

Beveridge North West Precinct Structure Plan Area

METROPOLITAN PLANNING AUTHORITY

Site Suitability Assessment

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Beveridge North West Precinct Structure Plan Area

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Contents

List of abbreviations	v
Executive summary	1
1. Introduction	5
1.1 Background and objectives.....	5
1.2 Scope of work.....	5
1.3 Statement of limitations	5
2. Methodology	7
2.1 General assessment approach	7
2.1.1 Stage 1 assessment.....	7
2.1.2 Stage 2 assessment.....	7
2.1.3 Stage 3 assessment.....	7
2.1.4 Remediation.....	8
2.1.5 Environmental auditing.....	8
3. Regulatory framework for assessment	9
3.1 Legislation and policy.....	9
3.1.1 Planning and Environment Act 1987	9
3.1.2 Environment Protection Act 1970.....	9
3.1.3 Land State Environment Protection Policy 2002	9
3.1.4 Groundwater State Environment Protection Policy 1997.....	9
3.1.5 Surface Water State Environment Protection Policy 2003.....	10
3.2 Guidelines and standards	10
3.2.1 National Environment Protection (Assessment of Site Contamination) Amendment Measure (NEPM) 2013	10
3.2.2 Various EPA publications and guidelines.....	10
3.2.3 Potentially Contaminated Land General Practice Note 2005	10
3.2.4 Australian Standard AS4482.1-2005: Guide to the investigation and sampling of sites with potentially contaminated soil – Part 1: Non-volatile and semi-volatile compounds.....	10
3.2.5 Australian Standard AS4482.2-1999: Guide to the sampling and investigation of potentially contaminated soil – Part 2: Volatile substances	11
3.2.6 Australian Standard AS1726-1993: Geotechnical Site Investigations	11
3.3 Regulatory framework in the context of this assessment.....	11
4. Site description	12
5. Environmental setting	14
5.1 Regional geology	14
5.2 Soils and acid sulfate soils map review	14
5.3 Regional hydrology.....	15
5.4 Regional hydrogeology.....	15
5.5 Local groundwater quality.....	16
5.6 Local groundwater use	17
5.7 Ecology.....	18
5.7.1 Desktop assessment.....	18
5.7.2 Wetlands.....	18

5.7.3	Sites of national significance.....	19
6.	Information review	22
6.1	Current Certificate of title information	22
6.2	EPA Priority Sites Register	22
6.3	EPA List of sites issued with Statements and Certificates of Environmental Audit.....	22
6.4	EPA List of current environmental audit sites.....	22
6.5	Reviewed reports	23
6.5.1	Yarra Valley Water, 2008: Wallan Reclaimed Water Re-Use Scheme: Camerons Lane Lots 8 & 9 – Preliminary Assessment of Groundwater Monitoring Results.....	23
6.5.2	Arris Pty Ltd, 2008: Lots 8 & 9 Camerons Lane Reuse Scheme – Assessment of Soil Monitoring Data for 2006 to 2007	23
6.6	Historical aerial photography review.....	24
6.7	Historical zoning records review.....	25
6.8	Data integrity assessment.....	25
7.	Site characterisation	26
7.1	Site contamination assessment.....	26
7.1.1	Potential sources of contamination on site and findings of site inspection.....	28
7.1.2	Potential off-site sources of contamination	34
7.1.3	Potential receptors of contamination	37
7.1.4	Exposure pathways & routes	37
7.2	Geotechnical assessment.....	37
7.3	Hydrogeological general.....	37
8.	Development opportunities and constraints	39
8.1	Site contamination.....	39
8.2	Geotechnical	39
8.3	Hydrological	40
8.4	Hydrogeological	40
8.5	Future quarrying.....	41
9.	Conclusion and recommendations	43
9.1	Conclusions	43
9.2	Recommendations	45
10.	References	46

Figures

Appendix A. SEPP information

- A.1 Land SEPP
 - A.1.1 Land use categories
 - A.1.2 Beneficial uses of land to be protected
- A.2 Groundwater SEPP
 - A.2.1 Beneficial uses of groundwater to be protected

Appendix B. Certificate of title information

- B.1 Summary of Title information

B.2 Copies of title documents

Appendix C. Priority sites register

Appendix D. Groundwater bores

Appendix E. Approval process for extractive industries

E.1 Flow chart for approval process

E.2 Work Authority approval process likely to apply for 175 Northern Highway

Appendix F. Yarra Valley Water (2008) report for Lot 8 & 9 Camerons Lane

Appendix G. Arris Pty Ltd (2008) report for Lot 8 & 9 Camerons Lane

List of abbreviations

AEP	Annual Exceedance Probability
AHD	Australian Height Datum
AMG	Australian Map Grid
ANZECC	Australian New Zealand Environment and Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
AS	Australian Standard
ASRIS	Australian Soil Resources Information System
ATES	Aquifer Thermal Energy Storage
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
BH	Borehole
CoC	Chain of Custody
DS	Stock and Domestic
DM	Domestic
DO	Dissolved Oxygen
DQO	Data Quality Objective
DY	Dairy
EAO	Environmental Audit Overlay
EC	Electrical Conductivity
EHS	Environment, Health and Safety
EIL	Ecological Investigation Levels
EMP	Environmental Management Plan
EPA	Environment Protection Authority
ESA	Environmental Site Assessment
FZ1	Farming Zone Schedule 1
GAA	Growth Areas Authority
GME	Groundwater Monitoring Event
GMS	Groundwater Management System
GQO	Groundwater Quality Objective
GWZ1	Green Wedge Zone 1
HIL	Health Investigation Levels
IR	Irrigation
IV	Investigation
LPP	Local Planning Policies
LPPF	Local Planning Policy Framework
mbgl	Metres below ground level
MAH	Monocyclic Aromatic Hydrocarbons
MAR	Managed Aquifer Recharge
MI	Miscellaneous
MPA	Metropolitan Planning Authority
MSS	Municipal Strategic Statement
MW	Monitoring Well
NATA	National Association of Testing Authorities, Australia
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure

NKN	Not known
OCP	Organochlorine Pesticides
OPP	Organophosphate Pesticides
PAH	Polycyclic Aromatic Hydrocarbons
PASS	Potential Acid Sulphate Soils
PSP	Precinct Structure Plan
RWL	Reduced Water Level
SAP	Sampling & Analysis Plan
SB	Soil Bore
SEPP	State Environment Protection Policy
SKM	Sinclair Knight Merz
SPPF	State Planning Policy Framework
ST	Stock
SWL	Standing Water Level
TDS	Total Dissolved Solids
TPH	Total Petroleum Hydrocarbons
UST	Underground Storage Tank
UGZ	Urban Growth Zone
WSPA	Water Supply Protection Area

Executive summary

Background and objectives

Sinclair Knight Merz Pty Ltd (Jacobs SKM) was commissioned by Metropolitan Planning Authority (MPA), formerly Growth Areas Authority (GAA) to undertake a Desktop Environmental, Hydrogeological and Geotechnical Site Assessment of the Beveridge North West Precinct Structure Plan (PSP) area (reference D/13/4728), hereafter referred to as “the site” or “PSP area”).

The Beveridge North West site has been identified as future land supply primarily for residential land use, although also with a view to various commercial and community land uses. The aim of this assessment is to identify opportunities and constraints to the proposed land development which may potentially be caused by existing or past land uses, and site and sub-surface conditions. The assessment comprised two stages; Stage 1 being a review of the history of land use at the site and a preliminary desktop review of information, with Stage 2 involving inspections of the properties within the PSP area identified as presenting a potential risk. Risk in this regard relates to potential contamination, hydrogeology and/or geotechnical issues. Intrusive site investigations were not conducted at this stage, although site inspections were conducted at selected properties, primarily for the purpose of assessing potential issues relating to contamination. This report includes the findings of both the Stage 1 and 2 assessment completed.

Scope of works

The following scope of work was undertaken at the site:

- The Stage 1 assessment comprised the gathering of relevant information (including the use of literature sources) for the purposes of identifying potential sources of contamination, hydrogeological and geotechnical issues
- The Stage 2 assessment included inspecting the site for potential sources of contamination, and areas of geotechnical and hydrogeological significance (i.e. areas of water logging, existing groundwater bores, etc.) identified during the stage one assessment

The approach and findings of the assessment, together with supporting information, are documented within this report.

Conclusions

Site contamination assessment

Based on the information gathered during the Stage 1 & 2 assessments, the following conclusions can be made in relation to the Beveridge North West PSP area:

- The site history assessment found that the site has a long history of agricultural land uses, with much of the areas remaining under cultivation to the present day
- A groundwater quality assessment was recently undertaken by SKM (Jacobs SKM, 2014) which found that concentrations of heavy metals and nutrients such as ammonia, nitrite and nitrate were likely reflective of background / regional groundwater conditions. No beneficial uses of groundwater were found to be precluded. Therefore, the groundwater quality across the site is unlikely to pose a constraint to future development.
- Based on the available information, including a site walkover and site history assessment, the following primary potential sources of contamination have been identified:
 - Potentially contamination associated with general agricultural activity around the homesteads of properties 2, 6 and 22. At these sites, potential contamination is likely to be confined to a small number of localised areas (i.e. immediately around fuel storage tanks or stockyards) rather than distributed across a wide area).

- Highly localised areas of potential contamination associated with stockpiles and general dumped materials. In these locations contamination is likely to be localised to stockpiles themselves and in some instances shallow underlying soils which can be easily removed.
- Diffuse but low level sources of contamination associated with the widespread application of agricultural chemicals on farmland as well as tree plantations. These chemicals may include pesticides, herbicides, fungicides and fertilizers.
- A number of off-site sources of potential contamination have been identified in the vicinity of the PSP site. Based on the nature of the site uses as well as the environmental setting of the site (hydrological, hydrogeological and geological conditions), the greatest risk to the Beveridge North West PSP area is presented by two quarries; one to the east (property 17) and one to the south (property 12). The remaining properties were deemed to present either a low or very low potential for contamination of the PSP area. However, none of these off-site land uses are considered to present constraints to future site development.

Based on the information obtained from the sources described in this report, with the exception of highly localised areas of potential contamination associated with current and/or former land uses identified above, there do not appear to be any significant risks from a site contamination perspective which would render the land unsuitable for residential or other sensitive land uses. Any areas of localised contamination are likely to be able to be effectively managed or remediated during any future site development. However, it should be noted that the site has a long history of agricultural use. While unlikely, it is possible that the broad application of agricultural chemicals may have impacted upon soil at the site. Similarly, potential impacts by nutrients on groundwater as a result of irrigation may place restrictions on the use of groundwater at the site.

Geotechnical assessment

Based on the available geological information, the eastern half of the site is likely to be underlain by highly reactive residual basaltic clay overlying basalt rock, and the western half underlain by residual soils overlying weathered siltstone/sandstone. An indicative site classification of Class "H2 to E" has been assessed in accordance with Table D1, AS2870-2011.

Key geotechnical issues associated with development of the site include the depth and reactivity of the basaltic clay in terms of its influence on site classification, change and interface of variable ground conditions, foundation selection, differential settlement, subgrade performance, excavations and site accessibility. Fill material, if present, is expected to be uncontrolled and may not be suitable for development in its present state. Areas subject to poor drainage may comprise soft material which provides low bearing capacity for foundations.

Hydrology assessment

The site is located at the headwaters of Kalkallo Creek and an unnamed waterway draining to Kalkallo Creek. Kalkallo Creek has its headwaters in the north west corner of the site, and drains to the south west corner. The unnamed waterway drains from the east of the site to the south of the site. The 100 year flood extent and floodway do not cross into the site, indicating no major flood risk. There is an area that is classified as the UFZ zone, which restricts the use of land because of high flood risk. This area is along Kalkallo Creek, with a buffer of approximately 100 m on each side of the waterway.

Hydrogeological assessment

Based on the regional hydrogeological information and bore data in the vicinity of the site, the Newer Volcanics forms the major aquifer at the site, given the better quality (compared to the Kilmore Siltstone) and the number of users currently utilising it in the area.

The site is currently within a Salinity Management Overlay (SMO). Under the SMO, a planning permit will be required as part of the subdivision process, which will detail recommendations for land management practices. Jacobs SKM note that nearby areas have recently had the SMO removed (Mitchell Planning Scheme Amendment C93). Given the vicinity to the Beveridge North West PSP and the lack of observed salinity

affected area on this site, the SMO may also be removed from this PSP area upon application for removal (with applicable environmental assessment).

Over the majority of the site there does not appear to be any significant hydrogeological constraints which would render the land unsuitable for development. However, shallow depth to groundwater is likely to exist in some areas of the site. The following issues would need to be considered in the planning and design of any development:

- Shallow watertable may cause groundwater inflow to excavations and may impact on site drainage (i.e. cause waterlogging)
- Brackish nature of the groundwater may require careful monitoring if dewatering or extraction is required
- Decreased local groundwater recharge in winter and early spring as the result of dewatering or extraction associated with development has the potential to reduce discharge to nearby surface water features, which could potentially have a negative impact on the ecological health of local waterways
- There may be additional land management requirements imposed by council or other regulatory body (relating to the SMO), as part of any proposed subdivision for the site

Opportunities for potential use of extracted groundwater include garden watering and irrigation of parks and ovals, depending on the salinity of the groundwater the groundwater may need to be shandied with potable water to improve the salinity

It is recommended that a field investigation into groundwater elevation and quality be undertaken to confirm the findings of this desktop study. This may include:

- Sampling of existing local bores for quality and water level
- Drilling of narrow test bores for ongoing observation to determine seasonal fluctuations in water level and quality if required

Recommendations

We understand that the proposed future use of the site is as a broad ranging urban development and is likely thus to include sensitive uses such as residential and community facilities in addition to open space, retail and a range of business uses such as offices, light industrial and manufacturing. However, since specific future land uses within the PSP boundary are yet to be confirmed, this assessment has been completed based on the assumption that residential or other sensitive uses will be the probable land future uses across the study area.

