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PRELIMINARY CONTAMINATION ASSESSMENT WITHOUT SOIL SAMPLING & DESKTOP HYDROGEOLOGICAL REVIEW

1425 POUND ROAD & 2100 THOMPSONS ROAD, CLYDE NORTH

DOCUMENT CONTROL DATA

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1 INTRODUCTION

At the request of the Campbell Park Property Developments Pty Ltd, a preliminary contamination assessment without soil sampling and desktop hydrogeological review have been conducted at Thompsons Road, Clyde North.

The purpose of the preliminary contamination assessment without soil sampling and desktop hydrogeological review was to determine whether the site contains any significant contamination from past activities and evaluate likely groundwater conditions which may pose constraints to future development of the site.

This report presents information on the site history, anticipated site geology, regional hydrogeological information, likelihood of contamination and provides recommendations for further work.

2 SITE DETAILS

2.1 Location

The site comprises two adjacent properties located at 1425 Pound Road (Lot 2, Lot 3 and Lot 4 on Plan of Subdivision 300094R) and 2100 Thompsons Road (Lot 2 on Plan of Subdivision 433177T) in Clyde North. The site covers approximately 171.2 hectares and is irregular in shape. The location of the site is shown on Figure 1.

2.2 Growth Areas Framework

Based on the proposed Growth Areas Framework plan it is anticipated that the site will be developed to include low to medium density residential and a commercial subdivision. The Growth Areas Framework is provided in Appendix A.

2.3 Zoning

The site is currently zoned as Urban Growth Zone and Farming Zone under the Casey Planning Scheme. Planning Scheme maps are provided in Appendix A.

2.4 Adjacent Properties

Details of adjacent properties are listed below:

- North – Grazing land, residential housing, horse riding school and a Melbourne Water Retention Basin (RB013) across Thompsons Road;
- East – Grazing land, residential housing and high voltage transmission lines;
- South – Grazing land and residential housing; and
- West – Grazing land, residential housing and high voltage transmission lines across Pound Road.

3 GEOLOGY, HYDROGEOLOGY AND SURFACE WATER

3.1 Geology

GeoVic Online (2011), 1:63,360 Cranbourne Sheet and the 1:25,000 Berwick Sheet of the Geological Survey of Victoria indicates the site to be underlain by Devonian to Silurian period marine shale, mudstones and siltstones of the Murrindindi Supergroup along the west boundary and towards the south portion of the site, Neogene period Baxter Sandstone Formation (sand, sandy clay, clayey sand, occasional gravel, ferruginous sandstone, conglomerate, siltstone and ironstone) in the south east portion of the site, Quaternary period unnamed swamp and lake deposits (sand, silt and clay) along the west and north boundary, and Quaternary period unnamed alluvial deposits (gravel, sand, silt, clay and peaty clay). A site geology plan is provided on Figure 2.

The 1:25,000 Berwick Sheet of the Geological Survey of Victoria printed in 1979 and GeoVic Online (accessed in February 2011) indicates a sand pit is located 100 m to the west of the site.

3.2 Topography

The site generally slopes down to the north, north east and east from the south west corner. The lowest point (between 20 to 30 m AHD) on the site is located near the south east corner. The highest point (between 40 to 50 m AHD) on the site is near the south west corner. Regional and site topography plans are provided on Figures 3a and 3b.

3.3 Surface Water

The site contains three open drainage channels which originate offsite:

- The drainage channel originating from the north west traverses the site from the north west corner to the south east corner;
- The drainage channel originating from the north enters the site from the junction of Thompsons Road and Soldiers Road and merges with the north west drain approximately 250 m inside the site boundary; and
- The drainage channel originating from the north east enters the site and traverses across the north east corner, exiting the site approximately 100 m along the east boundary from the north east corner.

Surface water is likely to flow from the site towards Cardinia Creek which is ephemeral and located approximately 3.5 km south east of the site.

3.4 Hydrogeology

The Melbourne Groundwater Map produced by the DSE shows the site to be underlain by groundwaters with total dissolved solids (TDS) ranging from 1,001 to 7,000 mg/L. Conservatively, this would classify the groundwater beneath the site as Segment B waters, as per the State Environment Protection Policy (SEPP) for Groundwaters of Victoria (1997).

The protected beneficial uses of Segment B are:

- Potable mineral water supply;
- Agriculture, parks and gardens;
- Stock;
- Maintenance of ecosystems;
- Stock watering;
- Industrial water use;
- Primary contact recreation; and
- Buildings and structures.

3.5 Victorian Groundwater Database

The Victorian Groundwater Database was accessed as part of this review. A search was completed for registered groundwater bores within a four kilometre circular radius from the centre of the site.

One hundred and forty six (146) groundwater bores were registered within the four kilometre radius. The Victorian Groundwater Database search data is presented in Appendix D. A summary of the data is presented in the following table.

Bore use	Number of bores	Total depth (m)	Standing water level range (m)
Domestic	2	17.5-20.65	0.2-2
Domestic and Stock	43	0-98	0-13.1
Domestic, Stock and Irrigation	2	37.2-41.76	10-10.7
Stock	22	0-56.5	2-5.5
Irrigation	11	39.62-106.68	0-24.4
Investigation	6	7-15	-
Non-groundwater	48	2.44-106.68	-
Unknown	11	24-150	2-5
Unknown Domestic	1	105	-

Two groundwater bores (57284 and 57285) were registered at the site. Bore 57284 (bore depth of 47.5 m BGL) was registered as being a domestic/stock bore and was located near the south west corner and bore 57285 (bore depth of 19.5 m BGL) was registered as a stock bore and was located near the centre of the site. The Groundwater Database search provided no data on aquifer parameters, groundwater chemistry or drilling logs for either of these two bores.

