	North West	-37.9603037	145.0985832
WRK054563	Observation						01/07/2010	1289	West	-38.00019397	145.0971182
WRK046823	Irrigation	0.00m-0.30m TOP SOIL 0.30m-15.00m SANDY CLAYS & IRONSTONE 15.00m-56.80m MARL LAYERS UP TO 300MM THICK 56.80m-57.30m HARD LENSES (VOLCANIC?) 57.30m-63.00m WERRIBEE FORMATION LITTLE SAND 63.00m-72.00m WEATHERED SHALE 72.00m-87.00m FIRM SHALE 87.00m-88.00m FRACTURED SHALE 88.00m-91.00m FIRM TO HARD SHALE		0.00m-75.00m Marl 75.00m-91.00m Shale		0.00m-75.00m INNER LINING - CASING = Pvc11.00m-75.00m OUTER LINING - GRAVEL = Cement	29/08/2005	1290	South West	-38.01138914	145.0942957
81746	Domestic	0.00m-3.05m BROWN CLAY 3.05m-15.24m BROWN SANDY CLAY 15.24m-24.38m BLUE GREY GRAVELLY CLAY 24.38m-39.62m GREY GREEN SANDY CLAY 39.62m-45.41m GREY GREEN GRAVELLY CLAY		33.05m-38.10m Clay 39.92m-41.15m Clay		0.00m-4.57m INNER LINING - CASING = Pvc0.00m-33.05m INNER LINING - CASING = Pvc33.05m-38.10m INNER LINING - SCREEN = Pvc39.92m-41.15m INNER LINING - SCREEN = Wire W S/Steel	28/02/1982	1294	East	-38.00332448	145.1401803
WRK054562	Observation						01/07/2010	1294	West	-38.00013091	145.0971199
134540	Groundwater Investigation	0.00m-0.80m ORGANIC SILTY SAND 0.80m-1.80m SANDY CLAY 1.80m-3.20m CLAYEY SAND 3.20m-5.80m SANDY CLAY 5.80m-7.00m CLAYEY SAND 7.00m-8.50m SILTY CLAYEY SAND				0.00m-7.00m INNER LINING - CASING = Pvc Class 187.00m-8.50m INNER LINING - SCREEN = Pvc Class 18	17/07/1996	1300	North West	-37.95402564	145.1004521
134543	Groundwater Investigation	0.00m-0.80m ORGANIC SILTY SAND 0.80m-5.50m SANDY CLAY 5.50m-5.60m CLAYEY SAND 5.60m-8.50m SILTY CLAY				0.00m-7.00m INNER LINING - CASING = Pvc Class 187.00m-8.50m INNER LINING - SCREEN = Pvc Class 18	18/07/1996	1300	North West	-37.95402564	145.1004521
134538	Groundwater Investigation	0.00m-1.00m SILTY SAND 1.00m-2.00m SANDY CLAY 2.00m-4.00m CLAYEY SAND 4.00m-5.00m SANDY CLAY 5.00m-8.50m CLAYEY SAND				0.00m-7.00m INNER LINING - CASING = Pvc Class 187.00m-8.50m INNER LINING - SCREEN = Pvc Class 18	17/07/1996	1300	North West	-37.95402564	145.1004521
134542	Groundwater Investigation	0.00m-1.80m ORGANIC SILTY SAND 1.80m-2.80m SANDY CLAY 2.80m-4.20m CLAYEY SILTY SAND 4.20m-6.20m SANDY CLAY 6.20m-9.50m CLAYEY SAND				0.00m-8.00m INNER LINING - CASING = Pvc Class 188.00m-9.50m INNER LINING - SCREEN = Pvc Class 18	17/07/1996	1300	North West	-37.95402564	145.1004521
134544	Groundwater Investigation	0.00m-0.80m FILL 0.80m-2.50m SANDY GRAVELLY CLAY 2.50m-3.00m SILTY SAND 3.00m-9.50m CLAYEY SILTY SAND				0.00m-8.00m INNER LINING - CASING = Pvc Class 188.00m-9.50m INNER LINING - SCREEN = Pvc Class 18	18/07/1996	1300	North West	-37.95402564	145.1004521
134541	Groundwater Investigation	0.00m-0.80m ORGANIC SILTY SAND 0.80m-3.00m SANDY CLAY 3.00m-4.00m CLAYEY SAND 4.00m-4.50m SANDY CLAY				0.00m-4.00m INNER LINING - CASING = Pvc Class 184.00m-4.50m INNER LINING - SCREEN = Pvc Class 18	17/07/1996	1300	North West	-37.95402564	145.1004521
134539	Groundwater Investigation	0.00m-0.80m SILTY SAND 0.80m-3.50m SANDY GRAVELLY CLAY 3.50m-4.50m SANDY CLAY 4.50m-9.50m SAND				0.00m-7.50m INNER LINING - CASING = Pvc Class 187.50m-9.50m INNER LINING - SCREEN = Pvc Class 18	17/07/1996	1300	North West	-37.95402564	145.1004521
WRK032943	Irrigation	0.00m-60.00m SAND / CLAY 60.00m-95.00m GRANITE				0.00m-60.00m INNER LINING - CASING = Steel60.00m-75.00m INNER LINING - CASING = Pvc75.00m-95.00m INNER LINING - SCREEN = Pvc 0.00m-1.00m OUTER LINING - GRAVEL = Cement	24/05/2000	1305	North	-37.94790348	145.1119898
112415	Groundwater Investigation	0.00m-0.20m FINE DRY SAND 0.20m-2.00m DARK SAND CLAY SHELLS 2.00m-4.10m LIGNIOUS SILTY SAND 4.10m-11.80m MEDIUM-COARSE SAND 11.80m-12.50m FINER GREEN SAND 12.50m-18.50m FINE TO MEDIUM GREEN SILTY SAND 18.50m-20.00m FIRM GREY CLAY (MUDSTONE)		13.00m-19.00m Sand		-0.10m-13.00m INNER LINING - CASING = Pvc13.00m-19.00m INNER LINING - SCREEN = Pvc 0.00m-1.00m OUTER LINING - GRAVEL = Cement 18.00m-20.00m OUTER LINING - GRAVEL = Gravel	29/01/1992	1311	North	-37.94768744	145.1154097
WRK964725								1320	South	-38.0575648	145.1389903
WRK990956								1326	West	-38.00004358	145.0967349
WRK984509								1328	West	-38.00002538	145.096724
81694	Miscellaneous	0.00m-4.26m FINE GREY-BROWN SAND 4.26m-7.92m FIRM YELLOW BROWN SANDY CLAY 7.92m-13.72m BROWN SILTY FINE-MEDIUM SAND				0.00m-13.72m INNER LINING - CASING = Not Known8.22m-13.72m INNER LINING - SCREEN = Not Known	18/04/1973	1332	North	-37.98158243	145.1329871
WRK054967	Domestic & Stock	0.00m-0.30m top soil 0.30m-8.00m old sea bed 8.00m-9.00m soft sandstone 9.00m-12.00m brown sands 12.00m-13.00m soft sandstone 13.00m-16.00m sands 16.00m-17.00m soft sandstone 17.00m-18.00m sands		0.00m-11.00m Sand 11.00m-17.00m Sand		0.00m-11.00m INNER LINING - CASING = Pvc11.00m-17.00m INNER LINING - SCREEN = Pvc	10/02/2010	1342	South West	-38.0184202	145.1007477
WRK042421	Irrigation	0.00m-12.00m SAND CLAY 12.00m-18.00m SANDY SILT 18.00m-35.00m MUDSTONE 35.00m-57.00m SLATESTONE 57.00m-91.00m BASALT QUARTZ 91.00m-97.70m BASALT				-0.20m-42.00m INNER LINING - CASING = Steel-0.20m-42.50m INNER LINING - CASING = Steel42.00m-85.00m INNER LINING - SCREEN = Steel85.00m-97.70m INNER LINING - SCREEN = Slotted Steel	07/01/1993	1346	North West	-37.96755574	145.0984523
WRK980684								1348	West	-38.0004285	145.0960189
WRK990027	Domestic	0.00m-1.00m top soil 1.00m-4.60m sandy clay 4.60m-27.00m sloppy beach sands				0.00m-15.00m INNER LINING - CASING = Pvc15.00m-27.00m INNER LINING - SCREEN = Pvc 0.00m-6.00m OUTER LINING - GRAVEL = Cement 6.00m-27.00m OUTER LINING - GRAVEL = Gravel	21/05/2009	1350	South East	-38.01399842	145.1529622
WRK970676								1360	South	-38.0354407	145.1179572