The following further works are recommended, including recommended timings:

- Assessment of potential contamination associated with general agricultural land uses around the homesteads of properties 2, 6 and 22. These sites are likely to present the greatest potential for contamination, albeit likely a small number of localised areas (i.e. around septic tanks, fuel storages, stockyards etc.). This process may be best undertaken through the preparation of a Sampling, Analysis and Quality Plan (SAQP) followed by a Phase 2 Environmental Site Assessment (which may include targeted sampling of soils and groundwater). *Timing: It is recommended that this task be undertaken to coincide with the cessation or scaling down of current site operations at these sites and prior to the commencement of the proposed development and construction works.*
- Completion of a hazardous materials assessment for properties 2 and 22 to confirm not only the extent of potential asbestos containing materials and lead based paints, but to identify controls that should be implemented during future development to prevent exposure by site workers or future users of the site. *Timing: It is recommended that this task be undertaken to coincide with the cessation or scaling down of current site operations at these sites and prior to the commencement of the proposed development and construction works.*
- Further drilling and collection of soil samples for the purposes of assessing the geotechnical soil properties for building foundation and road design. *Timing: This task should be undertaken on a site-by-site basis during future development as part of the building permit application process.*

- Completion of aquifer hydraulics testing on existing groundwater bores to determine aquifer properties. This should also include assessment of depth to groundwater. This assumes existing wells are in a suitable condition for such an assessment. *Timing: It is recommended that this task be undertaken to coincide with the cessation or scaling down of current site operations at these sites and prior to the commencement of the proposed development and construction works.*
- Excavation and removal of underground storage tanks, soil remediation and tank pit validation if USTs are found on properties. *Timing: This task should be undertaken on a site-by-site basis during future site development.*
- Removal of other potentially contaminating infrastructure (e.g. septic tanks and above ground storage tanks) followed by soil validation. *Timing: This task should be undertaken on a site-by-site basis during future site development.*
- Classification and appropriate removal (if required) of various stockpiles and dumped materials observed at sites across the study area. This includes subsequent validation following removal. It is noted that sampling of some stockpiles of soil observed may indicate that the material is suitable for re-use as part of future development and as such removal may not be required in all instances. *Timing: This task should be undertaken on a site-by-site basis during future site development.*
- An application to have the salinity management overlay (SMO) removed from the PSP should also be undertaken, as per the recent Mitchell Planning Scheme Amendment C93 for a nearby development area. This will remove the requirement for an intensive planning permit application process for future development. *Timing: This task should be undertaken prior to site development*
- Consultation with YVW to establish their intentions in relation to the future use of the winter storage dams. If these structures are retained a buffer distance may need to be applied in accordance with EPA requirements. In their current form the basins would likely require a 50m buffer from the nearest sensitive land uses. *Timing: This task should be undertaken prior to finalising future land use zones.*

1. Introduction

1.1 Background and objectives

Sinclair Knight Merz Pty Ltd (Jacobs SKM) was commissioned by Metropolitan Planning Authority (MPA), formerly Growth Areas Authority (GAA) to undertake a Desktop Environmental, Hydrogeological and Geotechnical Site Assessment of the Beveridge North West Precinct Structure Plan (PSP) area (reference D/13/4728), hereafter referred to as “the site” or (“PSP area”).

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1.2 Scope of work

The following scope of work was undertaken at the site:

- The Stage 1 assessment comprised the gathering of relevant information (including the use of literature sources) for the purposes of identifying potential sources of contamination, hydrogeological and geotechnical issues
- The Stage 2 assessment included inspecting selected properties within the two PSP areas for potential sources of contamination and areas of geotechnical and hydrogeological significance (e.g. areas of water logging, existing groundwater bores, etc.) identified during the Stage 1 assessment.

The approach and findings of the assessment, together with supporting information, are documented within this report.

1.3 Statement of limitations

This Report has been prepared by Jacobs SKM for the sole use of Metropolitan Planning Authority (“the Client”).

Undertaking an assessment or study of the on-site conditions may reduce the potential for exposure to the presence of contaminated or inadequate bearing ground and/or groundwater. All reports and conclusions that deal with sub-surface conditions are based on interpretation and judgement and as a result have uncertainty attached to them. It should be noted that this report contains interpretations and conclusions which are uncertain, due to the nature of the investigations. No study can completely eliminate risk, and even a rigorous assessment and/or sampling program may not detect all problem areas within a site. The following information sets out the limitations of the Report.

This Report should only be presented in full and should not be used to support any objective other than those detailed within the Agreement. In particular, the Report does not contain sufficient information to enable it to be used for any use other than the project specific requirements for which the Report was carried out, which are detailed in our Agreement. Jacobs SKM accepts no liability to the Client for any loss and/or damage incurred as a result of changes to the usage, size, design, layout, location or any other material change to the intended purpose contemplated under this Agreement.

It is imperative to note that the Report only considers the site conditions current at the time of investigation, and to be aware that conditions may have changed due to natural forces and/or operations on or near the site. Any decisions based on the findings of the Report must take into account any subsequent changes in site conditions and/or developments in legislative and regulatory requirements. Jacobs SKM accepts no liability to the Client for any loss and/or damage incurred as a result of a change in the site conditions and/or regulatory/legislative framework since the date of the Report.

The Report is based on an interpretation of factual information available and the professional opinion and judgement of Jacobs SKM. Unless stated to the contrary, Jacobs SKM has not verified the accuracy or completeness of any information received from the Client or a third party during the performance of the services under the Agreement, and Jacobs SKM accepts no liability to the Client for any loss and/or damage incurred as a result of any inaccurate or incomplete information.

The Report is based on assumptions that the site conditions as revealed through selective sampling are indicative of conditions throughout the site. The findings are the result of standard assessment techniques used in accordance with normal practices and standards, and (to the best of our knowledge) they represent a reasonable interpretation of the current conditions on the site. However, these interpretations and assumptions cannot be substantiated until specifically tested and the Report should be regarded as preliminary advice only.

Any reliance on this Report by a third party shall be entirely at such party's own risk. Jacobs SKM provides no warranty or guarantee to any third party, express or implied, as to the information and/or professional advice indicated in the Report, and accepts no liability for or in respect of any use or reliance upon the Report by a third party.

This Report makes no comment on the presence of hazardous materials, unless specifically requested.

2. Methodology

2.1 General assessment approach

2.1.1 Stage 1 assessment

A Stage 1 assessment (also referred to as a Phase 1 Environmental Site Assessment (ESA)) is typically undertaken to establish site conditions, historical site uses and practices. As part of this Stage 1 assessment the following sources of information have been reviewed:

- Relevant reports
- EPA priority sites register
- EPA list of certificates and statements of environmental audit (current and completed audits)
- Topographical maps
- Groundwater management system (GMS) bore searches
- Geological maps
- Hydrogeological maps
- Potential acid sulfate soils (pass) probability maps

The Stage 1 assessment seeks to identify if possible:

- The potential source(s) of on and off site contamination
- Pathways and receptors of contamination
- Areas of environmental concern (contamination, hydrogeological and geotechnical) which will form the basis of subsequent assessments at the site

2.1.2 Stage 2 assessment

For this particular investigation, the site inspection works are referred to as a Stage 2 assessment. The site inspections undertaken included an inspection of areas that were identified during the Stage 1 as presenting a low, medium or high risk from a contamination, hydrogeological and geotechnical perspective. Those properties identified during the Stage 1 assessment as presenting a very low risk were not inspected. Based on the findings of the site inspections, the need for further soil and groundwater investigation (typically by sampling and analysis) has been identified. While the completion of these further investigations does not form part of this scope of work, **Section 2.1.3**, **Section 2.1.4** and **Section 2.1.5** below provides an overview of the typical objectives/outcomes of such assessments.

2.1.3 Stage 3 assessment

The Stage 3 intrusive site investigation may be undertaken to characterise the site with respect to contamination, hydrogeology and geotechnical conditions. Note that this stage of site investigation is usually referred to as a Stage 2 (or Phase 2) ESA. With respect to each of the abovementioned disciplines, the following works may be undertaken as part of a Stage 3 assessment:

- **A contamination assessment** will typically seek to determine the level (if any) of contamination present on site, establish the lateral and vertical distribution of contamination and identify the source(s) of on-site and off-site contamination. Prior to undertaking any intrusive soil and/or groundwater investigation, a Sampling and Analysis Plan (SAQP) is generally prepared. The SAQP defines the intended sampling locations and the contaminants which will be tested for, based on the site characteristics as determined in a Phase 1 ESA.

- **A geotechnical assessment** will typically seek to obtain information on the sub-surface conditions at the site through a geotechnical site investigation comprising a series of boreholes and/or test pits and laboratory testing. Field and laboratory test data is used to develop a site model describing the soil and/or rock profile and the variability across the site. A geotechnical assessment would generally include advice on site classification and allowable bearing capacity for shallow foundation design and comments regarding excavations, foundation systems, pavement design and other items relevant to the proposed development.
- **A hydrogeological assessment** will typically include determination of the depth to the water table and the potentiometric surface of deeper confined aquifers through the installation of groundwater observation bores, assessment of groundwater and surface water interaction and assessment of aquifers suitability for managed aquifer recharge (MAR).

2.1.4 Remediation

If significant contamination is identified at a site, to a level where the beneficial uses of land, surface water or groundwater are at risk or precluded (described in further detail in **Section 3**), remediation of the identified contamination may be required in order to allow for a particular land use to continue or commence in future.

2.1.5 Environmental auditing

The environmental audit system under the Environment Protection Act 1970 is administered by the Victorian Environment Protection Authority. A statutory Environmental Audit of a site involves the appointment of an EPA accredited environmental auditor to undertake an independent assessment of the environmental condition of a site and provide an opinion regarding the site's suitability for feasible or proposed end uses. A range of information including a site history assessment and results of relevant soil and groundwater testing undertaken are evaluated by the environmental auditor when forming such an opinion. At the conclusion of the audit a certificate or statement of environmental audit may be issued. A certificate indicates that the use of the land is unrestricted, whereas a statement indicates that particular beneficial uses of the land or groundwater are either precluded or suitable only under specified conditions.

3. Regulatory framework for assessment

3.1 Legislation and policy

3.1.1 Planning and Environment Act 1987

The *Planning and Environment Act 1987* sets out the requirements of planning authorities when preparing planning schemes or amendments to planning schemes. The Act requires planning authorities to “take into account any significant effects which it considers the scheme or amendment might have on the environment or which it considers the environment might have on any use or development envisaged in the scheme or amendment”.

Under Section 12 (2) (a) of the *Planning and Environment Act 1987*, the *Ministerial Direction No. 1 – Potentially Contaminated Land* requires planning authorities to satisfy themselves that the environmental conditions of land proposed to be used for a sensitive use, agriculture or public open space are, or will be, suitable for that use. This is generally done through the completion of an environmental site assessment and audit process.

3.1.2 Environment Protection Act 1970

The *Environment Protection Act 1970* established the Victorian Environment Protection Authority (EPA) and made provisions with respect to the powers, duties, and functions of the EPA and the protection of the environment. The Act provides for environmental audits, which are used to provide an authoritative opinion on the suitability of potentially contaminated land for future use, and form an integral part of the land use planning and approval process. The Act also provides the basis for the various State Environment Protection Policies (outlined below) which provide the framework for the assessment and management of the environmental quality of land, surface waters and groundwater in Victoria.

3.1.3 Land State Environment Protection Policy 2002

The State Environment Protection Policy (Prevention and Management of Contamination of Land) (Land SEPP) sets out the regulatory framework for the prevention and management of contaminated land within the State of Victoria. The intent of this framework is to maintain and maximise, to the extent practicable, the quality of the land environment in Victoria, in order to protect its existing and potential beneficial uses. The Land SEPP was declared in June 2002 in accordance with Section 16 of the *Environment Protection Act 1970*, and the Victorian EPA is responsible for its implementation.

The Land SEPP identifies a range of land use categories and a range of protected beneficial uses for each of these categories. The EPA considers that land (soil) is *polluted* where current and/or future protected beneficial uses for the relevant land use categories are precluded. Beneficial uses of land are considered to be precluded when relevant soil quality objectives set out in the Land SEPP for those beneficial uses have been exceeded. Further information on the beneficial uses of land with respect to specific land use categories can be found in **Appendix A**.

3.1.4 Groundwater State Environment Protection Policy 1997

The quality of groundwater in Victoria is protected under the 1997 State Environment Protection Policy (SEPP) ‘Groundwaters of Victoria’ (Groundwater SEPP), declared under the *Environment Protection Act 1970* and administered by the EPA. The groundwater SEPP defines a range of protected beneficial uses for defined segments of the groundwater environment, which are based on the total dissolved solids (TDS) content of the groundwater. The EPA considers that groundwater is *polluted* where protected beneficial uses for the relevant segment are precluded. Beneficial uses of groundwater are considered to be precluded when relevant groundwater quality objectives set out in the groundwater SEPP for those beneficial uses have been exceeded, or where non-aqueous phase liquid is present.