Of the 146 groundwater bores registered within four kilometres of the site, nine bores (57227, 57242, 57252, 57283, 57316, 57357, 57468, 113068, and S9023938/1) are registered within 500 m of the property boundary. Six of the nine groundwater bores are registered as domestic and stock bores (bore depths range from 0 to 82 m BGL), two are registered as stock bores (bore depths range from 0 to 56.5 m BGL) and one is registered as a domestic bore (bore depth of 58 m BGL). Based on records from groundwater bores 57468 (recorded in 1985), 113068 (recorded in 1992), 57357 (recorded in 1975) and S9023938/1 (recorded in 2005) groundwater standing water levels ranged between 1.5 to 4 m BGL. Chemistry data from the groundwater database search shows that pH levels were generally between 6.6 and 7.9 pH units, electronic conductivity ranged between 158 to 9350 $\mu\text{S}/\text{cm}$ which equate to a TDS of approximately 103 to 6,080 mg/L (using a conversion factor of 0.65 at 25°C).

3.6 Southern Rural Water

The site is located within Zone 3 of the Koo-Wee-Rup Water Supply Protection Area that is administered by Southern Rural Water. All of the groundwater within this Zone is fully permitted. As this area has reached its Permissive Consumptive Volume, new allocations can only be granted if an application to transfer licensed volume from an existing licence holder within the same Water Supply Protection Area is made to Southern Rural Water.

3.7 Other Information

A supply pipeline for the Victorian Desalination Project has been constructed inside the western boundary of the site from just south of electricity transmission lines to the corner of Pound Road and Thompsons Road.

4 SITE HISTORY EVALUATION AND SITE INSPECTION SUMMARY

The following sources of historical information were reviewed:

- Aerial photographs;
- Certificates of Title;
- EPA Priority Sites Register; and
- List of issued Certificates and Statements of Environmental Audit.

4.1 Aerial Photographs Review

Aerial photographs held by the Department of Sustainability and Environment from 1960, 1970, 1978 and 1987 were reviewed. Aerial photographs from Google Earth taken in 2006 and aerial photographs from NearMap taken in 2011 were also reviewed. Copies of the aerial photographs are shown in Appendix B.

Year	Scale	Summary
1960	1:9,600	<p>The site appears to be cleared of vegetation and used for grazing or cropping. There are several large farm buildings located in the south west portion of the site. There appears to be two dams located near the buildings. A water course on the eastern side of the site looks to have been dammed. There appears to be a large dam located to the north of the possible dammed water course. There are several vegetated fence lines within the site boundary. There appears to be two man-made drainage channels entering the site near the north west corner and near Soldiers Road and traversing towards the small dam in the east portion of the site. There appears to be small holding yards to the south of the buildings near the south boundary.</p> <p>The surrounding area appears to be used for grazing. There is a small disturbed area adjacent to the west boundary of the site which appears to be the former sand pit noted in the geology maps.</p> <p>Please note that a small portion of the north west corner and portion of the east boundary were not visible in the aerial photograph.</p>

Year	Scale	Summary
1970	1:12,000	<p>The site appears to not have been significantly modified although the site may be used for cropping. It appears that one of the small dams north of the large buildings located in the south west portion has been filled. There appears to be a building towards the middle of the south boundary. There appears to be a small structure midway along the east boundary. A new building appears to have been constructed north of the buildings in the south west portion. There appears to be two very small areas of disturbance towards the centre of the site. There also appears to be disturbed soil where two fence lines intersect in the eastern portion of the site.</p> <p>The surrounding area appears to be used for grazing, however there appears to be extractive activities (quarrying, sand excavation) approximately 500 m west of the site. There appears to be a small dam constructed 200 m across Pound Road to the south.</p>
1978	1:10,000	<p>The site appears to not have been significantly modified. The building located towards the middle of the south boundary cannot be easily seen. There appears to be a small shed/building located close to the south east corner of the site. There appears to be a darker patch of paddock midway along the northern boundary within the site.</p> <p>There appears to be no significant change in the surrounding area.</p> <p>Please note that a small portion of the southern west corner of the site near the buildings was not visible in the aerial photograph.</p>
1987	1:10,000	<p>There appears to be two high voltage transmission lines running parallel to the south boundary of the site. There appears to be a new residence built approximately 100 m north west of the buildings in the south west portion. The dam near the west boundary appears to be dry, however, the water course and the dam north of the water course appear to be nearly full. There appears to be two disturbed areas in two of the northern paddocks. A residence has been constructed adjacent to the east boundary.</p>
2006	-	<p>There appears to be some small areas of disturbed soil towards the west boundary of the site. There appears to be a decline in woody vegetation along the fence lines across the site. There appears to be some minor disturbed areas within the small paddocks surrounding the residential houses in the south west portion of the site. There appears to be holding yards in the site along the east boundary.</p> <p>There appears to be market gardens approximately 1,500 m east and approximately 1,300 m south of the property. A large dam has been constructed 150 m across Pound Road to the south of the property and contains water.</p>

Year	Scale	Summary
2011	-	<p>There appears to be a third electricity transmission line constructed along the south boundary and parallel to the two high voltage transmission lines. There appears to be several boggy areas over the site.</p> <p>There appears to be no significant change in the surrounding area, however, the large mine to the west appears to have expanded and there appears to be a large area holding water to the north of the site. There is a large area of disturbed soil along the west boundary. This area is part of the works on the Victorian Desalination Project supply pipeline.</p>

4.2 Certificates of Title

The following Certificates of Title for the site were reviewed:

- *Certificate of Title Volume 1247 Folio 222;*
- *Certificate of Title Volume 3918 Folio 783545;*
- *Certificate of Title Volume 5860 Folio 1171868;*
- *Certificate of Title Volume 5860 Folio 1171869;*
- *Certificate of Title Volume 8079 Folio 884;*
- *Certificate of Title Volume 8079 Folio 885;*
- *Certificate of Title Volume 8762 Folio 766;*
- *Certificate of Title Volume 9960 Folio 868;*
- *Certificate of Title Volume 10027 Folio 604;*
- *Certificate of Title Volume 10027 Folio 605;*
- *Certificate of Title Volume 10027 Folio 606;*
- *Certificate of Title Volume 8762 Folio 768; and*
- *Certificate of Title Volume 10027 Folio 603.*

Based on the information provided in the Certificates of Title, the site was first registered in 1881 and has since changed ownership 19 times. The previous owners have generally been farmers but also include a produce merchant, a bank officer, a barrister and the Equity Trustees Executors and Agency Company Ltd.