WRK987956	Domestic	0.00m-0.20m FILL: SILTY SAND 0.20m-0.40m SAND 0.40m-0.60m SANDY CLAY 0.60m-2.00m SAND 2.00m-4.50m SANDY CLAY 4.50m-9.00m CLAYEY SAND				0.00m-1.00m OUTER LINING - GRAVEL = Cement 4.50m-5.50m OUTER LINING - GRAVEL = Bentonite 5.50m-9.00m OUTER LINING - GRAVEL = Gravel	24/09/2008	1366	West	-38.0046365	145.0932108
WRK039211	Irrigation	0.00m-0.30m SURFACE SANDY SOIL 0.30m-4.00m FINE SAND 4.00m-30.50m CLAYEY SAND & STONE PIECES 30.50m-37.00m SILTY ORANGE SAND 37.00m-41.00m SILTY GREY SAND 41.00m-47.00m FIRM GREY MUDSTONE 47.00m-130.00m MEDIUM HARD BLUE SHALE 130.00m-162.00m HD BL SHALE SOME FRACS. - ALTER.TO BCP/28133		106.00m-162.00m Shale		0.00m-106.00m INNER LINING - CASING = Mild Steel106.00m-162.00m INNER LINING - SCREEN = Mild Steel	24/04/1987	1374	East	-37.99576722	145.1392192
111010	Groundwater Investigation	0.00m-6.00m SAND (FINE TO MEDIUM) 6.00m-10.00m GREY SANDY CLAY 10.00m-18.00m SAND (MEDIUM TO FINE) WITH CEMENTED BANDS		10.00m-18.00m Sand		-1.00m-10.00m INNER LINING - CASING = Pvc Class 1210.00m-18.00m INNER LINING - SCREEN = Pvc Class 12 0.00m-1.00m OUTER LINING - GRAVEL = Cement 3.50m-4.50m OUTER LINING - GRAVEL = Bentonite 4.50m-18.00m OUTER LINING - GRAVEL = Gravel	13/12/1991	1383	North	-37.9476825	145.1094918
81793	Groundwater Investigation	0.00m-22.50m BROWN & GREY SAND 22.50m-28.00m COARSE GREY SAND 28.00m-35.10m FINE BROWN SAND 35.10m-37.20m GREY SILTSTONE			Date/time: 1996-10-03 0000 Quality: 47 WLMP: 6.55m DBNS: RWL:	0.00m-3.00m INNER LINING - CASING = Pvc3.00m-37.20m INNER LINING - SCREEN = Pvc 3.00m-0.00m OUTER LINING - GRAVEL = Seal	13/08/1990	1399	North	-37.94775033	145.1249676
81680	Not Used - Capped	0.00m-12.19m YELLOW GREY CLAY 12.19m-21.34m SANDY GRAVEL AND CLAY 21.34m-47.24m LIGHT GREY SANDY CLAY 47.24m-47.55m SMALL BAND OF LIMESTONE 47.55m-53.34m COARSE SAND - SHELL AND WOOD 53.34m-55.78m DECOMPOSED BASALT 55.78m-60.96m HARD BASALT				0.00m-56.08m INNER LINING - CASING = Not Known0.00m-56.08m OUTER LINING - GRAVEL = Cement	13/01/1973	1400	West	-37.99231886	145.1000337

Station	UseType	DrillersLog	Stratigraphy	Geology	Levels	Construction	CompleteDate	Distance	Direction	Latitude	Longitude
127481	Groundwater Investigation, Observation, State Observation Network	0.00m-2.00m DARK GREY SAND 2.00m-7.00m YELLOW GREY CLAYEY SAND 7.00m-10.00m FINE YELLOW SAND 10.00m-15.00m FINE BROWN SAND			Date/time: 2016-05-24 0943 Quality: 43 WLMP: 3.31m DBNS: 3.36m RWL: 21.88mAHD	0.00m-12.00m INNER LINING - CASING = Pvc12.00m-14.00m INNER LINING - SCREEN = Pvc14.00m-15.00m INNER LINING - CASING = Pvc 11.00m-12.00m OUTER LINING - GRAVEL = Bentonite 12.00m-15.00m OUTER LINING - GRAVEL = Gravel	17/04/1996	1405	North West	-37.95826614	145.0973845
WRK990926								1409	South East	-38.0126247	145.152712
112413	Groundwater Investigation	0.00m-0.30m RUBBLE FILL 0.30m-2.00m SILTY SAND 2.00m-6.00m SILTY CLAY 6.00m-7.30m FIRM GREY CLAY 7.30m-15.50m FINE TO MEDIUM DRY SAND 15.50m-17.00m HARD LIGNIOUS SAND 17.00m-20.00m LIGNIOUS SAND HARD BARS 20.00m-22.00m MEDIUM SAND 22.00m-27.00m GREEN SAND MEDIUM		19.00m-25.00m Sand		-0.20m-22.50m INNER LINING - CASING = Steel-0.15m-25.00m INNER LINING - CASING = Pvc19.00m-25.00m INNER LINING - SCREEN = Pvc 18.00m-25.00m OUTER LINING - GRAVEL = Gravel	14/01/1992	1411	North	-37.94694239	145.1195256
WRK056199	Observation						14/09/2010	1413	North	-37.96171591	145.1423327
WRK991461								1464	North	-37.97062671	145.1376571
81435	Groundwater Investigation, Observation, State Observation Network				Date/time: 1985-09-24 0000 Quality: 43 WLMP: 8.88m DBNS: 8.51m RWL: 24.59mAHD	0.00m-16.50m INNER LINING - CASING = Pvc	29/04/1976	1473	North	-37.96684426	145.1413287
76481	Domestic	0.00m-3.61m SAND		3.00m-3.61m Sand		0.00m-3.00m INNER LINING - CASING = Pvc3.00m-3.61m INNER LINING - SCREEN = Pvc	31/12/1983	1493	South	-38.05430192	145.1270385
109632	Observation, State Observation Network	0.00m-0.60m TOP SOIL 0.60m-11.90m SANDY CLAY GREY 11.90m-16.20m DARK BROWN SILTY COAL 16.20m-18.90m BROWN CLAY 18.90m-22.90m SILTY SAND PY RITES 22.90m-27.40m GREEN SILTY MARL 27.40m-32.00m GRREN SILTY MARL 32.00m-32.60m SILTY MARL HARD BAR CEMENTED GRAVEL 32.60m-36.60m GREY CLAY STONE CLAY (BEDROCK) 36.60m-39.62m GREY CLAY (BEDROCK)		9.14m-15.24m Coal	Date/time: 1974-05-30 0000 Quality: 43 WLMP: 5.81m DBNS: 5.76m RWL: 28.69mAHD	0.00m-9.14m INNER LINING - CASING = Pvc9.14m-15.24m INNER LINING - SCREEN = Pvc 0.00m-1.00m OUTER LINING - GRAVEL = Cement 9.00m-15.30m OUTER LINING - GRAVEL = Gravel	30/07/1973	1501	North	-37.96622524	145.1420277
109633	Observation, State Observation Network			18.29m-30.48m Marl	Date/time: 1974-05-30 0000 Quality: 43 WLMP: 9.05m DBNS: 9.00m RWL: 25.45mAHD	0.00m-18.29m INNER LINING - CASING = Pvc18.29m-30.48m INNER LINING - SCREEN = Pvc30.48m-39.62m INNER LINING - CASING = Pvc 0.00m-1.00m OUTER LINING - GRAVEL = Cement 15.24m-18.29m OUTER LINING - GRAVEL = Bentonite 18.29m-39.62m OUTER LINING - GRAVEL = Gravel	30/07/1973	1501	North	-37.96622524	145.1420277
76428	Domestic	0.00m-0.30m TOP SOIL (SANDY) 0.30m-1.40m LIGHT GREY FINE SAND 1.40m-2.13m LIGHT BROWN FINE SAND 2.13m-3.20m VERY DARK BROWN SILTY SAND 3.20m-4.40m LIGHT GREY TO WHITE SAND				0.00m-3.61m INNER LINING - CASING = Pvc	22/03/1983	1506	South	-38.05206193	145.1244855
81678	Domestic, Stock	0.00m-0.91m DARK SANDY SOIL 0.91m-2.44m GREY AND BROWN SAND CLAY 2.44m-4.57m GREY BROWN CLAY 4.57m-7.31m FATTY FINE COARSE SAND 7.31m-11.28m FINE FATTY CLAYED SAND 11.28m-12.19m FINE AND COARSE SAND 12.19m-14.02m FINE AND COARSE SAND				0.00m-11.27m INNER LINING - CASING = Not Known11.27m-12.80m INNER LINING - SCREEN = Not Known	30/11/1972	1511	North East	-37.98525041	145.1369931
WRK991269								1513	West	-37.99906898	145.0949836
WRK056198	Observation						14/04/2010	1513	North	-37.96176991	145.1434696
