



APPENDIX B

Site History Report



B1.0 INTRODUCTION

The Melbourne Metro Rail Project (Melbourne Metro) is a proposed new twin rail alignment approximately 9 km in length between Kensington in the west and South Yarra in the east. The proposed Melbourne Metro alignment would connect into the existing rail network near station Kensington station, run beneath North Melbourne and Parkville, then continue south beneath Swanston Street, under the Yarra River, south and beneath St Kilda Road, then East beneath Toorak Road and Fawkner Park. The alignment connects to the existing rail network at South Yarra.

In general accordance with recommendations within the National Environment Protection (Assessment of Site Contamination) Measure (NEPM) 1999¹, this site history report has been undertaken to assist in understanding source and nature of potential contamination that may affect the Melbourne Metro Concept Design ("The Project Area") (Appendix B1).

The Project Area is defined as the Melbourne Metro Concept Design which incorporates the areal extent of the Stations, Portals & the Tunnel.

The Offsite Assessment Area is the zone that incorporates land use activities within:

- 500m from the central alignment of the station Boxes and Portals ¹⁾
- 100m from the central alignment of the Tunnel ²⁾

Notes:

1) Detailed review of Audits was undertaken within 250m of stations and portals.

2) Based on the capacity for groundwater contamination to move beneath the assessment area, Groundwater Quality Restricted Use Zones (GQRUZ) sites were reviewed within 500m of both stations and tunnelled and open cut sections of the alignment.

The purpose of considering Offsite historic activities is to highlight potential contamination issues that may be a source of broader impacts to be considered for the Melbourne Metro construction or operation. The assessment of significance is a subject judgement that considers the nature of the activity and the potential for contamination to migrate via soil and/or groundwater to the Melbourne Metro infrastructure.

This factual site history report comprises a summary of historical activities which have occurred at the Project Area and within the Offsite Assessment Area and the identification of potential contaminants of interest (COI) associated with these types of activities or historical land uses.

In addition to site history assessment of the above described Melbourne Metro Project Area, a Preliminary Site Investigation (PSI) comprising a site history review (without an intrusive assessment) has been undertaken for the "Western Turnback" in West Footscray. The results of the PSI have been included in this report.

B1.1 Objectives

The objectives of this site history report are to:

- Identify potential contamination sources, nature of contamination and the affected media;
- Highlight areas of potential contamination which may be intercepted by the Melbourne Metro Concept Design; and
- Inform the Melbourne Metro risk register(s) and the various phases of intrusive investigation (Concept Design and Procurement Phase).

¹ As amended in 2013



This report, is a reference document that should be readily updated as new or additional historical information relating to contamination is identified that may affect the Melbourne Metro Concept Design.

The findings of this site history review would support the Melbourne Metro Concept Design Interpretative reports for contamination of land; soil, soil vapour/gas and groundwater.

B1.2 Background

The Melbourne Metro Concept Design is expected to include the construction of tunnels and associated structures, including portals and stations. Figures presented in Appendix B1 shows the proposed Melbourne Metro alignment, stations and portals.

Five new stations are proposed to be constructed at:

- Arden (North Melbourne);
- Parkville (Royal Parade and Grattan Street);
- CBD North (connected to Melbourne Central);
- CBD South (connected to Flinders Street station); and
- The Domain Interchange (St Kilda Road).

The Western Portal is located within a current rail and road alignment. Arden station is located within industrial land. The Parkville, CBD North, CBD South and Domain station boxes are located predominantly within roads and road reserves. The Eastern Portal and decline are located within the existing rail corridor in South Yarra.

The Melbourne Metro would involve construction of underground infrastructure, above and below the existing groundwater table and would involve:

- Excavation of fill, soil and rock (collectively referred to as "spoil");
- Offsite disposal of excavated spoil; and
- Management of groundwater level and excavation in flow disposal.

Therefore, an understanding of the potential for contamination of soil, soil vapour and groundwater which may be intercepted by the Melbourne Metro Concept Design is integral to plan appropriate environmental management.

B1.3 What is contamination?

Land, groundwater and surface water may be contaminated by substances or waste that has the potential to cause adverse impacts to human health and/or the environment.

Contamination of land often results from historic uses associated with inadequate practices for handling, storing and disposing of hazardous waste and chemicals which often reflect the absence of adequate historical environmental regulations relevant to controlling these practices. Contamination may also occur through the importation of contaminated fill or the migration, dispersion or leaching of contamination through soil or groundwater and discharge to hydraulically connected surface waters. Table B1 summarises the typical types of land contamination source.



Table B1: Categories of land contamination

Land contamination type	Typical sources of contamination
Point source contamination (local scale)	<ul style="list-style-type: none"> ■ Sources include chemical spills, leakage of chemicals from landfill sites, storage drums, underground storage tanks, pipes and drains. ■ Leakage of chemicals can occur during industrial plant operation, storage or transportation. ■ Contamination can also arise from deliberate dumping of waste, or the historical use of materials considered appropriate at the time, but no longer considered safe.
Diffuse contamination (broad scale)	Sources are associated with the widespread application of persistent chemicals such as pesticides and fertilizers. These can also be especially difficult and costly to clean up.

The distinction between land contamination and pollution is important from a regulatory perspective. Land may have contaminants present below levels likely to adversely impact on the use of that land, the environment or human health. Pollution of land occurs where contaminant concentrations are sufficient to adversely impact on the beneficial uses, as described in the *State Environment Protection Policy (Prevention and Management of Contamination of Land)* of that land.

B1.4 Structure of this Report

Golder acquired information from a wide range of sources to understanding the nature of potential contamination within the proposed Melbourne Metro Concept Design. Documents, references and other sources of information used in our review are summarised within Section B3.1. Key information identified during the review, as well as supporting tables and text, are provided in the appendices as follows:

- Appendix B1: Figures
- Appendix B2: Summary of relevant guidance for site history review
- Appendix B3: Data extraction methods
- Appendix B4: Summary of historical information to support the understanding of potential contamination for inclusion in the GIS.
- Appendix B5: Western Turnback - West Footscray Preliminary Site Investigation

B2.0 RELEVANT GUIDANCE FOR SITE HISTORY REVIEW

The relevant guidance to support a review of potential activities and land uses with the potential to cause site contamination are summarised in Appendix B2 and briefly described in Table B2.

Table B2: Relevant Guidance for Site History Review

Document	Brief Description
National Environment Protection Measure (NEPM) 1999, as amended 2013, document ID F2013C00288 (NEPM, 2013)	The NEPM provides information on the design and implementation of soil, groundwater and vapour sampling programs and the presentation of site assessment reports. Guidance is also provided on the measures that should be adopted to ensure protection of the environment during site assessment, including recommendations of what should be included within a preliminary site investigation (PSI) site history review. It defines radius of extent that site histories should consider to understand the potential sources of impacts.



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Document	Brief Description
Australian Standard, 2005, Guide to Investigation and sampling of sites with potentially contaminated soil. Part 1: Non-volatile and semi volatile compounds (AS, 2005)	The Australian Standard provides guidance for collecting sufficient and reliable information for the assessment of a site potentially contaminated by non-volatiles and semi-volatile compounds. Includes guidance on the scope and useful sources that should be reviewed when undertaking a preliminary site investigation. Appendix J of the standard also provides a list of industries and associated chemicals that should be considered.
EPA Publication IWRG621, Soil Hazard Categorisation and Management, dated June 2009 (EPA, 2009)	Contaminated soil must be managed as a Prescribed Industrial Waste where they are to be removed from site. This document provides guidance on relevant chemicals and criteria for the categorisation of potentially contaminated soil.

The NEPM recommends relevant sources which should be reviewed when undertaking site history review and lists historical activities/events that should be considered, including the following:

- Location of previous and present buildings and structures
- Presence of services to the property, which may act as a potential contaminant pathway
- Industrial processes carried out on site and the products manufactured
- Chemical storage and transfer areas
- Raw material used
- Intermediate products
- Product spills, losses, incidents and accidents (including fire)
- Discharges to land and groundwater
- Waste produced
- Onsite power generation
- Waste disposal locations and imported fill
- Earth moving activities carried out on site

This site history review has included high level consideration of these activities or events. A checklist showing the sources of material reviewed during this assessment and recommendations from the NEPM is outlined in Appendix B2.

The findings of the Project Area history report would be used to develop a conceptual understanding of the potential risks posed to the Melbourne Metro Concept Design. This report provides a compilation and summary of historical information.