1455 Pound Road (Lot 2, Lot 3 and Lot 4 on Plan of Subdivision 300094R) is currently subject to eight easements:

Affected Land/Parcel	Parcel Identifier	Dealing Number	Purpose	Width (m)	Date
Lots 3 and 4	E-1	J927024	Transmission of Electricity	131.5	13/05/1983
Lots 3 and 4	E-2	AE262622T	Transmission of Electricity	22.5	26/06/2009
Lot 3	E-3, E-4 and E-5	AG919932B	Water Supply	15 – 20	27/01/2010
Lot 3	E-6	AG919748T	Water Supply	6	27/01/2010
Lot 4	E-7 and E-8	AG919744C	Water Supply	20	11/12/2009

2100 Thompsons Road (Lot 2 on Plan of Subdivision 433177T) is currently subject to four easements:

Affected Land/Parcel	Parcel Identifier	Dealing Number	Purpose	Width (m)	Date
Lot 2	E-1 and E-2	J241841	Transmission of Electricity	131.5	20/11/1980
Lot 2	E-3 and E-4	AE262622T	Transmission of Electricity	22.5	26/06/2009

Copies of the Certificates of Title are presented in Appendix C.

4.3 EPA Priority Sites Register

There were no EPA Priority Sites located within two kilometres of the site.

4.4 List of Issued Certificates and Statements of Environmental Audit

There were no Issued Certificates and Statements of Environmental Audit located within two kilometres of the site.

4.5 Site Inspection

A site inspection of 1425 Pound Road (Lot 2, Lot 3 and Lot 4 on Plan of Subdivision 300094R) and 2100 Thompsons Road (Lot 2 on Plan of Subdivision 433177T) in Clyde North was carried out by a Beveridge Williams Environmental Engineer on 25 February 2011 where the following observations were made:

1425 Pound Road - Portion Surrounding Farm Storage Sheds

- The portion was grassed, comprised several paddocks and was used for stock grazing;
- The portion sloped down gently to the north;
- The portion contained seven farm storage sheds and an empty grain silo;
- The farm storage sheds were generally constructed from galvanised iron. One shed had rendered walls;
- Farm storage sheds generally contained farm vehicles and equipment, and some containers of Calcium Hypochlorite, Teepol Detergent, Pennzoil Dextron 111, Harts Supreme Sheep Dip (Dieldrin or aldrin), Terminator – Mice and Rat Bait, Mobil, Shell and Valvoline Engine Oil, Roundup, Paints, Rabbait, Agtryne Herbicide, Estericide Herbicide, Dellas Insecticide and Blue Kerosene;
- Asbestos cement roofing was identified on one shed near the silo and possibly on the rendered walled shed;
- An underground storage tank (UST) was located in the shed closest to the lot entrance. It was located by the identification of a breather and hand pump;
- An above ground storage tank (AST) was found to the north of the far north shed;
- Soil staining was found in three farm storage sheds (the former milking/sheep shearing shed, the shed near the feed silo and the north most shed). The staining appears to be from leaked oils, petroleum and grease;
- A cement semi-circle was found in between the rendered wall shed and the former milking/sheep shearing shed. It is not known what the area was used for;
- Concrete slabs and large cobble/small boulder sized pieces of basalt were found north east of the former milking/sheep shearing shed;

- A rain water tank and stock holding yards were located to the south of the former milking/sheep shearing shed; and
- There was a concrete pad located approximately 10 m to the south of northern shed. It sounded like a void was beneath the pad when tapped.

1425 Pound Road - Remaining Portion

- The portion was grassed, comprised several paddocks and was used for stock grazing;
- The portion sloped down to the north, north east and east towards drainage channels;
- Two drainage channels enter the site from the north boundary and traverse towards the east into 2100 Thompsons Road;
- The portion of land to the north of the drainage channel was generally flat, swampy and holding surface water;
- Towards the top of the slope near the area surrounding the farm storage sheds there was a depression that was filled with rusted metals, plastic, wood and other rubbish. The site owner said this area was used for the incineration of waste;
- Many trees along the fence lines appeared to be in poor health or dead;
- Several incineration areas were observed across the portion. The presence of bones in one area indicate areas these may have been used for the incineration of stock;
- An old windmill and water storage tank were located towards the centre of the portion;
- There were three electricity transmission lines traversing the portion. Two are high voltage supply lines and one appears to be a 66 kV residential supply line; and
- There was a well-used crushed rock track leading from the main entrance to the east boundary of the portion (through the area surrounding the farm storage sheds).

2100 Thompsons Road

- The portion was grassed, comprised several paddocks and was used for stock grazing;
- The portion was generally flat, however, the south east portion sloped gently towards the east;
- There were three farm dams located in the south half of the portion;
- There was a portion of disturbed soil located near the north boundary;
- There were three drainage channels that enter the portion. One from 1425 Pound Road and two from Thompsons Road. The drainage channel from 1425 Pound Road and one from the corner of Thompsons Road and Soldiers Road converge before entering the northern most dam. The remaining drainage channel that entered from Thompsons Road traverses the site for approximately 150 m and exited the site along Smiths Lane;
- There was an old windmill and water storage tank located to the west of the northern most dam. The water storage tank was dry and contained two relatively fresh cattle carcasses;

- The area to the east of the northern most dam appeared to contain small mounds of soil;
- A pump shed was located along the east boundary of the portion, north of the existing house block;
- A stock holding yard was located along the east boundary, south of the existing house block;
- A farm shelter was located along the east boundary of the lot. It appeared this shelter was used for the storage of hay. The shelter was in disrepair;
- A portion of land along the south boundary from the storage dam to the east boundary, appeared to be disturbed and contained pieces of brick, asphalt, concrete and galvanised iron from the adjoining shelter;
- Areas of disturbance identified in aerial photographs appeared to be former stock feeding locations; and
- There were three electricity transmission lines traversing the portion. Two are high voltage supply lines and one appears to be a 66kV residential supply line.

Site photographs are shown in Appendix E.

