ENVIRONMENTAL EARTH SCIENCES
THE KNOW AND THE HOW

REPORT NO. **213066_PSP74**

LAND CAPABILITY ASSESSMENT FOR THE SUNBURY SOUTH PRECINCT STRUCTURE PLAN, SUNBURY, VICTORIA

ENVIRONMENTAL EARTH SCIENCES VIC
REPORT TO GROWTH AREAS AUTHORITY
JULY 2015
VERSION 1




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EXECUTIVE SUMMARY

Objective

The Growth Areas Authority (GAA) requested a land capability assessment for the Sunbury South Precinct (known as Sunbury South Precinct Structure Plan [PSP]). The objective of this study was to identify the potential for contamination on accessible properties within each Precinct and to identify any issues or considerations for the future urban development of the study area in regard to hydrology, groundwater and geology.

Findings

Of the properties within the Sunbury South Precinct, two properties (670 and 675 Sunbury Road) were classified as having 'high' potential contamination risk due to the presence of asbestos containing materials, a sheep dip and the storage of fuels, solvents and agricultural chemicals. An additional property (40 Redstone Hill Road) had part of the site rated as 'high' due to the presence of former mining activities and open shafts. These activities are within the portion of the rural conservation zone and are not within the proposed developable area. A further ten properties were classified as having a 'moderate' risk due to activities associated with past or present agricultural activities. The remaining properties have been rated as having a 'low' potential for contamination risk.

Recommendations

Properties classified with 'moderate' or 'high' potential contamination risk are recommended for further works or environmental assessment as detailed in Table 11. Further assessment of these sites should be undertaken in accordance with the following guidelines and standards:

- National Environmental Protection Council, 2013 *National Environmental Protection (Assessment of Contaminated Sites) Amendment Measure*;
- Standards Australia 1999, *Australian Standard AS 4482.2 - Guide To The Sampling and Investigation Of Potentially Contaminated Soil. Part 2: Volatile Substances*;
- Standards Australia 2005, *Australian Standard AS4482.1 - Guide to the Investigation and Sampling of Sites with Potentially Contaminated Soil. Part 1: Non-volatile and Semi-Volatile Compounds*; and
- EPA Victoria, 2009, *Soil Hazard Categorisation and Management*, Industrial Waste Resource Guideline 621.

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1 INTRODUCTION

The Growth Areas Authority (GAA) requires a land capability assessment for the Sunbury South Precinct (known as Sunbury South Precinct Structure Plan [PSP]). The precinct is a large-scale development area in the Sunbury-Diggers Rest Growth Corridor around the Township of Sunbury. The Sunbury-Diggers Rest Growth Corridor Plan identifies specific locations where urban development needs to be considered as part of the preparation of a PSP (i.e. where some urban development is likely to occur within the current Rural Conservation Zone). Based on the environment and historic/ current land uses, this study has been completed to identify issues or considerations that pose a contamination risk, for the future urban development of the precinct.

2 OBJECTIVE AND SCOPE

The objective of this study was to identify the potential for contamination on accessible properties within each Precinct and to identify any issues or considerations for the future urban development of the study area in regard to hydrology, groundwater and geology.

This information will be used to determine the future land use and help inform the future urban structure for the Sunbury South and Lancefield Road Precinct Structure Plans.

The scope of works carried out meets the requirements as set by the Project Brief provided by GAA. The scope of works comprised the following three stages:

- Stage 1 – Desktop review;
- Stage 2 – Site inspection; and
- Stage 3 – Reporting.

3 LAND CHARACTERISTICS

3.1 Location and general description

The Sunbury South Precinct is located in the suburb of Sunbury in Victoria and is administered by Hume City Council. The location and properties are shown in Figure 1. Figure 2 shows the planning zones.

The Sunbury South Precinct encompasses a total area of 1822 ha of which 850 ha are proposed for development which includes 9000 dwellings. Table 1 lists the current addresses and corresponding legal descriptions.

TABLE 1 SITE PROPERTY DETAILS SUNBURY SOUTH

Address	Legal Description
605 Sunbury Road	Lot 2 LP147272
607 Sunbury Road	Lot 1 LP147272
615 Sunbury Road	Lot 4 LP4533
675 Sunbury Road/ 2 Shepherds Lane/ 38 Shepherds Lane	Lot 2 PS423080/ Allotment 1C Sec 25 PP2258
580 Sunbury Road	Lot 2 PS645017
600 Sunbury Road	Lot 1 PS645017
650 Sunbury Road	Lot 2 LP203247
670 Sunbury Road	Lot 1 LP203247
680 Sunbury Road	Lot 1 TP620324
80 Redstone Hill Road	CP157019
70 Redstone Hill Road	Lot 1 LP145245
40 Redstone Hill Road	Lot 5 LP95031
50 Redstone Hill Road	Lot 2 LP88415
60 Redstone Hill Road	Lot 4 LP145245
35 Redstone Hill Road	Lot 1 LP203339
700 Sunbury Road	PS372386
720 Sunbury Road	Lot 3 LP77876
730 Sunbury Road	Lot 1 LP77876
35 Lancefield Road	Lot 2 LP77876
20 Lancefield Road	Lot 11 LP98382
30 Lancefield Road	Lot 10 LP98382
40 Lancefield Road	Lot 9 LP98382
50 Lancefield Road	Lot 8 LP98382
60 Lancefield Road	Lot 7 LP98382
70 Lancefield Road	Lot 6 LP87271
80 Lancefield Road	Lot 5 LP98382
10 Gellies Road	Lot 1 TP857832
30 Gellies Road	Lot 1 TP164678
50 Gellies Road	Lot 1 TP156620
60 Gellies Road	Lot 1 LP98382
155 Vineyard Road	Lot 1 LP82390
165 Vineyard Road	Lot 2 LP82390
175 Vineyard Road	Lot 3 LP82390

Address	Legal Description
1 Obeid Drive	Lot 1 PS507586
19 Obeid Drive	Lot 2 PS507586
39 Obeid Drive	Lot 3 PS507586
2 Obeid Drive	Lot 3 PS425707
20 Obeid Drive	Lot 2 PS425707
195 Vineyard Road	Lot 1 PS447997
215 Old Vineyard Road	Lot 2 PS302331
235 Old Vineyard Road	Lot 3 PS302331
25 Watsons Road	Lot 1 LP83019
35 Watsons Road	Lot 1 LP135051
45 Watsons Road	Lot 2 LP135051
35 Buckland Way	Lot 14 LP143133
45 Buckland Road	Lot 13 LP143133
55 Buckland Way	Lot 12 LP143133
20 Buckland Way	Lot 6 LP143133
26 Buckland Way	Lot 1 PS516735
30 Buckland Way	Lot 2 PS516735
40 Buckland Way	Lot 8 LP143133
50 Buckland Way	Lot 9 LP143133
60 Buckland Way	Lot 10 LP143133
65 Buckland Way	Lot 11 LP143133
65 Watsons Road	Lot 3 LP135051
75 Watsons Road	Lot 4 LP135051
85 Watsons Road	Lot 1 PS404987
93 Watsons Road	Lot 20 PS404987
95 Watsons Road	Lot 5 PS404987
97 Watsons Road	Lot 3 PS404987
35 Fox Hollow Drive	Lot 18 PS617530
37 Fox Hollow Drive	Lot 17 PS617530
45 Fox Hollow Drive	Lot 6 PS404987
30 Fox Hollow Drive	Lot 16 PS404987
40 Fox Hollow Drive	Lot 15 PS404987
60 Fox Hollow Drive	Lot 13 PS404987
65 Fox Hollow Drive	Lot 12 PS404987
55 Fox Hollow Drive	S6 PS404987

Address	Legal Description
115 Watsons Road	Allotment 2006 PP2761
Shields Street	Allotment 16 Sec 25 PP2761
Shields Street	Allotment 2007 PP2761
245 Old Vineyard Road	Lot 1 PS448006
10-12 Watsons Road	Lot 2 PS448006
20 Watsons Road	Lot 1 PS345756
24 Watsons Road	Lot 2 PS345756
30 Watsons Road	Lot 1 PS341518
725 Sunbury Road	Lot 1 LP4533
785 Sunbury Road	All 1 Sec 26 PP2258
	All 2 Sec C TP783284
	Lot 1 TP747658
	Lot 1 TP867376
108 Brook Street	Lot 1 TP863725
108 Brook Street	Lot 29 or 21?? LP88021
108 Brook Street	Lot 4 LP7204

3.2 Surrounding land uses

Sunbury township is located north west of the Sunbury South Precinct and includes a mix of standard residential and commercial/ industrial land uses. The remainder of the surrounding land uses are rural/ agricultural and rural residential.

Commercial/ industrial land uses located in or adjacent to the precinct include a sewage treatment plant and quarry/landfill. These are further discussed in Section 4.5 Licensed Activities.

3.3 Geology

The geology across most of the Precinct as described by the Sunbury 1:63,360 map sheet (Geological Survey of Victoria, 1973) is late Tertiary-aged Newer Volcanics. This formation is characterised by olivine basalts, minor limburgite, trachy-andesite, and scoria, with thin inter-bedded layers of sand, clay and tuff. The Newer Volcanics formation is expected to overlay Upper Ordovician aged marine sediments comprised of interbedded shale and greywacke, with minor grit horizons.

Quaternary alluvial deposits are present along the northern portion Jacksons Creek, consisting of sand, sandy silt, silt and gravel. Upper Ordovician marine sediments are exposed around the southern part of Jacksons Creek around Watsons Road and also north of Sunbury Road and around Watsons Road south west of Jacksons Creek. Brighton Group tertiary deposits consisting of quartzite, gravel, sand, silt and rare tuff are also present in a location at the western end of Watsons Road.

3.4 Soil

According to Van de Graaf and Wootton (1996), the soil in the area is classified as heavy clay on younger basalts. These soils occur extensively north west of Melbourne and are described as shallow dark and reddish brown heavy clays with thin loamy topsoil. They have poor drainage, are hard when dry and very sticky when wet and are slightly alkaline to slightly acidic.

Jeffrey (1981) described the soils in the Sunbury area derived from Ordovician parent material as mottled yellow brown duplex soils which are sodic. This is in agreement with search results from the Australian soil resource information system (ASRIS) (CSIRO, 2008) which also indicates that the soils in the area are sodosols. Sodosols are described as soils with a strong texture contrast between the A and B horizons and the upper B horizon is sodic and not strongly acidic (Isbell, 1996). Sodic soils are dispersive and can be a high erosion hazard.

The occurrence of sodic soils in, particular, are prone to dispersion and erosion. Development of the land area should consider the impact of these soils by minimising erosion, which may include maintaining a vegetative cover, where possible and minimising clearing and exposing bare soil on slopes for prolonged periods of time.

Soils derived from the alluvial deposits along Jacksons Creek and Emu Creek consist of loams, clays and sands that have variable drainage rates depending on sand, gravel and clay content (Van de Graaf and Wootton, 1996).

Observations during the site inspections are also consistent with these findings.

Due to the elevation of the area (>10 m AHD) and the distance from the coast, the site is not considered to be a risk for the presence of potential acid sulfate soils.

3.5 Topography

The Sunbury area contains three former eruption points which have formed hills higher than the surrounding area. Former eruption points in the area are Sunbury Hill, Winilba Hill and Resdstone Hill.