3.0 METHODOLOGY

B3.1 Information Sources

The source and purpose of information reviewed during this site history assessment are summarised in Table B3.

Table B3: Summary of Site History Information Sources

Information Source reviewed	Purpose
Planning Maps	A planning property report provides some basic background information on a property or parcel including planning information, current zones and any overlays. Comparison of changes in planning overlays can provide an understanding of broad scale changes in the land use of different areas overtime.
Aerial Photographs	Aerial photographs of the Project Area are reviewed to assess land use change over the last century. The photos can provide useful information on what appeared within the assessment area, including buildings, storage tanks, quarries, landfills, dams, vegetation, etc.
Environmental Audit reports	Environmental Audit reports for nearby properties can provide information on the geology, hydrogeology and environmental condition of the surrounding environment.
Priority Sites Register	Priority Sites are sites which the EPA has issued a Clean-Up Notice pursuant to section 62A, or a Pollution Abatement Notice pursuant to section 31A or 31B (relevant to land and/or groundwater) of the Victorian Environment Protection Act 1970. Typically, these are sites where pollution of land and/or groundwater presents an unacceptable risk to human health &/or to the environment. The EPA maintains the Priority Sites Register as a listing of priority sites and the register is available to the public. The Priority Sites Register can provide information of potential sources of contamination.
EPA register of <i>groundwater quality restricted use zone</i> " (GQRUZ)	Identification of GQRUZ can provide information of established existing level of contamination, and groundwater conditions. The SEPP Groundwater defines the specific requirements for such zones related to management, clean up to the extent practicable and periodic review.
Melbourne Water Base Plans (MWBP)	MWBP are detailed historical plans for large areas of Melbourne drawn by employees of the then Melbourne Metropolitan Board of Works which show building outlines, outhouses, fences, roads / streets and public structures (such as gas works, hospitals etc.). The earlier plans (1894- early 1900s) were normally updated over a period of years and an accurate date cannot usually be supplied. These plans were drawn in preparation for the sewerage of Melbourne. The later plans (1950s to 1960s) are more definite on the date for the features. These plans can provide information on the location of historical industrial building and quarries.
Publically available directories (including yellow pages, Urban Business Directory and Sands and McDougal directory	Directories can provide the address of historical businesses, in particular the address of key business types, such as service stations and dry cleaners can be searched for by business category or name.
Current Land Owner information (AJM Joint Venture , 2015)	The current land owner and business, provides information on whether the property may be currently used for industrial or commercial activities.

Several historical environmental assessments and site history reviews have been undertaken by other consultants on properties for various Melbourne Metro alignments. The information within these reports has been considered, where available, and the original historical references from publically available records have been reviewed.

Golder has undertaken soil and groundwater assessment works within the Melbourne Metro alignment. Golder's experience has been used to assist in describing the expected environmental conditions, particularly our understanding of the local geology and hydrogeology.



B3.2 Data Extraction and Compilation Methods

Methods of data extraction, assumptions and limitations are described in Appendix B3.

Using the information from the sources described in Table B3, maps have been developed to spatially display the location of historical “potential sources of contamination” relevant to the Melbourne Metro Figures B1 to B26.

In addition to key environmental policies, the Potentially Contaminated Land, General Practice Note DSE2005) provides a list of land uses that may have a “high potential” for contaminating land including, but not limited to, abattoirs, asbestos disposal, asphalt manufacturing, automotive repairs/engine works, breweries, brickworks, cement manufacture, concrete batching, council works depot, dry cleaning, fuel storage depot, foundries and landfills. The General Practice note also lists activities which may have been carried out on the land, incidental to the main site activity, which are categorised as a medium potential to generate contamination, including, but not limited to, chemical storage, fuel storage and land filling with imported soil.

The Project Area history assessment aims to identify land uses that may present potential significant contaminant issues (i.e. “high potential” to cause impact) to Melbourne Metro construction or operation, such as former service stations, gas works, landfills, and dry cleaners.

Where applicable, the reviewed information has been geo-referenced and compiled within a Geographic Information System (GIS), allowing the frequency, distribution and proximity of historical activities to the Melbourne Metro Concept Design to be assessed to inform the intrusive investigation program and assessment of risk.

B3.3 Assessment of the Western Turnback - West Footscray

In addition to assessment of the site history within the Melbourne Metro Project Area, a PSI comprising a site history review (without an intrusive assessment) has been undertaken within West Footscray, at the location of a proposed rail turnback area. The PSI comprises a summary of historical activities which have occurred within and surrounding the proposed Western Turnback and the potential contaminants of interest associated with these types of activities/historical land uses. This Western Turnback PSI is attached as Appendix B5 and results have been included within Section B4.2 of this report.



B4.0 LAND CONTAMINATION REVIEW

This section summarises the findings of the Project Area history assessment. Information to support this summary is provided in Appendix B4 as described below. This information is included within the Project Area history interactive map.

Table B4: Site history documentation

Appendix	Summary
Appendix B4 I	Summary of council zoning documents and changes of current and historical land zoning within the alignment.
Appendix B4 II	Information from the review of EPA Statutory Environmental Audits, GQRUZs and the Priority Sites Register.
Appendix B4 III	Historical land use changes observed within historical aerial photos.
Appendix B4 IV	Historical land uses identified within historical MMBW plans
Appendix B4 V	Data extracted from Melbourne Business directories (including the yellow pages, Sands and sands and McDougall and the Urban Business Directory) including the location of service stations, dryers, landfills, service stations and mechanics.

In addition to review of site history information, activities included a walk over of the Project Area, except for the area east of Punt Rd due to project access restrictions. The Project Area walk over was undertaken on 26 August 2015 and 1 September 2015 to assess the current activities and land uses.

An overall summary of the historic and current land uses are outlined in Table B 4VI, Appendix B4.

Past and present potential contaminating land uses and activities within the Project Area or Offsite Assessment Area include:

- Manufacturing industries including for leather, concrete works, timber yards and printing works.
- A Gas holder associated with a manufactured gas facility.
- A brewery.
- Transport infrastructure including, rail, tram lines, supply laydown and storage areas, maintenance areas and warehousing.
- Filling of low lying or swampy areas.
- Motor garages and other vehicle services including service stations.
- Dry cleaners and dyers.
- Agricultural industries including a hay market and pig market.
- Engineering and metal manufacturing, refining and finishing works including foundries and heavy engineering firms (e.g. manufacture of heavy machinery), iron, steel and other metals works, electroplating and enamelling.
- Various other industrial and commercial uses including depots, workshops, sub-stations, fire brigade and post office.
- Parks, schools and recreation areas and covered open space areas.
- High and low density residential use.



B4.1 Potential Contaminants and Contaminant Sources

Based on this high level contamination review the potential contaminants and their general sources are listed below. Further details for specific industries are provided in Appendix B4, Table B4 VI, of this report.

The following potential contaminants and contaminant sources within the Project Area and Offsite Assessment Area include:

- Metals (arsenic (As), cadmium (Cd), copper (Cu), chromium (Cr), mercury (Hg), lead (Pb), nickel (Ni), zinc (Zn)) and metalloids associated with imported fill and various industrial waste streams (e.g. foundries and other metal works, timber works, paint works, printing works, etc).
- Polycyclic aromatic hydrocarbons (PAHs) associated with nearby North Melbourne and imported fill (especially gasworks wastes), use and storage of fuels and oils, by-products from boiler houses and various industrial waste streams.
- Petroleum hydrocarbons (total petroleum hydrocarbons (TPH), monocyclic aromatic hydrocarbons (MAHs)) and phenols associated with the use and storage of fuels and oils and various industrial waste streams.
- Solvents (non-chlorinated solvents (e.g. kerosene, petroleum ether, white spirit, turpentine, phenol, acetone) and chlorinated solvents (e.g. Pentachloroethane (PCE), trichloroethene (TCE), and breakdown products) associated with the use and storage of lubricating and hydraulic oils, printing, degreasers, various industrial waste streams and dry cleaners.
- Creosote, associated with gasworks and treatment of rail timbers.
- Asbestos associated with the construction and demolition of existing and former buildings, and the wearing of mechanical parts, including brakes (of cars and trains).
- Methane and hydrogen sulphide associated with degradation of organic waste or natural organic rich soils/sediments in fill.
- Polychlorinated biphenyls (PCBs) associated with electrical sub-stations (transformers and capacitors and manufacture of electrical equipment).