Information provided by Site Owner (Gordon Gill)

- The site owner described an area north of the farm storage sheds that was used as an incineration area. He indicated that this area was the main burn area on the site;
- The UST had not been used since the owner had taken ownership of the site. The UST had contained petroleum (most likely 'Super');
- The farm storage shed with rendered walls was previously used to house machinery that separated cream from milk;
- The site prior to 1978 had a pig shed located behind the stock holding yards;
- The north large farm storage shed was previously used as a fertiliser holding area;
- The AST was originally located to the west of the rendered walled farm storage shed. It is not known when this AST was relocated; and
- The incineration area to the north of the farm storage area was originally used as a rubbish dump by the previous owners.

4.6 Potential for Contamination

Based on the findings of the site history evaluation, the site has historically been use for light cropping/grazing purposes.

Beveridge Williams considers the risk of widespread contamination of the site as low. However, possible crop spraying of the site or nearby properties may have resulted in residual contamination of surface soil. Based on the use of the site for agricultural uses, some potential existed for onsite stock treatment which may have resulted in localised contamination.

Beveridge Williams considers the risk of contamination of the area surrounding the farm storage sheds as high. The farm storage sheds onsite may have been used for potentially contaminating activities such as storage of machinery, chemicals, fuels etc. Bonded cement sheeting and an electrical switchboard possibly containing asbestos were noted in a site pump shed.

It is possible that fertiliser applied to the site and surrounding areas, the farm dump and petroleum products leaking from fuel storage tanks may have impacted groundwater below the site.

4.7 Summary

Based on the site history evaluation and site inspection, Beveridge Williams considers the main potential sources of contamination to be:

Potential Sources	Contaminants
Possible pesticide and/or herbicide residue from former farming practices onsite or from nearby sites	Organochlorine pesticides (OCP) and heavy metals
Hydrocarbon storage in above ground and underground tanks, vehicle/machinery oil leaks and spills,	Heavy metals, total petroleum hydrocarbons (TPH), monocyclic aromatic hydrocarbons (MAH) and polycyclic aromatic hydrocarbons (PAH)
Burnt materials, residues and wastes located within the incineration area	Heavy metals, total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAH), asbestos, putrescible wastes and solid inert materials

5 CONCEPTUAL HYDROGEOLOGICAL MODEL

5.1 Topography

The main regional topographical high point in the region is the area occupied by residential housing which is approximately 70 to 80 m AHD and is located approximately 2.6 km north of the site. The land slopes gradually to around 20 to 30 m AHD from the residential estate. Western Port Bay is the main regional low point and is located approximately 12.8 km south of the site. A plan showing the regional topography is presented in Figure 3a.

The site generally slopes down to the north, north east and east from the south west portion. The lowest point on the site (20 to 30 m AHD) is located near the south east corner. The highest point on the site (40 to 50 m AHD) is along the south boundary.

5.2 Surface Hydrology

At the time of the site inspection the dams in the east portion contained water. The base of the dam was estimated at between 1 to 2 m below the depth of the original ground surface. Based on the location of the dam, it is considered that the dam is naturally filled by regional runoff as it appears to be in a natural channel. Although, baseflow from the upper tertiary aquifer is also possible. The north east portion of the site was very boggy at the time of the inspection. There appeared to be very little flow within the main drain traversing through this area.

The site contains three open drainage channels which originate offsite:

- The drainage channel originating from the north west traversed the site from the north west corner to the south east corner;
- The drainage channel originating from the north entered the site from the junction of Thompsons Road and Soldiers Road and merged with the north west drain approximately 250 m inside the site boundary; and
- The drainage channel originating from the north east entered the site and traversed across the north east corner, exiting the site approximately 100 m along the east boundary from the north east corner.

Surface water is likely to flow from the site towards Cardinia Creek which is ephemeral and located approximately 3.5 km south east of the site. Cardinia Creek travels south east before heading south towards Western Port Bay near Tooradin.

Other notable surface water features in the vicinity of the site include the Melbourne Water Cardinia Creek Drop Structure – a Flood Retarding Basin which is located approximately 550 m north of the site. There appears to be another wetland approximately 600 m north of the site.

5.3 Land Use and Vegetation

The majority of the surrounding area is used for grazing and in general most of the original vegetation has been replaced by exotic grass species. Several large trees exist on the site and also nearby farms but are limited to fence lines.

Significant residential development is occurring to the north and west of the site.

5.4 Geology and Aquifers

The main aquifer system in the region is the middle Tertiary Older Volcanics. It is considered that the majority of bores in the region are targeting the aquifer in the Older Volcanics. Based on data in the Victorian Groundwater Database from nearby bores, the Older Volcanics are approximately 20 to 40 m thick but with significant heterogeneity in terms of the strata present. The Older Volcanics are overlain by the Baxter Formation. Based on data in the Victorian Groundwater Database from nearby bores, the Baxter Formation is approximately 14 to 25 m thick but with significant heterogeneity in terms of the strata present.

The DSE Groundwater Notes *Groundwater Occurrence in the Port Phillip Basin* (2004) states that bore yields in the Older Volcanics are up to 15 L/s but typically less than 5 L/s. It is considered that the high number of bores located within the properties to the south west and north east indicates that there is sufficient yield in the aquifer to sustain the use of bore water for domestic and stock purposes.

Groundwater flow within the shallower Baxter Formation, an upper Tertiary aquifer, is also utilised. *Groundwater Occurrence in the Port Phillip Basin* states that bore yields in the Baxter Formation are up to 18 L/s but typically less than 2.6 L/s. The Baxter Formation aquifer is generally unconfined. It is considered that the high number of bores located within the properties near the south portion of the site indicates that there is sufficient yield in the aquifer to sustain the use of bore water for domestic and stock purposes.

The drilling logs in Appendix D confirm that most of the bores installed immediately north of the site intercept sandy clay, volcanic clay, sandstone and mudstone/shale. The bores near the east site boundary intercept clay, sand, and mudstone. The bores near the south site boundary intercept clay, sandy clay, lignite, basalt and mudstone. The bores near the west site boundary intercept clay, silt, sand and siltstone. Based on the drilling logs it has been inferred that the basalt flow extends below the south portion of the site but the north portion is underlain by weathered basaltic clay with no basalt or highly weathered basalt.