WRK056197	Observation	0.00m-5.00m sandy clay		0.00m-1.50m Clay 1.50m-5.00m Clay		0.00m-1.50m INNER LINING - CASING = Pvc1.50m-5.00m INNER LINING - SCREEN = Pvc 0.00m-0.50m OUTER LINING - GRAVEL = Cement 0.50m-2.00m OUTER LINING - GRAVEL = Bentonite 2.00m-5.00m OUTER LINING - GRAVEL = Gravel	13/04/2010	1513	North	-37.96176991	145.1434696
81714	Domestic, Stock	0.00m-3.05m TOP SOIL 3.05m-6.10m SAND 6.10m-12.19m CLAY RED 12.19m-18.29m CLAY BROWN 18.29m-24.38m GRAVEL 24.38m-39.62m GREY CLAY - ROCK LAYERS 39.62m-42.67m SAND WHITE		18.29m-30.48m Gravel 41.15m-42.67m Sand		0.00m-18.29m INNER LINING - CASING = Pvc Class 918.29m-30.48m INNER LINING - SCREEN = Pvc Class 930.48m-41.15m INNER LINING - CASING = Pvc Class 941.15m-42.67m INNER LINING - SCREEN = Pvc Class 9	27/02/1983	1522	North East	-37.98561441	145.1372121
124236	Groundwater Investigation					0.00m-13.80m INNER LINING - CASING = Pvc13.80m-17.80m INNER LINING - SCREEN = Pvc 0.00m-9.80m OUTER LINING - GRAVEL = Cement 9.80m-10.50m OUTER LINING - GRAVEL = Bentonite 10.50m-18.00m OUTER LINING - GRAVEL = Gravel	07/12/1993	1524	North East	-37.96845927	145.1408327
WRK960319	Domestic & Stock	0.00m-0.30m TOPSOIL 0.30m-1.80m GREY CLAY 1.80m-3.50m ORANGE & GREY CLAY 3.50m-10.00m GREY SILTY CLAY 10.00m-19.00m BLACK SILTY CLAY 19.00m-24.00m LIGNIOUS CLAY 24.00m-27.00m VOLCANIC CLAY 27.00m-61.00m GRANITE		27.00m-58.00m Granite		0.40m-27.00m INNER LINING - CASING = Pvc27.00m-58.00m INNER LINING - SLOT = Pvc0.00m-3.00m OUTER LINING - GRAVEL = Cement 3.00m-27.00m OUTER LINING - GRAVEL = Gravel	19/12/2002	1531	South East	-38.02090613	145.1567075
WRK068620	Observation	0.00m-1.00m FILL 1.00m-5.00m SAND		0.50m-5.00m Sand		0.00m-0.50m INNER LINING - CASING = Pvc0.50m-5.00m INNER LINING - SCREEN = Pvc 0.00m-0.50m OUTER LINING - GRAVEL = Bentonite 0.50m-5.00m OUTER LINING - GRAVEL = Gravel	23/03/2012	1532	North	-37.96163838	145.1437006
76486	Domestic	0.00m-5.00m PROBABLY SAND				0.00m-5.00m INNER LINING - CASING = Pvc	31/12/1983	1533	South	-38.0402379	145.1210153
142526	Domestic	0.00m-0.50m SANDY LOAM 0.50m-18.00m SAND/CLAY 18.00m-50.00m SILT/CLAY 50.00m-56.00m SAND				0.00m-53.00m INNER LINING - CASING = Pvc53.00m-56.00m INNER LINING - SCREEN = Pvc 0.00m-2.00m OUTER LINING - GRAVEL = Cement 2.00m-3.00m OUTER LINING - GRAVEL = Bentonite 50.00m-56.00m OUTER LINING - GRAVEL = Gravel	06/10/2000	1538	West	-38.00685805	145.0907751
81816	Groundwater Investigation	0.00m-1.00m SAND FINE WHITE 1.00m-2.74m SILTY SAND BROWN 2.74m-10.70m FINE SANDY CLAY BROWN/RED 10.70m-12.00m COARSE CLAYEY SAND BROWN 12.00m-17.45m MEDIUM GRAIN SANDY GREY 17.45m-20.00m SAND DARK BROWN/BLACK FINE TO MEDIUM				-0.30m-10.00m INNER LINING - CASING = Pvc10.00m-20.00m INNER LINING - SCREEN = Pvc 10.00m-20.00m OUTER LINING - GRAVEL = Gravel	03/09/1991	1552	North	-37.97146832	145.1379678
76430	Domestic	0.00m-1.00m BLACK SAND TOP SOIL 1.00m-3.00m BLACK AND GREY MEDIUM SAND 3.00m-4.83m GREY MEDIUM COARSE SAND		4.00m-4.80m Sand		0.00m-4.00m INNER LINING - CASING = Pvc4.00m-4.80m INNER LINING - SCREEN = Pvc	11/02/1983	1554	South	-38.05926175	145.1448283
WRK992181	Groundwater Investigation	0.00m-3.00m fill clay 3.00m-9.00m silty clay				0.00m-6.00m INNER LINING - CASING = Pvc6.00m-9.00m INNER LINING - SCREEN = Pvc 0.00m-4.50m OUTER LINING - GRAVEL = Cement 4.50m-5.50m OUTER LINING - GRAVEL = Bentonite 5.50m-9.00m OUTER LINING - GRAVEL = Gravel	05/08/2009	1567	North	-37.94895997	145.1019916
WRK991460	Groundwater Investigation	0.00m-5.00m clay 5.00m-7.00m coarse sands				0.00m-4.00m INNER LINING - CASING = Pvc4.00m-7.00m INNER LINING - SCREEN = Pvc 2.00m-3.00m OUTER LINING - GRAVEL = Cement 3.00m-7.00m OUTER LINING - GRAVEL = Seal	23/06/2009	1576	North East	-37.969147	145.1409615
WRK042424	Irrigation						31/05/1996	1579	North West	-37.96889779	145.0950604
WRK099815	Investigation, Irrigation	0.00m-0.30m SURFACE SOIL 0.30m-1.80m MOTTLEY CLAY 1.80m-4.00m LIGHT BROWN CLAY 4.00m-5.50m WHITE CLAY 5.50m-6.50m LIGHT BROWN CLAY 6.50m-7.60m WHITE COURSE SAND 7.60m-9.50m BROWN COURSE SAND 9.50m-10.50m LIGHT BROWN SOFT CLAY 10.50m-10.80m RED CLAY 10.80m-12.20m LIGHT BROWN CLAY 12.20m-12.40m COARSE BROWN SAND 12.40m-15.00m LIGHT BROWN CLAY 15.00m-15.20m GREYCOURSE SAND 15.20m-17.60m GREYCLAY 17.60m-36.70m DARK MARINE CLAY 36.70m-38.50m CREAMY SOFT CLAY 38.50m-39.00m FINE MEDIUM SAND 39.00m-46.00m MEDIUM SAND		37.50m-46.00m Sand		0.00m-37.50m INNER LINING - CASING = Pvc Class 1237.50m-46.00m INNER LINING - SCREEN = Screened Pvc 30.00m-46.00m OUTER LINING - GRAVEL = Gravel	04/05/2017	1587	North East	-37.99082058	145.1401936
140374	Groundwater Investigation	0.00m-1.00m SAND, SOME SILT & GRAVEL, DARK BROWN, LOOSE 1.00m-2.00m SANDY CLAY, FINE TO COARSE SAND, SOFT TO FIRM 2.00m-6.00m SANDY CLAY, LIGHT GREY, SAND FINE-MEDIUM, SOFT TO FIRM				0.00m-1.50m INNER LINING - CASING = Pvc Class 181.50m-6.00m INNER LINING - SCREEN = Pvc Class 18	13/04/1999	1599	North West	-37.97316482	145.0942215
140378	Groundwater Investigation	0.00m-1.00m SILTY SAND, DARK BROWN, FINE-COARSE GRAINED, MOIST 1.00m-3.00m SAND, SOME CLAY, GREY/ORANGE/BROWN, SAND FINE TO COARSE, MOI 3.00m-5.00m SANDY CLAY, ORANGE/GREY, FINE TO COARSE SAND, STIFF				0.00m-2.00m INNER LINING - CASING = Pvc Class 182.00m-5.00m INNER LINING - SCREEN = Pvc Class 18	13/04/1999	1607	North West	-37.97346982	145.0941445

Station	UseType	DrillersLog	Stratigraphy	Geology	Levels	Construction	CompleteDate	Distance	Direction	Latitude	Longitude
134547	Groundwater Investigation	0.00m-0.30m SANDY CLAY 0.30m-0.80m SILTY SAND 0.80m-2.60m SAND FINE TO MED 2.60m-3.70m SANDY CLAY 3.70m-4.80m CLAYEY SAND 4.80m-5.80m SAND MED TO COARSE 5.80m-5.90m CLAYEY SAND 5.90m-11.50m SAND MED TO COARSE				0.00m-10.50m INNER LINING - CASING = Pvc10.50m-11.50m INNER LINING - SCREEN = Pvc	20/08/1996	1614	North West	-37.95158265	145.098193