Redstone Hill is the highest point in the Sunbury South Precinct at approximately 250 m AHD. The area slopes towards Jacksons Creek, Harpers Creek or Emu Creek.

The topography contours are shown in Figure 3.

3.6 Surface water

Two major creeks dissect the Sunbury area; Emu Creek runs north south along the eastern boundary of the precinct and Jacksons Creek (also fed by Harpers Creek in the south) runs north south in the western portion of the precinct. Emu Creek is a tributary of Deep Creek which both feed into the Maribyrnong River which discharges into the Yarra River and Port Philip Bay.

A number of dams are located on rural properties in the precinct. If these properties are to be redeveloped and the dams are not to be retained, they will need to be drained and filled with suitably clean fill.

3.7 Hydrogeology

According to Dahlhaus (2004) *Port Phillip and Westernport Groundwater Flow Systems*, the uppermost aquifer occurs in the fractured basalt. This aquifer is hosted in a fine-grained crystalline lithology (basalt) and has been weathered to form a layer of clay soil of various thicknesses. These weathered clays buried by subsequent lava flows have resulted in discontinuous confining layers in the basalt aquifer.

The depth to groundwater ranges considerably across the precinct (Victoria Government, 2013) and generally reflects the topography, with the shallowest watertable close the creeks and the deepest watertable under Redstone Hill. Groundwater flow is expected to flow towards either Jacksons Creek or Emu Creek.

According to the Groundwater Resources Victoria Map (Department of Mines and Energy, 1982), groundwater beneath the Sunbury South Precinct is variable and a TDS concentration of 1000 – 7000 mg/L which makes the groundwater suitable for most stock except poultry and in some areas all stock and salt tolerant plants. The aquifer lithology also varies either present in the Newer Volcanics (basalt, tuff and scoria) or sedimentary rock (fractured and weathered indurated sediments, metasediments and intrusives).

Groundwater of this salinity is classified as either Segment B or Segment C under Victorian Government (December 1997) *State Environment Protection Policy - Groundwaters of Victoria*. The beneficial uses of groundwater that are protected for Segment B and Segment C classified groundwater, which are the following:

- maintenance of ecosystems;
- potable mineral water supply (Segment B only);
- agriculture, parks and gardens (Segment B only);
- stock watering;
- industrial water use;
- primary contact recreation; and
- buildings and structures.

The Visualising Victorias Groundwater (Victoria Government, 2013), was used to identify groundwater bores within the vicinity of the site. According to this resource, there are 30 registered groundwater bores located in the Sunbury South Precinct. Table 2 summarises the relevant information.

TABLE 2 GROUNDWATER BORES - SUNBURY SOUTH

Bore number	Easting	Northing	Depth (mbgs)	Bore Type
302693	302213.169	5837496.207	0.6	Non-Groundwater
S9029000/1	302393	5837502	54	Domestic & Stock
S9035585/5	303844	5837363	33	Groundwater Investigation
S9035443/1	302426	5837168	150	Groundwater
S9035585/1	303614	5836845	43	Groundwater Investigation
S9035585/2	303619	5836843	60	Groundwater Investigation

Bore number	Easting	Northing	Depth (mbgs)	Bore Type
S9035585/3	303891	5836767	57	Groundwater Investigation
S9035585/4	303974	5836765	41.5	Groundwater Investigation
302692	302150.168	5836546.206	4.1	Non-Groundwater
52414	303109.168	5835854.205	0	Groundwater
302677	302584.168	5835736.205	6.09	Non-Groundwater
302678	302584.168	5835736.205	6.09	Non-Groundwater
302683	302584.168	5835736.205	6.09	Non-Groundwater
302679	302584.168	5835736.205	6.09	Non-Groundwater
302675	302584.168	5835736.205	6.09	Non-Groundwater
302676	302584.168	5835736.205	6.09	Non-Groundwater
302684	302584.168	583576.205	6.09	Non-Groundwater
302690	302871.167	5835069.204	49.39	Non-Groundwater
52417	304798.171	5835847.203	17.37	Groundwater-Industrial
WRK043044	304513.17	5835684.203	37	Groundwater-Miscellaneous
WRK043169	304431	5835595	5	DRG-Commercial
S9038841/1	300410	5836670	25	Groundwater
S9036605/2	300443	5836589	25	Groundwater
S9036605/1	300412	5836502	25	Groundwater
WRK047094	299930	5834484	150	Groundwater
309857	298119.162	5835934.209	54.4	Non-Groundwater
S9034844/1	297793	5835179	150	Groundwater
S9038329/1	297877	5835166	150	Groundwater
140058	298223.161	5835144.208	57	Groundwater Domestic
142384	298163.161	5834284.207	100	Domestic Stock

3.8 Environmental considerations

3.8.1 Ministers Direction No. 1

The Minister for Planning re-issued *Ministers Direction No. 1 – Section 12 (2) (a) of the Planning and Environment Act 1987 – Potentially Contaminated Land* on 27 September 2001. This document specifically addresses how planning authorities make a decision on whether potentially contaminated land (i.e. land used for industry, mining, chemical, gas, wastes or liquid fuel storage) can be used for more sensitive uses (such as residential, a child care centre, a pre-school centre or a primary school).

The Minister's Direction No. 1 directs planning authorities that in preparing any amendment to a planning scheme that would allow potentially contaminated land to be used for a more sensitive use; they must satisfy themselves that the environmental condition of the land is suitable for the nominated use.

3.8.2 Protected Areas

The Department of Environment Protected Matters Search Tool identified one protected area, in the Sunbury South Precinct. The protected area, titled Holden Fauna and Flora Reserve, is located between Watsons Road and Jacksons Creek.

3.8.3 Biodiversity Conservation Strategy (BCS)

The Biodiversity Conservation Strategy for Melbourne's Growth Corridors (Department of Environment and Primary Industries, 2013) has been prepared to inform the Growth Corridor Plans of areas committed to conservation outcomes and to protect matters of national environmental significance. Conservation areas in the Sunbury South Precinct include the the Growling grass frog corridor (21). This land is within the rural conservation zone.

3.8.4 Growling grass frog habitat

The Sub-regional Species Strategy for the Growling Grass Frog (Department of Environment and Primary Industries, 2013) has been prepared to inform the Growth Corridor Plans and the design of precincts of the areas of habitat to be protected in the precinct areas.

There are Growling Grass Frog corridors along Jacksons Creek and Emu Creek in the Sunbury South/ Lancefield Road Precinct. The areas include Category 1 protection areas and potentially important habitat outside urban expansion areas. Furthermore, Category 2 (other suitable habitat requiring offset if cleared) is present across the precinct and offsets will need to be considered in these areas.

3.8.5 Environmental significance overlays

Environmental significance overlays exist over parts of the Sunbury South Precinct. The three different schedules present in the precinct are detailed below.

- ESO01 which represents rural waterways and environs is present along and nearby both Jacksons Creek and Emu Creek;
- ESO10 which represents rural conservation areas is present in similar areas to ESO01 along both Jacksons Creek and Emu Creek; and
- ESO04 which represents the northern railways reservation exists along parts of the railway line.

A permit is generally required in these areas before development can proceed unless the schedule specifically states that it is not required.

The protected areas have been incorporated into the planning zones. Protected areas are accounted for in the regional conservation zones (RCZ1) with the exception of the Bulla Hi Quality which falls in a special use zone (SUZ).

3.8.6 Wetlands

A search of protected wetlands (Department of the Environment Protected Matters Search Tool, 2013) was undertaken and did not identify any Ramsar wetlands or nationally important wetlands in the Precinct.

3.8.7 Bushfire prone areas

According to Landchannel, the entire area, with the exception of the Bulla landfill, is under a designated bushfire prone area. Planning restrictions associated with a bushfire prone area will need to be considered and this overlay may need to be updated in accordance with the proposed land uses.

3.9 Heritage considerations

There are four heritage overlays in the Sunbury South Precinct, details are as follows:

- Gellies Road bridge (HO28) is located at the creek crossing of Emu Creek on Gellies Road. External paint controls apply. It is not expected that development would impact on this site, however if the bridge was to be widened to accommodate extra traffic to be generated from the development this would need to be considered;
- House (former Leyden) (HO210) is located at 670 Sunbury Road. External paint controls apply, tree controls apply and prohibited uses may be permitted;
- Former Constitution Hotel (HO358) is located at 675 Sunbury Road. External paint controls apply and prohibited uses may be permitted;
- Former Rankin Farmhouse (HO344) is located at 725 Sunbury Road adjacent to Redstone Hill Road. No special conditions apply and prohibited uses may be permitted; and
- Anecdotal evidence suggests that an area of heritage significance exists at 40 Redstone Hill Road at the rear of the property on Jacksons Creek (within the rural conservation area).

The above locations will need to be considered in line with any development.

3.10 Geotechnical considerations

Geotechnical considerations based on available desktop information have been summarised below. Please note that during the planning and design phase, site and project specific geotechnical investigations will be required. The full geotechnical report can be found in Appendix B.

- The precinct is gently to moderately undulating. Moderate undulations will somewhat constrain the layout of road and block formations.
- Steeply undulating areas and creek banks are likely to consist of exposed and shallow rock which will result in more difficult and costly excavation.
- In generally, the land appears to be suitable for creek crossings. The construction may require substantial road works and earthworks to overcome the topography. Rocky ground conditions will result in more difficult excavation for bridge abutments and associated earthworks and subsurface erosion may pose a problem if significant excavation is required.
- Creek crossings and associated works should be constructed above the creek flow path (including inundation areas) or should accommodate creek flow through the works.
- An allowance for dewatering areas of earthworks or excavations should be provided for and a geotechnical investigation conducted as part of the planning and design phase may determine this requirement.

- Light traffic new road pavements typically consist of granular sub base and base material with an asphalt surface with an approximate thickness of 300 mm to 500 mm. Heavy traffic road pavements typically require a thickness of 500 mm to 1000 mm. Alternative pavement compositions should be considered for heavy traffic areas or overlays of existing roads.
- Considerations of road pavement should include the subgrade conditions, anticipated traffic over the life of the pavement and the preferred or locally available construction materials and equipment.
- In general, it would be best to site allotments up and down any slope and construct roads to follow the contours. This minimises road profile grades, minimises driving up or down steep slopes, minimises earthworks and allows roads to be used for surface drainage control.
- Selection of residential building footings is primarily based on the shrink-swell potential of the soil. Areas of the Sunbury South Precinct in particular have soils with higher shrink swell potential. These areas will require deeper and more expensive building footings.
- Subusurface erosion is a potential in steep sites and may present a problem in areas where deep excavations (greater than 3 m) are cut and exposed. In areas where slope instability is an issue, a full geotechnical investigation should be undertaken.

4 HISTORICAL REVIEW

4.1 Aerial photography

A review of historical and current aerial photographs of the precinct was undertaken. The objective of the review was to provide supporting information obtained from other sources and identify any large scale changes that may have impacted the contamination status of the area.

The Sunbury South aerial photographs show that the eastern and western parts of the precinct are predominantly farming and agriculture properties since at least 1951. Paddocks and small farm houses are scattered throughout the area. Jackson's Creek and Emu Creek have remained relatively unchanged since 1951. The north western area of the precinct is a large residential development and has been expanding in size since 1982.

The aerial photographs obtained from DSE Aerial Photograph Archive are described in Tables 3 and 4 and copies are provided in Appendix A.