Due to the relative permeability of the Baxter Formation it is generally considered that there is reasonable hydraulic connection between the two aquifers.

The Older Volcanics are underlain by Silurian age mudstone, siltstone and sandstone which is relatively impermeable. A conceptual hydrogeological model is shown on Figure 4.

5.5 Groundwater Flow Systems

Water Levels

Time series data from March 1996 to December 2010 for bore 126975, which is located approximately 3.5 km south west of the site, has been reviewed. The measured relative water levels in the bore show a steady increase in depth from 31.69 to 34.34 m over this time period. The cause of the depth increase may be due to climatic factors such as the drought which has reduced the volume of groundwater recharge and possibly increased the quantity of bore water used for irrigation of nearby market gardens.

The groundwater level in an onsite bore located towards the centre of the site was measured during the site inspection conducted on the 25 February 2011. The groundwater was recorded at 2.8 m depth below ground surface.

Discharge and Recharge

Groundwater flow in the upper Tertiary aquifer is likely to follow topography in the region. Hence it is considered that general groundwater flow beneath the site will be to the north east towards Cardinia Creek. Groundwater is then expected to flow along the alignment of Cardinia Creek towards Western Port Bay approximately 12 km south east of the site. Some upward leakage into Cardinia Creek and low-lying swamp areas could be expected prior to discharge into tributaries that enter Western Port Bay.

The recently installed high volume water pipe along the west boundary of the site may provide a local sink. The disturbed packing soil along the alignment of the Victorian Desalination Project may act as a preferential groundwater flow path near the west boundary of the site.

Groundwater recharge is most likely to occur in the open grassland predominantly from rainfall.

Onsite, the drainage channels may become areas of local recharge during rain and after significant rain events. Onsite dams may be hydraulically connected to the underlying upper Tertiary aquifer.

5.6 Groundwater Chemistry

The Melbourne Groundwater Map produced for the Department of Sustainability and Environment shows the site to be underlain by groundwaters with total dissolved solids (TDS) ranging from 1,001 to 7,000 mg/L. Data sourced from the Victorian Water Resources Warehouse showed that the electrical conductivity of offsite bore 57468 (depth 46 m, located approximately 40 m to the north of the site) was recorded at 6,600 $\mu\text{S}/\text{cm}$ and TDS was recorded at 3,398 mg/L. The electrical conductivity of offsite bore 113068 (depth 12.8 m, located approximately 90 m to the east of the site) was recorded at 830 $\mu\text{S}/\text{cm}$ which equates to a TDS of approximately 540 mg/L. The electrical conductivity of offsite bore 57242 (depth 7.6 m, located approximately 220 m to the south of the site) was recorded at 158 $\mu\text{S}/\text{cm}$ which equates to a TDS of approximately 100 mg/L. The general range for the TDS concentrations in the upper Tertiary aquifer in the surrounding area is considered to be less than 1,000 mg/L, whilst the TDS concentrations in the lower Tertiary aquifer in the surrounding area is approximately 3,000 to 4,000 mg/L.

Therefore, the groundwater in the upper Tertiary aquifer beneath the site could be conservatively classified as segment A2 and the groundwater in the lower Tertiary aquifer beneath the site could be conservatively classified as segment C under the SEPP *Groundwaters of Victoria* (1997).

The protected beneficial uses of segment A2 under the SEPP are listed below:

- Potable water supply – acceptable;
- Maintenance of ecosystems;
- Potable mineral water supply;
- Irrigation;
- Stock watering;
- Industrial water use;
- Primary contact recreation; and
- Buildings and structures.

The protected beneficial uses of segment C under the SEPP are listed below:

- Maintenance of ecosystems;
- Stock watering;
- Industrial water use;
- Primary contact recreation; and
- Buildings and structures.

5.7 Opportunities for Groundwater Use

Based on the known use of groundwater in the region and variable salinity it is reasonable to conclude that groundwater beneath the site could provide a supplementary source of water for a range of beneficial uses that may be applicable in an urban environment including irrigation of planted areas, filling of swimming pools, showering, household use for general purposes etc. However, any groundwater abstraction would need prior approval and licensing from Southern Rural Water.

Prior to any use of onsite groundwater we recommend that a detailed groundwater assessment be undertaken, including sampling and testing by a suitably qualified environmental professional. The purpose of the detailed groundwater assessment would be to confirm the contamination status and possible beneficial uses of groundwater.

5.8 Groundwater Summary

Groundwater below the site is likely to be suitable for a range of beneficial uses. The likely groundwater depths at the site are shallow (<3 m) which may mean that groundwater could be a development constraint.

6 CONCLUSIONS AND RECOMMENDATIONS

6.1 Preliminary Contamination Assessment

Based on the site history evaluation and site inspection, Beveridge Williams recommends that as a minimum:

- A preliminary soil contamination assessment be undertaken generally in accordance with Australian Standard 4482.1 *Guide to the Investigation and Sampling of Sites with Potentially Contaminated Soil* (2005);
- Targeted soil sampling be undertaken near the UST and AST locations, farm storage sheds, incineration area, drainage areas and selected site features such as incineration areas and burial pit;
- The underground storage tank be removed from the site in accordance with EPA Victoria Publication 888.1 *Guidelines on the Design, Installation and Management Requirements for Underground Petroleum Storages*; and
- Onsite wastes need to be removed in accordance with EPA Victoria Regulations.

6.2 Desktop Hydrogeological Review

Based on the desktop hydrogeological review, Beveridge Williams recommends that as a minimum:

- A groundwater assessment be undertaken in accordance with EPA Victoria Publication 668 *Hydrogeological Assessment (Groundwater Quality) Guidelines* (2006);
- Confirm groundwater depths across the site to ascertain if shallow groundwater may constrain the proposed development and develop a basic hydrogeological model to assess any impact from adjacent land uses, the water supply pipeline near the west boundary and drainage channels on the site; and
- Confirm the applicable beneficial uses and contamination status of groundwater through sampling and testing.

7 LIMITATIONS

Soil and rock formations are variable. The borehole logs indicate the approximate subsurface conditions only at the specific test locations. Boundaries between zones on the logs are often not distinct, but rather are transitional and have been interpreted. The precision with which subsurface conditions are indicated depends largely on the frequency and method of sampling, and the uniformity of subsurface conditions.