Where groundwater has been polluted, groundwater must be cleaned up such that the protection of beneficial uses is restored, or to be cleaned up to the extent practicable. Further information on the beneficial uses of groundwater with respect to the various segments of groundwater can be found in **Appendix A**

3.1.5 Surface Water State Environment Protection Policy 2003

The quality of Victoria's surface water environments are protected under the 2003 State Environment Protection Policy 'Waters of Victoria' (Surface Water SEPP) declared under the *Environment Protection Act 1970* and administered by the EPA. The Surface Water SEPP sets out the environmental values and beneficial uses of water which are to be protected for each segment of the surface water environment and includes schedules which cover some specific surface water catchments in Victoria. Beneficial uses of surface waters are considered to be precluded when relevant water quality objectives set out in the surface water SEPP for those beneficial uses have been exceeded.

In addition to assessment of surface water quality, the relevant water quality objectives stated in this SEPP are applied to groundwater at the point of groundwater discharge to a surface water system, to assess whether the maintenance of ecosystems beneficial use of groundwater is protected.

3.2 Guidelines and standards

3.2.1 National Environment Protection (Assessment of Site Contamination) Amendment Measure (NEPM) 2013

The NEPM is the national guideline for assessing contaminated sites and was prepared by the National Environment Protection Council (NEPC). The NEPM is implemented in each Australian jurisdiction under the *National Environment Protection Measures (Implementation) Act 1998 (Commonwealth)*. The NEPM document ensures there is a nationally consistent approach to the assessment of contamination. The NEPM provides guidance on the methods of site contamination assessment, environmental and health based investigation levels for soil and groundwater contaminants, human and environmental health risk assessment and reporting requirements. The original NEPM published in 1999 has been recently superseded by a version published in April 2013.

3.2.2 Various EPA publications and guidelines

The following publications and guidelines from the Victorian and New South Wales Environment Protection Authorities are commonly applied and referenced for intrusive soil and groundwater site assessments:

- EPA Victoria, 2000. Groundwater Sampling Guidelines. Publication 669
- EPA Victoria, 2006. Hydrogeological assessment (groundwater quality) guidelines. Publication 668

3.2.3 Potentially Contaminated Land General Practice Note 2005

This general practice note was produced by the Department of Sustainability and Environment in conjunction with the Victorian EPA and provides guidance to the general public and planners on the identification of potentially contaminated land and the stages of assessment and audit required should a site be considered contaminated.

3.2.4 Australian Standard AS4482.1-2005: Guide to the investigation and sampling of sites with potentially contaminated soil – Part 1: Non-volatile and semi-volatile compounds

Australian Standard 4482.1 provides guidance on the collection of sufficient and reliable information when assessing potentially contaminated sites. In particular this standard focuses on the assessment of sites potentially contaminated with non-volatile and semi-volatile compounds. The standard covers key elements of preliminary site investigations (i.e. Stage 1 or Phase 1 ESAs), detailed site investigation methods (i.e. Phase 2 ESAs), data quality objectives (DQO), developing sampling strategies, the collection of samples and quality assurance procedures.

3.2.5 Australian Standard AS4482.2-1999: Guide to the sampling and investigation of potentially contaminated soil – Part 2: Volatile substances

This standard refers to AS448.1 regarding the establishment of preliminary site information, and provides more specific guidance on field screening and sample collection techniques when assessing sites that are potentially contaminated with volatile compounds.

3.2.6 Australian Standard AS1726-1993: Geotechnical Site Investigations

Australian Standard AS1726 sets out minimum requirements for a geotechnical site investigation, as a component in the engineering design, construction, commissioning and operation of civil engineering and building works.

The standard specifies considerations affecting the design and construction of works which must be made in a geotechnical site investigation. Assessment of these factors enables the identification of field and laboratory work to obtain the geotechnical data required to facilitate the engineering design and construction of the works. The standard provides guidance on suitable field and laboratory examination and testing of geotechnical materials and outlines a system of material classification.

The applications of this Standard include assessment of natural or filled ground, new construction, maintenance of existing facilities, the evaluation of post construction performance and the assessment of failure.

3.3 Regulatory framework in the context of this assessment

The acts, policies, guidelines and standards relevant for each stage of assessment are set out in **Table 3.1**.

Table 3.1 : Acts, policies, guidelines and standards relevant for site assessments

Stage of Assessment	Relevant Acts and Policies	Relevant Guidelines and Standards	How the Regulatory Framework Applies
Proposed Change to Land Use	<i>Planning and Environment Act 1987</i>	<i>Ministerial Direction No. 1 – Potentially Contaminated Land</i> <i>DSE Potentially Contaminated Land Practice Note 2005</i>	The Planning and Environment Act requires planning authorities to satisfy themselves that the environmental conditions of land proposed to be used for a sensitive use, agriculture or public open space are, or will be, suitable for that use. This is generally done through the completion of an environmental site assessment and audit process (see below).
Desktop Investigation (Phase 1 ESA)	<i>Environment Protection Act 1970</i> <i>Planning and Environment Act 1987</i> <i>National Environment Protection Measures (Implementation) Act 1998 (Commonwealth)</i>	NEPM 1999 AS4482.1-2005 AS4482.2-1999	The Environment Protection Act and SEPPs provide the legislative basis and policy framework for the assessment and management of contaminated land and groundwater in Victoria.
Intrusive Soil, Groundwater and Geotechnical Assessments (Phase 2 ESA)	<i>Environment Protection Act 1970</i> <i>Land SEPP 2002</i> <i>Groundwater SEPP 1997</i> <i>Waters of Victoria SEPP 2003</i>	NEPM 1999 AS4482.1-2005 AS4482.2-1999 AS1726-1993	The guidelines and standards provide guidance on the collection of reliable information in order to assess the environmental condition of a site appropriately.
Statutory Environmental Auditing	<i>Environment Protection Act 1970</i> <i>Planning and Environment Act 1987</i> <i>Land SEPP 2002</i> <i>Groundwater SEPP 1997</i> <i>Waters of Victoria SEPP 2003</i>	NEPM 1999 Various Victorian EPA Guidelines and Publications	The environmental audit system is provided for in the Environment Protection Act 1970 and the audit process is administered by the Victorian EPA.

4. Site description

General information relating to the Beveridge North West PSP area is presented in **Table 4.1** below. Refer to **Figure 1** for a site location map and **Figure 2** for a site plan, attached at the end of this report.

Table 4.1 : Details for Beveridge North West PSP area

Item	Beveridge North West PSP Area Description
Location / Address	The Beveridge North West PSP area comprises a roughly square shaped area of land to the immediate north-west of the township of Beveridge. The PSP area is demarcated to the south by Camerons Lane and to the west by Old Sydney Road while the eastern edge of the site is bounded by the Hume Freeway and Northern Highway. There are no physical features that demarcate the northern extent of the PSP (except for field boundaries), however it does represent the most northerly extent of the wider Beveridge locality.
Australian Map Grid Coordinates (MGA 55)	Centre at 319,120mE; 5,852,980mN North-western extent at 317,570mE; 5,854,860mN South-western extent at 316,570mE; 5,851,670mN North-eastern extent at 321,080mE; 5,854,420mN South-eastern extent at 320,610mE; 5,851,210mN
Current Title Information	The Beveridge North West PSP area is divided into approximately 15 individual parcels of land. Current title information for selected parcels of land are summarised in Appendix B .
Site Area (ha)	1,276 hectares
Local Council	Mitchell Shire Council
Current Land Zoning	Under the Mitchell Shire Planning Scheme, the majority of the PSP area is zoned as Urban Growth Zone (UGZ) with the following notable exceptions: <ul style="list-style-type: none"> An irregularly shaped area of land across the northern and eastern extents of the study area is zoned as Rural Conservation Zone (RCZ). A further irregular strip is also zoned as RCZ is located along the western extent of the PSP. These zones occupy an area of approximately 320 ha and 50 ha respectively. A narrow strip of land towards the western side of the PSP is zoned as Urban Floodway Zone (UFZ). This parcel is 65 ha in size and follows the route of the Kalkallo Creek that crosses the site. Figure 4 and 5 shows the land zoning for the Beveridge North West PSP study area.
Zoning of Surrounding Land	Under the Mitchell Shire Planning Scheme, the PSP area is bounded variously by the following zones: <ul style="list-style-type: none"> Road Zone 1 (RDZ1) Comprehensive Development Zone – Schedule 2 (CDZ2) Urban Floodway Zone (UFZ) Farming Zone (FZ) Figure 4 and 5 shows the land zoning relevant to the Beveridge North West PSP Area.
Environmental Audit Overlay	There are no sites with an environmental audit overlay within the PSP area or within 200 m of the site.
Site Layout	The site is moderately undulating with the Kalkallo Creek crossing the western extent of the site in a north/south orientation. The high points of the PSP are generally towards the north while the low point is towards the south-west. While there are no public roads crossing the site, there are some private tracks providing access to existing residential properties and farms. To the east of the site is the Hume Freeway which is joined by the Northern Highway adjacent to the PSP.
Current Land Uses	The site is primarily used for agricultural purposes with large areas of open farmland and associated infrastructure (farm buildings, water bores, farm dams etc.). However, there are also some rural residential properties. A large retention basin owned by Yarra Valley Water is also situated towards the centre of the PSP. This is used to irrigate some of the surrounding farmland.

Item	Beveridge North West PSP Area Description
Proposed Land Uses	<p>The proposed future use of the site is as future land supply for various land uses including sensitive uses such as residential and community facilities, in addition to open space, retail and a range of business uses such as office, light industrial and manufacturing.</p> <p>At present, no specific land uses have been allocated to individual parcels of land.</p> <p>Jacobs SKM also understands that an application is intended to be submitted for part of the north-eastern most parcel of land within the PSP to be operated as a scoria/basalt quarry. This parcel is located at 175 Northern Highway. If such a land use were to be approved, a buffer distance of up to 500m between the quarry and sensitive land uses would be required in accordance with EPA Victoria publication 1518 <i>Recommended Separation Distances for Industrial Residual Air Emissions</i> (EPA, 2013)</p>
Surrounding Land Uses	<p>To the north and the west of the PSP, as well as to the east beyond the Hume Freeway is predominantly agricultural land. To the south of the PSP the area is undergoing significant residential development with a golf course also recently constructed. To the east of the site, around 500m from the edge of the PSP, is a scoria quarry set into the side of Mount Fraser which is a volcanic cone.</p>

5. Environmental setting

Information on the general environmental setting of the Beveridge North West PSP area is outlined in the following sections.

5.1 Regional geology

The Department of Primary Industries (DPI) Online Geological Map (accessed in October 2013) was reviewed to determine the geological conditions at the Beveridge North West PSP area.

The main geological unit to be encountered during future development of the eastern half of the site is likely to be basalt and localised scoria of the Newer Volcanic Group (Neo and Neo2). However, towards the west the main geological units are likely to be siltstone with minor sandstone (Dxh) as well as alluvial/colluvial deposits of sand, gravels and silts along the Kalkallo Creek (Qa2 and Nc1).

The surface geology for the site and the immediate surrounding area is presented in **Figure 3** at the end of this report.

The site inspection confirmed the above in part, with rock outcropping (basalt) observed across the study area as well as eroded alluvial deposits along creek. These are illustrated in the images below.



Plate 5.1 : Basalt quarried from a site to the south of the PSP Plate 5.2 : Eroded deposits of silt along the Kalkallo Creek

5.2 Soils and acid sulfate soils map review

A review of the Australian Soil Resources Information System (ASRIS) online map in October 2013 describes the subsoil at the Beveridge North West PSP site as clay (40%) with sand (20%) and silt (10%).

The ASRIS online map was also accessed for information regarding acid sulfate soils. The map indicates that soils within the Beveridge North West area can be classed as having an extremely low to low probability of acid sulfate soil occurrence (ASRIS, 2010).

5.3 Regional hydrology

The site is located at the headwaters of Kalkallo Creek and an unnamed waterway draining to Kalkallo Creek. Kalkallo Creek has its headwaters in the north west corner of the site, and drains to the south west corner. The unnamed waterway drains from the east of the site to the south of the site. There are several on stream farm dams on each of the waterways, particularly on Kalkallo Creek which would play a role in retarding flow and would change the natural flow conditions along the waterways. Kalkallo Creek is a tributary of Merri Creek, which is ultimately a tributary of the Yarra River.

The largest water body on the site is a wetland on the northern boundary of the site; it has a total area of 586,000 m², but only 30% falls into the site boundary. There is also a reasonably sized water body just north of the middle of the site which has an area of 53,000 m². Neither of these water bodies appear to be connected to any of the above mentioned waterways.

The 100 year flood extent and floodway do not cross into the site, they pass to the north east of the site and are approximately 500 m away from the site boundary at the closest point. There is an area that is classified as the UFZ zone, which restricts the use of land because of high flood risk. This area is along Kalkallo Creek, with a buffer of approximately 100 m on each side of the waterway.