TABLE 3 AERIAL PHOTOGRAPH REVIEW SUNBURY SOUTH (EAST)

Year	Title	Colour/ Black and White	Comments
1951	Melbourne & Metropolitan Project	Black and white	The aerial shows Emu creek running through the eastern part of the area. Sunbury road runs along the south western part. The area has no buildings or structures. The area appears to vacant grassland or farming land.
1966	Melbourne 1966 project	Black and white	The aerial shows Sunbury road which runs from the south to the east. Emu and Deep creek both run from the north to south. The quarry is evident in the southern part of the area. The remaining area consists of vacant paddock and farmland.
1974	Melbourne 1974 project	Black and white	The aerial shows a large open active quarry that is operating next to Emu creek. The surrounding area remains as farm land. A farm house appears next to Sunbury road.
1991	Melbourne 1991 project	Colour	The aerial shows the quarry; however, it appears to have decreased in size since 1974. There are several small farm buildings and structures scattered around the area. Vacant paddocks and farmland surround the area. Emu Creek runs through the eastern part of the area and remains to be unchanged.
2002	Google earth	Colour	The quarry is still in operation and appears to have been backfilled in some parts. The surroundings areas remain unchanged, consisting of vacant farming land and small farm houses. Emu Creek remains unchanged.
2011	Google Earth	Colour	The quarry is still active and has expanded to the north. A small dam has also been built next to the quarry. Residential houses now appear towards the north of Sunbury road. Emu creek remains unchanged. The area to the west remains as vacant farming land with small farm houses scattered in the area.

TABLE 4 AERIAL PHOTOGRAPH REVIEW SUNBURY SOUTH (WEST)

Year	Title	Colour/ Black and White	Comments
1960	Melbourne & Metropolitan project	Black and white	The entire area appears to be vacant farming land with small roads that intersect some paddocks. Jackson's creek is located towards the north east. Small dams are visible to the south.
1960	Melbourne & Metropolitan project	Black and white	The area consists of vacant farming land. Four small farming houses also appear in the area. Jackson's creek is located to the west and Sunbury road traverses the north east corner where two farm building are visible.
1968	Melbourne Poject	Black and white	The aerial shows Jackson's creek to the north east. There are also two dams present in the area. Surrounding land use remains as farming land and vacant grassland.
1979	Broadmeadows	Black and white	Jackson's creek remains unchanged from 1968. Towards the east vacant farming land is apparent with some small farm houses scattered in the north east.

Year	Title	Colour/ Black and White	Comments
1982	Melbourne	Black and white	The aerial image is consistent with the previous images being predominately vacant grassland / farming land. The Calder freeway is visible with other roads intersecting through this freeway.
1986	Melbourne	Black and white	The aerial shows Jackson's Creek running through the area, surrounded by farming land. Farm houses are scattered throughout the area. Small dams for stock watering are also present.
1991	Melbourne project	Colour	The area is made up of small to medium sized hobby farms and vacant paddocks. Small roads intersect the area. Jackson's creek is located to the north east. Numerous small dams on farm properties are also evident.
2001	Google Earth	Colour	The aerial shows established wind breaks on a number of small rural properties. The surrounding area remains unchanged from the 1991 aerial with small dams and roads present.
2011	Google Earth	Colour	Recently sown crops or worked ground is evident to the north. Small farms remain. Additional residential development has occurred towards the west of the area as in 1991 and 2001.

4.2 Historical title search

In order to obtain details of the historical owners of the site, a historical title search was conducted. The historical title searches provide details about past owners and leases, including business names, which may provide an indication of potential contaminating activities undertaken during the respective use period.

Table 5 below provides a summary of ownership and inferred land use. The original titles can be provided on request.

TABLE 5 SELECTED HISTORICAL TITLES

Street address	Significant past or present usage
600 Sunbury Road, Bulla	Currently High Quality Quarry Products Pty Ltd. Site has been used historically as a dairy and grazing farmland since 1929.
80 Redstone Hill Road, Sunbury	Currently Sunbury Pastoral Pty Ltd. Site has been historically used as farm land since 1938.
2 Shepherds Land, Sunbury	Currently Hongfengshei International Property Investment Pty ltd. Site has been used historically as farming/ grazing land since 1945.
40 Redstone Hill Road, Sunbury	Currently Viewgrange Farming Pty Ltd. Previous proprietors include Pioneer Quarries 1974. Farming since 1945
670 Sunbury Road, Bulla	Currently private proprietors. Previous land use includes farming since 1923

4.3 EPA records

The Priority Sites Register lists properties which the Environment Protection Authority (EPA) Victoria has issued a clean-up notice or pollution abatement notice under the *Environment Protection Act 1970*. These properties are considered to present an unacceptable risk to human health or the environment. A search conducted on the Priority Sites Register dated July 2013, identified that there are no sites in the Sunbury South Precinct or in the immediate vicinity listed.

A search of the Statement of Environmental Audit and Certificates of Environmental Audit register revealed that there are no properties with previously issued Statutory Audits in the Sunbury South Precinct or in the immediate vicinity.

4.4 Local government records

Hume City Council was contacted to obtain records relating to the Sunbury South Precinct. Records requested and reviewed include information on former and current landfills and quarries, planning permits and development approvals and information on former council depots.

4.5 Licensed activities

Bulla quarry/landfill

A quarry and landfill is located at 600 Sunbury Road, Bulla, Victoria which operates under EPA Licence 45279 under the name Hi-Quality Quarry Products Pty Ltd. The EPA licence was issued in 2001 for the scheduled categories of prescribed industrial waste management and landfills.

Recommended noise levels for this industry are determined by following the procedures located in EPA Publication 1411 and are allocated to different parts of the day (EPA Victoria, 2011).

Separation distances for active landfills to sensitive receptors were compiled from EPA publication 788.2 and are summarised in Table 6 below (EPA Victoria, 2014).

TABLE 6 BUFFER DISTANCES REQUIRED FOR LANDFILL GAS MIGRATION, SAFETY AND AMENITY IMPACTS

Landfill Type	Sensitive Receptors	Buffer Distance (in metres)
Type 2 (Municipal/putrescibles waste)	Surface waters	100 m
	Buildings or structures	500 m
	Aerodrome for piston-engine propeller driven aircraft	1,500 m
	Aerodrome for jet aircraft	3,000 m
Type 3 (solid inert waste)	Surface waters	100 m
	Buildings or structures	200 m
	Aerodrome for piston-engine propeller driven aircraft	1,500 m
	Aerodrome for jet aircraft	3,000 m

Separation distances for quarries to sensitive receptors were compiled from the EPA publication 1518 and are summarised in Table 7 below (EPA Victoria, 2013).

TABLE 7 BUFFER DISTANCES RECOMMENDED FOR QUARRY RESIDUAL AIR EMISSIONS

Quarry type	Buffer distance
Without blasting	250 m
With blasting	500 m
With respirable crystalline silica	500 m

Sewage Treatment Plant

A sewage treatment plant is located west of Jacksons Creek (outside the Precinct). The developable area adjacent to this sewage treatment plant is currently restricted by Jacksons Creek and the associated escarpment and is not expected to be further impacted by the presence of the sewage treatment plant. The setback distances stated in EPA Publication 891.3 Onsite Wastewater Management are not expected to impact on the developable area within the Precinct. Furthermore, based on the steep escarpment separating the developable area in the Precinct from the sewage treatment plant, the risk to the Precinct is considered to be low. However, the aesthetic/ odour issues may need to be considered. Separation distances for sewage treatment plants to sensitive receptors were stated from the EPA publication 1518 and are summarised in Table 8 below.

TABLE 8 SEPARATION DISTANCES FOR SEWAGE TREATMENT PLANTS (IN METRES)

Type of installation	Separation Distance (n = equivalent population)
Mechanical /biological wastewater plants	$=10n^{⅓}$
Aerobic pondage systems	$=5n^{½}$
Facultative ponds	$=10n^{½}$
Disposal areas for secondary treated effluent by spray irrigation	200 m
Disposal areas for secondary treated effluent by flood irrigation	50 m

Notes: Example of how to use this table:

What is the recommended separation distance of an aerobic pondage system serving an equivalent population of 10,000 people?
Distance = $5n^{½}$
Distance = $5(10{,}000)^{½}$
Separation distance = 500 m

5 SITE INSPECTION

An initial inspection of the Sunbury South Precinct was undertaken on 18 October 2013. A further more detailed inspection of selected properties was undertaken on 6 November 2013.

All properties were inspected from the road. A summary of the properties inspected in further detail (site walkover) are listed below:

- 600 and 650 Sunbury Road (Bulla Landfill);
- 670 Sunbury Road (Hi Quality);
- 675 Sunbury Road (Villawood);
- 40 Redstone Hill Road (Villawood); and
- 2 Shepherds Lane (Hong Feng Shi International).

Observations from the site inspection are provided below:

115 Watsons Road
The Holden Fauna and Flora reserve is predominantly grassland with a mix of native grasses and noxious weeds observed in the reserve. The reserve slopes down towards Jacksons Creek on to narrow creek flats. Stockpiles of soil were observed on the adjacent property that is not part of the PSP area.

Watsons Road and Vineyard Road
The properties located along Watsons Road, Fox Hollow Drive and Buckland Way are rural residential properties. Some properties are used for some light sheep grazing. Properties of particular note are discussed below:

- 55 Fox Hollow Drive and 95 Watsons Road are small scale olive farms.
- 37 Fox Hollow Drive has had some cut and fill and stockpiles are also present on 45 Fox Hollow Drive. The stockpiles all appear to originate from the site therefore do not pose a risk of unknown imported fill, however if these properties are to be redeveloped, the stockpiled soil will need to be managed appropriately. Also note due to the sodic nature of some of the soil it may not be suitable for use as topsoil.
- 60 Fox Hollow Drive has some stockpiles of bitumen/ asphalt material, which does not pose a major risk, however will need to be managed appropriately.
- 97 Watsons Road is a small horse training centre (Little Oaks Training).
- 215 Vineyard Road has a small scale vineyard.

Sunbury Road
Observations of specific properties along Sunbury Road are discussed below:

- Craiglee Vineyard (The Carmody Estate) is located at 795 Sunbury Road. Crops and pasture are located along the southern side of Sunbury Road. Overall the operations appear to be relatively small scale and there is little evidence of intensive agriculture which might suggest the heavy use of chemicals (e.g. herbicides and pesticides). There was also little evidence of any large machinery sheds or warehouses on the properties which might have the potential to have storages areas of chemicals and fuel.