These conditions may differ due to the variability of contaminant concentrations in imported fill material or in natural soil as a consequence of activities on the site or adjacent sites. Where conditions encountered at the site or the proposed development differ significantly from those anticipated in this report, it is a condition of this report that Beveridge Williams & Co Pty Ltd be notified of the changes and provided with an opportunity to review the recommendations of this report.

BEVERIDGE WILLIAMS & CO PTY LTD

Prepared by



Brad Clay
Environmental Engineer

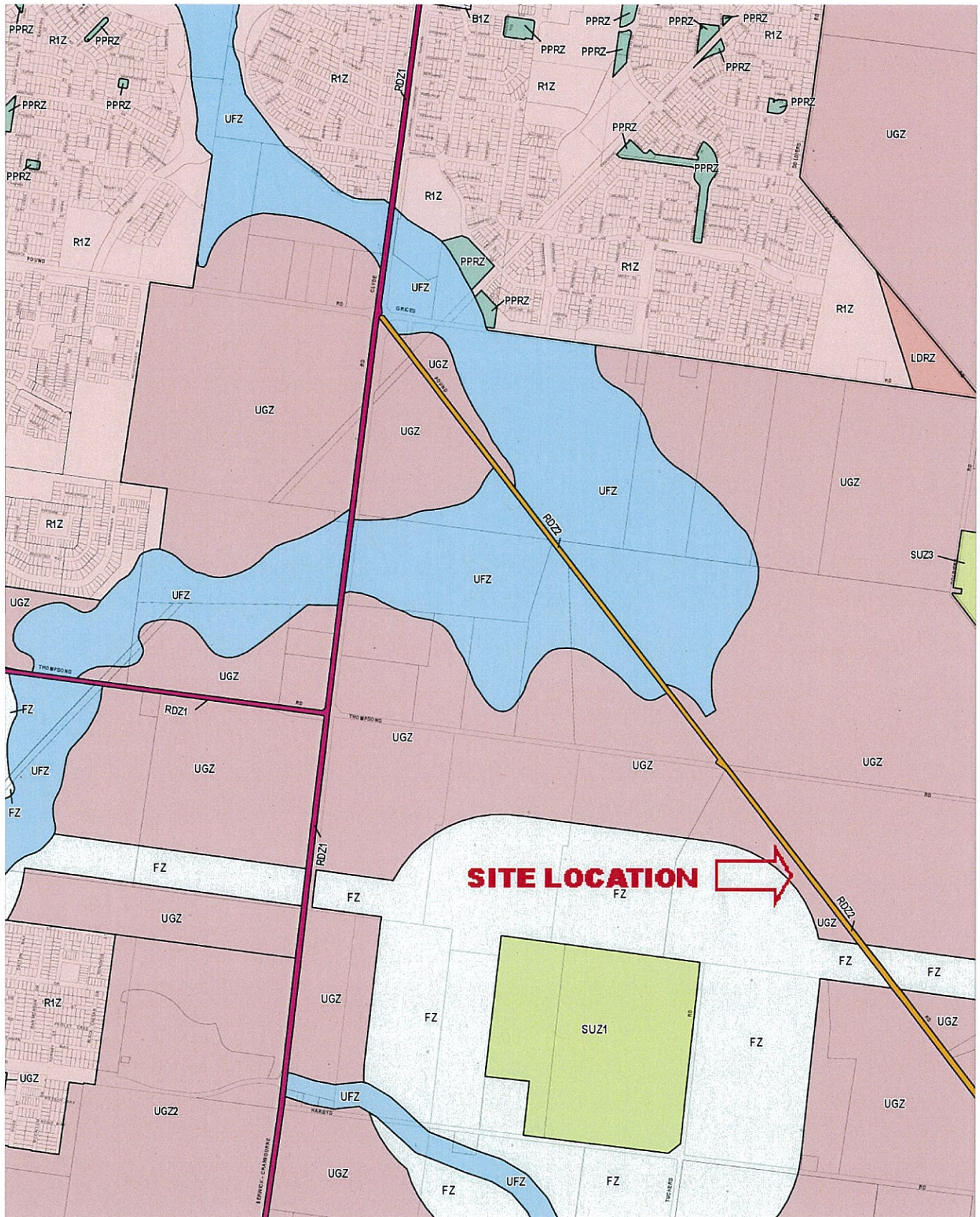
Approved for issue by



Andrew Mellett
Manager Environmental Division

APPENDIX A. GROWTH AREA FRAMEWORK PLAN AND PLANNING SCHEME MAPS

CASEY PLANNING SCHEME - LOCAL PROVISION



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This map should be used in conjunction with additional Planning Overlay Maps (POs) as indicated on the INDEX TO UTM.

Business	Special Purpose
Business 1 Zone	Special Use Zone - Schedule 1
Public Park and Recreation Zone	Special Use Zone - Schedule 2
Road Zone - Category 1	Urban Growth Zone
Road Zone - Category 2	Urban Growth Zone - Schedule 1
Residential	
Low Density Residential Zone	
Residential 1 Zone	
Rural	
Farming Zone	