5.4 Regional hydrogeology

The Beveridge North West PSP area is directly underlain by three aquifer units:

- The Silurian Kilmore Siltstone is the bedrock unit which forms a minor aquifer at the site. The aquifer is considered to be a fractured rock aquifer, with groundwater occurring within the joints and fractures of the rock mass. Groundwater yields from fractured rock aquifers are variable and largely a function of the degree of fracturing and extent of interconnection of fracture systems.
- The Newer Volcanics aquifer is also a fractured rock aquifer and forms a major regional aquifer. In this area, the Newer Volcanics produce can produce yields up to 6 L/s, with salinity ranging from 1500 – 5000 mg/L TDS. However Harris (1974) notes that the use of water from the aquifer in this area is restricted to stock supplies with bores typically drawing less than 1 L/s. The aquifer thickness is approximately 20 m across the site (University of Ballarat, 2013).
- The Quaternary Alluvium forms a minor aquifer at the site, with a thickness of approximately 7 m across the site (University of Ballarat, 2013). The Alluvium is comprised of a porous medium aquifer, in which groundwater flows through the gaps and pore spaces between the sand particles making up the aquifer.

The nature of recharge to the aquifer units of the area is direct infiltration via rainfall. Groundwater flow is expected to follow subdued topography and as such will flow from north east to south west.

Visualising Victoria's Groundwater (VVG) mapping (University of Ballarat, 2013) indicates that groundwater salinity to the west of the site varies from 3500 – 7000 mg/L (where the Kilmore Siltstone outcrops) and 1000 – 3500 mg/L TDS to the east (within the Newer Volcanics). Groundwater quality information specific to the Quaternary Alluvium was not available.

Local water level information was not available in the Victorian Groundwater Management System (GMS) database. However, depth to water table mapping **Figure 3** indicates depth to watertable is:

- < 5 m below surface within the Alluvium, along the course of Kalkallo Creek
- Approximately 10 m below surface to the east of the site, where the Newer Volcanics outcrops
- 20 – 50 m below surface to the west of the site, where the Kilmore Siltstone outcrops

A review of the Atlas of Groundwater Dependent Ecosystems (GDEs) (BoM, 2012) was undertaken to determine any GDEs within the PSP area. The Atlas identifies that within the PSP area, Kalkallo Creek is listed as having a “high potential for groundwater interaction” indicating that the watertable is likely to be shallow in this area. Just north of the PSP area is an unnamed wetland, which is identified as having a “low potential for groundwater interaction”.

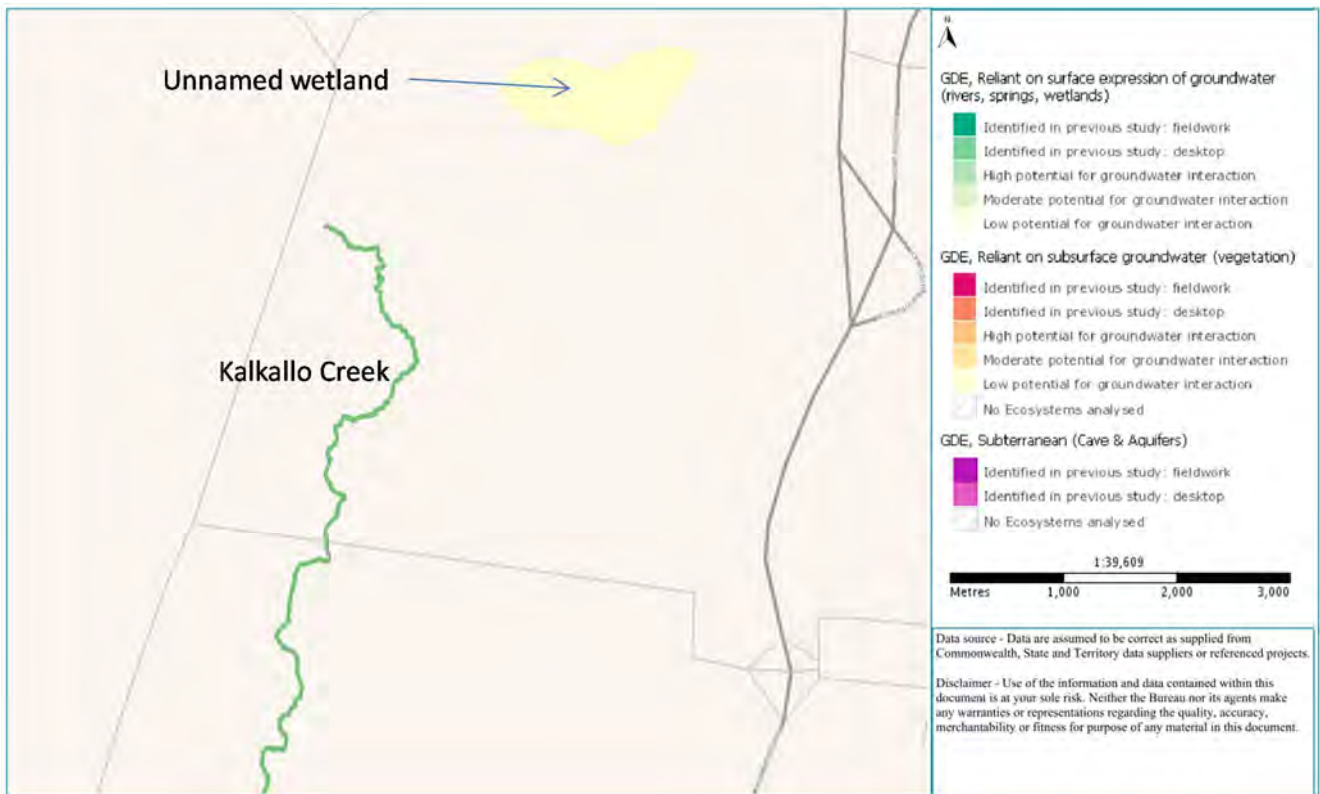


Figure 5.1 : GDE identified within PSP area (BoM, 2012)

5.5 Local groundwater quality

The GMS database was accessed to identify the presence of any nearby registered groundwater bores. The extent of the search area is shown in **Figure 5.1**. Details of local bores are summarised in **Table 5.3**, **Table 5.4** and **Table 5.5**. Bore details are provided in **Appendix D**.

Of the local bores identified within the GMS, none are listed as State Observation Bores. As such, the only water quality information available in the GMS was collected at the time of drilling and this has variable reliability. A summary of available water quality results for the Newer Volcanics and Kilmore Siltstone are shown below in **Table 5.1**. No water quality information was available for bores associated with the Quaternary Alluvium.

TDS is approximately 1500 – 5000 mg/L in the regional basalt aquifer (Harris, 1974) and this is supported by salinity readings shown in GMS records.

The beneficial use of groundwater resources is defined in the State Environment Protection Policy (SEPP) - Groundwaters of Victoria (Victorian Government 1997) in terms of total groundwater salinity (TDS). Comparison of regional groundwater salinities (TDS) with beneficial use segments defined in the SEPP indicates that the beneficial uses of groundwater in the vicinity of the site fall within segment B and C. This indicates that the groundwater is suitable for all beneficial uses except for potable water use.

Table 5.1 : Summary of available water quality data (GMS, 2013)

Parameter	Newer Volcanics Reported concentration (mg/L unless otherwise specified)	Kilmore Siltstone Reported concentration (mg/L unless otherwise specified)
TDS*	1469 – 6786	83 – 2243
pH	7.55 – 8.7 (dimensionless)	6.59 – 9.3

Parameter	Newer Volcanics Reported concentration (mg/L unless otherwise specified)	Kilmore Siltstone Reported concentration (mg/L unless otherwise specified)
Chloride (Cl)	546 – 3260	11 – 785
Carbonate (CO ₃)	54	13 – 64
Bicarbonate (HCO ₃)	435 – 727	32 – 727
Total Alkalinity	-	-
Sulfate (SO ₄)	37 – 376	5 – 47
Nitrogen (N)	-	-
Calcium (Ca)	40 – 93	5 – 58
Magnesium (Mg)	127 – 627	5 – 216
Sodium (Na)	254 – 1755	14 – 389
Potassium (K)	5 – 33	2 – 8
Iron (Fe)	1 – 20	1 – 13

Notes: * Converted from EC to TDS using a conversion factor of 0.65.

TDS – Total Dissolved Solids and EC – Electrical Conductivity

A Yarra Valley Water (YVW) report was prepared in 2008, which contained groundwater data from wells sampled onsite from 2002 - 2008 (see **Section 6.5.1** for further detail regarding this report). Results were generally consistent with the above, with data provided for the following additional analytes (2008 data provided):

Table 5.2 : Summary of available water quality data (YVW, 2008)

Parameter	Geology of bores unknown (mg/L unless otherwise specified)
Nitrate	0.01 – 24
Nitrite	0.01 – 0.82
Ammonia	0 - 1 ⁽¹⁾

Notes: (1) Excludes two anomalous concentrations of 12 and 250 mg/L

5.6 Local groundwater use

The site is not currently represented by any Groundwater Management Areas, which are generally declared in response to significant groundwater use and declining water levels in the area.

The majority of known use is associated to the Newer Volcanics aquifer, likely due to the availability of groundwater quality and yield suitable to stock and domestic supply.

Table 5.3 : Details of local bores known to intersect the Newer Volcanics (major aquifer at the site)

Number of bores	Uses	Bore depth range (m)	Bore yield (L/s)	Groundwater salinity (uS/cm EC)
16	Stock and domestic	16 - 80	0.2 – 2.5	1320 - 3450
1	Commercial	90	NA	NA
1	Observation	12	NA	NA

Table 5.4 : Details of local bores known to intersect the Kilmore Siltstone (minor aquifer at the site)

Number of bores	Uses	Bore depth range (m)	Bore yield (L/s)	Groundwater salinity (uS/cm EC)
5	Stock and domestic	56 – 68	0.4 – 2.4	3100 - 8600

Table 5.5 : Details of bores where the screened unit is unknown (not listed)

Number of bores	Uses	Bore depth range (m)	Bore yield (L/s)	Groundwater salinity (uS/cm EC)
29	Stock and domestic	14 - 76	0.4 - 22	1210- 10440

5.7 Ecology

5.7.1 Desktop assessment

A review of the following Victorian Department of Environment and Primary Industries (DEPI) and Commonwealth Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) databases and documentation was undertaken to provide information on wetlands and sites of national significance in proximity to the investigation area.

- Biodiversity Interactive Map (DEPI 2013)
- Protected Matters Search Tool (DSEWPaC, 2013)
- Melbourne Strategic Assessment – The impact of Melbourne’s grown on ‘seasonal herbaceous wetlands (freshwater) of the temperate lowland plains’ (DEPI, 2013)

5.7.2 Wetlands

A review of the Biodiversity Interactive Map identified one wetland in the vicinity of the Beveridge North West PSP as outlined in **Table 5.6**, below. The wetland identified is naturally occurring and not listed under the Ramsar Convention. It is recommended these areas be retained during development, including any native vegetation.

A review of the Melbourne Strategic Assessment document (DEPI, 2013) was also undertaken, identifying a single seasonal herbaceous freshwater wetland (SHW) area within the PSP. While the lateral extent of the wetland is not defined, it is broadly located within the volcanic crater towards the north east corner of the PSP (property 2\LP6746). While this site has previously been recorded as SHW, an inspection carried out in late 2012 confirmed that SHW was not identified at the site with evidence that the area had instead been recently ploughed and sown for grain crop. As such, DEPI recommended that the area be removed from the SHW dataset.

Table 5.6 : Wetlands in proximity to Beveridge PSP site

Easting/Northing	Wetland ID	Wetland category	Area (Ha)	Subcategory	Proximity to site
319419mE, 5854708mN	70701	Freshwater Meadow	60.22	Herb	Within and along northern boundary of PSP
320742mE 5853708mN	Spring Hill Crater Wetland	Seasonal herbaceous wetland	N/A	N/A	Within parcel 2\LP6746 towards the north east corner of the PSP

5.7.3 Sites of national significance

A report was created using the EPBC Act PMST (DSEWPaC, 2013). This report highlighted any matters of NES (*i.e.* matters relevant to the EPBC Act) that are likely to occur within the investigation area. The information generated in this report is from modelled rather than derived data, meaning that threatened species lists supplied by DEPI are considered more accurate. However the PMST remains a useful tool for identifying potential values

Listed threatened communities

Five threatened ecological communities are modelled as potentially occurring at the site as documented in **Table 5.7**.

Table 5.7 : Conservation status and likelihood of occurrence of threatened ecological communities at the site (DSEWPaC, 2013).

Name	Status	PMST modelled likelihood of occurrence
Grassy Eucalypt Woodland of the Victorian Volcanic Plain	Critically Endangered	Community known to occur within area
Grey Box (<i>Eucalyptus microcarpa</i>) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	Endangered	Community may occur within area
Natural Temperate Grassland of the Victorian Volcanic Plain	Critically Endangered	Community likely to occur within area
Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains	Critically Endangered	Community likely to occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community likely to occur within area

Jacobs note that while DSEWPaC identify the potential presence of seasonal herbaceous wetlands within the study area, this community no longer appears to occur within the PSP (refer Section 5.7.2).

Listed species

Twenty-one EPBC listed threatened species are modelled as potentially occurring within the investigation area as described in **Table 5.8**.

Table 5.8 : Conservation status and likelihood of occurrence of threatened species at the investigation area (DSEWPaC, 2013).