- The eastern end of 675 Sunbury Road is a water pumping station.
- 600 and 650 Sunbury Road (Bulla holdings) - A walkover of the cropped area of the Bulla Holdings was undertaken, which is proposed to be rezoned to light industrial/ commercial use. A canola crop is present, which has a low risk associated with the use of agricultural chemicals as they are used at low rates. No structures were encountered. Outside the canola crop area along the edge of the escarpment, the site cover is dominated by weeds. The soil on this site was observed to be a vertosol.
- The Bulla HiQuality quarry and landfilling operations are present at 600 Sunbury Road.
- 670 Sunbury Road has sheds and a house which contain potential asbestos materials were observed. It is recommended that should this area be redeveloped, care should be taken with the disturbance and any demolition of these structures and appropriate disposal of any asbestos containing materials. A former (in-ground) sheep dip was observed which has the potential for soil contamination around the dip. Chemicals of concern include arsenic and pesticides including DDT. Some old chemical containers and an old heating oil tank were also observed in the shed.
- 680 Sunbury Road has a machinery shed which has the potential to contain fuel and chemicals.
- The Vic Roads land on the corner of Sunbury Road and Lancefield Road (west of 680 Sunbury Road) have a number of stockpiles present including a range of bitumen, road base and fill material. Appropriate management of any unknown stockpiles is recommended which may include some stockpile sampling for characterisation.
- 2 Shepherds Lane (Hong Feng Shi International) was inspected. One house is located on the property and a second house is under construction and a number of building materials were observed. Stockpiles of red soils were observed and originate from surface levelling of the site. The area around the houses is planted with olive trees or is vacant grassed land.
- 615 Sunbury Road has a Vineyard on part of the property.
- 40 Redstone Hill was inspected. Chemical storage was noted in a shed and is on hardstand. An old above ground storage tank (AST) for diesel was observed, no surface staining of soil under or around the tank was observed. The farm manager noted that it has not been used in at least 3 years. On the escarpment two gold mining shafts are noted as well as some tailings. Substantial gully erosion on the escarpment was also noted. An old wall from a farmhouse is also present on the property which is under heritage, however does not appear in the heritage overlays available.
- 675 Sunbury Road, horse stalls and a number of sheds were observed and are no longer in use. An old diesel AST, three IBCs and fuel containers were observed. It is not clear what the IBCs have been used for. No surface staining of soils was observed. A former dairy including drums containing aviation turbine fuel (2) and fertiliser were present on hardstand. The bluestone wall from a former hotel which is under a heritage overlay was observed.

6 SUMMARY OF IDENTIFIED ISSUES AND MANAGEMENT OPTIONS

6.1 Stockpiles of unclassified fill material.

A number of stockpiles of soil and/or fill material were identified during the initial site inspections of the Sunbury precincts. Sampling and analysis of any soil to be removed off site is recommended as per EPA Publication IWRG621 to confirm if soil is clean fill or otherwise. If the stockpiled material is classified as contaminated material it needs to be disposed of at a landfill licensed to accept that type of material.

6.2 Asbestos containing materials

Asbestos containing materials, mainly corrugated cement sheet and cladding were observed in building/sheds onsite at 670 and 675 Sunbury Road. Removal of ACM must be undertaken by a Licensed Asbestos Removalist and a clearance certificate provided by an occupational hygienist stating that the ACM has been removed to the extent practicable. Relevant guidance on asbestos removal:

- WorkSafe Compliance Code Removing asbestos in workplaces (2008); and
- Victorian Occupational Health and Safety Regulations (2007).

6.3 Sheep dip

A single sheep dip was identified at 670 Sunbury Road during the site inspections undertaken. Sheep dips have been shown to cause some soil contamination associated with the use of a number of different chemicals used for insect control. Sheep dip chemicals were arsenic-based, being replaced by the use of organochlorine and organophosphorus compounds and later by synthetic pyrethroids. A detailed soil investigation is recommended to determine if soil surrounding the sheep dip has been impacted or contaminated with the chemicals of concern listed above. If an unacceptable impact is identified, remedial options may include the disposal of impacted material off site to a licensed landfill and validation of the resulting excavation.

6.4 Chemical/ fuel storage

The potential exists for the storage of fuels/oils/degreasers and agricultural chemicals (i.e. herbicides and/or pesticides) on former and/ or existing agricultural properties across the precinct. The potential for spillage of these chemicals needs to be considered as they represent a source of contamination. Following removal of any chemical or fuel containers, a visual inspection should be undertaken to determine the presence of any spills, such as the staining or discolouration of soils. If staining is identified, a soil assessment should be undertaken to determine the concentrations of the chemicals of concern and remediated appropriately (if required).

7 ENVIRONMENTAL RISK ASSESSMENT

7.1 Introduction

The environmental risk assessment was based on the *source-pathway-receptor* relationship, which allows an assessment of potential environmental risks to be determined, based on the source, extent of exposure of a receptor to a source and the sensitivity of the receptor to the type of contamination. As such an assessment is made of the environmental liabilities associated with risk. These liabilities may be expressed in terms of additional costs associated with site redevelopment or remediation measures, the potential for fines or penalties imposed for contravention of particular environmental legislation or loss of land value.

The identified potential environmental liabilities with regard to contamination have been evaluated with respect to the potential impacts on:

- sensitive sites and ecosystems;
- groundwater aquifers;
- soils;
- surface water bodies;
- construction and maintenance workers; and
- current and future site users.

7.2 Sources of potential contamination

Sources of potential contamination were identified within the Precinct, and the following contaminants were identified as having the potential to be on-site:

- petroleum hydrocarbons – total petroleum hydrocarbons (TPH); benzene, toluene, ethylbenzene, xylenes and naphthalene (BTEXN); and polycyclic aromatic hydrocarbons (PAH);
- heavy metals, in particular lead;
- fertilisers, pesticides, fungicides and herbicides;
- arsenic, organochlorines, organophosphates, synthetic pyrethroids;
- waste livestock products – buried carcasses, manure and slurry pits;
- asbestos containing materials; and
- volatile and semi-volatile organic hydrocarbons.

7.3 Pathways of potential contamination

Potential contaminant pathways that may impact on human health and/ or the environment include the following:

- localised drainage to down-gradient surface water bodies;
- leaching of contaminants to groundwater;

- vapour inhalation of contaminants; and
- direct contact with soil contaminants or hazardous materials.

The potential exists for the migration of contaminants from the PSP via surface water runoff to local surface water features, by seepage through the subsoil into groundwater, as an airborne release such as dust or vapour (usually from demolition and excavation activities), and by dermal absorption caused by direct contact between skin with contaminated material.

Contaminated soil has the potential to migrate during transportation or movement of stockpiles to either on-site or offsite locations.

Within the Precinct the dispersal and migration of chemical of concern (contaminants) will generally be controlled by sub-surface conditions (soil type/ permeability and groundwater levels) along with physical and chemical properties of individual contaminants and climatic conditions. Other factors that may impact on the migration of contaminants include:

- erosion of disturbed and cleared areas that contribute to sediment transport and deposition;
- removal of topsoil material and exposure of underlying sodic subsoils to erosion;
- on-site movement of light vehicles and machinery that will contribute to shallow soils being disturbed;
- construction of drainage infrastructure forming preferential migration pathways down gradient of identified areas of environmental concern; and
- precipitation rates.

7.4 Potential receptors

Potential receptors indentified within the precinct and the surrounding areas include:

- residential properties onsite and offsite;
- agricultural land onsite and offsite;
- construction works involve in redevelopment activities;
- surface water bodies onsite and offsite; and
- groundwater beneath the investigation areas.

7.5 Qualitative risk assessment

A qualitative risk assessment was conducted to identify the risk of potential contaminating activities in the area. Risk is a function of both likelihood and a measure of consequence, and it can be defined as:

Risk = Consequence × Likelihood

The risk matrix is presented in Table 9 and the risk ratings is presented in Table 10.

7.5.1 Likelihood

- Almost certain (95-100%): is expected to occur in most circumstances;

- Likely (55-95%): will probably occur in most circumstances;
- Possible (45-55%): could occur;
- Unlikely (5-45%): could occur but not expected; and
- Rare (0-5%): occurs only in exceptional circumstances.

7.5.2 Consequences

- Extreme: death, contaminant release off-site with detrimental effect to human health and/or the environment, huge financial loss;
- Major: extensive injuries, off-site contaminant migration release contained with outside assistance and little detrimental impact, major financial loss;
- Moderate: medical treatment required, on site release contained with outside assistance, high financial loss;
- Minor: first aid treatment, on site release immediately contained, medium financial loss; and
- Insignificant: no injuries, low financial loss, negligible environmental impact.

TABLE 9 RISK MATRIX

Consequence	Likelihood				
	1 – Almost Certain	2 – Likely	3 – Possible	4 – Unlikely	5 – Rare
1 – Extreme	1	2	3	4	5
2 – Major	2	4	6	8	10
3 – Moderate	3	6	9	12	15
4 – Minor	4	8	12	16	20
5 – Insignificant	5	10	15	20	25

TABLE 10 RISK RATING

Risk Matrix Result	Risk Rating	Mitigation Recommendation
1 to 2	Extreme	Immediate intervention required to eliminate or reduce risk.
3 to 6	High	Essential to eliminate or reduce risk to a lower level with the implementation of control measures.
8 to 12	Moderate	Management may be required via monitoring or response to procedures; however risk should be appropriately quantified.
15 to 25	Low	Manage potential risk by routine procedures, unlikely to require further action.

Note: Risk issues with a rating of Moderate to Extreme require associated controls or actions.

7.6 Risk Assessment

Based on the observations and results of the site inspections, desktop review and Environmental Earth Sciences' understanding of the proposed future land use for the precinct, the overall risk of contamination being encountered across the majority of the precinct during the proposed development works is considered to be 'Low to High'.

However, the likelihood or risk of contamination being encountered at specific locations within the precinct due to identified potential sources of contamination is considered 'Moderate to High'. A summary of the risk of contamination being encountered is provided in Table 11 and shown in Figure 4.

The recommendations provided below should be considered as part of any rezoning or prior to redevelopment of sites to a more sensitive land use. In accordance with the Ministers Direction No. 1, Council must satisfy itself that the environmental condition of the land will be suitable for the proposed land use.

TABLE 11 RISK ASSESSMENT - SUNBURY SOUTH PRECINCT

Property	Risk issue	Consideration	Risk rating	Recommendations
215 Old Vineyard Rd	Vineyard	Historic and current agricultural and vineyard activities including the use of herbicides, fungicides and insecticides	Moderate	Soil investigation for contaminants of concern prior to redevelopment for residential land use with soil access.
60 Buckland Way	Stockpiled soil	Stockpiles of soil onsite containing asphalt	Moderate	Sampling and analysis of any topsoil to be removed off site as per EPA Publication IWRG621 to confirm if soil is clean fill or otherwise.
37 Fox Hollow Dr	Stockpiled soil	Stockpiles of soil from onsite excavations	Moderate	
45 Fox Hollow Dr	Stockpiled soil	Stockpiles of soil from onsite excavations	Moderate	
580 Sunbury Rd	Agricultural activities	Historic agricultural activities such as livestock grazing	Low	-
600 Sunbury Rd (not including Bulla Quarry area)	Agricultural activities	Historic and current agricultural activities including cropping and the use of herbicides and pesticides	Low	-
605 Sunbury Rd	Machinery storage and maintenance	Use and possible leakage of small amounts of fuel, oil, grease and solvents during machinery maintenance activities.	Moderate	Removal and disposal of fuels/oils/solvents/agricultural chemicals offsite. Soil investigation of any identified spills or staining
	Agricultural activities	Historic agricultural activities such as livestock grazing	Low	-
615 Sunbury Rd	Agricultural activities	Historic and current agricultural activities including cropping and the use of herbicides and pesticides	Low	-
2 Sheppard's Ln	Horticultural/Agricultural activities	Historic and current agricultural activities including olive orchard and the use of herbicides and pesticides	Low	-
	Stockpiled soil	Stockpiles of topsoil from onsite excavations and site preparation for residence	Moderate	Sampling and analysis of any topsoil to be removed off site as per EPA Publication IWRG621 to confirm if soil is clean fill or otherwise.
650 Sunbury Rd	Machinery storage and maintenance	Use and possible leakage of small amounts of fuel, oil, grease and solvents during machinery maintenance activities.	Moderate	Removal and disposal of fuels and waste oils offsite. Soil investigation of any identified spills or staining.