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AMENDMENT VC68

INDEX TO ADJOINING METRIC SERIES MAP

1	2	3
4	5	6
7	8	9
10	11	12
13	14	15
16	17	18
19	20	21

ZONES

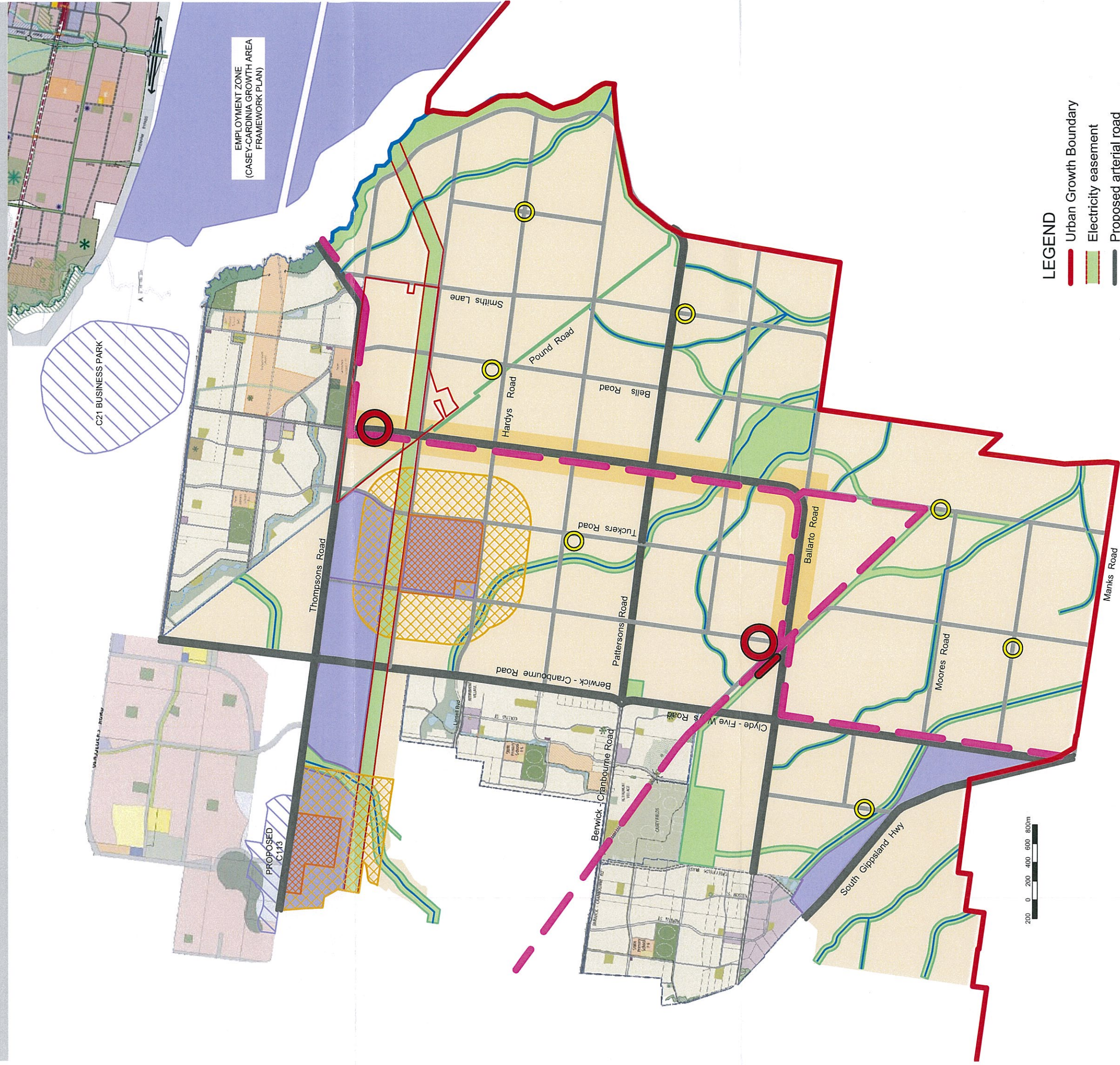
MAP No 12

See CARDINAL PLANNING SCHEMES

This map should be read in conjunction with additional Planning Overlay Maps (if applicable) as indicated on the INDEX TO MAPS.

INDEX TO ADJOINING
METRIC SERIES MAP

AMENDMENT VC68



EMPLOYMENT ZONE
(CASEY-CARDINA GROWTH AREA
FRAMEWORK PLAN)

C21 BUSINESS PARK

PROPOSED
C173



Notes
- The Cadastral Base shown is from VicMap and is approximate only.
- Contour interval is 1m (note contours are not from ground survey and may be incomplete / outdated)

LEGEND

- Urban Growth Boundary
- Electricity easement
- Proposed arterial road
- Proposed collector road
- Proposed major public transport route
- Major activity centre
- Neighbourhood activity centre
- Activity corridor
- Employment based activity
- Residential
- Open space
- Wetlands/drainage function
- Quarry
- 500 metre quarry buffer

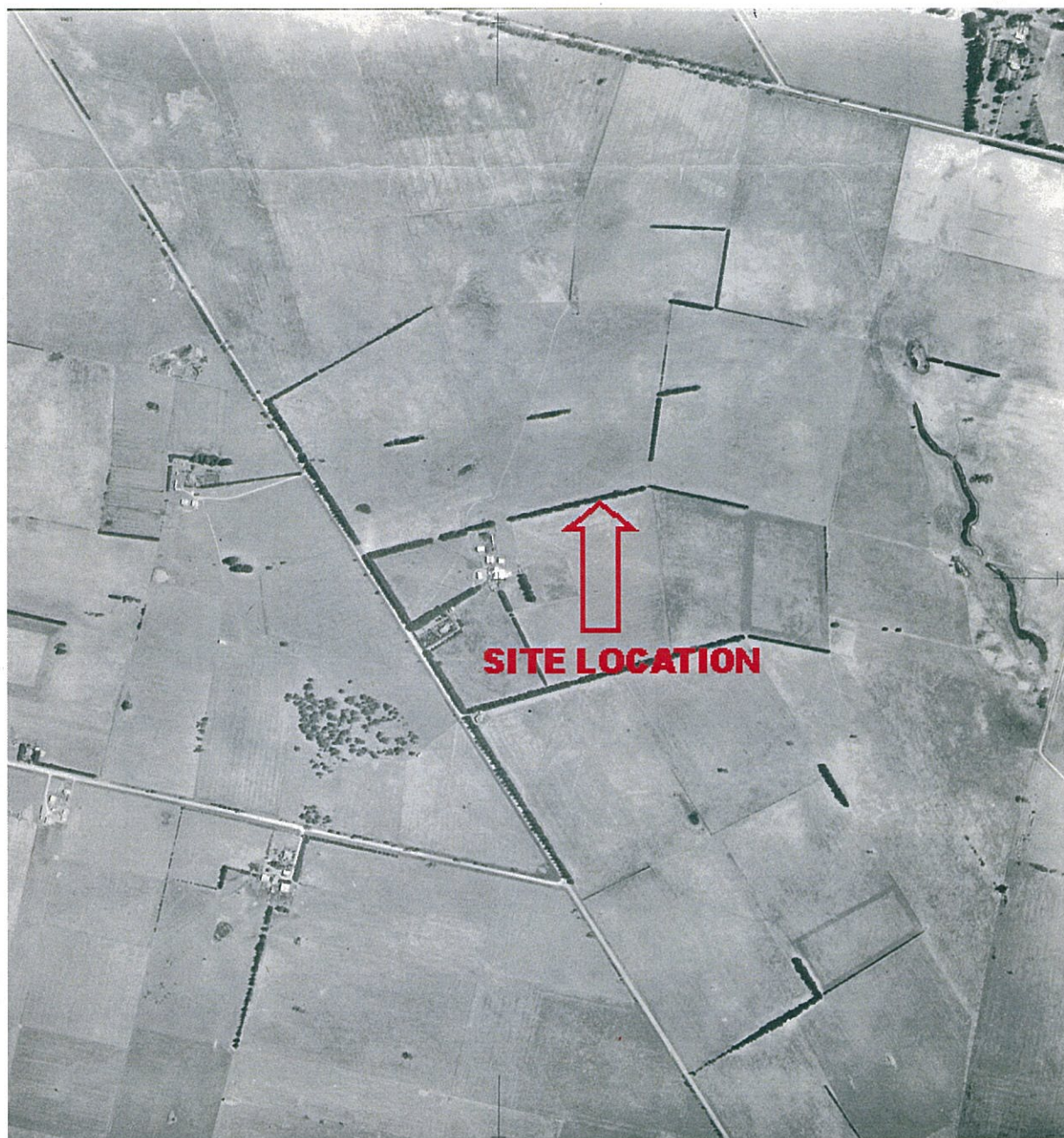
Growth Area Framework Plan Clyde / Clyde North