Other potential contaminants that may be present but less likely to be widespread:

- Acids and caustics associated with imported fill and various industrial waste streams.
- High salinities (TDS) and nutrients (ammonia, nitrate, sulfates) associated with imported fill (including Coode Island Silt), agricultural industries and various industrial waste streams.
- Pesticides / herbicides associated with spraying of weeds and pests.
- Chemicals associated with plastics, adhesives and resins (e.g. polyvinyl acetate, formaldehyde, acrylates, phthalates etc).
- Cyanide associated with imported fill, metal treatment and other industrial streams.
- Perfluorinated compounds (PFC) and associated chemicals used as fire retardants/suppressants. These can be present where fire-fighting Aqueous Film Forming Foams (AFFF) were used (See Appendix B4, Table VII, for further details).
- Other industrial chemicals that would need to be assessed during site specific site history assessment (see Table VI in Appendix B4).

The analysis of Asbestos, PFCs, nutrients, creosote is not included within the current guidance (IWRG621) for categorisation of soils for offsite disposal.



B4.2 Onsite and Offsite Land uses with the Potential to Cause Contamination

The Project Area history review provided information on potential land uses and activities at the Project Area and within the Offsite Assessment Area that may be sources of potential contamination. The following table presents an evaluation of identified potential sources of contamination, the potential contaminants that may be associated with these sources and provides a relative ranking for each item with respect to potential contamination to various media within the Project Area. The rankings are not intended to infer severity or extent of impact; rather, it is intended to indicate the potential for the contamination issues that may exist at the identified source to impact soil, soil vapour or groundwater on Site and hence affect project schedule or cost.

The rankings are defined as follows:

- **Low:** Unlikely to present a potential contamination issue to the proposed Melbourne Metro construction or operation.
- **Medium:** Possibly present a potential contamination issue for the proposed Melbourne Metro construction or operation.
- **High:** Increased potential to presents a contamination issue that needs to be considered for the proposed Melbourne Metro construction or operation.

Table B5 summarises the historical activities within the Project Area comprising the stations and Portals as well historical land uses in the Offsite Assessment Area with the potential cause contamination to the Melbourne Metro Concept Design. While Table B7 summarises the historical activities associated with the Tunnel alignment.

Both tables also highlight those Offsite historical land use/ activities with the potential to cause significant contamination issues during construction and operation of Melbourne Metro. As outlined earlier in Section B0, the assessment of significance is a subject judgement that considers the nature of the activity and the potential for contamination to migrate via soil and/or groundwater to the Melbourne Metro infrastructure.



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Table B5: Historical Land Uses with the Potential to Cause Contamination of stations, Portals and Western Turnback

Area	Summary of historical activities and potential sources of contamination	Potential Contaminants ¹	Potential impact to site		
			Soil	Ground-water	Soil Vapour
Western Portal	<p>Onsite: Since at least the 20th century this area has been used as a rail corridor, former rail siding and maintenance yard. This area has been subjected to historical filling, using unknown sources of waste/fill, which may include asbestos and methane generating materials.</p>	Metals (particularly As), asbestos, TPH, PAH, methane, creosote, pesticides and herbicides	Medium	Low	Medium
	<p>Offsite Assessment Area: The surrounding area was historically swamp land, which was reclaimed using unknown sources of fill. An electricity terminal and small substation has been present to the north of the portal directly west of Moonee Ponds creek since the 1960s. Adjacent land uses include a freight terminal, parkland and industrial uses. Storage of chemicals, domestic waste, and stockpiling of soil has occurred at 1-39 Hobsons Rd, Kensington (north west).</p>	Metals (particularly As), asbestos, TPH, PAH and PCBs	Low	Low	Low
Arden	<p>Onsite: In the mid to late 1880s the western area of proposed station was on the edge of a swamp. The swamp was filled, potentially with dredged sediments (considered a potential source of methane). The area was developed as railway sidings, largely to support timber and the local flour mills.</p> <p>Within the proposed station footprint activities including cement works, carpentry and print works have historically been undertaken. The Print works has the potential for high solvent use and storage s. There is also fuel and chemical storage, with the potential to cause impacts to soil, soil vapours & groundwater.</p>	Metals, asbestos, methane, SVOCs, TPH, MAH, PAHs, phenols and solvents	High	High	High
	<p>Offsite Assessment Area: The proposed station area is part of a larger property bound by Laurens St, Arden St and the Railway, which has included store yards, Victorian Railways offices, timber/firewood leases, a railway depot, railway workshops, cement works, printing works, storage and transport of grain and fuel merchants. Historical environmental assessment has identified a UST and chemical storage areas within close proximity to the proposed station. A large gasholder was present approximately 300m north of the station. Fill from historic manufactured gas facilities are known to have been broadly distributed within west Melbourne. Groundwater beneath the historic manufactured gas facility is expected to be contaminated with TPH, PAHs (naphthalene), ammonia, cyanide, benzene, xylene, ethyl benzene and toluene.</p>	Creosote, nutrients, methane, asbestos, SVOCs, TPH, MAH, PAHs, phenols and solvents	Low	High	Medium
Parkville	<p>Onsite: The area of the proposed Parkville station has predominantly been within a roadway. Historically the area was used as a pig and hay market and for commercial purposes.</p>	Metals, TPH, PAH, MAH, nutrients	Low	Low	Low



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Area	Summary of historical activities and potential sources of contamination	Potential Contaminants ¹	Potential impact to site		
			Soil	Ground-water	Soil Vapour
CBD North	<p>Offsite Assessment Area: Residences were historically located immediately east and south of the proposed station. Filling has occurred immediately to the north west of the proposed station. A paddock (later parkland) and baths were present to the north. The Royal Melbourne Hospital was built to the north of the proposed Parkville station in the 1930s. It is considered that fill was likely removed before or during construction of the hospital. Later the southern area was developed as a dental hospital, which has recently been demolished.</p> <p>A service station and motor garage was historically present approximately 50 metres south of the proposed station at 213 Berkeley St. Industries east of the station area included electroplating and leather manufacture.</p>	Metals, TPH, PAH, MAH, Asbestos, solvents, SVOCs	Low	Medium	Medium
	<p>Onsite: The proposed CBD North station location is on Swanston Street between Franklin Street (and the Melbourne city baths) and Lonsdale Street. Swanston Street has been a main thoroughfare in the Melbourne CBD since the 1840s.</p>	Metals, TPH, PAH, MAH,	Medium	Low	Low
	<p>Offsite Assessment Area: Commercial and light industrial activities occurred immediately adjacent to the proposed station location in Swanston Street. The industrial activities included: boiler and engine rooms, forges, a flour mill, a saw mill, a tobacco factory, a clothing factory, a coach factory, a jam factory, and a bicycle factory.</p>	Metals, Asbestos, SVOCs, TPH, MAH, PAHs, phenols and solvents	Low	Medium	Medium
CBD South	<p>Significant Off Site Assessment Activities: North west of the proposed station has historically been part of the Carlton United Brewery (CUB), with brewing activities undertaken between the 1860s and 1980s. The CUB included stables, engine rooms, boilers, sales areas and residential areas. Impacts to groundwater, including fuels and chlorinated solvents have been reported in this area.</p>	Chlorinated solvents, PAHs, MAHs, TPHs	Low	High	High
	<p>Onsite: The proposed CBD South station location is within Swanston Street between Flinders Street and Collins Street. The proposed station area has predominantly been used as a road, tramline and pavement.</p>	Metals, TPH, PAH, MAH,	Medium	Low	Low
CBD South	<p>Offsite Assessment Area: Several historic businesses which have offered dry cleaning or dyeing services are listed within or immediately adjacent to the proposed station area, including at 9a Swanston St and 81 Swanston St and may be a source of groundwater impacts (including VOCs and chlorinated solvents).</p> <p>The land uses surrounding the proposed station area have included St Paul's Cathedral (previously St Paul Church), hotels and other commercial or</p>	Metals, asbestos, TPH, MAH, PAHs, phenols and solvents	Low	Medium	Medium