127487	Groundwater Investigation, Observation, State Observation Network	0.00m-0.50m FINE GREY SNAD 0.50m-2.00m BROWN SANDY CLAY 2.00m-4.00m YELLOW SANDY CLAY 4.00m-15.00m ORANGE CLAYEY SAND			Date/time: 2016-05-24 1240 Quality: 43 WLMP: 5.92m DBNS: 5.97m RWL: 18.21mAHD	0.00m-12.00m INNER LINING - CASING = Pvc12.00m-14.00m INNER LINING - SCREEN = Pvc14.00m-15.00m INNER LINING - CASING = Pvc 11.00m-12.00m OUTER LINING - GRAVEL = Bentonite 12.00m-15.00m OUTER LINING - GRAVEL = Gravel	19/04/1996	1614	North East	-37.98311845	145.1374395
140376	Groundwater Investigation	0.00m-1.00m SAND , SOME SILT & CLAY, DARK BROWN, FINE TO MEDIUM GRAINED, 1.00m-2.00m SANDY CLAY, GREY/ORANGE, FINE-MEDIUM SAND, SOFT TO FIRM 2.00m-3.00m SAND WITH SOME CLAY, FINE-MEDIUM SAND, MOIST 3.00m-4.00m SANDY CLAY, ORANGE/GREY, FINE-MEDIUM SAND, MOIST 4.00m-5.00m SANDY CLAY, ORANGE/GREY, FINE-COARSE SAND, FIRM TO STIFF				0.00m-3.00m INNER LINING - CASING = Pvc Class 183.00m-5.00m INNER LINING - SCREEN = Pvc Class 18	13/04/1999	1617	North West	-37.97320682	145.0940155
140377	Groundwater Investigation	0.00m-1.00m SAND, SOME SILT & CLAY, BROWN/ORANGE, FINE TO MEDIUM GRAINED 1.00m-2.00m CLAYEY SAND, MOTLLED GREY & ORANGE, SAND FINE TO COARSE, MOI 2.00m-3.00m SAND, SOME CLAY, FINE TO MEDIUM GRAINED, MOIST 3.00m-4.00m SANDY CLAY, ORANGE/GREY, FINE TO COARSE SAND, FIRM TO STIFF 4.00m-5.00m SANDY CLAY, ORANGE/GREY, FINE TO COASE SAND, FIR TO STIFF				0.00m-2.00m INNER LINING - CASING = Pvc Class 182.00m-5.00m INNER LINING - SCREEN = Pvc Class 18	13/04/1999	1620	North West	-37.97344982	145.0939975
WRK987954	Groundwater Investigation	0.00m-0.30m FILL: SANDY GRAVEL 0.30m-0.60m FILL: SILTY CLAY 0.60m-2.70m SILTY CLAY 2.70m-3.30m SANDY CLAY 3.30m-4.40m SAND 4.40m-11.20m CLAYEY SAND				0.00m-1.00m OUTER LINING - GRAVEL = Cement 6.00m-7.20m OUTER LINING - GRAVEL = Bentonite 7.20m-11.20m OUTER LINING - GRAVEL = Gravel	24/09/2008	1621	West	-37.99798047	145.0945448
81771	Irrigation	0.00m-0.30m TOP SOIL 0.30m-13.70m ORANGE/BROWN CLAY 13.70m-14.00m CLAY BOUND SAND 14.00m-40.80m SANDY CLAY AND LAYERS OF LIMESTONE 40.80m-43.20m COARSE SAND 43.20m-44.00m MUDSTONE		40.70m-43.70m Sand		0.00m-40.70m INNER LINING - CASING = Mild Steel40.70m-43.70m INNER LINING - SCREEN = Mild Steel43.70m-44.00m INNER LINING - CASING = Mild Steel0.00m-36.00m OUTER LINING - GRAVEL = Cement 36.00m-44.00m OUTER LINING - GRAVEL = Gravel	12/11/1986	1625	North East	-37.99281037	145.1414347
115977	Groundwater Investigation	0.00m-0.30m GRAVEL SILT TOP SOIL 0.30m-3.75m DARK GREY SAND CLAY 3.75m-4.10m YELLOW CLAYEY SAND 4.10m-11.60m YELLOW SILTY-SANDY CLAY 11.60m-12.37m GREY SANDY CLAY			Date/time: 1995-04-27 1400 Quality: 47 WLMP: 2.68m DBNS: RWL:	0.00m-10.37m INNER LINING - CASING = Pvc10.37m-12.31m INNER LINING - SCREEN = Pvc 10.00m-10.37m OUTER LINING - GRAVEL = Bentonite 10.37m-12.37m OUTER LINING - GRAVEL = Gravel	26/01/1990	1642	South	-38.05915171	145.1481822
76470	Domestic	1.00m-1.50m GREY BLACK LOAM 1.50m-2.00m GREY SAND 2.00m-3.00m COARSE SAND AND SHELL		2.50m-3.00m Marl		0.00m-2.50m INNER LINING - CASING = Pvc2.50m-3.00m INNER LINING - SCREEN = Pvc	03/07/1984	1642	South	-38.05730192	145.1286715
125274	Groundwater Investigation, State Observation Network	0.00m-1.00m DRY SAND 1.00m-6.00m SANDY CLAY 6.00m-10.00m GRAVEL SAND & CLAY (WET) 10.00m-12.00m SANDY CLAY 12.00m-35.00m GREY SANDY CLAY			Date/time: 2016-05-24 1252 Quality: 43 WLMP: 2.15m DBNS: 2.15m RWL: 20.57mAHD	0.00m-8.00m INNER LINING - CASING = Pvc8.00m-10.00m INNER LINING - SCREEN = Pvc10.00m-24.00m INNER LINING - CASING = Pvc 6.00m-7.00m OUTER LINING - GRAVEL = Bentonite 7.00m-12.00m OUTER LINING - GRAVEL = Gravel 24.00m-24.50m OUTER LINING - GRAVEL = Bentonite	29/01/1995	1642	North East	-37.98101532	145.1366346
WRK039216	Not Known						01/01/1988	1647	East	-37.99456027	145.1421079
76414	Domestic	0.00m-1.30m PEAT - CLAY 1.30m-2.30m SAND - WET 2.30m-4.57m CLAY - WET 4.57m-0.00m WHITE-GREY SANDSTONE		3.96m-4.57m Sandstone		0.00m-3.96m INNER LINING - CASING = Pvc3.96m-4.57m INNER LINING - SCREEN = Pvc	24/02/1983	1681	South West	-38.02507096	145.1080742
76417	Domestic	0.00m-0.50m TOP SOIL 0.50m-2.85m LIGHT GREENY BROWN FINE SAND 2.85m-3.00m VERY DARK BROWN TO BLACK SILTY SAND 3.00m-4.50m LIGHT GREY TO WHITE FINE MED SAND		3.50m-4.50m Sand		0.00m-3.50m INNER LINING - CASING = Pvc3.50m-4.50m INNER LINING - SCREEN = Pvc	22/03/1983	1683	South	-38.05407995	145.1238525
115976	Groundwater Investigation	0.00m-0.40m DARK BROWN SILTY TOP SOIL 0.40m-1.00m DARK BROWN SILTY CLAY 1.00m-9.87m MOTTLED YELLOW GREY & BROWN SANDY-SILTY CLAYS				0.00m-7.87m INNER LINING - CASING = Pvc7.87m-9.87m INNER LINING - SCREEN = Pvc 7.00m-7.87m OUTER LINING - GRAVEL = Bentonite 7.87m-9.87m OUTER LINING - GRAVEL = Gravel	18/01/1990	1704	South East	-38.05366356	145.158475
81734	Domestic	0.00m-0.15m TOP SOIL 0.15m-3.00m FINE BROWN SAND 3.00m-4.00m TACKY FINE WHITE SAND 4.00m-5.50m GREY CLAY 5.50m-8.00m FINE TACKY SAND 8.00m-9.50m FINE CLEAN SAND 9.50m-11.00m BROWN LIGNIOUS SAND 11.00m-14.60m BROWN MEDIUM SAND		11.70m-14.60m Sand		0.00m-11.70m INNER LINING - CASING = Pvc11.70m-14.60m INNER LINING - SCREEN = Pvc	03/10/1983	1706	North	-37.94445447	145.1104847
WRK056389	Observation						03/12/2010	1707	North West	-37.97613709	145.0934932
76425	Domestic	0.00m-0.61m LOAM 0.61m-1.06m WHITE SAND 1.06m-1.37m BLACK CLAY 1.37m-1.83m GREY SAND AND SHELLS 1.83m-2.27m BLACK CLAY 2.27m-2.74m GREY SAND AND SEA SHELLS 2.74m-3.35m BLACK CLAY 3.35m-3.66m GREY SAND AND SEA SHELLS 3.66m-4.57m BLACK CLAY 4.57m-5.18m GREY SAND AND SEA SHELLS		4.57m-5.18m Sand		0.00m-4.57m INNER LINING - CASING = Pvc4.57m-5.18m INNER LINING - SCREEN = Pvc	12/12/1983	1715	South West	-38.02606497	145.1082762
76329	Domestic, Stock					0.00m-4.26m INNER LINING - CASING = Abs Plastic0.00m-4.26m INNER LINING - SCREEN = Not Known	01/12/1972	1716	South West	-38.02029106	145.0966913