Property	Risk issue	Consideration	Risk rating	Recommendations
670 Sunbury Rd	Asbestos	Asbestos containing materials identified on site	High	Removal of ACM by Licensed Asbestos Removalist and clearance certificate provided by occupational hygienist
	Sheep dip	Potential for soil contamination associated with arsenic-based pesticides and organochlorine chemicals.	High	Detailed soil investigation for contaminants of concern. Removal of infrastructure and any impacted soil as required.
	Storage of fuels/agricultural chemicals	Potential for uncontrolled storage of pesticides and herbicides, fuels, oils and solvents	High	Removal and disposal of fuels/oils/solvents/agricultural chemicals offsite. Soil investigation of any identified spills or staining.
675 Sunbury Rd (Villawood property)	Asbestos	Asbestos containing materials identified on site	High	Removal of ACM by Licensed Asbestos Removalist and clearance certificate provided by occupational hygienist
	Storage of fuels/agricultural chemicals	Potential for uncontrolled storage and potential spillage of pesticides and herbicides, fuels, oils and solvents.	High	Removal and disposal of fuels/oils/solvents/agricultural chemicals offsite. Soil investigation of any identified spills or staining
	Machinery storage and maintenance	Use and possible leakage of small amounts of fuel, oil, grease and solvents during machinery maintenance activities.	Moderate	
680 Sunbury Rd	Storage of fuels/agricultural chemicals	Potential for uncontrolled storage and potential spillage of pesticides and herbicides, fuels, oils and solvents	Moderate	Removal and disposal of fuels/oils/solvents/agricultural chemicals offsite. Soil investigation of any identified spills or staining
	Machinery storage and maintenance	Use and possible leakage of small amounts of fuel, oil, grease and solvents during machinery maintenance activities.	Moderate	
725 Sunbury Rd	Agricultural activities	Historic agricultural activities such as cropping and livestock grazing, and the potential use of fertilisers, herbicides and/or pesticides	Low	-
785 Sunbury Rd	Agricultural activities	Historic agricultural activities such as cropping and livestock grazing, and the potential use of fertilisers, herbicides and/or pesticides	Low	-

Property	Risk issue	Consideration	Risk rating	Recommendations
40 Redstone Rd	Deep excavations	Historic mine shafts located within the rural conservation zone adjacent to property, although barricaded, remain open and represent a hazard.	High	Establishment of appropriate barriers to prevent access and warning signs
	Agricultural activities	Historic and current agricultural activities including cropping and the use of herbicides and pesticides	Low	-
	Storage of fuels/agricultural chemicals	Potential for uncontrolled storage and potential spillage of pesticides and herbicides, fuels, oils and solvents	Moderate	Removal and disposal of fuels/oils/solvents/agricultural chemicals offsite. Soil investigation of any identified spills or staining
80 Redstone Rd	Agricultural activities	Historic and current agricultural activities including cropping and the use of herbicides and pesticides	Low	-
	Storage of fuels/agricultural chemicals	Potential for uncontrolled storage and potential spillage of pesticides and herbicides, fuels, oils and solvents	Moderate	Removal and disposal of fuels/oils/solvents/agricultural chemicals offsite. Soil investigation of any identified spills or staining
Part of 785 Sunbury Road (Carmody Estate)	Vineyard	Historic and current agricultural and vineyard activities including the use of herbicides, fungicides and insecticides	Moderate	Soil investigation for contaminants of concern prior to redevelopment for residential land use with soil access.

8 CONCLUSION AND RECOMMENDATIONS

Based on the environmental desktop evaluation, property specific site inspections and a qualitative risk assessment, the risk for potential contamination of soil, surface water and groundwater in the Sunbury South Precinct has been determined. Table 11 and Figure 4 show the properties as having a 'high', 'moderate' or 'low' potential for contamination.

Of the properties within the Sunbury South Precinct, two properties (670 and 675 Sunbury Road) were classified as having 'high' potential contamination risk due to the presence of asbestos containing materials, a sheep dip and the storage of fuels, solvents and agricultural chemicals. An additional property (40 Redstone Hill Road) had part of the site rated as 'high' due to the presence of former mining activities and open shafts. These activities are within the portion of the rural conservation zone and are not within the proposed developable area. A further ten properties were classified as having a 'moderate' risk due to activities associated with past or present agricultural activities. The remaining properties have been rated as having a 'low' potential for contamination risk. The assessments of potential risk have been made in accordance with the Victoria Department of Sustainability and Environment, Potentially Contaminated Land, General Practice Note, 2005.

Land capability constraints of old mine shafts would largely be based on an assessment of hazards and risks associated with former mining activities. Immediately obvious hazards are likely to include environmental risk associated with mine tailings and safety and geotechnical issues around abandoned mine shafts.

Whilst the occurrence of historic mine shafts has been noted in the report, no further advice regarding geotechnical, environmental or safety considerations has been provided. However, it is noted that a strategic framework may be required to manage the occurrence of abandoned mine shafts in this area. Specific geotechnical, safety and environmental advice as well as possible cultural and community input would form part of the input to such a strategy. This issue may need to be explored further.

Properties classified with 'moderate' potential contamination risk are recommended for further works or environmental assessment as detailed in Table 11. Further assessment of these sites should be undertaken in accordance with the following guidelines and standards:

- National Environmental Protection Council, 2013 *National Environmental Protection (Assessment of Contaminated Sites) Amendment Measure*;
- Standards Australia 1999, *Australian Standard AS 4482.2 - Guide To The Sampling and Investigation Of Potentially Contaminated Soil. Part 2: Volatile Substances*;
- Standards Australia 2005, *Australian Standard AS4482.1 - Guide to the Investigation and Sampling of Sites with Potentially Contaminated Soil. Part 1: Non-volatile and Semi-Volatile Compounds*; and
- EPA Victoria, 2009, *Soil Hazard Categorisation and Management*, Industrial Waste Resource Guideline 621.

The results of any soil sampling and analysis undertaken should be compared with the relevant guidelines for protection of human health and the environment, as well as waste disposal criteria (as applicable).

In addition, hazardous materials surveys should be carried out for structures identified for demolition due to the potential presence of asbestos containing materials. The surveys should address lead-based paint and hazardous materials storage (fuels, oils, solvents and chemicals). Asbestos containing materials were observed at two locations and removal of asbestos materials is required to be undertaken by a suitably qualified and licensed asbestos removalist.

In accordance with The Minister's Direction No. 1, recommendations in this report (refer to Table 11) should be considered/implemented as part of Council consideration of any planning scheme amendments (rezoning) or planning permit applications (redevelopment). Council may seek further information/advice for the level of assessment required under the Land Practice Note (Potentially Contaminated Land).

9 LIMITATIONS

This report has been prepared by Environmental Earth Sciences VIC ABN 13 109 404 024 in response to and subject to the following limitations:

1. The specific instructions received from Growth Area Authority;
2. The specific scope of works set out in PO213121 issued by Environmental Earth Sciences for and on behalf of Growth Areas Authority;
3. May not be relied upon by any third party not named in this report for any purpose except with the prior written consent of Environmental Earth Sciences VIC (which consent may or may not be given at the discretion of Environmental Earth Sciences VIC);
4. This report comprises the formal report, documentation sections, tables, figures and appendices as referred to in the index to this report and must not be released to any third party or copied in part without all the material included in this report for any reason;
5. The report only relates to the site referred to in the scope of works being located at Sunbury South ("the site");
6. The report relates to the site as at the date of the report as conditions may change thereafter due to natural processes and/or site activities;
7. No warranty or guarantee is made in regard to any other use than as specified in the scope of works and only applies to the depth tested and reported in this report,
8. Fill, soil, groundwater and rock to the depth tested on the site may be fit for the use specified in this report. Unless it is expressly stated in this report, the fill, soil and/or rock may not be suitable for classification as clean fill if deposited off site; and
9. Our General Limitations set out at the back of the body of this report.

10 REFERENCES

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ENVIRONMENTAL EARTH SCIENCES GENERAL LIMITATIONS

Scope of services

The work presented in this report is Environmental Earth Sciences response to the specific scope of works requested by, planned with and approved by the client. It cannot be relied on by any other third party for any purpose except with our prior written consent. Client may distribute this report to other parties and in doing so warrants that the report is suitable for the purpose it was intended for. However, any party wishing to rely on this report should contact us to determine the suitability of this report for their specific purpose.

Data should not be separated from the report

A report is provided inclusive of all documentation sections, limitations, tables, figures and appendices and should not be provided or copied in part without all supporting documentation for any reason, because misinterpretation may occur.

Subsurface conditions change

Understanding an environmental study will reduce exposure to the risk of the presence of contaminated soil and or groundwater. However, contaminants may be present in areas that were not investigated, or may migrate to other areas. Analysis cannot cover every type of contaminant that could possibly be present. When combined with field observations, field measurements and professional judgement, this approach increases the probability of identifying contaminated soil and or groundwater. Under no circumstances can it be considered that these findings represent the actual condition of the site at all points.

Environmental studies identify actual sub-surface conditions only at those points where samples are taken, when they are taken. Actual conditions between sampling locations differ from those inferred because no professional, no matter how qualified, and no sub-surface exploration program, no matter how comprehensive, can reveal what is hidden below the ground surface. The actual interface between materials may be far more gradual or abrupt than an assessment indicates. Actual conditions in areas not sampled may differ from that predicted. Nothing can be done to prevent the unanticipated. However, steps can be taken to help minimize the impact. For this reason, site owners should retain our services.

Problems with interpretation by others

Advice and interpretation is provided on the basis that subsequent work will be undertaken by Environmental Earth Sciences VIC. This will identify variances, maintain consistency in how data is interpreted, conduct additional tests that may be necessary and recommend solutions to problems encountered on site. Other parties may misinterpret our work and we cannot be responsible for how the information in this report is used. If further data is collected or comes to light we reserve the right to alter their conclusions.