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Area	Summary of historical activities and potential sources of contamination	Potential Contaminants ¹	Potential impact to site		
			Soil	Ground-water	Soil Vapour
	industrial properties, including warehouses, printing offices and leather manufacturers.				
Domain	Onsite: The Domain station is proposed to extend from the junction of Domain Rd and St Kilda Rd, south along St Kilda Rd. This area has historically been used as roads and includes a traffic island, historically used as a tennis court. Potential for significant filling from nearby industries.	Metals, TPH, PAH, MAH, nutrients,	Medium	Low	Low
	Offsite Assessment Area: Historical uses of nearby land include parkland, schools (including Melbourne Grammar School, opened in the 1850s), residential and commercial properties. A tramway engine house was located on the corner of Bromby Street and St Kilda Road. The tramway engine house may have housed boilers and stored oils and greases for tram maintenance.	Metals, TPH, PAH, MAH, nutrients, herbicides, pesticides, solvents,	Low	Medium	Low
Fawkner Park shaft	Onsite: Since the late 1890s the area of the proposed tunnel shaft has been covered by parkland. From 1966 a building is present in the proposed Fawkner shaft area. From the Project Area walkover observations this building forms part of the Fawkner Park Tennis Centre. Potential for significant filling from nearby industries.	Metals, TPH, PAH, MAH, nutrients, cyanide	Medium	Low	Low
	Offsite Assessment Area: Historic industries of potential interest including a motor garage, service station and drycleaners with 500m but greater than 200m from the proposed shaft. East to the proposed Fawkner Shaft is the Fawkner Park Child Centre and Kindergarten. This building visible in aerial photographs from 1966 to the present.	Metals, TPH, PAH, MAH, solvents	Low	Low	Low
Eastern Portal	Onsite: The proposed Eastern Portal would include excavation starting at Osborne Street and joins the existing Rail corridor to the south of the existing South Yarra station. This area includes VicTrack land, a public park (the South Yarra Rail Siding) and rail verge and rail tracks for the Sandringham and Caulfield rail lines. The parkland was formerly occupied by the Royal South Yarra Lawn Tennis Club and including 3 tennis courts, a squash court, and club house. These facilities were removed by 1982. Within the last 30 years the South Yarra Rail Siding has been used for lay-down of railway materials including sleepers and gravel or soil. Historically the railway cutting has flooded.	Metals (particularly As), Asbestos, TPH, PAH, Creosote, Pesticides and herbicides	Medium	Low	Low
	Offsite Assessment Area: Within the park, north of the proposed excavation, there was a former post office, fire brigade and an air raid trench located adjacent to the Sandringham Rail Line on Osborne Street. An historic service station was listed adjacent to the end of the alignment at 512 to 514 Chapel St.	Metals (particularly As), Asbestos, TPH, PAH, MAHs	Low	Low	Low



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Area	Summary of historical activities and potential sources of contamination	Potential Contaminants ¹	Potential impact to site		
			Soil	Ground-water	Soil Vapour
	<p>Significant offsite: A high density of dry cleaners, service stations and motor garages has been present within the surrounding area. Long term storage and handling of fuel increases the risk of impact to soil, groundwater and soil vapour. Several GQRUZ are present approximately 250 m SE of the Eastern Portal, including LNAPL impacts to groundwater.</p>	TPH, PAH, MAH, metals, solvents	Low	High	High
Western Turnback	<p>Onsite: This area has predominantly comprised rail activities, including the West Footscray train station and railway. Activities including train stabling, routine maintenance works, weed control (traditional with arsenic) use of a rail substation and historical ash dumping may have resulted in contamination. Unknown sources of fill are likely to have been used to fill and /or landscape the area.</p>	Metals (particularly As), asbestos, TPH, PAH and PCB	Medium	Medium	Medium
	<p>Offsite Assessment Area: Stone quarries were historically present in the surrounding area. Filling of these quarries is likely to have involved waste disposal from surrounding industry. The surrounding area has comprised many industrial activities, including woollen mills and store houses, tyre manufacture, agricultural implement manufacture, service stations and garages, dry cleaners and council depots. Environmental Audits within this area have identified chlorinated solvents in groundwater.</p>	Metals, MAH, TPH, PAH, SVOCs, VOCs, nitrate, phosphates and OCP, OPP, pH, solvents, degreasers, asbestos	Low	High	Medium

The historical activities that have occurred within areas overlying and surrounding sections of tunnel are summarised below. The significance to the Melbourne Metro in these sections has been ranked with respect to the potential cause contamination to tunnel spoil, vapour & groundwater related tunnel construction or operation.



Table B6: Summary of historical activities and potential sources of contamination within Tunnels

Tunnel Section	Areas of Potential Issues/ Sources of Contamination	Potential Contaminants ¹	Tunnel Spoil	Ground-water	Soil Vapour
Western Portal to Arden	The tunnel includes a section under Moonee Ponds Creek. Historical and current land uses in the area include industrial and commercial warehouses, including the SP AusNet electricity terminal.	Metals (particularly As), TPH, PAH & PCB	Low	Low	Low
Arden to Parkville	Historical activities in the overlying area include residential, industrial, agricultural and commercial businesses. The alignment is shown to go beneath a current service station on the corner of Dryburgh and Arden St and a former service station on the corner of Abbotsford and Arden St. Service stations are a potential source of impact to soil, groundwater and soil vapour. A manufactured gas facility was historically present, north of the alignment area. The facility is a potential source of contaminated fill and impacts to groundwater within the area. Audit information at 35 Arden St, indicate the presence of LNAPL and metal impacts in groundwater.	Metals, creosote, nutrients, methane, asbestos, TPH, MAH, PAHs, phenols and solvents	Low	High	High
Parkville to CBD North	Historical land uses in this area have included industrial and commercial activities, with medium high density residential use. The tunnel would go below part of the former Carlton United Brewery site. The tunnelled section is also in the vicinity of former historic motor garages / service stations at 636 Swanston St, 503 Swanston St, and, 183 Queensberry St, 170 Queensberry St and potential historic dry cleaners at 605 Swanston St and 157 Queensberry St (based on Sands and McDougal records). Dry cleaners and service stations are considered potential sources of groundwater, soil and soil vapour impacts.	Metals, TPH, PAH, MAH, Asbestos, solvents	Low	High	High
CBD North to CBD South	Tunnel is beneath Swanston St. This area of the CBD has included various commercial and industrial properties including forges, engine and boiler rooms, a laboratory, Victorian Lead Works, a hospital and a printing office. Factories were prevalent in the late 1800s and early 1900s. Later uses of property in the CBD were for commercial purposes. Several businesses listed as providing dry cleaning or dyeing services are present within 50 m of the alignment. In addition, road material over time was likely to have been comprised of fill potentially from industrial sources, such as manufactured gas facilities.	Metals, TPH, PAH, MAH, Asbestos, solvents	Low	Medium	Medium



Tunnel Section	Areas of Potential Issues/ Sources of Contamination	Potential Contaminants ¹	Tunnel Spoil	Ground-water	Soil Vapour
CBD South to Domain:	Includes a tunnel under the Yarra River and over the city link tunnel. The section of the Yarra to be tunnelled was chosen for the development of Princes Bridge, as it was a shallow narrow section of the river. During 1886 the Yarra was straightened, deepened and widened using dynamite to blast the bedrock. Stone embankments were constructed along the edge of the river and Princes Bridge was constructed. Sewage has historically been directly drained into the Yarra (Allison 2007). South of the Yarra, the western portion of Alexandra Gardens, have largely been swamps which were later filled and developed into park land. Filling in the area may have included sources of methane generating material. During the 19 th century, this area was used for short term housing for immigrants and a police and military barracks was present. The area has since predominantly been used as parks and gardens. Domain Gardens was established by late 1850s.	Metals, TPH, PAH, MAH, Asbestos, solvents, Methane	Low	Low	Low
Domain to Eastern Portal	Several historic service stations and motor garages were historically present on St Kilda Rd, adjacent to the tunnelled area. The proposed tunnel passes under Fawkner Park and Toorak Rd and residential properties. The section of Toorak Rd includes historic service stations, a motor garage and at least 7 historical businesses listed as dry cleaners /dyers.	Metals, TPH, PAH, MAH, Asbestos, solvents	Low	High	High

B4.3 Summary of Potential Contamination Issues and affected Environmental Media

The following sections outline the potential contamination issues as they may relate to different environmental media (land, groundwater and air (vapours/gases)) at the Project Area and Offsite Assessment Area.

B4.3.1 Land issues

The potential soil contamination issues within the Project Area are primarily associated with the importation of fill and where relevant the historical industrial land uses and activities at specific sites such as print works within the Arden station footprint.

A wide range of chemicals, oils and solvents may have been used in manufacturing and other industrial processes within the Offsite Assessment Area. Soil contamination risks mainly arise from production areas, fuel and energy services, bulk storage and transfer operations associated with underground storage tanks or above ground storage tanks, underground pipework, drains, pits and hazardous materials storage areas. There may be soil contamination issues associated with ancillary activities, such as maintenance workshops, fuel storage, oil storage and pest control etc. Activities within the Offsite Assessment Area have the potential to contaminate soil, via the migration of impacted soil gases and/or groundwater.