Casey UGB Expansion Area

K:\UGB DATA\1001306 CASEY UGB EXPANSION AREA_LAN\W04\1001306 GAPP 20101101.DWG

APPENDIX B. AERIAL PHOTOGRAPHS

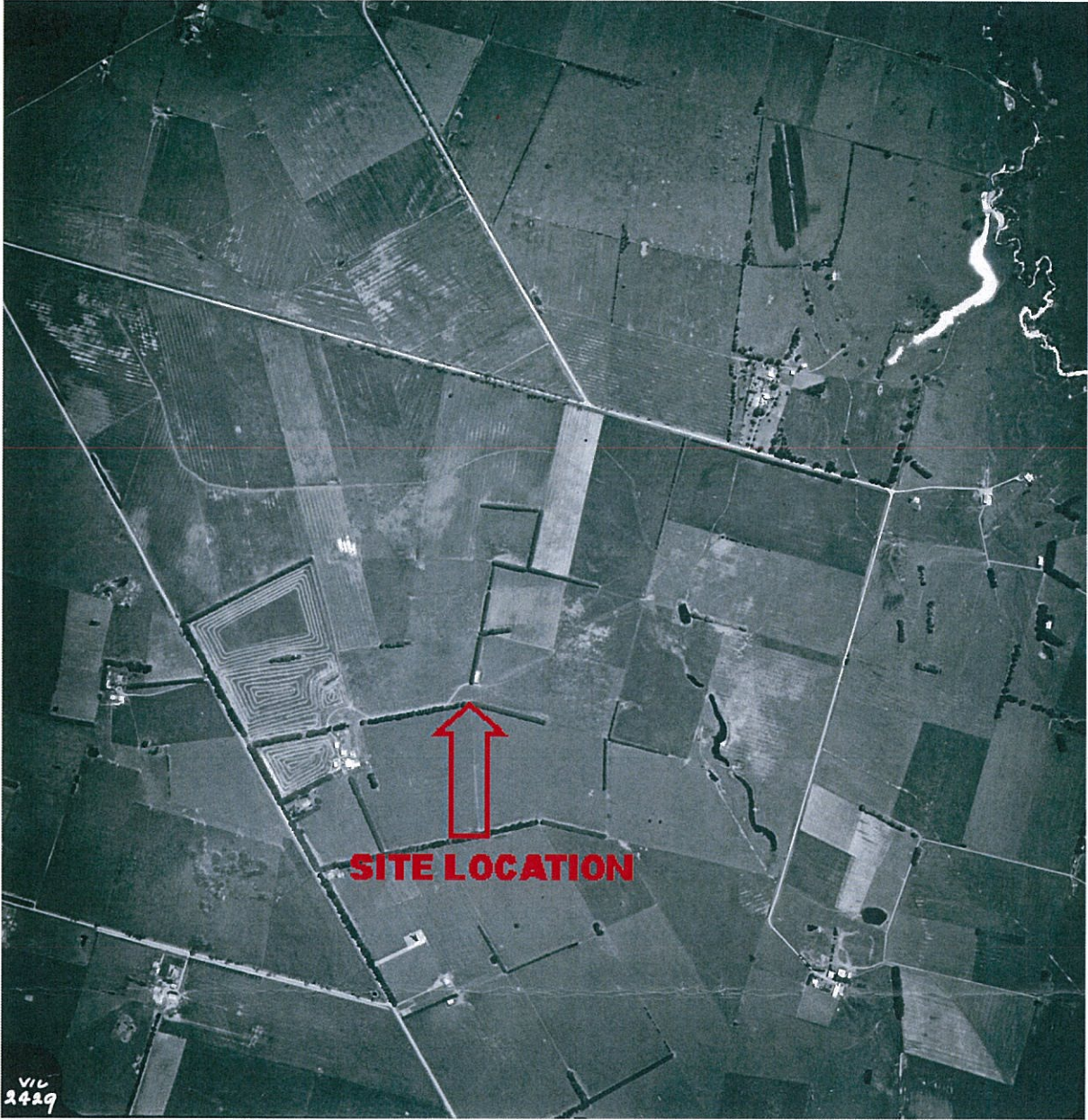
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Year: 1970a



Year: 1970b



Year: 1978a