Common name	Scientific name	EPBC status	PMST modelled likelihood of occurrence
Birds			
Regent Honeyeater	<i>Anthochaera phrygia</i>	Endangered	Foraging, feeding or related behaviour likely to occur within area
Australasian Bittern	<i>Botaurus poiciloptilus</i>	Endangered	Species or species habitat known to occur within area.
Swift Parrot	<i>Lathamus discolor</i>	Endangered	Species or species habitat likely to occur within area
Malleefowl	<i>Leipoa ocellata</i>	Vulnerable	Species or species habitat may occur within Area
Plains-wanderer	<i>Pedionomus torquatus</i>	Vulnerable	Species or species habitat likely to occur within area
Australian Painted Snipe	<i>Rostratula australis</i>	Endangered	Species or species habitat may occur within area

Common name	Scientific name	EPBC status	PMST modelled likelihood of occurrence
Fish			
Eastern Dwarf Galaxias	<i>Galaxiella pusilla</i>	Vulnerable	Species or species habitat likely to occur within area
Australian Grayling	<i>Prototroctes maraena</i>	Vulnerable	Species or species habitat may occur within area
Frogs			
Growing Grass Frog	<i>Litoria raniformis</i>	Vulnerable	Species or species habitat known to occur within area
Insects			
Golden Sun Moth	<i>Synemon plana</i>	Critically Endangered	Species or species habitat may occur within area
Mammals			
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	Vulnerable	Species or species habitat likely to occur within area
Plants			
Curly Sedge	<i>Carex tasmanica</i>	Vulnerable	Species or species habitat likely to occur within area
Matted Flax-lily	<i>Dianella amoena</i>	Endangered	Species or species habitat likely to occur within area
Clover Glycine, Purple Clover	<i>Glycine latrobeana</i>	Vulnerable	Species or species habitat likely to occur within area
Basalt Pepper-cress	<i>Lepidium hyssopifolium</i>	Endangered	Species or species habitat likely to occur within area
Plains Rice-flower, Spiny Rice-flower, Prickly Pimelea	<i>Pimelea spinescens subsp. spinescens</i>	Critically Endangered	Species or species habitat may occur within Area
Maroon Leek-orchid, Slaty Leek-orchid, Stout Leek-orchid, French's Leek-orchid, Swamp Leekorchid	<i>Prasophyllum frenchii</i>	Endangered	Species or species habitat likely to occur within area
Swamp Fireweed, Smooth-fruited Groundsel	<i>Senecio psilocarpus</i>	Vulnerable	Species or species habitat likely to occur within area
Spiral Sun-orchid	<i>Thelymitra matthewsii</i>	Vulnerable	Species or species habitat may occur within area
Swamp Everlasting	<i>Xerochrysum palustre</i>	Vulnerable	Species or species habitat likely to occur within area
Reptiles			
Striped Legless Lizard	<i>Delma impar</i>	Vulnerable	Species or species habitat likely to occur within area

Migratory species

Thirteen migratory species are modelled as potentially occurring within the investigation area as described in **Table 5.9**.

Table 5.9 : Migratory species modelled as likely to occur within the Woolshed Swamp Reserve

Scientific name	Common name	PMST modelled likelihood of occurrence
<i>Apus pacificus</i>	Fork-tailed Swift	Species or species habitat likely to occur within area
<i>Ardea alba</i>	Great Egret	Species or species habitat likely to occur within area
<i>Ardea ibis</i>	Cattle Egret	Species or species habitat likely to occur within area
<i>Gallinago hardwickii</i>	Latham's Snipe	Species or species habitat may occur within area
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	Species or species habitat likely to occur within area
<i>Hirundapus caudacutus</i>	White-throated Needletail	Species or species habitat known to occur within area
<i>Leipoa ocellata</i>	Malleefowl	Species or species habitat may occur within area
<i>Merops ornatus</i>	Rainbow Bee-eater	Species or species habitat may occur within area
<i>Monarcha melanopsis</i>	Black-faced Monarch	Species or species habitat likely to occur within area
<i>Myiagra cyanoleuca</i>	Satin Flycatcher	Species or species habitat known to occur within area
<i>Rhipidura rufifrons</i>	Rufous Fantail	Species or species habitat likely to occur within area
<i>Rostratula benghalensis (sensu lato)</i>	Painted Snipe	Species or species habitat may occur within area
<i>Xanthomyza phrygia</i>	Regent Honeyeater	Foraging, feeding or related behaviour likely to occur within area

6. Information review

This section summarises the various sources of information, records and reports reviewed as part of the Stage 1 desktop assessment.

6.1 Current Certificate of title information

Certificates of title were reviewed to ascertain information on the current and historical land uses within and in the Beveridge North West PSP area. A summary of the title information is provided in **Appendix B** with locations illustrated in **Figure 8**. A review of the titles revealed the following information:

- The majority of historical title documents suggest that the area was used for agricultural purposes (as well as rural residential use), as anticipated.
- A large proportion of the PSP area is now owned by Yarra Valley Water, having been transferred from Elsberry Pty Ltd (5 parcels) and Goulburn Valley Regional Water Authority (2 parcels) in 2005.
- Current title documents suggest the remainder of the PSP area is used for agricultural purposes or rural residences. There is no suggesting that any other potentially contaminating land uses are present.

All title searches were conducted by Feigl and Newell Title Searchers. Where possible, the three most recent titles were reviewed for each identified parcel at the site.

6.2 EPA Priority Sites Register

A search of the EPA's Priority Sites Register (PSR), which lists those sites for which EPA has requirements for active management of land and groundwater contamination, was conducted. Sites within the Beveridge North West PSP area were not listed on the Register, nor were there any registered priority sites within a 5km radius of the area. A copy of the reviewed PSR (dated 31st August 2013) is provided in **Appendix C**.

6.3 EPA List of sites issued with Statements and Certificates of Environmental Audit

Under Victoria's *Environment Protection Act 1970*, statutory environmental audits of potentially contaminated land result in the issue of a Certificate of Environmental Audit if the site is considered suitable for any beneficial use (and land uses). Sites are issued a Statement of Environmental Audit if they are not found to be suitable for all beneficial uses (or land uses), as defined under Section 4 of the Act. Issue of a Statement indicates that some contamination remains at the site. A statement precludes one or more beneficial uses and/or requires management for the site to be suitable for one or more land uses.

The Victorian EPA maintains a list of all sites for which a Certificate or Statement of Environmental Audit has been issued. At the time of reporting no sites were identified within a 5km radius of the Beveridge North West PSP area as having been issued with either a Statement or Certificate of Environmental Audit.

6.4 EPA List of current environmental audit sites

The Victorian EPA also maintains a list of all sites which are currently subject to the environmental audit process. At the time of reporting there were no sites either within the PSP boundary or within a 5km radius of the area which are the subject of an ongoing audit.

6.5 Reviewed reports

Jacobs SKM was provided with two reports relating to the Wallan reclaimed water re-use scheme at Lot 8 and Lot 9, Camerons Lane (refer parcels 8/LP6746 and 9/LP6746 respectively in **Figure 8**). These reports are entitled:

- Yarra Valley Water, (YVW, 2008). *Wallan Reclaimed Water Re-Use Scheme: Camerons Lane Lots 8 & 9 – Preliminary Assessment of Groundwater Monitoring Results*. May 2008
- Arris Pty Ltd (Arris, 2008). *Lots 8 & 9 Camerons Lane Reuse Scheme – Assessment of Soil Monitoring Data for 2006 to 2007*. May 2008.

These reports are discussed in the following sections and are provided in Appendix F and Appendix G respectively.

6.5.1 Yarra Valley Water, 2008: Wallan Reclaimed Water Re-Use Scheme: Camerons Lane Lots 8 & 9 – Preliminary Assessment of Groundwater Monitoring Results

In 2008 Yarra Valley Water undertook groundwater monitoring across a network of 18 groundwater monitoring bores and windmills. The purpose of the assessment was to confirm that the irrigation of the site using recycled water was not having a detrimental impact upon groundwater quality and the relevant beneficial use segments as defined in the State Environmental Protection Policy (SEPP). Refer to **Appendix A** for further information regarding groundwater beneficial use segments. Laboratory results were compared against background results obtained by SKM in 2005 prior to commencement of irrigation in order to assess groundwater quality trends. These results were also compared against the ANZECC & ARMCANZ (2000) assessment criteria for the relevant protected beneficial uses.

Yarra Valley Water concluded that the majority of parameters generally reported stable concentrations trends between pre and post irrigation monitoring. Where exceedances of the relevant criteria were observed, these were either:

- For analytes that also reported exceedances prior to irrigation commencing and were therefore deemed unlikely to have resulted from the irrigation itself (i.e. TDS)
- For analytes that were not tested for during pre-irrigation monitoring and therefore results could not be attributed to irrigation (i.e. sodium, chloride and pH)

The report also provides a summary of the water quality parameters for the recycled irrigation water, which was derived from the Wallan Sewage Treatment Plant. The discharged water is rated as Class C recycled water, which can be used for the following uses (as described by Yarra Valley Water):

'Class C may be used for a number of uses including for cooked or processed human food crops including wine grapes and olives. It can also be used for livestock grazing and fodder and for human food crops grown over a meter above the ground and eaten raw such as apples, pears, table grapes and cherries. It can be used by councils for specific purposes but there are restrictions around human contact'

While nutrient concentrations (nitrate, nitrite and ammonia) as well as E.coli are generally raised, concentrations of metals, selected solvents, volatile organics and monocyclic aromatic hydrocarbons (MAHs) were generally reported below laboratory limits of detection. As such, irrigation is unlikely to result in contamination of the soil or groundwater by these analytes.

6.5.2 Arris Pty Ltd, 2008: Lots 8 & 9 Camerons Lane Reuse Scheme – Assessment of Soil Monitoring Data for 2006 to 2007

In May 2008, Arris Pty Ltd (Arris) was commissioned by Yarra Valley Water to undertake an assessment of impacts on soils at the site as a result of irrigation using recycled water. This assessment focussed predominantly on agronomic impacts, rather than impacts to ecological or human health.

The investigation involved the collection of soil samples from 8 separate locations across the area to the south of the recycled water reservoir, where the lateral irrigation systems operate. Samples were collected at two depth intervals (namely 0.0 – 0.1mbgl and 0.2 – 0.3mbgl) in 2006 and 2007, with 32 samples collected in total. Soil samples were tested for a range of analytes used to measure soil health (predominantly from an agronomic perspective).

The report concluded that the irrigation of the site with recycled water ‘has generally improved many indicators of soil health’ over the monitoring period. Notable trends included:

- Increased pH
- Decreased total aluminium
- Increased cation exchange capacity

While minimal laboratory analysis was undertaken for contaminants of concern relevant to the protection of human health, it is noted that the reported analysis of the irrigation water indicated concentrations of metals, selected solvents, volatile organics and monocyclic aromatic hydrocarbons (MAHs) generally below the laboratory limits of detection or at low concentration. While this does not rule out the presence of such contaminants in the soil as a result of other anthropogenic sources (or in the case of metals in particular from naturally derived sources), it is highly unlikely that irrigation would result in the accumulation of such contaminants in the soil.

6.6 Historical aerial photography review

Aerial photographs from 1968 to 2013 were reviewed for land use changes. Observations are summarised in **Table 6.1** below. Refer to **Figure 6A** through **Figure 6F** for aerial photographs.

Table 6.1 : Aerial photograph and historical plan summary

Date	Photo / Plan	Description	Source
1968	Aerial Photo	While some farm properties can be seen within the PSP, the vast majority of the study area appears to be agricultural land. There is no evidence of the Yarra Valley Water infrastructure, nor the Hume Freeway or Northern Highway.	DSE – LIC
1974	Aerial Photo	While only partial coverage of the study area is available for 1974, little has changed on site compared to 1968 and the site continues to be used as agricultural land. Off site, the Hume Freeway has been constructed and it appears that the Northern Highway is under construction. Potential disturbance at Mount Fraser suggests quarrying may have commenced.	DSE – LIC
1977	Aerial Photo	Little appears to have changed between 1968 and 1977 within the PSP itself (where coverage is available) with the major land use still predominantly agricultural land and no additional farm homesteads appear. No notable offsite land uses appear to have changed.	DSE – LIC
1984	Aerial Photo	The PSP extent still appears to be used for agricultural purposes with no notable changes reported since 1977. Some limited development (likely rural residences) are evident to the south of the site, but the surrounding area is otherwise unchanged.	DSE – LIC
1990	Aerial Photo	Once again, little has changed in the way of on-site land uses with still no evidence of the Yarra Valley Water reservoir. The area continues to be dominated by agricultural land uses. There is evidence in increased development to the south of the site with various properties present including trotting tracks.	DSE – LIC
2013	Aerial Photo	2013 imagery suggests the majority of the site continues to be used for agricultural purposes, with irrigation noted towards the centre of the site, including lateral irrigators as well as circular. A reservoir is also present as well as a plantation towards the western boundary of the site. No other notable features are evident at the site with the exception of rare rural residences.	Vicmap

Date	Photo / Plan	Description	Source
		Off-site, some development has continued to the south of the site although few changes are notable elsewhere around the site perimeter with the quarry at Mount Fraser still operational.	

6.7 Historical zoning records review

The Department of Planning and Community Development (DPCD) website was accessed for historical zoning information in relation to the site. However, no information was available the study area.

6.8 Data integrity assessment

It is recognised that not all prior land use information has been identified, and given the resources provided for this investigation only a relatively general history of the site has been established. However, the completeness and quality of the historical data is considered to be sufficient for the purposes of the investigation.