The desk-top review identified that broad scale filling exists across the Project Area and Offsite Assessment Area, including significant filling of swampy areas in the northern sections of the Melbourne Metro and on the



southern side of the Yarra crossing. The practice of filling in inner Melbourne in the late 1800s typically involved the use of surplus soil from construction works or industrial sites (including local manufactured gas facilities). Sediments recovered during the deepening of Coode Canal and the current Docklands area may have been used for land reclamation in the area adjacent to Arden station. Our experience in the South Melbourne and North Melbourne area suggests that imported fill is generally contaminated. The degree of contamination would be variable depending on the sources of fill used at the time. A review of publically available Environmental Audit reports indicated that fill can be impacted with varying concentrations of heavy metals, PAHs and potentially cyanide. The fill is also likely to be aesthetically impacted with inclusions such as building rubble (fragments of brick, glass, wood and possible asbestos containing materials), charcoal, ash and slag along with household wastes such as fragments of ceramics, glass and scrap metals are common. Asbestos can also occur in the fill.

Much of the proposed excavation areas are within existing road alignments and rail reserves. These areas have typically been filled to level surfaces and contain contamination associated with fuel emission and leaks, rail maintenance practices, including treatment of sleepers and mechanical maintenance.

In addition, chemical storage and print works activities were identified as specific sources with potential to create a "High" impact to soil within the Project Area, at Arden station.

B4.3.2 Groundwater issues

No Environmental Audit sites, Priority Sites or Groundwater Quality Restricted Use Zones (GQRUZ) were located immediately within the Project Area. However, there are 14 GQRUZ within the Off-site Assessment Area, with 7 of these within 500m of the Eastern Portal (See Appendix B1). A summary of completed Audits sites within the Off-site Assessment Area are presented in Table D2. No Priority Sites were present within the Offsite Assessment Area. It is also noted that there are 3-4 GQRUZ within 500m of the Western Turnback.

The most significant contamination issues to Melbourne Metro groundwater have been assessed to be associated with sources within the Off-Site Assessment Area. Based on the historical information reviewed to date, the significant groundwater contamination issues are likely to be associated with the following:

- Potential contamination from metals leaching from fill and contamination from the past use of the Project Area for many metal related industries;
- Potential contamination from hydrocarbons and/or other stored chemicals from underground storage tanks or above ground storage tanks should these be present on individual sites;
- Potential contamination from chlorinated solvents associated metal degreasing and various manufacturing industries; and
- Elevated ammonia and methane concentrations from manufactured gas facility wastes or the anaerobic conditions caused by the historic filling, reclamation activities and the presence of organic rich natural materials (i.e. sediments).

Identified areas and potential sources of groundwater contamination which are considered a high potential to present a contamination issue that needs to be considered for the proposed Melbourne Metro construction or operation are:

- *Arden station:* Potential groundwater impacts associated with the manufactured gas facility, historic fuel and chemical use and storage at the former print works and other industrial land uses at Arden station.
- *Tunnel between Arden station and Parkville station:* current service station on the corner of Dryburgh and Arden St and a former service station on the corner of Abbotsford and Arden St. Reported impacts to groundwater including LNAPL and metals associated with the Former Regal Cream Products facility at 33-35 Arden St (Audit report number 68498-1), located approximately 40m east of the tunnel between Arden station and Parkville station.



- *Tunnel between Parkville station and CBD North station:* Former service stations and dry cleaners including former Service station at corner of Swanston St and Pelham St, Carlton (Audit report number 48717-2), located approximately 100m from alignment (tunnelled section), noted as a potential source of TPH's and BTEX impacts to groundwater, former historic motor garages / service stations at 636 Swanston St, 503 Swanston St, and, 183 Queensberry St, 170 Queensberry St and potential historic dry cleaners at 605 Swanston St 157 Queensberry St (based on Sands and McDougal records).
- *Tunnel and adjoining CBD North station:* Former Carlton United Brewery located at 539-553 Swanston St, located within 50m of tunnelled alignment and north of CBD North station. Groundwater has been reported to be impacted with chlorinated hydrocarbons and petroleum hydrocarbons.

In addition there area adjacent to the *Western Turnback* which has been occupied by many industrial activities, including woollen mills and store houses, tyre manufacture, agricultural implement manufacture, service stations and garages, dry cleaners and council depots. Environmental Audits within this adjacent area have identified chlorinated solvents in groundwater.

B4.3.3 Aesthetic issues

This review identified that there are likely to be potential aesthetic impacts in fill and groundwater (e.g. visual and olfactory contamination such as hydrocarbon staining or building rubble in fill). These issues would require management during redevelopment by removal of those soils deemed aesthetically unsuitable in sensitive areas such as in open space developments where there is uncontrolled access to soils. However, where there would be a separation layer established between aesthetically impacted soils and site occupants by a building envelope or park area this risk can be managed.

In addition, noise and odour generated during the development activities would need to be monitored, particularly in residential areas.

B4.3.4 Air (soil vapour/gas) issues

The main potential sources of soil vapour contamination identified during the Project Area history review include:

- Fuel spills and leaks from above and underground fuel storage;
- Chlorinated solvents associated various manufacturing industries and breweries; and
- Methane associated with anaerobic conditions caused by the historic filling, reclamation activities and the presence of organic rich natural materials (i.e. sediments).

The areas were these sources are present, is described in the Groundwater Issues section, above.



B5.0 CONCLUSION

Golder Associates has undertaken a site history review of the Melbourne Metro Concept Design in general accordance with NEPM to assist in understanding source and nature of potential contamination issues that could affect the Project Area. The Project Area history review includes the consideration of Offsite historic activities that could be a source of significant contamination that may have implications for Melbourne Metro construction or operation. The findings of this study have concluded that much the Project Area, except for the tunnels, is located within existing road alignments and rail reserves. These areas have typically been filled to level surfaces and contain contamination associated with fuel emission and leaks, rail maintenance practices, including treatment of sleepers and mechanical maintenance. In addition to broad contamination associated with fill in particular manufactured gas facility wastes, the key source areas of potential impact to land within the Project Area are associated with chemical storage and print works and fuel storage and chemical handling activities, at the proposed Arden station.

Many sources of potential impact to groundwater and soil vapour are present within 500m of the Project Area, including a manufactured gas facility, former service stations, dry cleaners, and impacts associated with historical industrial activities. There is limited data available that indicates that there is groundwater impacted within 500m of the Project Area, except for presence of chlorinated hydrocarbons and petroleum hydrocarbons in the vicinity of the CUB and Western Turnback. Unfortunately there is not extensive information published on groundwater and soil impacts across the Melbourne Metro Concept Design. Therefore the extent and nature of groundwater and soil vapours need further investigation to understand and manage the potential impact on the Melbourne Metro Concept Design schedule or cost.