Obtain regulatory approval

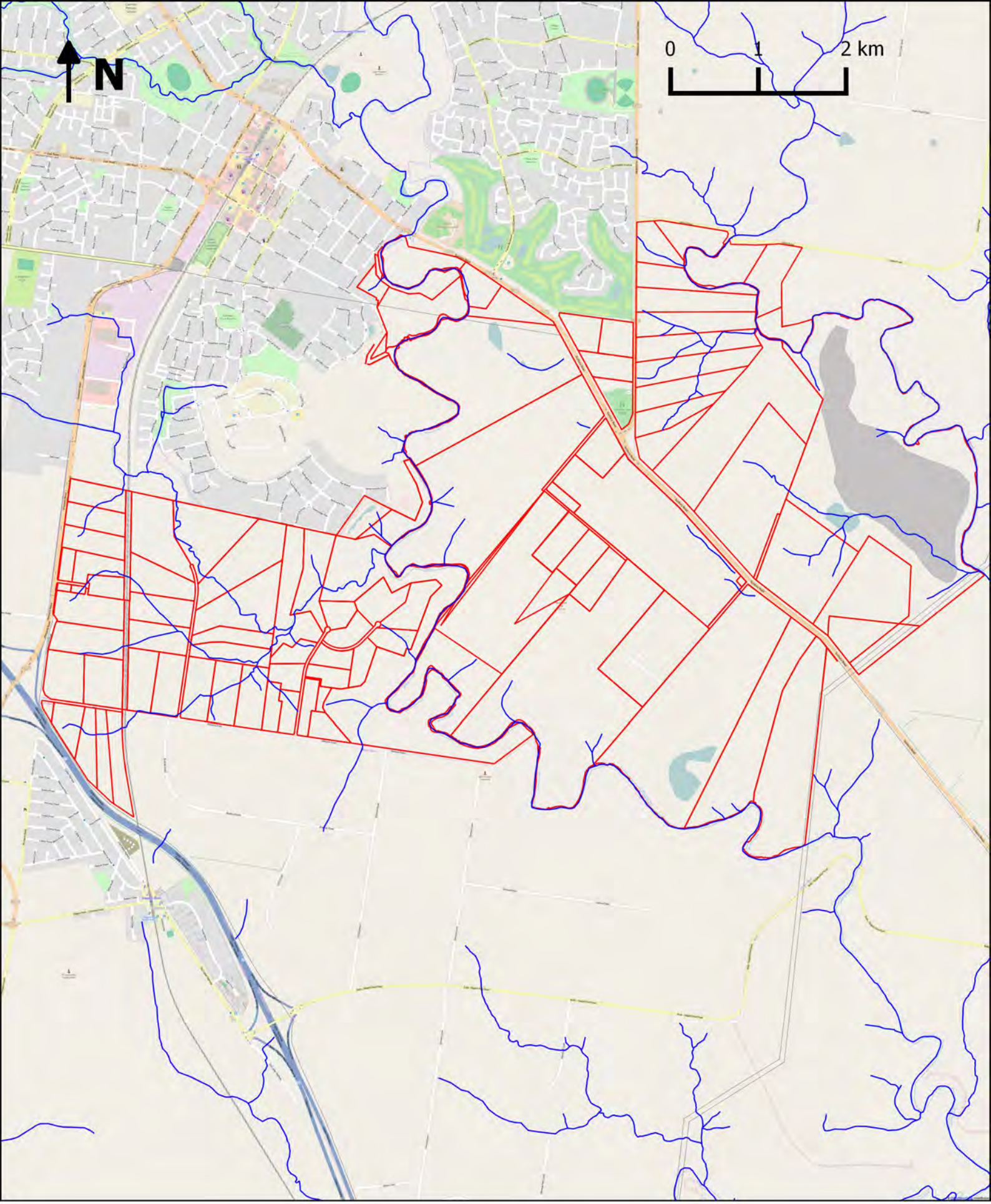
The investigation and remediation of contaminated sites is a field in which legislation and interpretation of legislation is changing rapidly. Our interpretation of the investigation findings should not be taken to be that of any other party. When approval from a statutory authority is required for a project, that approval should be directly sought by the client.

Limit of liability

This study has been carried out to a particular scope of works at a specified site and should not be used for any other purpose. This report is provided on the condition that Environmental Earth Sciences VIC disclaims all liability to any person or entity other than the client in respect of anything done or omitted to be done and of the consequence of anything done or omitted to be done by any such person in reliance, whether in whole or in part, on the contents of this report. Furthermore, Environmental Earth Sciences VIC disclaims all liability in respect of anything done or omitted to be done and of the consequence of anything done or omitted to be done by the client, or any such person in reliance, whether in whole or any part of the contents of this report of all matters not stated in the brief outlined in Environmental Earth Sciences VIC's proposal number and according to Environmental Earth Sciences general terms and conditions and special terms and conditions for contaminated sites.

To the maximum extent permitted by law, we exclude all liability of whatever nature, whether in contract, tort or otherwise, for the acts, omissions or default, whether negligent or otherwise for any loss or damage whatsoever that may arise in any way in connection with the supply of services. Under circumstances where liability cannot be excluded, such liability is limited to the value of the purchased service.

FIGURES



Legend

Lot boundaries

Figure 1: Site Locations (Sunbury South PSP)

Client: Growth Areas Authority
Job Number: 213066 PM: TA
Date: July 2015
Source Imagery: Google Maps

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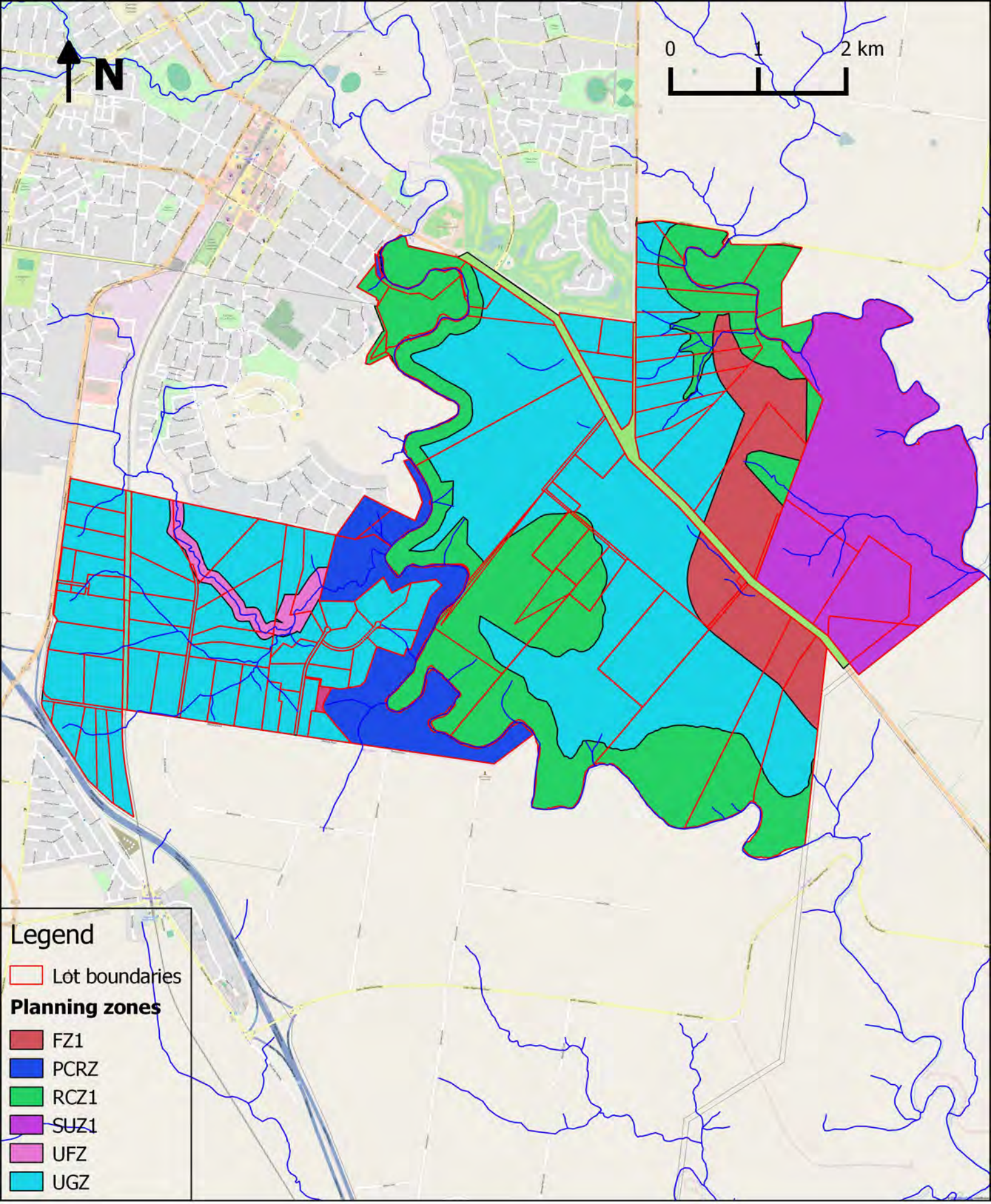
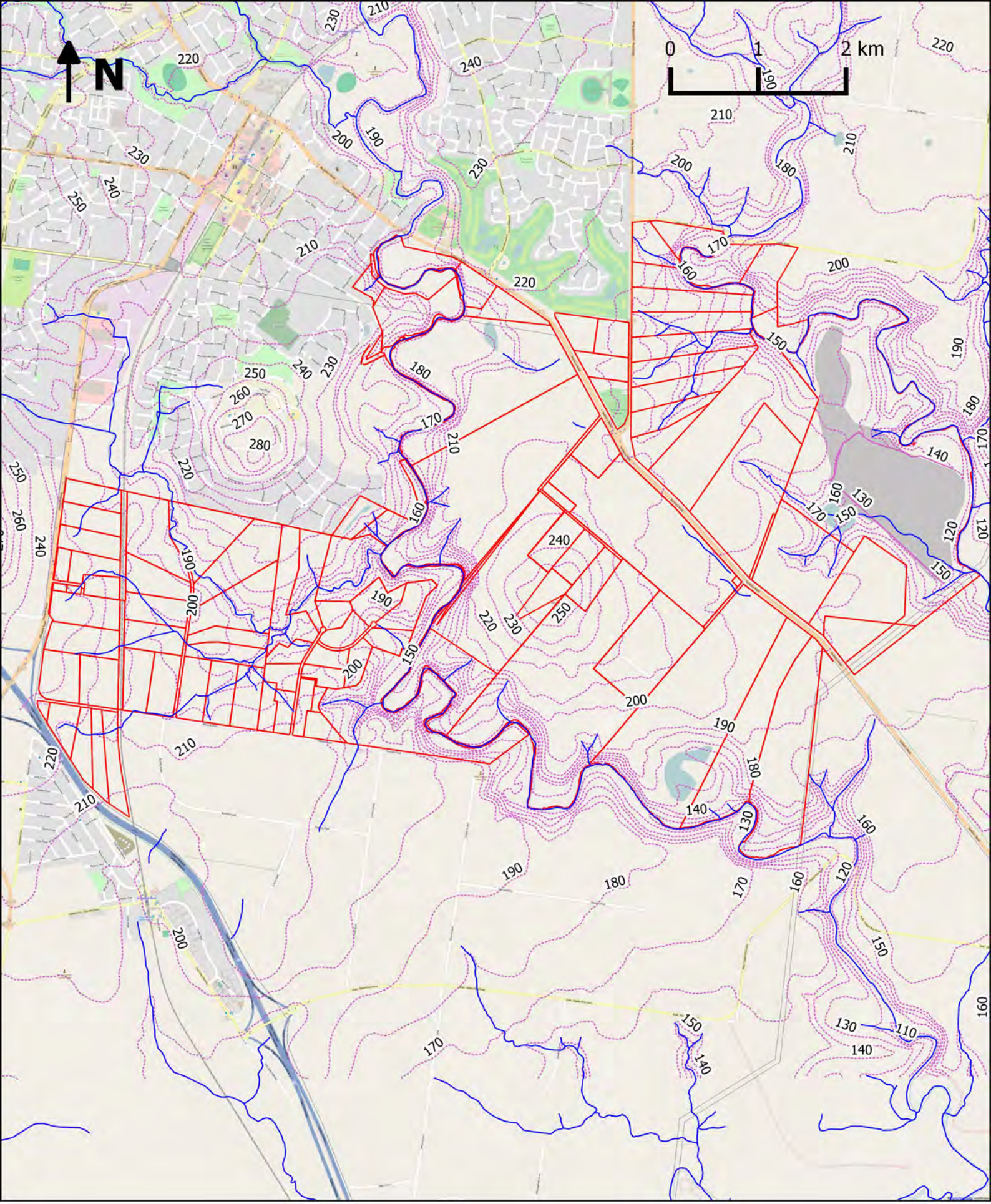