The table below represents the years for which site use history data collected during this investigation was available.

Table 6.2 : Information availability

	1880 - 1900	1900 - 1920	1920 - 1940	1940 - 1960	1960 - 1980	1980 - 2000	2000 -
Historical Plans							
Aerial Photographs							
Historical Photos							

Note: Blank boxes indicate no information was available.

Shaded Boxes indicate information was viewed.

7. Site characterisation

7.1 Site contamination assessment

Based on the information presented in the previous sections, a small number of potential sources of contamination were identified during the Stage 1 assessment of the Beveridge North West area. The potential sources of on-site contamination were assigned a qualitative level of risk based on the likelihood of the contamination representing a potential constraint to future development at the site. A site inspection was then undertaken (Stage 2 assessment) to verify the risk ranking. While the Stage 2 assessment focussed on those areas identified as presenting the greatest potential for contamination, SKM also assessed the wider site extent to confirm land uses.

Off-site potential sources of contamination were also inspected during the Stage 2 assessment (where possible). These too were assigned a qualitative risk level based on the likelihood of the contamination representing a potential constraint to future development of the Beveridge North West PSP area.

While each identified property is slightly different with respect to the potential for contamination, there are some land uses which recur across the PSP and are fairly typical of rural areas such as the Beveridge. The most common potential sources of contamination observed within the study area include farms residences and associated sheds, stockyards and imported fill (including tipped waste and miscellaneous stockpiles). While **Table 7.1** and **Table 7.2** identify potential contaminants of concern relevant to each parcel assessed, the presence of other contaminants of concern cannot be ruled out at this stage owing to the limited assessment of each individual property. These common land uses are discussed below as well as general comments relating to the PSP area and surrounding land use.

Farm residences and associated sheds

Farm residences and associated sheds are the most common potential source of contamination across the study area. These areas are typically used for storage of farm machinery (both operational and non-operational), materials, vehicles and many other miscellaneous items. These yards may also include fuel storage areas for refuelling farm machinery (typically in above-ground storage tanks) as well as storage areas for items such as agricultural chemicals (pesticides, herbicides etc.), oils, lubricants and solvents for machinery maintenance.

Since farm residences can be fairly isolated, the use of septic tanks for sewerage purposes rather than mains sewerage is fairly common. However, since these are underground they can be difficult to identify. However, conversation with residents suggests septic sewerage appears to be standard.

Storage shed construction can vary depending on their age and can be variously formed of timber, corrugated iron, asbestos cement sheeting, blocks/bricks and concrete. Some sheds may also incorporate concrete floor slabs while others do not.

Based on the above, the most likely sources of contamination include spillages of fuels as well as impacts on soils by metals resulting from general machinery/equipment storage and maintenance of farm vehicles. However, spillages of other agricultural chemicals may also impact upon soils. Given that such chemicals are typically stored in small volumes (less than 20L) impacts are therefore likely to be extremely localised in extent. Additional contaminants of concern can also include biological contaminants and nutrients associated with leakages from septic tank systems.

Asbestos was also commonly used as a building material with a number of applications in Australia as early as the 1880s (although more frequently in the mid to late 1900s). While asbestos presents a limited risk while it remain in a bonded matrix (i.e. as bonded asbestos cement sheeting), free fibres can present a greater potential risk. Mobilisation can occur through a number of processes including (but not limited to) abrasion, sanding and cutting.



Plate 7.1 : Example of above ground storage tank



Plate 7.2 : Example of typical farm machinery shed

Stockyards

Stockyard structures were frequently noted across the PSP study area, typically close to the main farm homestead. These are used to hold livestock prior to loading on to trucks and typically form a number of small timber enclosures. These occasionally include small covered sheds used for storage purposes.

Stockyards can also be accompanied by adjacent sheep dips which are used to dose/treat sheep. Typically forming a narrow pit/channel, they are filled with a liquid formulation of fungicide/insecticide through which the sheep are passed before being held in an enclosure to allow surplus liquid to drain from the fleece.

While sheep dips can be permanent structures, the absence of a dedicated in-situ pit does not rule out such an activity taking place at a stockyard. Metals troughs were also used a mobile alternative.

Contamination of soil and groundwater can result from the above activities as the liquid formulation either leaks from defects in the dipping infrastructure (be it a permanent sheep dip or mobile trough) or drains from sheep while they are retained in the holding enclosures after dipping is completed.



Plate 7.3 : Example of a stockyard structure



Plate 7.4 : Example of typical sheep dip

Imported fill, tipped waste and stockpiled material

The presence of imported fill can be difficult to identify without undertaking intrusive investigations, particularly in areas which are heavily vegetated. Fill material is most likely to be found in locations where previous construction/development works have been undertaken. Stockpiles of soil and tipped waste material were also noted frequently across the study areas, although mainly confined to areas around farm buildings.

Potential contaminants of concern associated with fill material, tipped waste and stockpiled materials can vary significantly depending on their source and time at which they were deposited. Since such information is rarely available specific contaminants of concern often cannot be adequately identified without laboratory analysis (although visual and olfactory observations can provide limited information). However, the most commonly encountered contaminant groups include total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAHs) and metals. However, asbestos is also a contaminant of concern, particularly in building rubble.

General agricultural land use

Much of the land forming the PSP area has been used for agricultural purposes for an extended period of time. As such, there is likely to be a long history of general agricultural processes within the study area. The most notable of these is crop spraying. Contaminants of concern associated with this process typically include pesticides, herbicides and fungicides as well as potentially nutrients (from manure, slurry application and other fertilizers).

While this general use has not been explicitly identified in **Table 7.1** and **Table 7.2** owing to their site-wide relevance, this historical use is considered to present a low to moderate risk of causing contamination. On the basis of this risk ranking and broad-scale and historical nature of these potential sources it is considered likely that further assessment of the land (through intrusive soil assessment in the first instance) may be required at a later date, once more certainty regarding the proposed land uses is available and an informed sampling strategy can be prepared. Further discussion on this topic is provided in **Section 8**.

7.1.1 Potential sources of contamination on site and findings of site inspection

The potential on-site sources of contamination were targeted during the site inspection of the Beveridge North West PSP area on 17th October 2013. Each of the potential sources of on-site contamination identified during the Stage 1 and 2 assessments are presented in **Table 7.1** along with the findings of the Stage 2 site inspection. The original risk rankings have been re-evaluated following the site inspection with the revised risk rankings also provided.

The property numbers referred to in **Table 7.1** have been allocated to a particular part of a property parcel by SKM for the purposes of this investigation. **Figure 7** shows the allocated property number and the location of each of these identified potential sources of contamination where possible.

General farm homesteads were the most frequently observed potential contamination sources within the PSP area. As described previously, these typically included fuel storage as well as storage of other miscellaneous chemicals. Stockpiling was also noted around these areas and in some cases potential asbestos containing materials (in varying conditions) were also identified. Properties 2, 6 and 22 were three such properties and were allocated the highest risk rankings for the PSP, namely a moderate potential for contamination. In all three cases these properties reported multiple localised potential sources of contamination.

Properties 9, 10 and 11 are owned by Yarra Valley Water and irrigated using recycled water from the Wallan Sewage Treatment Plant. This use has the potential to impact upon underlying groundwater quality that may result in restriction of future beneficial uses of groundwater (a groundwater quality assessment was recently undertaken – Jacobs SKM, 2014).



Plate 7.5 : Potential asbestos cement sheet at property 2



Plate 7.6 : Fuel storage tank at property 2



Plate 7.7 : Above ground diesel storage tank at property 6



Plate 7.8 : Potential asbestos cement sheet at property 22



Plate 7.9 : Typical miscellaneous stockpile at property 22



Plate 7.10 : Glyphosate herbicide stored at property 22

Table 7.1 : Summary of potential on site sources of contamination

Property No.	Site Use/Activity	Potentially Contaminated Medium	Potential Contaminants of Concern	Findings of Site Inspection	Potential Contamination Risk	Further Site Specific Assessment *
Beveridge North West PSP Area						
1	Tree plantation	Soil and groundwater	Nutrients, herbicides and pesticides	Christmas tree plantation occupies much of the site as well as a farm dam for water supply. No evidence of chemical storage on site, although this can't be ruled out. While a tanker was observed on site, it was most likely a water truck. Minor stockpiling was evident, but appeared to be site-won soil.	L – M	None
2	Farm buildings including a stockyard and residence	Soil and groundwater	TPH and metals around farm buildings as well as herbicides, insecticides and fungicides around stockyards. Nutrients and biological contaminants around septic tanks. Potential asbestos also observed	Stockyard present, although no sign of dipping infrastructure. General material stockpiles observed, mainly building materials (tiles, concrete, tin and timber). Small amounts of potential asbestos containing materials observed in localised areas (likely historically removed from buildings) totalling less than 1m ³ . Highly fragmented. Two fuel storage tanks were observed near farm buildings. Both were disused. One was empty, the other appeared to be filled with water. Numerous machinery sheds were noted as well as general farm infrastructure. A septic system was also noted at the property.	M	Targeted investigations around potential contamination sources such as stockyards, fuel storage areas and septic tanks Hazardous materials assessment to confirm the extent of asbestos and management requirements.
3	Farm buildings and stockyard	Soil and groundwater	TPH and metals around farm buildings as well as herbicides, insecticides and fungicides around stockyards.	Hay shed present with various items of farm machinery/infrastructure present. A stockyard was also present with potential dipping infrastructure, although now appears disused.	L – M	None
4	Residence and miscellaneous outbuildings	Soil	Nutrients and biological contaminants around septic tanks	Farm residence with various outbuildings, although used for domestic use rather than agricultural use. A swimming pool was also present in the back garden. Septic tank likely present but couldn't be verified.	L	None
5	Stockpile	Soil	Various associated with stockpiling	Small stockpile of gravel (less than 5m ³) likely used to maintain the access road to the nearby properties/sheds.	VL	None

Property No.	Site Use/Activity	Potentially Contaminated Medium	Potential Contaminants of Concern	Findings of Site Inspection	Potential Contamination Risk	Further Site Specific Assessment *
6	Farm buildings and stockyard	Soil and groundwater	TPH and metals around farm buildings as well as herbicides, insecticides and fungicides around stockyards. Nutrients and biological contaminants around septic tanks.	<p>Farm residence surrounded by various farm buildings and infrastructure.</p> <p>Two stockyards were noted, one with dipping infrastructure present. The sheep dip was full (likely rainwater rather than treatment). Neither stockyard appeared to have been used recently.</p> <p>Nearby sheds used to store farm machinery as well as workshop. Various oils and chemicals were stored in the sheds including an above ground fuel storage tank containing diesel. No solid floor slab was present with minor localised staining observed.</p>	M	Targeted investigations around observed sheep dips and stockyards as well as around fuel storage areas, septic tanks and buildings.
7	Stockyard	Soil and groundwater	Herbicides, insecticides and fungicides	Small farm shed noted along with a stockyard structure. No sheep dip was observed.	L – M	None
9	Irrigated farmland	Soil and groundwater	Nutrients and biological contaminants	<p>Two adjacent fields, each with large irrigation systems present. The fields are irrigated using recycled water from the nearby Yarra Valley Water reservoir, derived from the Wallan Sewage Treatment Plant.</p> <p>Fields are lined either side by plantation trees, likely to reduce the effect of wind.</p> <p>**A recent groundwater quality assessment was undertaken (Jacobs SKM, 2014) which found no beneficial uses of groundwater to be precluded</p>	L	Periodic groundwater monitoring of the bore network should be undertaken (by YVW or other) on an ongoing basis
10	Retention basin	Soil and groundwater	Nutrients and biological contaminants	<p>Yarra Valley Water storage reservoir, fed by recycled water from the nearby Wallan Sewage Treatment Plant.</p> <p>A nearby compound houses various pumps, a weather station, water tanks and other relevant infrastructure.</p> <p>**A recent groundwater quality assessment was undertaken (Jacobs SKM, 2014) which found no beneficial uses of groundwater to be precluded</p>	L	
11	Irrigated farmland	Soil and	Nutrients and biological	Two circular irrigation systems also fed from the nearby Yarra	L	

Property No.	Site Use/Activity	Potentially Contaminated Medium	Potential Contaminants of Concern	Findings of Site Inspection	Potential Contamination Risk	Further Site Specific Assessment *
		groundwater	contaminants	Valley Water storage reservoir which in turn is derived from the Wallan Sewage Treatment Plant. **A recent groundwater quality assessment was undertaken (Jacobs SKM, 2014) which found no beneficial uses of groundwater to be precluded		
15	Farm buildings and stockyard	Soil and groundwater	TPH and metals around farm buildings as well as herbicides, insecticides and fungicides around stockyards. Nutrients and biological contaminants around septic tanks.	Farm shed, now used primarily for garden machinery rather than for agricultural purposes. A stockyard is also present, although this now forms a garden feature and is not used for its original purpose. No redundant dipping infrastructure was observed.	L – M	None
22	Farm buildings including stockyard and residence	Soil and groundwater	TPH and metals around farm buildings as well as herbicides, insecticides and fungicides around stockyards. Nutrients and biological contaminants around septic tanks. Potential asbestos also observed as well as possible lead based paint.	Farm residence as well as sheds and associated infrastructure. The sheds themselves were in varying conditions, some extremely dilapidated. Some potential asbestos fragments were also observed around one of the buildings. The paint on the timber was also flaking heavily (potentially lead based paint given the likely age of the building). No fuel storage was noted on site with the exception of an LPG cylinder supplying the house. A diesel fuel tank was observed on the back of a ute, likely used to re-fuel machinery rather than a permanent above/below ground storage tank. An extensive stockyard was noted with cattle crush, although no dipping infrastructure was observed. However, given the presence of a shearing shed it is likely that dipping will have historically taken place. A septic system is also likely present.	M	Targeted investigations around potential contamination sources such as stockyards, septic tanks and around dilapidated buildings where potential asbestos and lead based paint was observed. Hazardous materials assessment to confirm the extent of asbestos and potential lead based paint and management requirements.
23	Haulage company with	Soil	Various associated with stockpiling	While the site could not be accessed, parts of it could be	L – M	None

Property No.	Site Use/Activity	Potentially Contaminated Medium	Potential Contaminants of Concern	Findings of Site Inspection	Potential Contamination Risk	Further Site Specific Assessment *
	stockpiling		as well as TPH associated with possible fuel storage	viewed from the roadside. The eastern extent of the site appeared to be used for parking trucks with minor stockpiling while the west appeared to be a residence. No notable features were present towards the central portion of the site. No fuel storage was observed but can't be ruled out at this stage.		