B6.0 REFERENCES

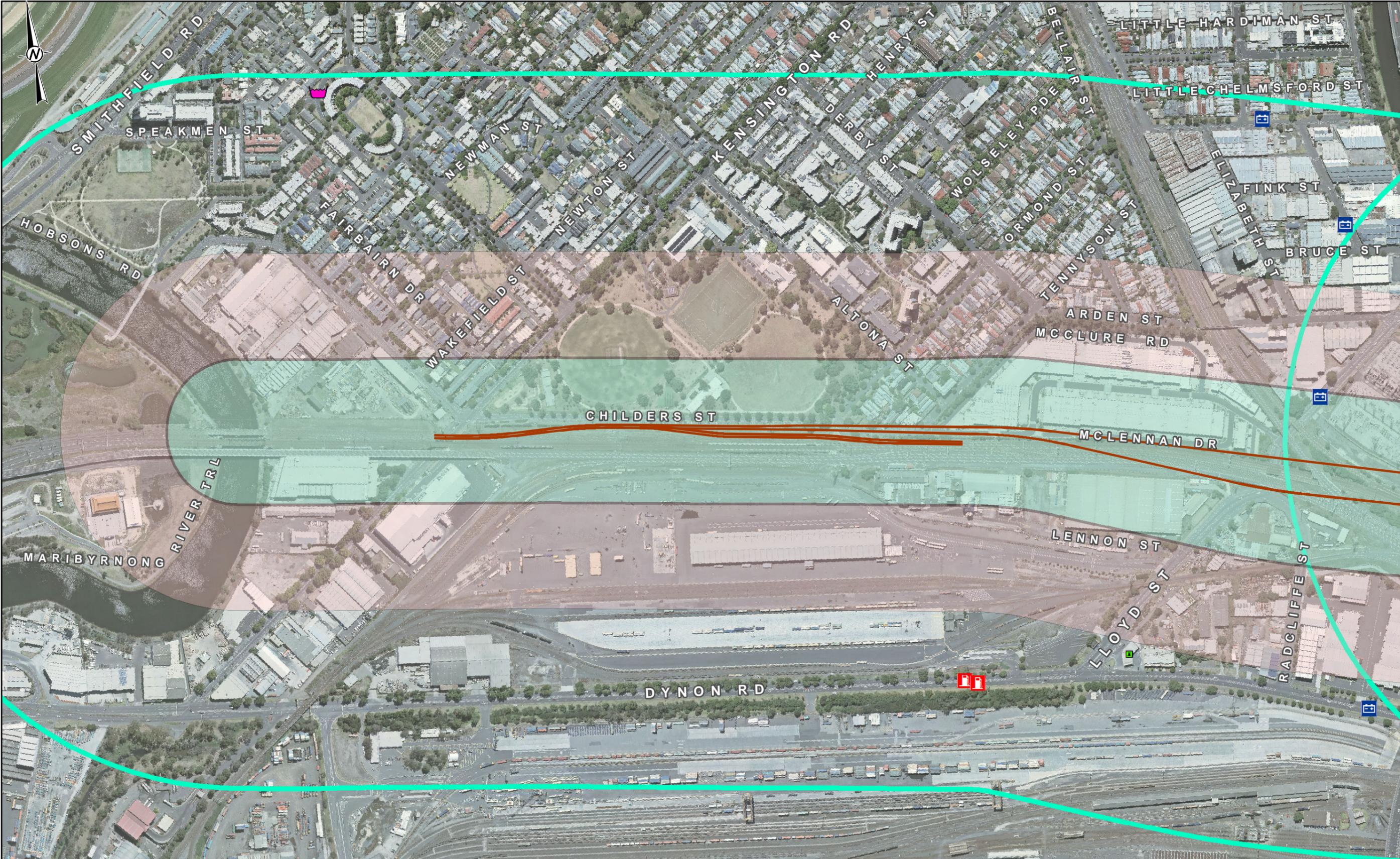
Data sources including maps, aerial photographs and databases, are summarised within Appendix B3.

- Potentially Contaminated Land General Practice Note (2005). State of Victoria, Department of Sustainability and Environment, in conjunction with the EPA Victoria Melbourne, Victorian Government, (DSE, 2005).
- Standards Australia (2005). Guide to the sampling and Investigation of Potentially Contaminated Soil, Part 1: Non-volatile and Semi-volatile compounds. AS4482.1 (SA 2005).
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- AJM Joint Venture (2015). *Current Land Owner Information*. [GIS data file] (AJM JV, 2015).
- Environment Protection Authority (2009). Information Bulletin No. 655.1: *Acid Sulfate Soil and Rock*. (EPA, 2009c).
- Pearson D R (2011). *Managing Contaminated Sites*, Victorian Government, Melbourne.
- National Environment Protection (Assessment of Site Contamination) Measure 1999 (April 2013), document ID F2013C00288, Canberra (NEPC, 2013) Allison, B (2007). John Harry Grainger: Architect and Civil Engineer, The University of Melbourne, 2007.



APPENDIX B1

Figures



LEGEND

- Alignment
- Current Service Station
- Dry Cleaner & Dyers
- Electroplaters & Enamellers
- Motor Garage
- Service Station
- Concept Design Buffer 100m
- Concept Design Buffer 250m
- Concept Design Buffer 500m

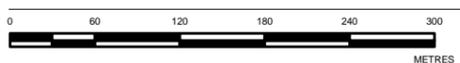
MAP INFORMATION
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NOTES

1. Aerial imagery sourced from Public Transport Victoria, image resolution 10cm and date of capture February 2015.
2. Road information sourced from Victorian Government Data Directory 2015.
3. Rail alignment sourced from AJM JV, revision P2.3 dated 28-10-2015.

CLIENT
 AJM JOINT VENTURE

PROJECT
 MELBOURNE METRO RAIL PROJECT



REFERENCE SCALE: 1:5,000 (at A3)
 PROJECTION: GDA 1994 MGA Zone 55

TITLE
 SITE HISTORY
 WESTERN PORTAL

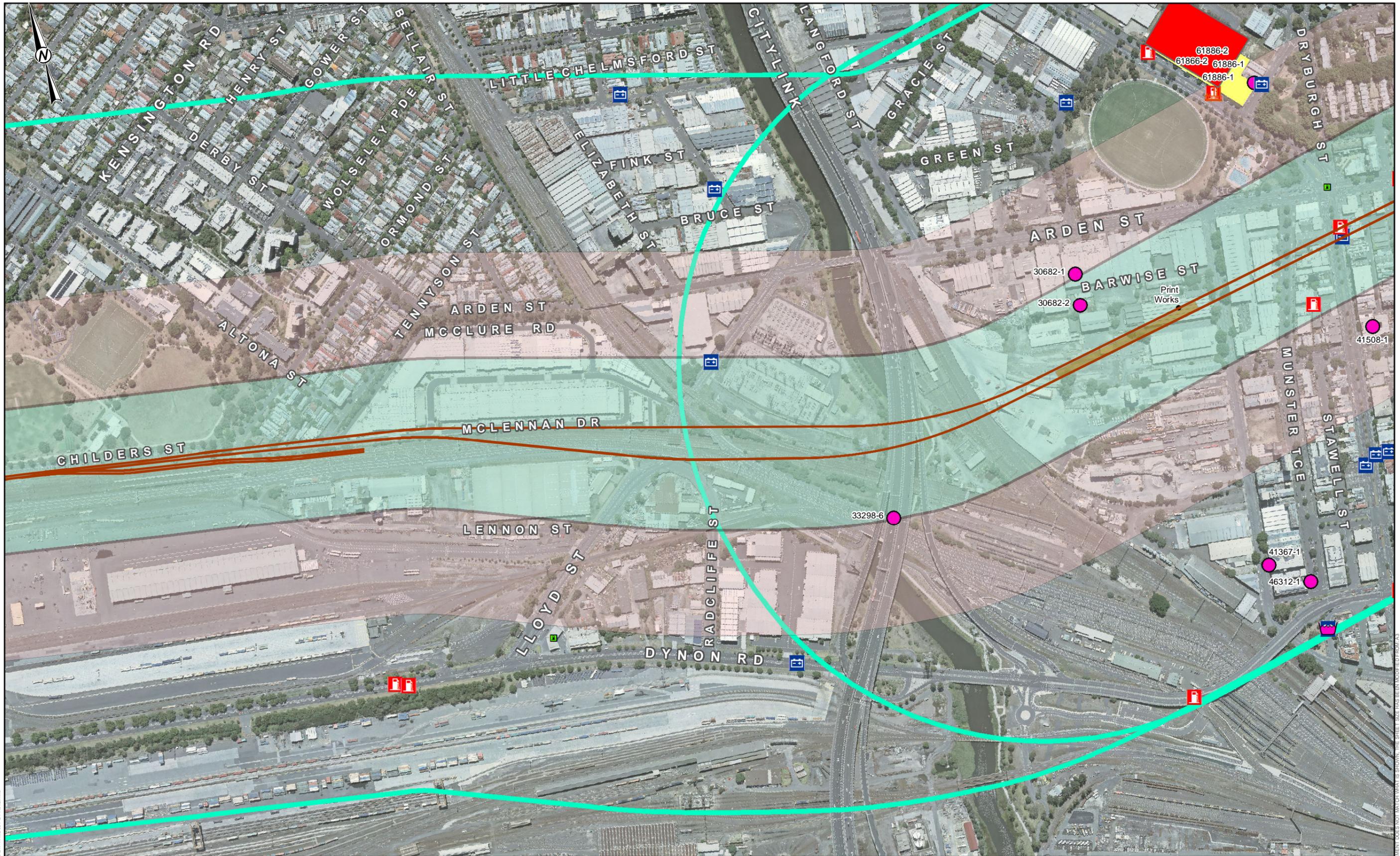
CONSULTANT	YYYY-MM-DD	2016-04-07
	PREPARED	JPH
	DESIGN	-
	REVIEW	CJW
	APPROVED	CJW