Figure 2: Planning Zones (Sunbury South PSP)

Client: Growth Areas Authority
Job Number: 213066 PM: TA
Date: July 2015
Source Imagery: Google Maps

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Legend

Lot boundaries

10m Contours

Figure 3: Topography (Sunbury South PSP)

Client: Growth Areas Authority
Job Number: 213066 PM: TA
Date: July 2015
Source Imagery: Google Maps

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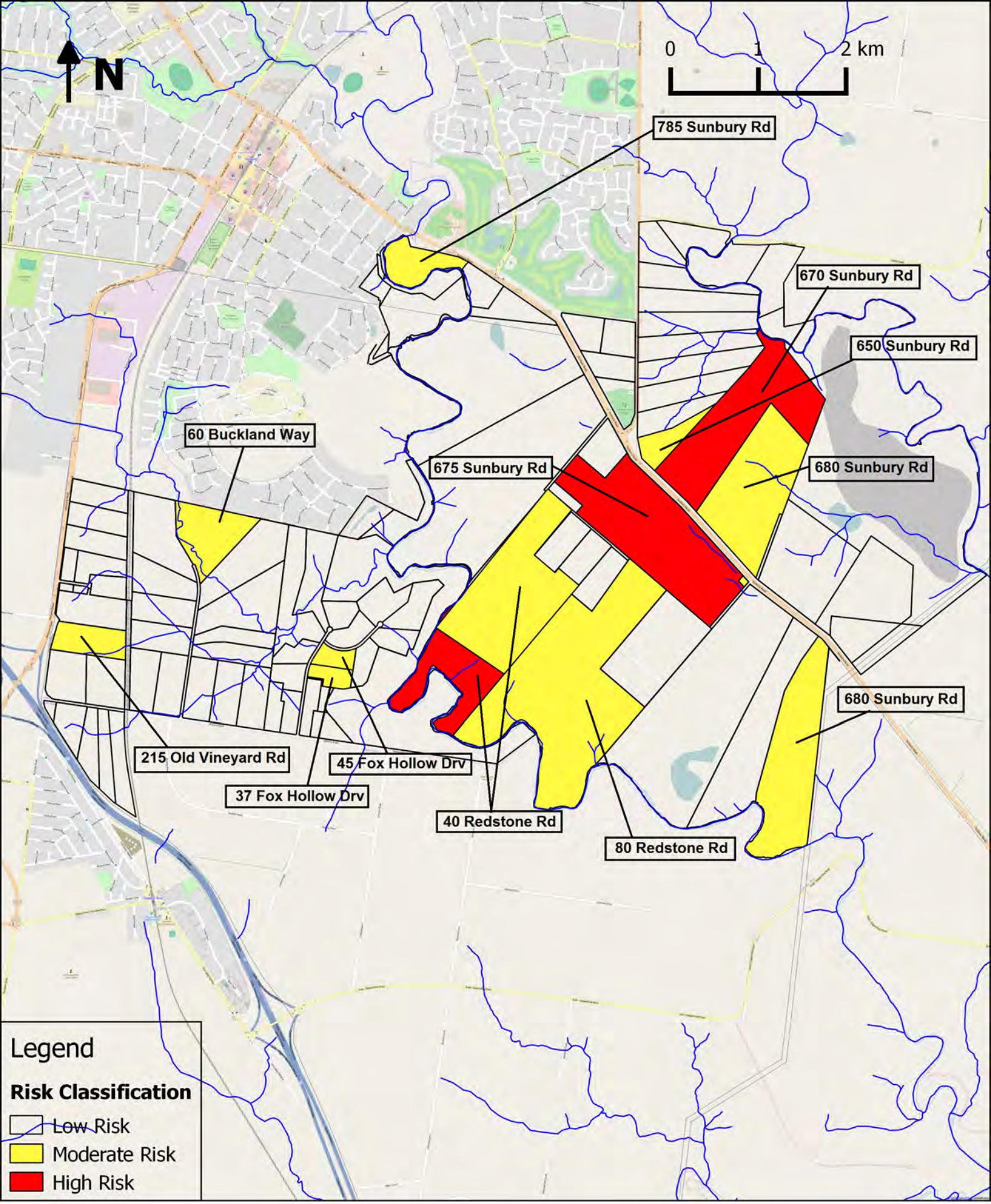


Figure 4: Risk Areas (Sunbury South PSP)

Client: Growth Areas Authority
Job Number: 213066 PM: TA
Date: July 2015
Source Imagery: Google Maps

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APPENDIX A AERIAL PHOTOGRAPHS



Vic·1284·115 MELBOURNE & METROPOLITAN PROJECT RUN 3 20·2·60 LENS 10" 8,200

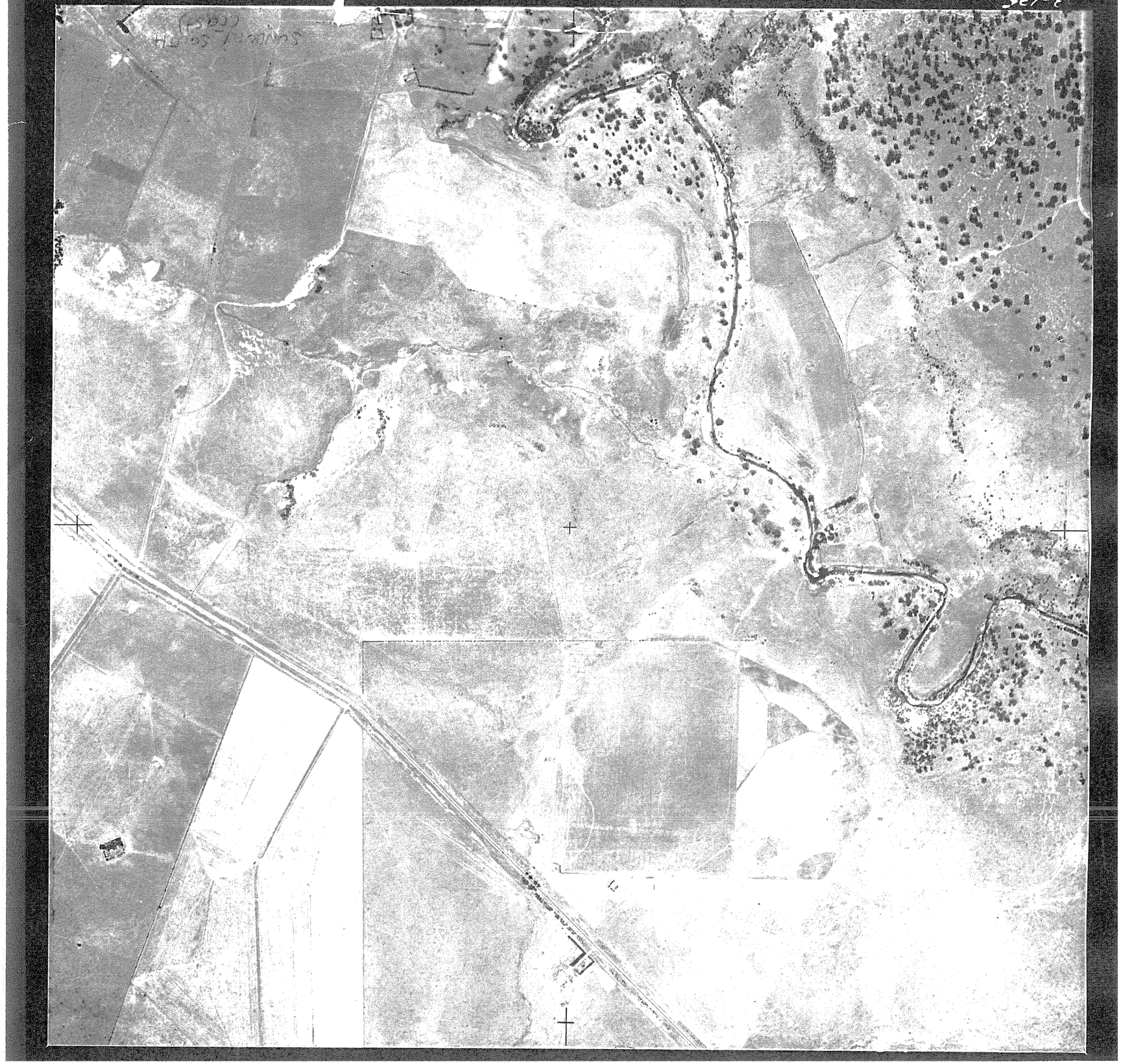

VIC
3325
/93
DEPT. OF CROWN
LANDS & SURVEY
VICTORIA ©
BROADMEADOWS
7822-1/79
RUN 8
H:5600'ASL
18.1.79


4018- 69 MELBOURNE 7822 M/S RUN 4 13700' ASL VIC DPS© 6- 3-86

SJ 55-5 004 16-66
MELBOURNE RUN 6 3-3-1969 VIC 25,000
Ca 472
SAg 28
f= 88.40
VIC 2269 1/6
44



RUN 4




VIC
1904
SUNBURY/SOUTH (EAST)
207
MELBOURNE 1966 PROJECT
RUN 3
9·1·66
LENS 122 151·75 MM 9,800'
ADASTRAPHOTO


Vic
2872
82
DEPARTMENT OF CROWN LANDS AND SURVEY, VICTORIA. ©
MELBOURNE 1974
PROJECT NO. 1148
RUN 22
17.3.74
5,250' ASL



4398-162 MELBOURNE 1991 PROJ NO. 2072 RUN 8 8,300'ASL VICDPS (C) 17-3-91

LIBRARY PRINT



4416-65 MELBOURNE 1991 PROJ NO.2072 RUN 9W 8300' ASL SMVIC (C) 28-8-91 >N

LIBRARY PRINT


KODAK SAFETY FILM
SUNBURY SOUTH
3698-139
MELBOURNE 7822 M/S RUN 4
5 00' ASL VIC DLS© 2 -11-82

APPENDIX B GEOTECHNICAL REPORT

CIVILTEST PTY LTD
SOIL TESTING & GEOTECHNICAL CONSULTANTS
ABN 91 006 855 689 ACN 006 855 689

7 November 2013 **Our Ref: 1131089**

Environmental Earth Sciences
PO Box 2253
FOOTSCRAY VIC 3011

Attention: Ms Tamara Ashford

RE: Sunbury Growth Corridor – Lancefield Road PSP and Sunbury South PSP

Dear Ms Ashford,

At your request, Civiltest Pty Ltd have reviewed the available documents and drawings and provided comments on potential geotechnical constraints and considerations as per Ms Tamara Ashford's email dated 31 October 2013. The following documents were provided by Ms Tamara Ashford and formed part of this review:

- Growth Corridor Plan - SUNBURY
- Sunbury – PSP Boundaries – Appendix 1 for RFQs

It should be understood that any comments made are based on general considerations for the Lancefield Road PSP area and the Sunbury South PSP area as a whole. Comments are based on general knowledge of the region, this organisation's experience in Sunbury and with geotechnical studies in general, and recognised geological data for the area.