81778	Not Known	0.00m-0.30m TOPSOIL 0.30m-2.00m LOOSE SAND 2.00m-4.00m CLAYEY SAND 4.00m-5.50m WELL-CEMENTED SAND 5.50m-15.00m QUARTZITE SAND 15.00m-19.00m SILTY MARINE SAND		3.50m-17.00m Sand		0.00m-3.50m INNER LINING - CASING = Pvc3.50m-17.00m INNER LINING - SCREEN = Pvc17.00m-17.50m INNER LINING - CASING = Pvc 3.00m-17.50m OUTER LINING - GRAVEL = Not Known	01/06/1988	1719	North East	-37.96823224	145.1435707
WRK095138	Investigation	0.00m-0.30m SURFACE SOIL 0.30m-2.00m MOTTLEY CLAY 2.00m-3.50m LIGHT BROWN CLAY 3.50m-4.00m WHITE CLAY 4.00m-6.50m LIGHT BROWN CLAY 6.50m-8.00m COURSE SANDY FORMATION 8.00m-10.00m SANDY SILTY CLAY 10.00m-12.00m LIGHT BROWN CLAY 12.00m-13.50m RED CLAY 13.50m-15.00m CLAYWITH SMALL LAYERS SANDSTONE 15.00m-18.00m MARLE 18.00m-19.00m SANDY MARLE 19.00m-32.50m MARLE WITH HARD LAYERS OF SANDSTONE 32.50m-37.00m SOFT LIMEY MARLE 37.00m-43.50m FINE MEDIUM SAND 43.50m-46.00m SILTY SAND		37.50m-43.50m Sand		0.00m-37.50m INNER LINING - CASING = Pvc Class 937.50m-43.50m INNER LINING - SCREEN = Screened Pvc 35.00m-43.00m OUTER LINING - GRAVEL = Gravel	03/10/2016	1720	North East	-37.9907193	145.1417675
76494	Domestic	0.00m-0.60m BLACK SANDY TOP SOIL 0.60m-1.00m BROWN CLAY SAND - FINE 1.00m-2.13m YELLOW CALCAREOUS SHELLY SAND- COARSE 2.13m-3.00m AS ABOVE TENDING GREY TO BLACK AND FINE GRAINED 3.00m-4.50m LIGNEOUS BLACK CLAY		2.10m-2.74m Marl		-0.10m-2.10m INNER LINING - CASING = Pvc Class 122.10m-2.74m INNER LINING - SCREEN = Pvc Class 12 1.50m-3.00m OUTER LINING - GRAVEL = Gravel	09/01/1987	1729	South	-38.03260896	145.1116973
81817	Groundwater Investigation	0.00m-1.00m SAND BROWN GREY 1.00m-4.00m CLAYEY BROWN MEDIUM SAND 4.00m-6.00m CLAYEY MEDIUM GREY SAND 6.00m-6.75m COARSE GREY SAND 6.75m-10.50m FINE GREY SAND 10.50m-19.67m DARK BROWN & GREY FINE & COARSE SAND SOME BLACK				-0.30m-10.00m INNER LINING - CASING = Pvc10.00m-19.67m INNER LINING - SCREEN = Pvc 10.00m-19.67m OUTER LINING - GRAVEL = Gravel	04/09/1991	1729	North East	-37.97049427	145.1418627
WRK056387	Observation						03/12/2010	1733	North West	-37.9761321	145.093186
WRK056390	Observation						03/12/2010	1738	North West	-37.97613118	145.0931291
WRK056386	Observation						03/12/2010	1738	North West	-37.97613118	145.0931291
WRK056392	Observation						03/12/2010	1738	North West	-37.97613118	145.0931291
WRK056391	Observation						03/12/2010	1740	North West	-37.97613081	145.0931063
WRK056385	Observation	0.00m-0.40m top soil 0.40m-1.50m sand 1.50m-7.50m sandy clay		3.00m-7.50m Sand		0.00m-3.00m INNER LINING - CASING = Pvc3.00m-7.50m INNER LINING - SCREEN = Pvc 0.00m-1.50m OUTER LINING - GRAVEL = Cement 1.50m-2.50m OUTER LINING - GRAVEL = Bentonite 2.50m-7.50m OUTER LINING - GRAVEL = Gravel	03/12/2010	1741	North West	-37.97613044	145.0930836
WRK056388	Observation						03/12/2010	1741	North West	-37.97613044	145.0930836
WRK982921								1747	West	-38.00307649	145.0892652
WRK042466	Irrigation					56.85m-0.00m OUTER LINING - GRAVEL = Packer	31/12/1963	1764	West	-37.99487492	145.0964948

Station	UseType	DrillersLog	Stratigraphy	Geology	Levels	Construction	CompleteDate	Distance	Direction	Latitude	Longitude
130775	Not Used - Capped	0.00m-2.50m GREY FINE SOIL 2.50m-3.50m LIGHT TAN/BROWN CLAY/COARSE SAND LAYERS 3.50m-7.50m LIGHT BROWN/SILTY/FINE SAND CLAY 7.50m-11.50m DARK BROWN WEATHERED SANDSTONE 11.50m-48.40m BLACK/GREY SILTY CLAY FINE SHELLS 48.40m-50.50m BROWN SILTY CLAY/FINE SHELLS 50.50m-52.10m HARD GREN LIMESTONE 52.10m-53.30m SOFT GREEN LIMESTONE 53.30m-55.70m BROWN FIRM CLAY/FINE SAND 55.70m-57.00m WHITE/BROWN FIRM CLAY 57.00m-61.50m BLACK/GREY BASALT 61.50m-61.80m WEATHERED BLACK BASALT 61.80m-63.70m WEATHERED BLACK/GREY BASALT 63.70m-64.00m GREY/BROWN CLAY BASALT GRAVEL				-0.20m-55.65m INNER LINING - CASING = Abs Plastic60.40m-64.00m INNER LINING - CASING = Abs Plastic0.00m-40.00m OUTER LINING - GRAVEL = Cement 40.00m-64.00m OUTER LINING - GRAVEL = Gravel	23/11/1996	1771	West	-37.99469792	145.0966698
76449	Domestic	0.00m-1.00m BLACK SAND 1.00m-3.04m GREY SAND					26/04/1983	1778	South	-38.04811797	145.1190025
WRK070392	Observation	0.00m-0.60m FILL 0.60m-2.20m CLAY 2.20m-10.00m CLAY		6.00m-10.00m Clay		0.00m-6.00m INNER LINING - CASING = Pvc6.00m-10.00m INNER LINING - SCREEN = Pvc 0.00m-4.00m OUTER LINING - GRAVEL = Cement 4.00m-5.00m OUTER LINING - GRAVEL = Bentonite 5.00m-10.00m OUTER LINING - GRAVEL = Gravel	20/08/2012	1786	North	-37.94740522	145.1372079
76442	Domestic	0.00m-7.62m SAND		7.00m-7.62m Sand		0.00m-7.00m INNER LINING - CASING = Pvc7.00m-7.62m INNER LINING - SCREEN = Pvc	12/01/1983	1797	South	-38.03705097	145.1133493
81814	Domestic, Miscellaneous, Stock	0.00m-1.10m TOP SOIL 1.10m-18.00m CLAY 18.00m-42.00m DECOMPOSED ROCK (MUDSTONE) 42.00m-48.00m CLAY 48.00m-67.00m COAL/SAND		54.70m-67.00m Sand		0.00m-54.70m INNER LINING - CASING = Not Known54.70m-67.00m INNER LINING - SCREEN = Not Known	01/02/1990	1797	North West	-37.96255677	145.0930613
WRK986390							02/06/2008	1800	South	-38.05412696	145.1222197
WRK054968	Domestic & Stock	0.00m-2.00m fien sand 2.00m-15.00m clay 15.00m-30.00m coarse sand		0.50m-22.00m Clay 22.00m-28.00m Sand 28.00m-30.00m Sand		0.50m-22.00m INNER LINING - CASING = Pvc22.00m-28.00m INNER LINING - SCREEN = Pvc28.00m-30.00m INNER LINING - CASING = Pvc 0.00m-9.00m OUTER LINING - GRAVEL = Cement 9.00m-10.00m OUTER LINING - GRAVEL = Bentonite 10.00m-30.00m OUTER LINING - GRAVEL = Gravel	02/04/2010	1802	South West	-38.02338559	145.1018612
81795	Groundwater Investigation	0.00m-3.00m BROWN SANDY CLAY 3.00m-18.00m BROWN & GREY SILTY SAND 18.00m-19.00m GREY SILTSTONE			Date/time: 1996-10-03 0000 Quality: 47 WLMP: 3.83m DBNS: RWL:	3.00m-19.00m INNER LINING - SCREEN = Slotted Pvc10.00m-3.00m INNER LINING - CASING = Pvc	23/08/1991	1803	North	-37.94354135	145.1209776