PROJECT No. 1525532 CONTROL 217-R Rev. 2 **FIGURE B-1**

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LEGEND

Alignment	Service Station	Platform Footprint
Current Service Station	Waste Industries	Concept Design Buffer 100m
Manufactured Gas Facility	EPA GQRUZ Stations 500m	Concept Design Buffer 250m
Dry Cleaner & Dyers	EPA 53X 500m	Concept Design Buffer 500m
Electroplaters & Enamellers	EPA GQRUZ Metro	
General Manufacturers	EPA 53X Stations 250m	
Motor Garage	EPA Polygons Metro	

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CLIENT
 AJM JOINT VENTURE

PROJECT
 MELBOURNE METRO RAIL PROJECT

REFERENCE SCALE: 1:5,000 (at A3)
 PROJECTION: GDA 1994 MGA Zone 55

TITLE
 SITE HISTORY
 WESTERN PORTAL-ARDEN TUNNEL

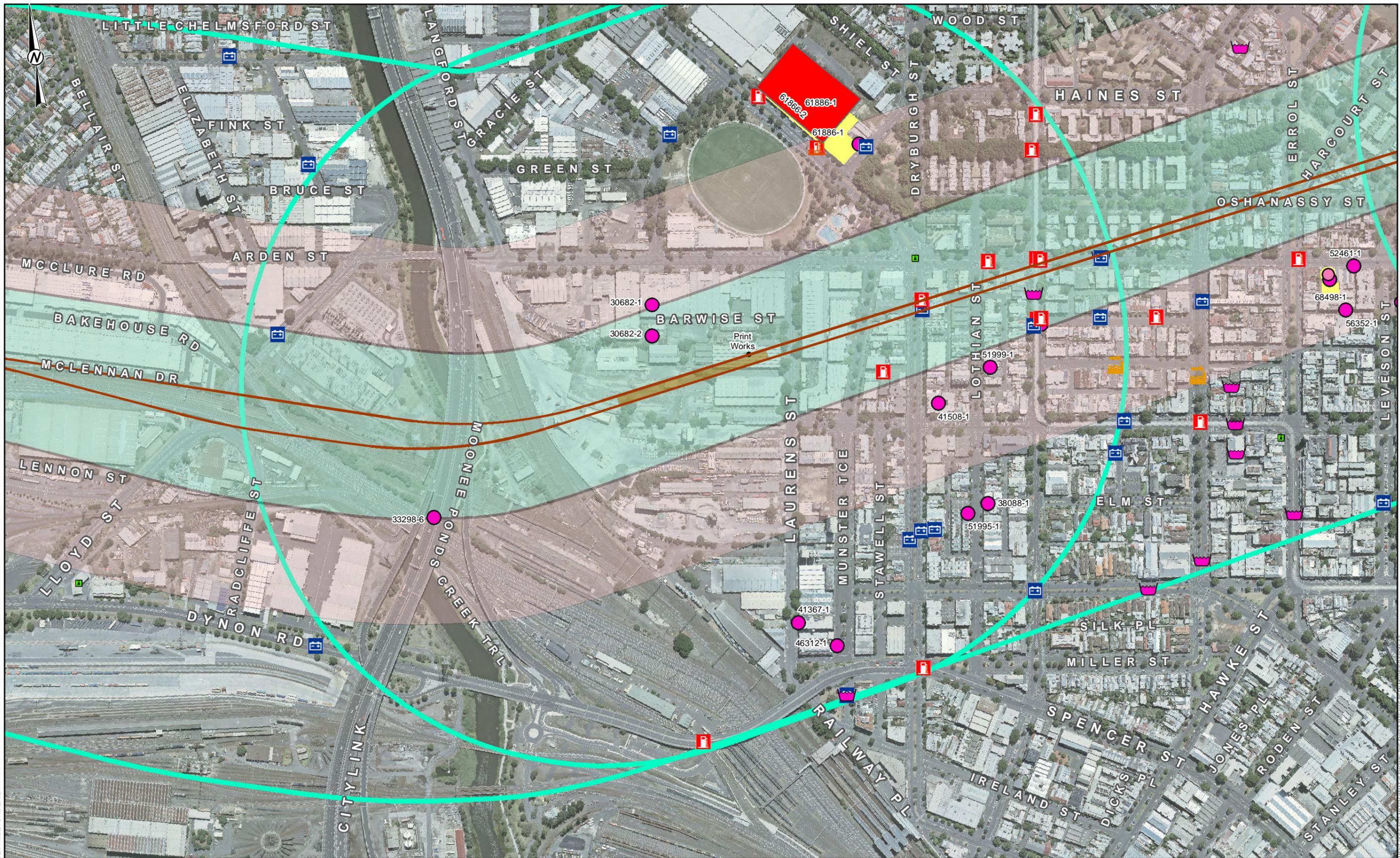
CONSULTANT

YYYY-MM-DD	2016-04-07
PREPARED	JPH
DESIGN	-
REVIEW	CJW
APPROVED	CJW

PROJECT No. 1525532 CONTROL 217-R Rev. 2 **FIGURE B-2**

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LEGEND

Alignment	Motor Garage	EPA GQRUZ Metro
Current Service Station	Service Station	EPA 53X Stations 250m
Manufactured Gas Facility	Waste Industries	EPA Polygons Metro
Dry Cleaner & Dyers	General Manufacturers	Platform Footprint
Foundries	EPA GQRUZ Stations 500m	Concept Design Buffer 100m
General Manufacturers	EPA 53X 500m	Concept Design Buffer 250m
EPA GQRUZ Alignment 100m	Concept Design Buffer 500m	

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PROJECT
 MELBOURNE METRO RAIL PROJECT

REFERENCE SCALE: 1:5,000 (at A3)
PROJECTION: GDA 1994 MGA Zone 55

TITLE
 SITE HISTORY
 ARDEN STATION

CONSULTANT

YYYY-MM-DD	2016-04-07
PREPARED	JPH
DESIGN	-
REVIEW	CJW
APPROVED	CJW

PROJECT No. 1525532 **CONTROL** 217-R **Rev.** 2 **FIGURE** B-3

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LEGEND

Alignment	Current Service Station	General Manufacturers	EPA 53X 500m	Concept Design Buffer 250m
Manufactured Gas Facility	Motor Garage	EPA GQRUZ Alignment 100m	EPA GQRUZ Metro	Concept Design Buffer 500m
Dry Cleaner & Dyers	Service Station	EPA 53X Stations 250m	EPA Polygons Metro	
Electroplaters & Enamellers	Textiles	Platform Footprint	Concept Design Buffer 100m	
Foundries	Waste Industries			
	EPA GQRUZ Stations 500m			

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CLIENT
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PROJECT
 MELBOURNE METRO RAIL PROJECT