No site or intrusive investigations were conducted as part of this review. A comprehensive geotechnical investigation is recommended for the planning and design of any proposed bridge, road, building works or associated earthworks. Geotechnical investigations conducted as part of the planning and design of proposed works would provide site specific details of existing ground conditions and geotechnical constraints.

1. GEOTECHNICAL CONSTRAINTS:

The Lancefield Road PSP area is predominantly flat or gently undulating with significant slopes in the areas surrounding the creeks, specifically Jacksons Creek and Emu Creek. The steep slopes surrounding the creeks generally slope down towards the creeks. These steep slopes will significantly constrain development in these areas.

The Sunbury South PSP area is moderately undulating south of Sunbury towards Diggers Rest and gently undulating in the areas South East of Sunbury. Moderate undulations will somewhat constrain the layout of any proposed road and block formations.

Redstone Hill in the Sunbury South PSP area comprises of predominantly moderate slopes. This hill, as well as any other notable slopes or hills, will constrain the layout of any proposed road and block formations.

The moderately to steeply undulating areas and creek bank areas are likely to consist of exposed or shallow rock. Rocky ground conditions will result in more difficult excavation for road and earthworks, incurring additional costs.

Geotechnical investigations conducted as part of the planning and design of proposed works will provide site specific details of existing ground conditions and geotechnical constraints if applicable.

2. CREEK CROSSINGS:

In regard to creek crossings, there would appear to be nothing out of the ordinary in this area and in general, the land would appear to be suitable for creek crossings.

The construction of creek crossings for any creeks that are within low-lying areas may require substantial road works and earthworks to overcome the topography. Additionally, rocky ground conditions will result in more difficult excavation for bridge abutments and associated earthworks, incurring additional costs. Subsurface erosion may also pose a problem if significant excavation is required in these areas.

Typically, the areas in the vicinity of the creeks are mapped with a Land Subject to Inundation overlay. Creek crossings and any other works within existing or projected creek flows should not unintentionally inhibit creek flow. Works should be constructed above the creek flow path or should accommodate creek flow through the works.

During construction, an allowance for dewatering areas of earthworks or excavations for foundation works should be provided for in these low-lying areas, or areas within the Land Subject to Inundation overlay. A geotechnical investigation conducted as part of the project planning or design phase may determine a requirement for dewatering during construction. A comprehensive geotechnical investigation is recommended for the planning and design of any proposed bridge, road, or associated earthworks.

3. ROAD PAVEMENTS:

Lightly trafficked new road pavements would typically consist of granular sub-base and base material with an asphalt surface with an approximate thickness of 300mm to 500mm. Heavily trafficked pavements will typically require a thickness of 500mm to 1000mm. Alternative pavement compositions should be considered for heavily trafficked pavements or overlays of existing roads.

Road pavements founded on softer natural subgrade materials may require subgrade improvement or select filling. Subgrade improvements or select filling will increase the thickness of road works required.

Each road pavement should be designed specifically to the subgrade conditions found on the site, the anticipated traffic over the life of the pavement, and the preferred or locally available construction materials and equipment. A geotechnical investigation along the proposed route of any road will be required to assess the existing subgrade conditions. The projected traffic loading and traffic types plays a significant role in the design of road pavements. Traffic information for design of road pavements may include;

- Traffic count data for the existing or connecting roads,
- Types of proposed and connecting developments,
- Numbers or plans of serviced dwellings, and
- Design Equivalent Standard Axles (DESA).

4. BLOCK FORMATION ON SLOPES:

In general it would be best to site allotments up and down any slope and construct roads to approximately follow the contours. Constructing roads to approximately follow contour lines minimises road profile grades and minimises driving up or down steep slopes. This arrangement also minimises earthworks required for access roads and building pads, and allows roads to be used for surface drainage control.

Figures 1 and 2 (on the following page) by the California Coastal Commission (1994) provide examples of a subdivision layout on a steep slope. Each of the examples demonstrates blocks/lots oriented up and down the slope or on relatively level areas, with the main roads running approximately along the contours. Sections of roads oriented up and down the slope are minor and kept to minimum lengths.

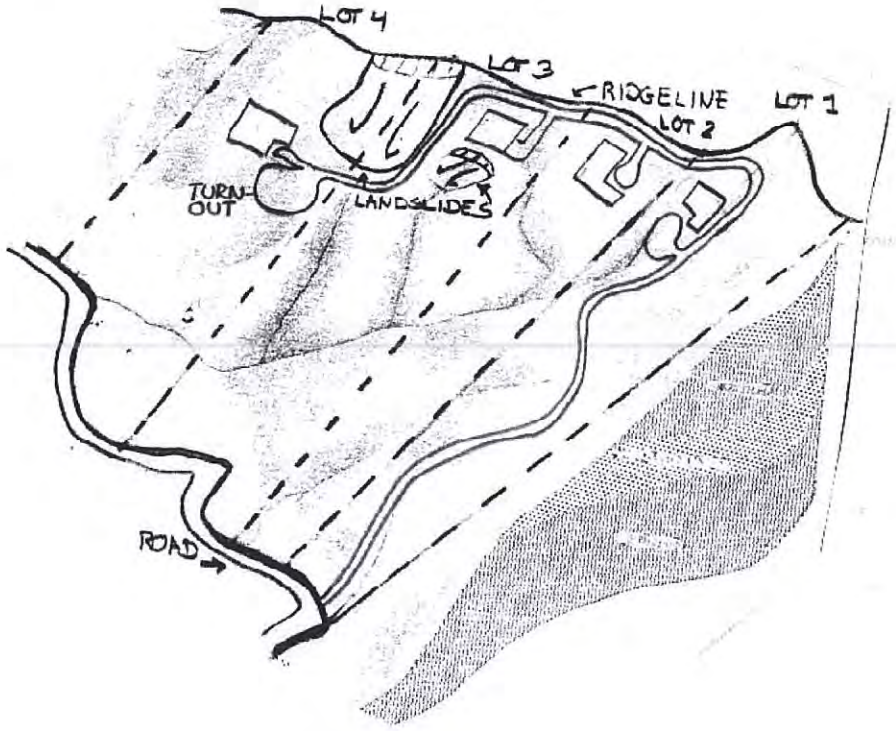


***Figure 1*: California Coastal Commission (1994) Land Form Alteration Policy Guidance, VI. Subdivision Examples, Parcel on Ridge Top with Steep Slope, Alternative 2 – Modified Lot Layout, http://www.coastal.ca.gov/landform/sec6c.html**

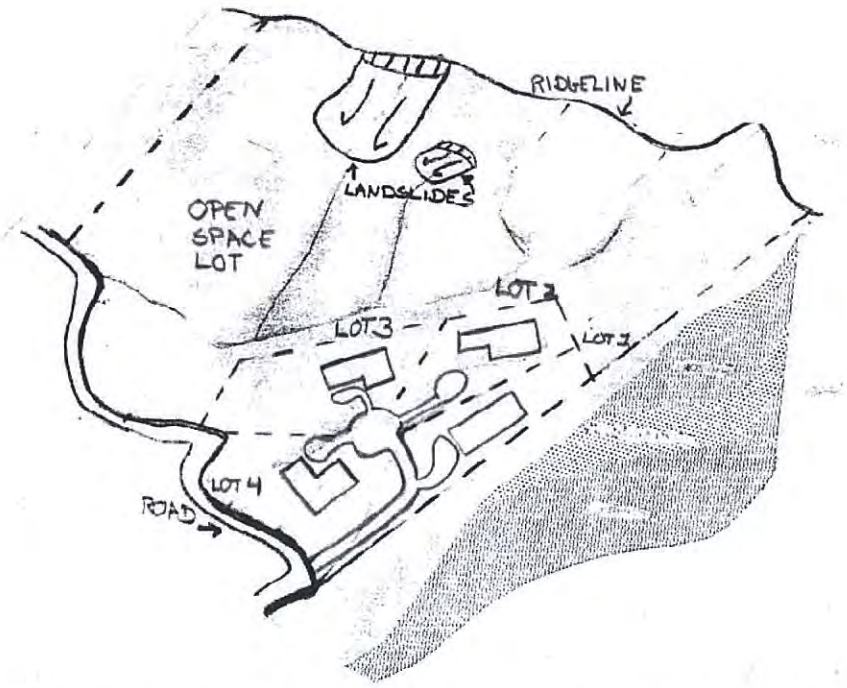


***Figure 2*: California Coastal Commission (1994) Land Form Alteration Policy Guidance, VI. Subdivision Examples, Parcel on Ridge Top with Steep Slope, Alternative 3 – Lot Layout with Lot Line Changes, http://www.coastal.ca.gov/landform/sec6c.html**

5. REACTIVITY OF SOILS:

Based on our experience, the soils in and around Sunbury are usually found to be moderately reactive where only moderate ground movement would be expected due to moisture changes. However, south of Sunbury the soils are found to be highly reactive, which typically experience high levels of ground movement from moisture changes. It should be expected that relatively level and gently undulating areas of greater Sunbury will have different ground conditions to areas of different character, such as the low-lying areas affected by creek flows.

Geological maps of the area, *VANDENBERG, A.H.M., 1997. MELBOURNE SJ 55-5 Edition 2, 1:250 000 Geological Map Series 1:250,000 geological map Geological Survey of Victoria*, shows the geology of the greater Sunbury area. Distinct differences are observed between the surroundings of Jacksons Creek including tributaries, and other areas away from Jacksons Creek.

The predominant geology of the Jacksons Creek surroundings, which incorporates the majority of the Lancefield Road PSP area, is various Sedimentary Quaternary Alluvium. The predominant geology of the greater Sunbury areas away from Jacksons Creek, which incorporates the majority of the Sunbury South PSP area, is Extrusive Igneous Quaternary Basalt. Quaternary Basalt sites are often found to be highly to extremely reactive.

Selection of residential building footings based on standard designs is primarily based on the reactivity or shrink-swell potential of the founding soil. To provide a sufficiently strong and stable base for building on more reactive sites, deeper more expensive building footings are required.

In addition to the natural geology, the study areas will be interspersed with various developments, such as quarries, dams, and other earthworks that have altered the natural ground conditions.

6. SUBSURFACE EROSION:

Based on our knowledge of the Sunbury area, we are aware that on steep sites there is a potential to encounter subsurface erosion. This does not normally cause a problem during construction except where deep excavations (greater than 3.0 metres) are cut and exposed.

Subsurface erosion can occur where an aquifer is allowed to drain, such as on a steep slope or excavation cut. The flow out of the aquifer erodes the aquifer soil, usually sand, from the point of drainage. This erosion or tunnelling can continue to worsen over time as long as the flow continues and can lead to broader slope instability. Steep slopes with substantial upslope areas can be susceptible to subsurface erosion.

For any proposed development site where there is potential for slope instability, it is recommended that the full slope be considered in a slope stability geotechnical investigation and assessment. The slope stability assessment should assess the site and proposed development for the potential of subsurface erosion as well as other failure modes.

Should you require any further information regarding this matter, please do not hesitate to contact me at our Mornington office.

Yours faithfully



Liam Cox
Geotechnical Engineer
CIVILTEST PTY LTD

REF: LC/SDB