125273	Groundwater Investigation, State Observation Network	0.00m-0.50m DRY SAND 0.50m-2.00m CLAY 2.00m-5.50m SANDY CLAY 5.50m-8.00m SANDY SILT & GRAVEL 8.00m-11.00m GRAVEL & CLAY (WET) 11.00m-12.00m SANDY CLAY			Date/time: 2016-05-24 1305 Quality: 43 WLMP: 6.33m DBNS: 6.33m RWL: 19.78mAHD	0.00m-8.00m INNER LINING - CASING = Pvc8.00m-11.00m INNER LINING - SCREEN = Pvc11.00m-12.00m INNER LINING - CASING = Pvc 5.00m-6.00m OUTER LINING - GRAVEL = Bentonite 6.00m-12.00m OUTER LINING - GRAVEL = Gravel	26/01/1995	1812	North East	-37.98257141	145.1395782
81434	Groundwater Investigation						23/04/1976	1813	North East	-37.96753622	145.1451816
81433	Groundwater Investigation			28.00m-30.00m Clay		0.00m-28.00m INNER LINING - CASING = Pvc28.00m-30.00m INNER LINING - SCREEN = Pvc30.00m-32.00m INNER LINING - CASING = Pvc 0.00m-1.00m OUTER LINING - GRAVEL = Cement	09/04/1976	1813	North East	-37.96753622	145.1451816
125272	Groundwater Investigation, State Observation Network	0.00m-0.50m DRY SAND 0.50m-2.00m CLAY 2.00m-5.50m SANDY CLAY 5.50m-8.00m SAND SILT & CLAY 8.00m-11.00m GRAVEL & CLAY (WET) 11.00m-16.00m SANDY CLAY 16.00m-18.00m GREY SILT SANDY CLAY 18.00m-23.50m DIRTY SAND & GRAVEL (WET) 23.50m-40.00m GREY SILTY CLAY			Date/time: 2016-05-24 1306 Quality: 43 WLMP: 7.28m DBNS: 7.28m RWL: 18.83mAHD	0.00m-20.50m INNER LINING - CASING = Pvc20.50m-22.50m INNER LINING - SCREEN = Pvc22.50m-40.00m INNER LINING - CASING = Pvc 17.00m-0.00m OUTER LINING - GRAVEL = Seal	26/01/1995	1813	North East	-37.98256523	145.1395867
129984	Groundwater Investigation, Observation	0.00m-16.00m CLAY 16.00m-41.00m SAND 41.00m-56.00m MUDSTONE 56.00m-70.00m CLAY & COAL 70.00m-95.00m FRACTURED ROCK 95.00m-130.00m FRACTURED ROCK				-0.30m-48.00m INNER LINING - CASING = Not Known-0.30m-95.00m INNER LINING - CASING = Not Known77.00m-95.00m INNER LINING - SCREEN = Not Known	02/03/1997	1817	North West	-37.9668558	145.0930524
WRK990503	Domestic						02/04/2009	1818	South	-38.05252543	145.1206879
WRK059399	Observation						10/11/2010	1821	South East	-38.01088794	145.1568902
WRK043374	Irrigation	0.00m-2.00m FINE & DRY SAND 2.00m-4.00m CLAY/SAND 4.00m-29.00m BRIGHTON GROUP 29.00m-42.00m SILTY SAND 42.00m-45.00m CLAY 45.00m-47.00m MUDSTONE CW 47.00m-66.00m MUDSTONE SOFT MW 66.00m-69.00m SANDSTONE HARD MW 69.00m-96.00m MUDSTONE FIRM MW		90.00m-96.00m Mudstone		0.00m-90.00m INNER LINING - CASING = Pvc90.00m-96.00m INNER LINING - SCREEN = Slotted Steel 0.00m-61.00m OUTER LINING - GRAVEL = Cement 61.00m-96.00m OUTER LINING - GRAVEL = Seal	21/01/2009	1826	East	-37.99491873	145.1442625
81796	Groundwater Investigation	0.00m-33.80m BROWN & GREY SAND			Date/time: 1996-10-03 0000 Quality: 47 WLMP: 6.76m DBNS: RWL:	0.00m-3.00m INNER LINING - CASING = Pvc3.00m-33.80m INNER LINING - SCREEN = Pvc	03/09/1990	1828	North	-37.94476726	145.1300504
WRK987759								1850	South	-38.06081951	145.1492894
WRK990264	Groundwater Investigation						13/03/2009	1862	North East	-37.99051629	145.1433942
WRK987859								1866	South	-38.06253379	145.1402873
WRK055928	Domestic & Stock	0.00m-10.00m clay sands 10.00m-20.00m clay orange 20.00m-24.00m clay sands 24.00m-25.00m course sand 25.00m-28.00m clay sand		0.00m-20.00m Clay 20.00m-32.00m Sand		0.00m-20.00m INNER LINING - CASING = Pvc20.00m-32.00m INNER LINING - SCREEN = Pvc 0.00m-10.00m OUTER LINING - GRAVEL = Cement 10.00m-32.00m OUTER LINING - GRAVEL = Gravel	21/04/2010	1876	North West	-37.96065617	145.0919018
WRK987858								1878	South	-38.06261466	145.139134
WRK038494	Irrigation, Not Known						31/12/1968	1881	East	-37.99384349	145.144654
81708	Domestic	0.00m-1.00m BLACK LOAM 1.00m-8.00m CLAY 8.00m-10.00m SANDSTONE				0.00m-10.00m INNER LINING - CASING = Pvc0.10m-10.00m INNER LINING - SCREEN = Pvc	08/03/1975	1883	North	-37.95092914	145.1435514
121283	Groundwater Investigation	0.00m-34.00m GREY SAND & CLAY PATCHES		31.00m-34.00m Sand		-0.50m-31.00m INNER LINING - CASING = Pvc31.00m-34.00m INNER LINING - SCREEN = Pvc 0.00m-2.00m OUTER LINING - GRAVEL = Cement 29.00m-30.00m OUTER LINING - GRAVEL = Bentonite 30.00m-34.00m OUTER LINING - GRAVEL = Gravel	20/10/1993	1884	South	-38.04069297	145.1156484
76490	Domestic	0.00m-5.00m SAND		4.00m-5.00m Sand		0.00m-4.00m INNER LINING - CASING = Pvc4.00m-5.00m INNER LINING - SCREEN = Pvc	31/12/1985	1887	South	-38.03712298	145.1122074
114249	Groundwater Investigation	0.00m-0.20m CONCRETE & FILL 0.20m-0.70m BLACK SILTY SAND & BRICKS 0.70m-4.20m FIRM GREY / BROWN SILTY CLAYEY SANDS 4.20m-4.25m BROWN HARD IRONSTONE LENSES 4.25m-6.00m BROWN SILTY FIRM SAND		3.00m-6.00m Sand		-0.10m-3.00m INNER LINING - CASING = Pvc Class 183.00m-6.00m INNER LINING - SCREEN = Pvc Class 18 1.80m-2.70m OUTER LINING - GRAVEL = Bentonite 2.70m-6.00m OUTER LINING - GRAVEL = Gravel	15/09/1992	1888	West	-38.00486008	145.0870682
76554	Not Known						01/01/1988	1888	South	-38.04506997	145.1172224
WRK040847	Commercial, Miscellaneous	0.00m-0.52m FILLING 0.52m-4.57m CLAY GREY 4.57m-8.23m CLAY GREY SANDY 8.23m-11.28m CLAY YELLOW SANDY 11.28m-15.85m CLAY GREY SANDY 15.85m-24.08m SAND FINE 24.08m-24.99m CLAY YELLOW SANDY 24.99m-31.09m CLAY RED STONEY 31.09m-31.70m CLAY BROWN AND GRAVEL 31.70m-32.00m CLAY GREY 32.00m-35.05m CLAY BROWN AND GREY 35.05m-36.27m CLAY BROWN WITH GRAVEL 36.27m-40.54m CLAY GREEN/GRAVEL 40.54m-43.59m CLAY GREEN SANDY 43.59m-48.16m CLAY MOTTLE 48.16m-65.53m CLAY GREEN SANDY 65.53m-66.45m BASALT WEATHERED 66.45m-74.37m BASALT 74.37m-78.03m BASALT AND CLAY 78.03m-79.55m CLAY LIGNEOUS AND SAND 79.55m-92.35m CLAY SILTY AND GRAVELLY				0.00m-10.67m INNER LINING - CASING = Steel10.67m-66.75m INNER LINING - CASING = Steel66.75m-78.94m INNER LINING - SCREEN = Steel 78.94m-91.13m INNER LINING - CASING = Not Known64.00m-0.00m OUTER LINING - GRAVEL = Seal	23/04/1974	1890	South	-38.06265179	145.1426574