REFERENCE SCALE: 1:5,000 (at A3)
PROJECTION: GDA 1994 MGA Zone 55

TITLE
 SITE HISTORY
 ARDEN-PARKVILLE TUNNEL

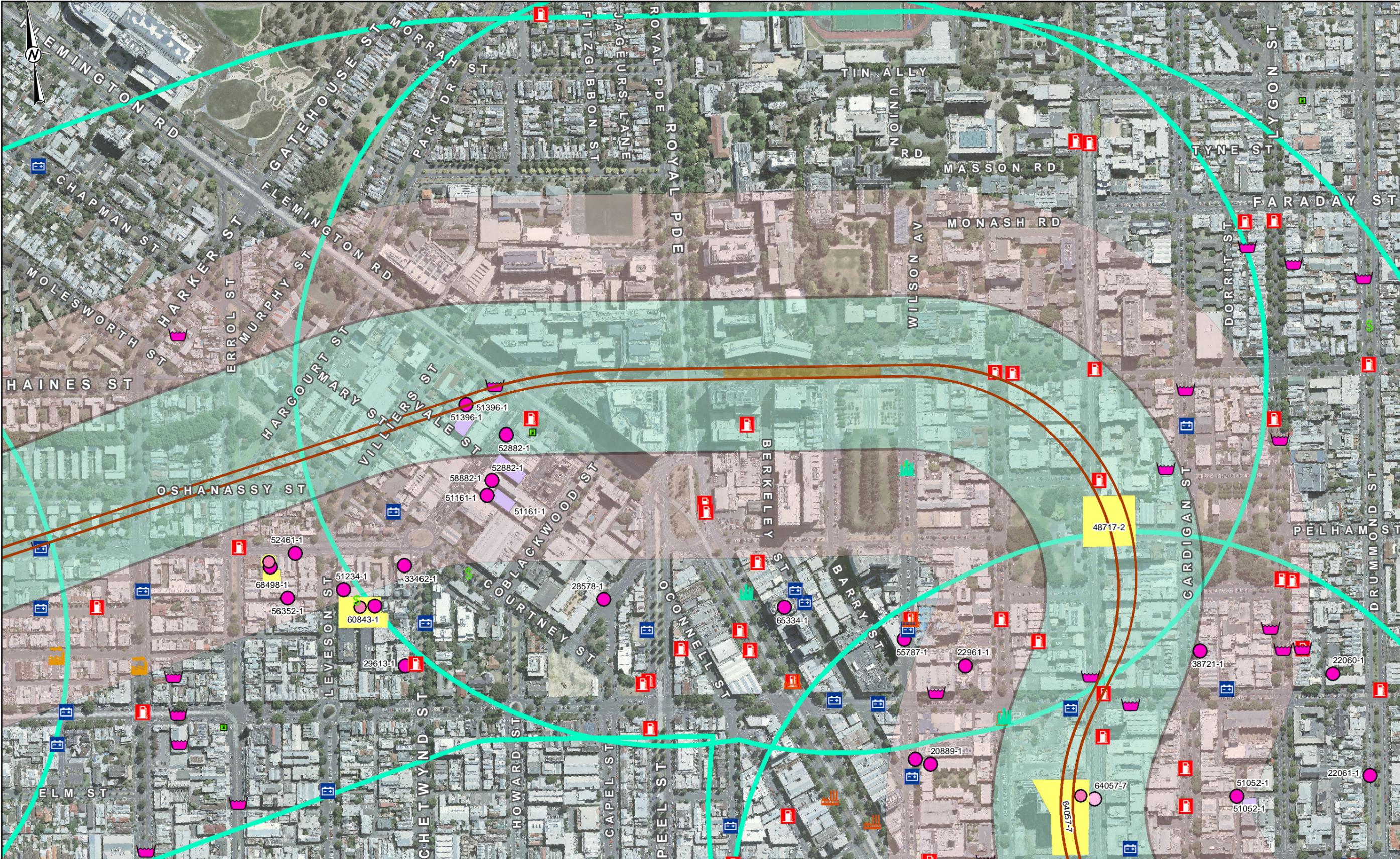
CONSULTANT

YYYY-MM-DD	2016-04-07
PREPARED	JPH
DESIGN	-
REVIEW	CJW
APPROVED	CJW

PROJECT No. 1525532 **CONTROL** 217-R **Rev.** 2 **FIGURE** B-4

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LEGEND

Alignment	General Manufacturers	EPA 53X 500m	Concept Design Buffer 250m
Current Service Station	Motor Garage	EPA GQRUZ Alignment 100m	Concept Design Buffer 500m
Brewery	Service Station	EPA GQRUZ Metro	
Dry Cleaner & Dyers	Textiles	EPA 53X Stations 250m	
Electroplaters & Enamellers	EPA GQRUZ Stations 500m	EPA Polygons Metro	
Foundries	Platform Footprint	Concept Design Buffer 100m	

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CLIENT
 AJM JOINT VENTURE

PROJECT
 MELBOURNE METRO RAIL PROJECT

TITLE
 SITE HISTORY
 PARKVILLE STATION

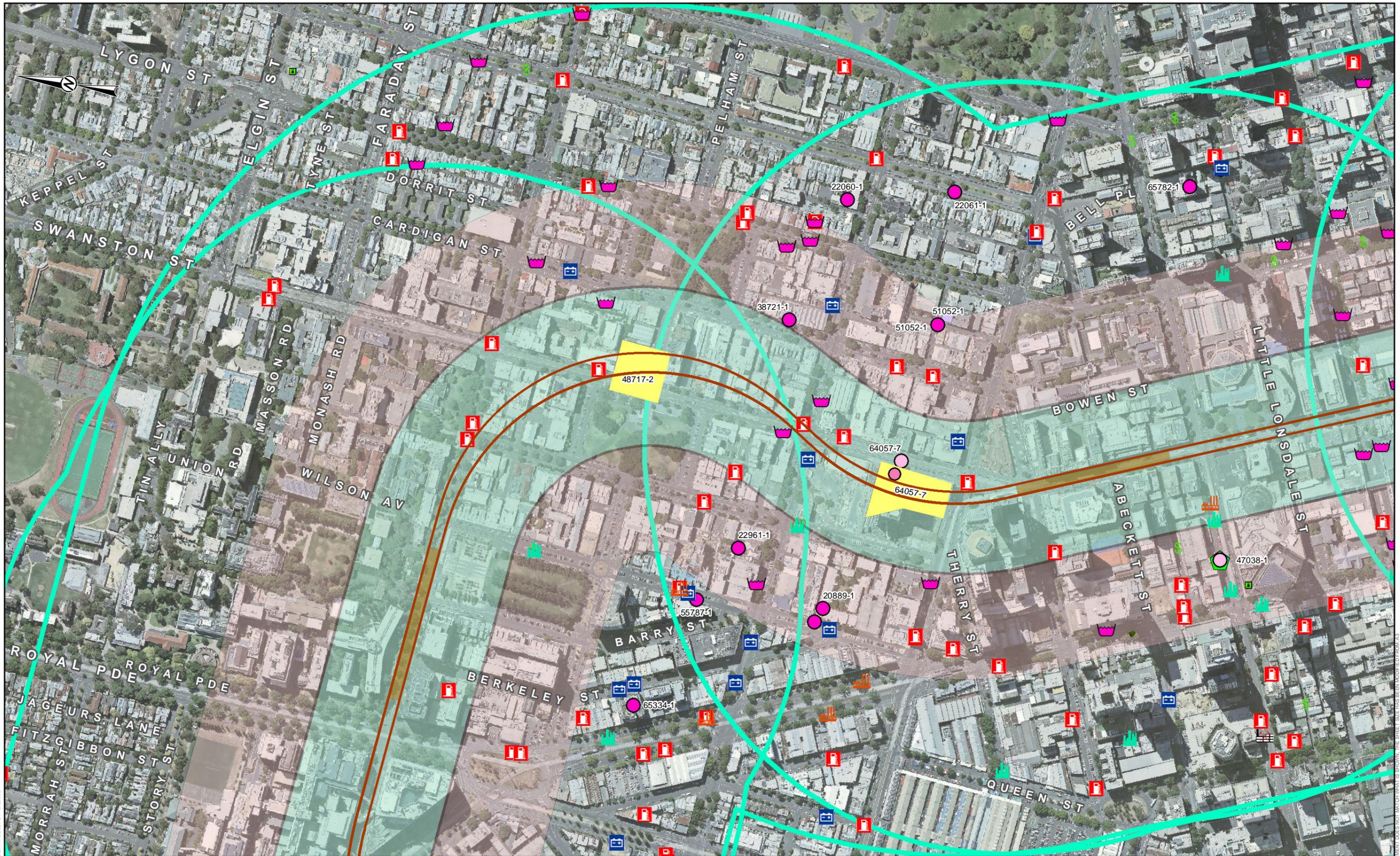
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REFERENCE SCALE: 1:5,000 (at A3)
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PREPARED	JPH
DESIGN	-
REVIEW	CJW
APPROVED	CJW
PROJECT No.	1525532
CONTROL	217-R
Rev.	2
FIGURE	B-5

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LEGEND

Alignment	Manufactured Gas Facility	Textiles	EPA 53X Stations 250m
Current Service Station	General Manufacturers	Waste Industries	EPA 53X Stations 100m
Brewery	Motor Garage	EPA GQRUZ Stations 500m	EPA Polygons Metro
Brick Works	Quarry and Extractive Industries	EPA 53X 500m	Platform Footprint
Dry Cleaner & Dyers	Service Station	EPA GQRUZ Alignment 100m	Concept Design Buffer 100m
Electroplaters & Enamellers		EPA GQRUZ Metro	Concept Design Buffer 250m
			Concept Design Buffer 500m

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- Rail alignment sourced from AJM JV, revision P2.3 dated 28-10-2015.

CLIENT
 AJM JOINT VENTURE

PROJECT
 MELBOURNE METRO RAIL PROJECT

REFERENCE SCALE: 1:5,000 (at A3)
PROJECTION: GDA 1994 MGA Zone 55

TITLE
 SITE HISTORY
 PARKVILLE-CBD NORTH TUNNEL

CONSULTANT

YYYY-MM-DD	2016-04-07
PREPARED	JPH
DESIGN	-
REVIEW	CJW
APPROVED	CJW

PROJECT No. 1525532 **CONTROL** 217-R **Rev.** 2 **FIGURE** B-6

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