Notes:

TPH – Total Petroleum Hydrocarbons

Nutrients – Ammonia, nitrate, nitrite, phosphate

*Note this excludes further broad-acre sampling recommended to assess potential soil contamination resulting from the historic uses of agricultural chemicals across farmland in general. Such an assessment would not target individual properties; rather representative samples would be collected across the wider extent of the PSP study area. Refer to **Section 9** for further details.

7.1.2 Potential off-site sources of contamination

Sites located outside of the PSP study area boundary were also considered during the Stage 1 assessment in order to identify any potentially contaminating land uses that may impact upon the future uses of land within the PSP study area itself. Off-site sources identified in the vicinity of the PSP area are summarised in **Table 7.2** and illustrated in **Figure 7**. Sites listed in this table were inspected from the closest publicly accessible areas during the Stage 2 assessment.

The sites located outside of the Beveridge North West PSP area with the highest risk rankings were properties 12 and 17, both allocated a risk ranking of low to moderate. These two sites are existing quarries- property 12 a scoria quarry and in the case of 17 a basalt (bluestone) quarry.

The remaining off-site properties generally comprised small farms with some areas of minor disturbance or stockpiling. Based on their proximity to the PSP as well as the nature of the operations observed, the potential for contamination of the PSP study area was perceived to be either low or very low.

Table 7.2 : Summary of potential off site sources of contamination

Property No.	Site Use/Activity	Potentially Contaminated Medium	Potential Contaminants of Concern	Findings of Site Inspection	Potential Contamination Risk	Further Site Specific Assessment
Beveridge North West PSP Area						
8	Farm sheds and possible stockpiles	Soil	Various associated with stockpiles as well as TPH and metals around farm buildings.	Single shed present with likely water storage tanks present. Imagery also suggest some stockpiling and possible stockyard structures.	L	None
12	Quarry	Soil and groundwater	TPH and metals associated with maintenance and refuelling of machinery	Scoria quarry set in the nearby hill side. The site was not accessed, but it appears to be a fairly significant operation with various infrastructure present in order to support the quarry (i.e. buildings and a weighbridge). Fuel storage is also likely given the number of machines present.	L – M	None
13	Dilapidated farm buildings and a water bore	Soil	TPH and metals around farm buildings	Buildings are almost completely demolished. A water bore remains at the site along with a water storage tank.	VL	None
14	Farm residence and stockyard	Soil and groundwater	Herbicides, insecticides and fungicides around the stockyard and nutrient and biological contaminants around septic systems	Residential property with what appears to be a redundant stockyard in the adjacent paddock.	VL	None
16	Golf course	Soil and groundwater	Nutrients, herbicides and pesticides	Newly constructed golf course.	VL	None
17	Quarry	Soil and groundwater	Various associated with stockpiling and TPH associated with potential fuel storage	The quarry itself appears to occupy much of the site, although the most significant area is a disturbed area towards the north east extent. While this could not be viewed from the road, imagery suggest general dumping of material and stockpiling. A few permanent structures appear to be present.	L – M	None

Property No.	Site Use/Activity	Potentially Contaminated Medium	Potential Contaminants of Concern	Findings of Site Inspection	Potential Contamination Risk	Further Site Specific Assessment
18	Residence and general stockpiling	Soil	Various associated with stockpiling	Residence with apparent limited stockpiling around the property. Could not be viewed from the road, but imagery suggests a number of outbuildings also located at the property.	VL	None
19	Residence with possible workshop	Soil	Metals and TPH	Residence with a number of outbuildings also present. Also numerous cars located at the property as well as a few trucks. This possibly suggests a workshop may also be present.	VL	None
20	General surficial waste and disturbed ground	Soil	Metals and TPH as well as various associated with stockpiling	Numerous vehicles are present at the site. It is not clear whether these have been abandoned or are being maintained. Imagery also suggests a number of buildings are also present, although it is unclear what they are used for. Possibly a workshop.	VL	None
21	Residence and general stockpiling	Soil	Various associated with stockpiling	A residence is present at the site with a large outbuilding. Behind the outbuilding there appears to be stockpiles.	VL	None

Notes:

TPH – Total Petroleum Hydrocarbons

Nutrients – Ammonia, nitrate, nitrite, phosphate

7.1.3 Potential receptors of contamination

Potential receptors of contamination (should any exist) at or near the site include:

- Site workers at the site
- Residents at the site
- Future construction workers at the site
- Visitors to the site
- Underground utilities located on and around the site (including easements)
- Surrounding residents and occupants and visitors (via windblown contamination during excavation works)
- Sensitive land based ecosystems on and near the site
- The nearest surface water bodies (including aquatic ecosystems), namely Kalkallo Creek
- Beneficial users of groundwater

7.1.4 Exposure pathways & routes

These potential receptors may be impacted through ingestion, inhalation or dermal contact with potentially contaminated soil (on site) and groundwater (on and off site). Off-site receptors (including humans and aquatic and land based ecosystems) may be impacted through the transport of contamination via a number of pathways such as trenches/conduits containing underground services (from the site to off-site locations), storm water drainage networks, surface drainage via overland flow (runoff), groundwater flow and surface water transport (e.g. to and in the nearest surface water bodies to the site, namely an unnamed creek along the southern site boundary and Kalkallo Creek).

7.2 Geotechnical assessment

Based on the geological map indicators, an indicative site classification of Class “H2 to E” is likely to be applicable to these conditions in accordance with Table D1 of AS2870-2011 *Residential slabs and footings - construction*. This classification would depend on the depth, thickness and reactivity of the clay material in this area.

The thickness of the residual soil profile in the Newer Volcanics is likely to be highly variable, and it is our experience in this area and with this geological unit that the depth to basalt can vary significantly over relatively short horizontal distances.

The above site classification is based on regional geological information and is intended for preliminary consideration only. Site specific geotechnical site investigations which may include soil sampling and laboratory testing should be undertaken prior to the design and construction of any footing systems, pavements and associated civil infrastructure as part of any future building permit application.

7.3 Hydrogeological general

Based on the available hydrogeological information and bore data in the vicinity of the site, a summary of the conceptual hydrogeological model for the site is detailed below:

- The local geology of the Beveridge North West PSP area is defined by three units – the outcropping bedrock of the Kilmore Siltstone, the overlying basalt of the Newer Volcanics and the Quaternary Alluvium that is associated with the course of Kalkallo Creek
- The Newer Volcanics forms the major aquifer at the site, given the better quality (compared to the Kilmore Siltstone) and the number of users currently utilising it in the area
- Groundwater is likely to be intersected within 10 m of the surface, but may be as shallow as 5 m in some areas

- Groundwater quality is likely to vary from 3500 – 7000 mg/L TDS within the Kilmore Siltstone (west of the site) and 1000 – 3500 mg/L TDS within the Newer Volcanics (east of site)
- Local aquifers are recharged by direct infiltration of rainfall through the soil. As such, all areas of the site are potential groundwater recharge areas
- The Atlas of Groundwater Dependent Ecosystems (BoM, 2012) identifies Kalkallo Creek as having “high potential for groundwater interaction” and therefore it is likely that the depth to groundwater in vicinity of the Creek will be shallow
- Available bore data registered in the GMS indicates that the majority of users intersect the Newer Volcanics aquifer with low yield, indicating poorly connected fractures within the basalt

Groundwater quality in the regional aquifer can range from 1500 – 5000mg/L TDS and is therefore brackish. Based on the beneficial use segments defined in the SEPP, the groundwater is suitable for all

8. Development opportunities and constraints

8.1 Site contamination

Based on the information described in this report, there do not appear to be any significant constraints from a site contamination perspective which would render the land unsuitable for any feasible land use. However, there are particular areas which have been identified as presenting a potentially moderate risk of contamination (see **Table 7.1**). It is likely that the identified areas of concern will comprise discrete or localised areas of contamination that can be cost-effectively remediated or managed as part of the development process. These areas will need to be assessed in greater detail through intrusive soil and groundwater sampling before a more robust conclusion regarding those particular site's suitability for a specific land use can be made. These risks are typically associated with general agricultural activities around the main homesteads at properties 2, 6 and 22. However, the potential presence of hazardous materials (asbestos at property 2 and lead based paint and asbestos at property 22) were also influencing factors.

A long history of agricultural land use has been identified within the Beveridge North West PSP area. The DSE (2005) *Potentially Contaminated Land General Practice Note* recommends that such land undergo detailed Phase (Stage) 1 and 2 environmental site assessments prior to change of land use to a more sensitive receptor. This is based on the potential contamination which may have resulted from such land uses. Therefore, further and more detailed site specific investigations would be required prior to change of land use to accommodate more sensitive end uses.

Subject to the findings of the further assessments identified above (and, if required, the implementation of any remedial measure or ongoing management requirements) the land may then be considered suitable for proposed sensitive end uses.

Alternatively, the Stage 1 and 2 assessments may be completed as part of a statutory Environmental Audit prior to the re-zoning of land to a more sensitive use in accordance with Environment Protection Act 1970. This may be considered a potential constraint due to the time and costs required to complete an Environmental Audit. If an audit results in a Statement of Audit being issued (not a Certificate of Audit), the Statement may also specify a number of site management measures that may constrain future development.

8.2 Geotechnical

The following issues requiring consideration in the planning and design of any development and should be assessed through a geotechnical site investigation.

- The depth and reactivity of the Newer Volcanics residual clay which forms the surface geology across eastern part of the site would govern the site classification for foundation design in this area. It is expected that the site would be considered highly reactive (Class "H2 to E"). A more favourable site classification may be applicable to the western half of the site, which is mapped as Humevale Formation. It is noted that a geotechnical site investigation is required to characterise the site classification across the site.
- The variable thickness of the clay horizon over relatively short horizontal distances can lead to differential settlement of structures. As such, a geotechnical investigation is required to assess the depth to rock across the site.
- The variable geological conditions across the site can lead sudden change ground conditions for excavation. Excavation in sand, gravel and fill or excavations extending below the water table will be unstable and should be battered or shored. This will need to be assessed at the time of construction; however, a conservative approach should be adopted when considering stability of short term batter slopes.
- Excavations in Newer Volcanics and can vary between relatively easy excavations in residual soils to difficult excavation in weathered rock. It is expected that the existing natural soils may be excavated using conventional excavation equipment such as tracked excavators. Excavators equipped with ripper attachments or hydraulic impact breakers may be required to loosen any weathered basalt that is encountered, prior to excavation. Blasting may be required for excavation in very high strength basalt rock.

- Construction in low lying areas may be difficult during wet months
- Dispersive soils may be encountered at the vicinity of the creek. Dispersive soils are easily reworked, and are susceptible to erosion and washing away. These soils may not be suitable for use as fill material as part of an engineered fill to support foundations or pavements.
- Design of roads, drainage works and underground assets would require consideration of the highly reactive nature of the clays to ensure serviceable performance and minimise on-going maintenance requirements.
- Fill material, which may be present on site, is expected to be uncontrolled and may not be suitable as a founding material in its current state.
- Areas subject to poor drainage may comprise soft material which provides low bearing capacity for foundations.

8.3 Hydrological

The location of the site at the headwaters of minor drainage lines results in low flood risk across most of the site prior to PSP development. All of the site is situated above the 1% AEP flood level.

Integrated water cycle management could potentially be utilised to harvest stormwater from the developed area. It is unlikely that any of the waterbodies within the site would have benefit in reducing peak flows, however this option could be further assessed. This is likely to have the benefit of reducing flood peaks, as well as improving the quality of stormwater runoff to Kalkallo Creek, and ultimately Merri Creek and the Yarra River.

8.4 Hydrogeological

The site is within a Salinity Management Overlay (SMO), which has the following associated objectives:

- To implement the SEPP Framework and the Local Planning Policy Framework, including the Municipal Strategic Statement and local planning policies
- To identify areas subject to saline ground water discharge or high ground water recharge
- To facilitate the stabilisation of areas affected by salinity
- To encourage revegetation of areas which contribute to salinity
- To encourage development to be undertaken in a manner which brings about a reduction in salinity recharge
- To ensure development is compatible with site capability and the retention of vegetation, and complies with the objectives of any salinity management plan for the area
- To prevent damage to buildings and infrastructure from saline discharge and high watertable

Under the SMO, a planning permit will be required as part of the subdivision process. This application will include information such as regional geology, soil types, high groundwater recharge areas, groundwater levels, sources of water, vegetation proposed to be removed and recommendations for land management practices.