76500	Domestic			3.00m-4.00m Clay		0.00m-3.00m INNER LINING - CASING = Pvc3.00m-4.00m INNER LINING - SCREEN = Pvc	01/01/1988	1891	South	-38.06229676	145.1452993

Station	UseType	DrillersLog	Stratigraphy	Geology	Levels	Construction	CompleteDate	Distance	Direction	Latitude	Longitude
121282	Groundwater Investigation	0.00m-31.00m GREY SAND & CLAY PATCHES		22.00m-31.00m Sand		-0.50m-22.00m INNER LINING - CASING = Pvc22.00m-31.00m INNER LINING - SCREEN = Pvc 0.00m-2.00m OUTER LINING - GRAVEL = Cement 19.00m-20.00m OUTER LINING - GRAVEL = Bentonite 20.00m-31.00m OUTER LINING - GRAVEL = Gravel	20/10/1993	1892	South	-38.04059897	145.1154224
114248	Groundwater Investigation	0.00m-0.15m CONCRETE 0.15m-0.85m BLACK MOIST SILTY CLAY SAND 0.85m-6.00m FIRM GREY/BROWN SILTY CLAY & CLAYEY SANDS		3.00m-6.00m Clay		-0.10m-3.00m INNER LINING - CASING = Pvc Class 183.00m-6.00m INNER LINING - SCREEN = Pvc Class 18 2.00m-2.50m OUTER LINING - GRAVEL = Bentonite 2.50m-6.00m OUTER LINING - GRAVEL = Gravel	14/09/1992	1897	West	-38.00494808	145.0869522
WRK992378								1898	West	-38.00493112	145.0869392
WRK099816	Investigation	0.00m-0.50m SURFACE SOIL 0.50m-2.20m MOTTLEY CLAY 2.20m-2.50m COFFEE ROCK 2.50m-5.50m GREYCLAY 5.50m-6.50m LIGHT BROWN CLAY 6.50m-7.50m COURSE SAND 7.50m-9.00m GREYCLAY 9.00m-11.80m COFFEE ROCK $ CLAY 11.80m-13.00m MEDIUM WHITE SAND 13.00m-13.80m SOFY CLAY 13.80m-14.30m DARK BROWN CLAY 14.30m-15.60m MARINE CLAY 15.60m-28.40m MARINE CLAY& LAYERS OF SANDSTONE 28.40m-32.00m HARD SANDSTONE 32.00m-32.60m MARINE CLAY 32.60m-37.70m MEDIUM/COURSE SAND 37.70m-42.00m FIE/MEDIUM SAND		36.00m-42.00m Sand		0.00m-36.00m INNER LINING - CASING = Pvc Class 1236.00m-42.00m INNER LINING - SCREEN = Screened Pvc 26.00m-42.00m OUTER LINING - GRAVEL = Gravel	11/05/2017	1899	North East	-37.99139735	145.1441872
81701	Domestic, Stock	0.00m-1.22m SURFACE SOIL 1.22m-3.05m CLAY 3.05m-3.66m ROCK 3.66m-5.49m SOFT CLAY 5.49m-6.10m GRAVEL					27/06/1974	1902	West	-37.99267293	145.0941038
134548	Groundwater Investigation	0.00m-1.30m SILTY SAND 1.30m-3.20m SAND MED 3.20m-5.70m SAND FINE TO MED 5.70m-6.90m CLAYEY SAND 6.90m-11.50m SAND COARSE				0.00m-10.50m INNER LINING - CASING = Pvc10.50m-11.50m INNER LINING - SCREEN = Pvc	20/08/1996	1905	North West	-37.94788164	145.097777
114247	Groundwater Investigation	0.00m-0.15m CONCRETE & FILL 0.15m-0.80m BLACK MOIST SILTY CLAY SAND 0.80m-1.20m FIRM GREY / BROWN SILTY CLAY 1.20m-6.00m FIRM CLAY / BROWN CLAYEY SAND		3.00m-6.00m Sand		-0.10m-3.00m INNER LINING - CASING = Pvc Class 183.00m-6.00m INNER LINING - SCREEN = Pvc Class 18 2.00m-2.50m OUTER LINING - GRAVEL = Bentonite 2.50m-6.00m OUTER LINING - GRAVEL = Gravel	14/09/1992	1907	West	-38.00490108	145.0868392
WRK059381	Observation	0.00m-0.00m NULL				0.00m-0.00m OUTER LINING - GRAVEL = Not Known	29/05/2015	1910	North	-37.94730978	145.1394932
WRK065493	Observation	0.00m-0.00m NULL				0.00m-0.00m OUTER LINING - GRAVEL = Not Known	29/05/2015	1910	North	-37.94730978	145.1394932
WRK059377	Observation	0.00m-0.00m NULL				0.00m-0.00m OUTER LINING - GRAVEL = Not Known	29/05/2015	1910	North	-37.94730978	145.1394932
WRK059379	Observation	0.00m-0.00m NULL				0.00m-0.00m OUTER LINING - GRAVEL = Not Known	29/05/2015	1910	North	-37.94730978	145.1394932
WRK059376	Observation	0.00m-0.00m NULL				0.00m-0.00m OUTER LINING - GRAVEL = Not Known	29/05/2015	1910	North	-37.94730978	145.1394932
WRK059380	Observation	0.00m-0.00m NULL				0.00m-0.00m OUTER LINING - GRAVEL = Not Known	29/05/2015	1910	North	-37.94730978	145.1394932
WRK065494	Observation	0.00m-0.00m NULL				0.00m-0.00m OUTER LINING - GRAVEL = Not Known	29/05/2015	1910	North	-37.94730978	145.1394932
WRK059378	Observation	0.00m-0.00m NULL				0.00m-0.00m OUTER LINING - GRAVEL = Not Known	29/05/2015	1910	North	-37.94730978	145.1394932
WRK065492	Observation	0.00m-0.00m NULL				0.00m-0.00m OUTER LINING - GRAVEL = Not Known	29/05/2015	1910	North	-37.94730978	145.1394932
109581	Observation, State Observation Network	0.00m-0.60m TOP SOIL 0.60m-1.80m SAND DRY 1.80m-5.20m MARL SHELLS 5.20m-7.00m SAND SHELLS (WATER) 7.00m-8.80m GREY GREEN CLAY 8.80m-15.90m GREY GREEN BROWN CLAY 15.90m-19.50m STONE CLAY 19.50m-22.90m CLAY GREEN BROWN 22.90m-30.50m SILTY CLAY GREEN MARL 30.50m-33.50m FIRM CLAY GRAVEL CEMENYED 33.50m-68.00m SILTY MARL SHELLS 68.00m-71.30m DARKER BROWN CLAY MARL 71.30m-71.60m HARD STONE BASALT 71.60m-74.40m HARD STONE 74.40m-75.00m SAND BAR PY RITES 75.00m-81.70m BROWN COAL 81.70m-83.80m HARD STONE GREY CLAY (BEDROCK)		1.00m-6.10m Marl	Date/time: 1979-04-24 0000 Quality: 43 WLMP: 0.56m DBNS: 0.53m RWL: 1.11mAHD	0.00m-1.00m INNER LINING - CASING = Pvc1.00m-6.10m INNER LINING - SCREEN = Pvc 0.00m-1.00m OUTER LINING - GRAVEL = Cement 1.00m-6.10m OUTER LINING - GRAVEL = Gravel	06/07/1973	1913	South	-38.04801999	145.1173975
109582	Observation, State Observation Network			73.76m-83.82m Coal	Date/time: 1984-12-31 0100 Quality: 43 WLMP: DBNS: RWL:	0.00m-73.76m INNER LINING - CASING = Pvc73.76m-83.82m INNER LINING - SCREEN = Pvc 0.00m-1.00m OUTER LINING - GRAVEL = Cement 71.63m-73.76m OUTER LINING - GRAVEL = Cement 73.76m-84.40m OUTER LINING - GRAVEL = Gravel	06/07/1973	1913	South	-38.04801999	145.1173975
76556	Not Known						01/01/1988	1913	South West	-38.025017	145.1047153
WRK985098								1916	East	-38.00583474	145.1524496
WRK987857	Domestic & Stock	0.00m-0.50m FILL (GRAVELS) 0.50m-4.00m CLAYEY SANDS (DARK)				0.00m-0.30m OUTER LINING - GRAVEL = Cement 0.30m-0.70m OUTER LINING - GRAVEL = Bentonite 0.70m-4.00m OUTER LINING - GRAVEL = Gravel	22/09/2008	1927	South	-38.06307805	145.139943
WRK989888	Domestic						13/02/2009	1936	West	-38.01042954	145.086466
81696	Not Known	0.00m-0.30m SURFACE SOIL 0.30m-1.22m SAND 1.22m-3.96m CLAY 3.96m-4.27m SLOPPY CLAYEY SAND 4.27m-12.80m SAND CLAY 12.80m-16.76m CLAYEY SAND 16.76m-21.34m MARINE STICKY CLAY 21.34m-21.94m BROKEN ROCK PIECES 21.94m-45.72m MARINE SILT AND SHELL 45.72m-49.68m LIGHT MARINE SILT SHELL 49.68m-50.29m LIMESTONE 50.29m-54.86m SHELL SILT FINE SAND 54.86m-55.17m SANDSTONE 55.17m-56.08m COARSE SAND				0.00m-49.99m INNER LINING - CASING = Not Known49.98m-51.20m INNER LINING - SCREEN = Not Known49.38m-0.00m OUTER LINING - GRAVEL = Seal	22/10/1973	1937	North West	-37.95353972	145.0927252
125270	Groundwater Investigation, State Observation Network	0.00m-1.00m DRY SAND 1.00m-2.50m CLAY 2.50m-6.50m SANDY CLAY 6.50m-9.00m DIRTY SAND (WET) 9.00m-14.00m SANDY CLAY 14.00m-16.00m GREY SILTY CLAY 16.00m-18.00m GREY DIRTY SAND & GRAVEL (WET) 18.00m-30.00m SANDY CLAY			Date/time: 2016-05-24 1324 Quality: 43 WLMP: 6.81m DBNS: 6.81m RWL: 20.45mAHD	0.00m-16.00m INNER LINING - CASING = Pvc16.00m-18.00m INNER LINING - SCREEN = Pvc18.00m-30.00m INNER LINING - CASING = Pvc 10.00m-11.00m OUTER LINING - GRAVEL = Bentonite	16/01/1995	1939	North East	-37.98195089	145.1408393
125271	Groundwater Investigation, State Observation Network	0.00m-1.00m DRY SAND 1.00m-2.50m CLAY 2.50m-6.50m SANDY CLAY 6.50m-9.00m DIRTY SAND (WET) 9.00m-10.00m SANDY CLAY			Date/time: 2016-05-24 1323 Quality: 43 WLMP: 5.93m DBNS: 5.93m RWL: 21.33mAHD	0.00m-7.00m INNER LINING - CASING = Pvc7.00m-9.00m INNER LINING - SCREEN = Pvc9.00m-10.00m INNER LINING - CASING = Pvc 4.50m-5.00m OUTER LINING - GRAVEL = Bentonite 5.00m-10.00m OUTER LINING - GRAVEL = Gravel	17/01/1995	1940	North East	-37.9819566	145.1408533
76560	Not Known						01/01/1988	1943	South West	-38.02516601	145.1039023
WRK058239	Observation						10/11/2010	1944	East	-38.01052164	145.1582434
76451	Domestic	0.00m-0.50m TOP SOIL 0.50m-0.80m FINE SAND 0.80m-3.10m COARSE SAND, SHELLS		2.10m-3.10m Marl		0.00m-2.10m INNER LINING - CASING = Pvc2.10m-3.10m INNER LINING - SCREEN = Pvc	20/02/1983	1944	South	-38.05878396	145.1255566
76465	Domestic	0.00m-1.00m GREY SANDY LOAM 1.00m-2.00m FINE GREY SAND 2.00m-3.50m GREY MEDIUM SAND 3.50m-4.50m COARSE SAND		4.00m-4.50m Sand		4.00m-4.50m INNER LINING - SCREEN = Wire W S/Steel	21/01/1983	1945	South	-38.05712598	145.1233186
134549	Groundwater Investigation	0.00m-0.40m SILTY SAND 0.40m-0.60m SILTY CLAYEY SAND 0.60m-2.60m CLAY 2.60m-3.40m SAND 3.40m-4.70m CLAYEY SAND 4.70m-9.00m SAND FINE 9.00m-15.00m SAND MED TO COARSE				0.00m-13.50m INNER LINING - CASING = Pvc13.50m-15.00m INNER LINING - SCREEN = Pvc	21/08/1996	1946	North West	-37.9511907	145.0940271
WRK043226	Groundwater Investigation	0.00m-2.30m TOP SOIL 2.30m-5.00m PEATY FORMATION 5.00m-9.00m SILTY SAND AND CLAY 9.00m-18.00m SAND 18.00m-33.00m MARL 33.00m-36.00m NEWPORT FORMATION 36.00m-51.00m VERY SOFT SHALE 51.00m-55.00m FIRMER SHALE 55.00m-78.00m HARDER SHALE				0.00m-55.50m INNER LINING - CASING = Pvc0.00m-55.40m OUTER LINING - GRAVEL = Seal	22/04/2003	1959	North East	-37.96427748	145.1481873
76336	Miscellaneous					0.00m-90.00m INNER LINING - CASING = Pvc80.00m-92.96m INNER LINING - SCREEN = Pvc 0.00m-30.00m OUTER LINING - GRAVEL = Cement	15/02/1974	1975	South	-38.06332378	145.1435864
WRK068557	Observation						21/01/2012	1975	East	-38.01085646	145.158907
WRK068558	Observation						21/01/2012	1976	East	-38.01104795	145.1590503
WRK062277	Observation	0.00m-0.60m SAND 0.60m-1.50m CLAY 1.50m-5.50m SAND		0.00m-2.50m Clay 2.50m-5.50m Sand		0.00m-2.50m INNER LINING - CASING = Pvc2.50m-5.50m INNER LINING - SCREEN = Pvc 0.00m-1.00m OUTER LINING - GRAVEL = Cement 1.00m-2.00m OUTER LINING - GRAVEL = Bentonite 2.00m-5.50m OUTER LINING - GRAVEL = Gravel	01/09/2011	1976	North East	-37.99148099	145.1451349

Station	UseType	DrillersLog	Stratigraphy	Geology	Levels	Construction	CompleteDate	Distance	Direction	Latitude	Longitude
WRK058238	Observation	0.00m-0.60m sandy silt 0.60m-2.80m sitly clay 2.80m-6.00m clayey sand		2.00m-6.00m Sand		0.00m-2.00m INNER LINING - CASING = Pvc2.00m-6.00m INNER LINING - SCREEN = Pvc 0.00m-0.30m OUTER LINING - GRAVEL = Cement 0.30m-1.50m OUTER LINING - GRAVEL = Bentonite 1.50m-6.00m OUTER LINING - GRAVEL = Gravel	10/11/2010	1982	East	-38.01075755	145.1589209
142438	Groundwater Investigation	0.00m-0.20m CLAY & GRAVEL FILL 0.20m-0.90m SANDY CLAY, DARK BROWN, MOIST 0.90m-2.80m SANDY CLAY, LIGHT BROWN, PALE BROWN, MOIST, SOFT, FINE & MED 2.80m-8.00m CLAYEY SAND, PALE BROWN, ORANGE, MED & COARSE SAND, MOIST/WE		4.50m-8.00m Sand		0.00m-4.50m INNER LINING - CASING = Pvc Class 184.50m-8.00m INNER LINING - SCREEN = Pvc Class 18 0.00m-0.50m OUTER LINING - GRAVEL = Cement 3.80m-4.30m OUTER LINING - GRAVEL = Bentonite 4.30m-8.00m OUTER LINING - GRAVEL = Gravel	15/06/1998	1987	North	-37.94323225	145.1298614
WRK059398	Observation						10/11/2010	1990	East	-38.01110556	145.1592767
WRK059375	Observation	0.00m-0.50m FILL 0.50m-5.00m CLAY 5.00m-10.00m SAND		5.90m-8.90m Sand		0.00m-5.90m INNER LINING - CASING = Pvc5.90m-8.90m INNER LINING - SCREEN = Pvc 0.00m-4.90m OUTER LINING - GRAVEL = Bentonite 4.90m-8.90m OUTER LINING - GRAVEL = Seal	21/09/2011	1992	North	-37.94738552	145.1410891
81762	Domestic	0.00m-1.50m FILL SANDY BLACK SOIL 1.50m-4.00m SAND 4.00m-6.00m CLAY SAND 6.00m-13.50m SAND MED TO FINE GRAINED 13.50m-0.00m BEDROCK		12.00m-13.50m Sand		0.00m-12.00m INNER LINING - CASING = Pvc12.00m-13.50m INNER LINING - SCREEN = Pvc	31/12/1983	1993	North East	-37.98280334	145.141837
WRK987957	Domestic	0.00m-0.50m FILL: SANDY GRAVEL 0.50m-2.60m SAND 2.60m-7.50m SILTY SAND 7.50m-8.80m CLAYEY SAND 8.80m-11.10m SANDY CLAY				0.00m-1.00m OUTER LINING - GRAVEL = Cement 2.50m-3.50m OUTER LINING - GRAVEL = Bentonite 6.00m-10.00m OUTER LINING - GRAVEL = Gravel	25/09/2008	1993	South	-38.06116978	145.1287302
81748	Domestic	0.00m-1.22m LOOSE SANDY SOIL 1.22m-1.83m HARD SOIL 1.83m-3.66m WHITE SAND 3.66m-4.27m CLAY 4.27m-5.18m LUMPY SOIL				0.00m-5.18m INNER LINING - CASING = Not Known	04/09/1983	1995	North East	-37.96083714	145.1489925