Under the applicable Schedule to the SMO (13/8/2009-C47), once the subdivision has been approved, individual planning permits will not be required to construct individual buildings or other structures on the site.

Jacobs SKM notes that two development areas to the south of site (Springridge Residential Estate & Newbridge Estate) were successful in having a SMO removed from their site areas (Mitchell Planning Scheme Amendment C93). Jacobs SKM understand this was based on both areas presenting a low salinity risk, and the lack of any salinity affected areas on either site. Given the vicinity to the Beveridge NW PSP and the lack of observed salinity affected area on this site, the SMO may also be removed from this PSP area upon application for removal (in conjunction with applicable environmental assessment).

Over the majority of the site, there does not appear to be any significant hydrogeological constraints which would render the land unsuitable for development. However, shallow depth to groundwater is likely to exist in some areas of the site.

The following issues require consideration in the planning and design of any development:

- Shallow watertable may cause groundwater inflow to excavations and may impact on site drainage (i.e. cause waterlogging)
- The brackish nature of the groundwater may require careful monitoring if dewatering or extraction is required
- Decreased local groundwater recharge in winter and early spring as the result of dewatering or extraction associated with development has the potential to reduce discharge to nearby surface water features, which could potentially have a negative impact on the ecological health of local waterways
- There may be additional land management requirements imposed by council or other regulatory body (relating to the SMO), as part of any proposed subdivision for the site

Opportunities for potential use of extracted groundwater include garden watering and irrigation of parks and ovals, depending on the salinity of the groundwater the groundwater may need to be shandied with potable water to improve the salinity.

8.5 Future quarrying

Jacobs understands that an application is intended to be submitted for the future use of the western half of 175 Northern Highway, Wallan (property plan number 2/LP6746) as a basalt and scoria quarry. The Work Authority reference that relates to this application is WA1473. The timing of the submission of this application is not yet known.

The approval process for the quarry depends upon the proposed extent of the quarry as well as the nature of the intended works. A flow chart illustrating the approval process is presented in **Appendix E**. Jacobs estimates that the extent of the property that will be used for quarrying will likely exceed 5 hectares (i.e. the threshold area above which the Code of Practice for Small Quarries does not apply). As such, the applicant is likely to require an approved Work Plan.

The Department of Primary Industries document entitle *Extractive Industry Work Plan Guideline: Mineral Resources (Sustainable Development) Act 1990* published in September 2010 provides applicants with guidelines for the preparation of a Work Plan. These guidelines require the applicant to submit information for approval by DPI relating to:

- Site plans (surface facilities, processing facilities, sequencing, stockpiling areas, water dams, access roads etc.)
- Processing methods (power supplies, fuel storage, water supplies, weighbridges, labs, workshops, offices etc.)
- Stability (i.e. address potential safety concerns relating to geotechnical risks associated with extraction)
- Environmental management (disposal of effluent, protection of groundwater, drainage, erosion, dust, odour and vibration control, waste management as well as ongoing monitoring commitments)
- Rehabilitation plans (concepts for end use, plans for progressive rehabilitation, landscaping provisions to minimise visual impact, provisions to protect native vegetation during operation and a plan for the final rehabilitation and revegetation for the site)
- Community engagement (identification of affected communities and processes for documenting and responding to complaints)

Only once the Department of Environment and Primary Industries (DEPI – formerly DPI) is satisfied that the above requirements will be met during the establishment, operation and post-closure of the quarry will the Work Plan be approved.

Council planning approval will also be required by the prospective applicant in order to allow commencement of activities at the site. It is likely that this will include the re-zoning of the affected quarry pit to Special Use Zone (SUZ) which will also likely include the application of a buffer zone around the quarry. In accordance with EPA Victoria publication 1518 *Recommended Separation Distances for Industrial Residual Air Emissions* (EPA, 2013) a buffer distance of 500m would be required between the quarry and the nearest sensitive land uses. This assumes blasting would be necessary and would be consistent with the 500m buffer that has been applied to the nearby scoria quarry at Mount Fraser. Future potential quarrying activities that would not require blasting may allow the buffer distance to be reduced to 250m. In the case of the Mount Fraser quarry the buffer zone has had its zoning retained as Farming Zone (FZ) and has not been rezoned as Urban Growth Zone (UGZ) as much of the surrounding area has.

9. Conclusion and recommendations

9.1 Conclusions

Site contamination assessment

Based on the information gathered during the Stage 1 & 2 assessments, the following conclusions can be made in relation to the Beveridge North West PSP area:

- The site history assessment found that the site has a long history of agricultural land uses, with much of the areas remaining under cultivation to the present day
- A groundwater quality assessment was recently undertaken by Jacobs (Jacobs SKM, 2014) which found that concentrations of heavy metals and nutrients such as ammonia, nitrite and nitrate were likely reflective of background / regional groundwater conditions. No beneficial uses of groundwater were found to be precluded. Therefore, the groundwater quality across the site is unlikely to pose a constraint to future development.
- Based on the available information, including a site walkover and site history assessment, the following primary potential sources of contamination have been identified:
 - Potentially contamination associated with general agricultural activity around the homesteads of properties 2, 6 and 22. At these sites, potential contamination is likely to be confined to a small number of localised areas (i.e. immediately around fuel storage tanks or stockyards) rather than distributed across a wide area).
 - Highly localised areas of potential contamination associated with stockpiles and general dumped materials. In these locations contamination is likely to be localised to stockpiles themselves and in some instances shallow underlying soils which can be easily removed.
 - Diffuse but low level sources of contamination associated with the widespread application of agricultural chemicals on farmland as well as tree plantations. These chemicals may include pesticides, herbicides, fungicides and fertilizers.
- A number of off-site sources of potential contamination have been identified in the vicinity of the PSP site. Based on the nature of the site uses as well as the environmental setting of the site (hydrological, hydrogeological and geological conditions), the greatest risk to the Beveridge North West PSP area is presented by two quarries; one to the east (property 17) and one to the south (property 12). The remaining properties were deemed to present either a low or very low potential for contamination of the PSP area. However, none of these off-site land uses are considered to present constraints to future site development.

Based on the information obtained from the sources described in this report, with the exception of highly localised areas of potential contamination associated with current and/or former land uses identified above, there do not appear to be any significant risks from a site contamination perspective which would render the land unsuitable for residential or other sensitive land uses. Any areas of localised contamination are likely to be able to be effectively managed or remediated during any future site development. However, it should be noted that the site has a long history of agricultural use. While unlikely, it is possible that the broad application of agricultural chemicals may have impacted upon soil at the site. Similarly, potential impacts by nutrients on groundwater as a result of irrigation may place restrictions on the use of groundwater at the site.

Geotechnical assessment

Based on the available geological information, the eastern half of the site is likely to be underlain by highly reactive residual basaltic clay overlying basalt rock, and the western half underlain by residual soils overlying weathered siltstone/sandstone. An indicative site classification of Class "H2 to E" has been assessed in accordance with Table D1, AS2870-2011.

Key geotechnical issues associated with development of the site include the depth and reactivity of the basaltic clay in terms of its influence on site classification, change and interface of variable ground conditions,

foundation selection, differential settlement, subgrade performance, excavations and site accessibility. Fill material, if present, is expected to be uncontrolled and may not be suitable for development in its present state. Areas subject to poor drainage may comprise soft material which provides low bearing capacity for foundations.

Subsurface conditions may present a critical issue for design of the structures and foundations, and therefore there is to be a cost-benefit in obtaining geotechnical data at targeted locations.

The results of the geotechnical investigation would form the basis of the geotechnical model for the site, which would be used to assess subgrade conditions, confirm the site classes, foundation design parameters, excavations and recommendations on earthworks.

Hydrology assessment

The site is located at the headwaters of Kalkallo Creek and an unnamed waterway draining to Kalkallo Creek. Kalkallo Creek has its headwaters in the north west corner of the site, and drains to the south west corner. The unnamed waterway drains from the east of the site to the south of the site. The 100 year flood extent and floodway do not cross into the site, indicating no major flood risk. There is an area that is classified as the UFZ zone, which restricts the use of land because of high flood risk. This area is along Kalkallo Creek, with a buffer of approximately 100 m on each side of the waterway.

Hydrogeological assessment

Based on the regional hydrogeological information and bore data in the vicinity of the site, the Newer Volcanics forms the major aquifer at the site, given the better quality (compared to the Kilmore Siltstone) and the number of users currently utilising it in the area.

The site is currently within a Salinity Management Overlay (SMO). Under the SMO, a planning permit will be required as part of the subdivision process, which will detail recommendations for land management practices. Jacobs SKM note that nearby areas have recently had the SMO removed (Mitchell Planning Scheme Amendment C93). Given the vicinity to the Beveridge NW PSP and the lack of observed salinity affected area on this site, the SMO may also be removed from this PSP area upon application for removal (with applicable environmental assessment).

Over the majority of the site there does not appear to be any significant hydrogeological constraints which would render the land unsuitable for development. However, shallow depth to groundwater is likely to exist in some areas of the site. The following issues would need to be considered in the planning and design of any development:

- Shallow watertable may cause groundwater inflow to excavations and may impact on site drainage (i.e. cause waterlogging)
- Brackish nature of the groundwater may require careful monitoring if dewatering or extraction is required
- Decreased local groundwater recharge in winter and early spring as the result of dewatering or extraction associated with development has the potential to reduce discharge to nearby surface water features, which could potentially have a negative impact on the ecological health of local waterways
- There may be additional land management requirements imposed by council or other regulatory body (relating to the SMO), as part of any proposed subdivision for the site

Opportunities for potential use of extracted groundwater include garden watering and irrigation of parks and ovals, depending on the salinity of the groundwater the groundwater may need to be shandied with potable water to improve the salinity

It is recommended that a field investigation into groundwater elevation and quality be undertaken to confirm the findings of this desktop study. This may include:

- Sampling of existing local bores for quality and water level

- Drilling of narrow test bores for ongoing observation to determine seasonal fluctuations in water level and quality if required

9.2 Recommendations

We understand that the proposed future use of the site is as a broad ranging urban development and is likely thus to include sensitive uses such as residential and community facilities in addition to open space, retail and a range of business uses such as offices, light industrial and manufacturing. However, since specific future land uses within the PSP boundary are yet to be confirmed, this assessment has been completed based on the assumption that residential or other sensitive uses will be the probable land future uses across the study area.

The following further works are recommended, including recommended timings:

- Assessment of potential contamination associated with general agricultural land uses around the homesteads of properties 2, 6 and 22. These sites are likely to present the greatest potential for contamination, albeit likely a small number of localised areas (i.e. around septic tanks, fuel storages, stockyards etc.). This process may be best undertaken through the preparation of a Sampling, Analysis and Quality Plan (SAQP) followed by a Phase 2 Environmental Site Assessment (which may include targeted sampling of soils and groundwater). *Timing: It is recommended that this task be undertaken to coincide with the cessation or scaling down of current site operations at these sites and prior to the commencement of the proposed development and construction works.*
- Completion of a hazardous materials assessment for properties 2 and 22 to confirm not only the extent of potential asbestos containing materials and lead based paints, but to identify controls that should be implemented during future development to prevent exposure by site workers or future users of the site. *Timing: It is recommended that this task be undertaken to coincide with the cessation or scaling down of current site operations at these sites and prior to the commencement of the proposed development and construction works.*
- Further drilling and collection of soil samples for the purposes of assessing the geotechnical soil properties for building foundation and road design. *Timing: This task should be undertaken on a site-by-site basis during future development as part of the building permit application process.*
- Completion of aquifer hydraulics testing on existing groundwater bores to determine aquifer properties. This should also include assessment of depth to groundwater. This assumes existing wells are in a suitable condition for such an assessment. *Timing: It is recommended that this task be undertaken to coincide with the cessation or scaling down of current site operations at these sites and prior to the commencement of the proposed development and construction works.*
- Excavation and removal of underground storage tanks, soil remediation and tank pit validation if USTs are found on properties. *Timing: This task should be undertaken on a site-by-site basis during future site development.*
- Removal of other potentially contaminating infrastructure (e.g. septic tanks and above ground storage tanks) followed by soil validation. *Timing: This task should be undertaken on a site-by-site basis during future site development.*
- Classification and appropriate removal (if required) of various stockpiles and dumped materials observed at sites across the study area. This includes subsequent validation following removal. It is noted that sampling of some stockpiles of soil observed may indicate that the material is suitable for re-use as part of future development and as such removal may not be required in all instances. *Timing: This task should be undertaken on a site-by-site basis during future site development.*
- An application to have the salinity management overlay (SMO) removed from the PSP should also be undertaken, as per the recent Mitchell Planning Scheme Amendment C93 for a nearby development area. This will remove the requirement for an intensive planning permit application process for future development. *Timing: This task should be undertaken prior to site development*
- Consultation with YVW to establish their intentions in relation to the future use of the winter storage dams. If these structures are retained a buffer distance may need to be applied in accordance with EPA requirements. In their current form the basins would likely require a 50m buffer from the nearest sensitive land uses. *Timing: This task should be undertaken prior to finalising future land use zones.*

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