Archbold Road Upgrade and Extension
Review of Environmental Factors
Volume 3 – Appendices H to N
May 2017
Appendix H

Stage 3 Aboriginal cultural heritage assessment report technical paper
Document Information

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<tr>
<th>Project Name</th>
<th>Archbold Road Extension and Upgrade, Great Western Highway to Southern Link Road: Cultural Heritage Assessment Report</th>
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<td>Project Number</td>
<td>1521</td>
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<td>Status</td>
<td>Final</td>
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<td>Client Name</td>
<td>Roads and Maritime Services</td>
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<td>Issue Date</td>
<td>24 March 2017</td>
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Executive Summary

Roads and Maritime Services (Roads and Maritime) propose to undertake an extension and upgrade of Archbold Road between the Great Western Highway at Minchinbury and the proposed Southern Link Road at Horsley Park (the project). The proposed works involve the duplication of the existing carriageway, construction of new dual carriageway and the installation of associated infrastructure. These works are in response to expected traffic growth generated by the continuing rapid development of western Sydney.

Roads and Maritime engaged Kelleher Nightingale Consulting Pty Ltd (KNC) to prepare an Aboriginal Cultural Heritage Assessment Report (CHAR) for Aboriginal archaeological sites within the project area as part of the Review of Environmental Factors (REF) for the project.

The CHAR complies with Stage 3 requirements of the Roads and Maritime Procedure for Aboriginal Cultural Heritage Consultation and Investigation (PACHCI).

Four Aboriginal archaeological sites will be at least partially impacted by the project.

<table>
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<tr>
<th>Site Name</th>
<th>AHIMS</th>
<th>Significance</th>
<th>Impact</th>
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<tr>
<td>Archbold Road 1</td>
<td>AHIMS 45-5-4492</td>
<td>Low Significance</td>
<td>Partial Impact</td>
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<td>RCAS 1</td>
<td>AHIMS 45-5-3165</td>
<td>Moderate Significance</td>
<td>Partial Impact</td>
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<td>AIF 06</td>
<td>AHIMS 45-5-4599</td>
<td>Low Significance</td>
<td>Total Impact</td>
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<tr>
<td>Ropes Creek AS3</td>
<td>AHIMS 45-5-3937</td>
<td>Moderate Significance</td>
<td>Partial Impact</td>
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Two of the four Aboriginal archaeological sites are located on creek terraces, exhibit relatively intact soil matrices including a range of Aboriginal objects and represent moderate archaeological significance, while the remaining two Aboriginal sites are highly disturbed and exhibit low archaeological significance.

An Aboriginal Heritage Impact Permit (AHIP) is required for the land within the project boundary and specifically for Aboriginal objects within the impacted sites.

Mitigation through salvage excavation is recommended for moderately significant sites RCAS 1 and Ropes Creek AS3. Salvage excavations must be completed prior to any activities which may harm Aboriginal objects at these site locations.

This CHAR has been prepared to support the application for an AHIP. It builds on the results of previous assessments and consultation regarding the project.
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1 Introduction

1.1 Proponent and consultants

Roads and Maritime Services (Roads and Maritime) is proposing the upgrade and extension of Archbold Road between the Great Western Highway at Minchinbury and the proposed Southern Link Road at Horsley Park, NSW (the project). The proposed works would be undertaken in order to service the expected traffic growth generated by the continuing rapid development of western Sydney.

Kelleher Nightingale Consulting Pty Ltd (KNC) was engaged by Roads and Maritime to prepare an Aboriginal Cultural Heritage Assessment Report (CHAR) for the project in accordance with Stage 3 of the Procedure for Aboriginal Cultural Heritage Consultation and Investigation (PACHCI) (Roads and Maritime 2011). The CHAR will be used to support an application for an Aboriginal Heritage Impact Permit (AHIP) for the project. The proposed extension and upgrade boundary is shown in Figure 1 and hereafter referred to as the project area.

1.2 Location and scope of activity

The project area corridor traverses the suburbs of Minchinbury, Eastern Creek and Horsley Park. All these suburbs are within the Blacktown Local Government Area (LGA) approximately 40 km west of the Sydney CBD. The project area is bounded by the Great Western Highway to the north, the proposed Southern Link Road to the south, Ropes Creek to the west and industrial estates to the east.

Proposed activities associated with the road upgrade and extension includes:

- upgrading the existing 2 km of Archbold Road south of the Great Western Highway from two to four lanes, including bridge duplication over the M4 Motorway and east facing ramps;
- extending Archbold Road 3 km to the south as a four lane dual carriageway, crossing the Erskine Park Link Road and meeting the southern extension of Old Wallgrove Road near the Sydney Water Warragamba-Prospect pipelines, including the construction of a bridge over the pipelines;
- installation of kerbs, medians and footpaths, as well as a 3 m wide shared pathway along the western edge of the road;
- installation of cross drainage structures along creek crossings, signalised intersections and bus priority measures.

1.3 Statutory controls and development context

The proposal is for road works carried out by Roads and Maritime and will be assessed under Part 5 of the Environmental Planning and Assessment Act 1979. Aboriginal objects will be harmed by the proposed activities and an application for an AHIP is being made under section 90A of the National Parks and Wildlife Act 1974.

This CHAR has been prepared to support the AHIP application. It has been prepared in accordance with the Office of Environment and Heritage (OEH) Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW (OEH 2011). This CHAR also complies with the PACHCI.

1.4 National Parks and Wildlife Act 1974

The National Parks and Wildlife Act 1974 (NPW Act) is the primary statutory control dealing with Aboriginal heritage in New South Wales. Items of Aboriginal heritage (Aboriginal objects) or Aboriginal places (declared under section 84) are protected and regulated under the NPW Act.

Under the Act, an “Aboriginal object” is defined as “any deposit, object or material evidence (not being a handicraft made for sale) relating to the Aboriginal habitation of the area that comprises New South Wales, being habitation before or concurrent with (or both) the occupation of that area by persons of non-Aboriginal extraction and includes Aboriginal remains”. As such, Aboriginal objects are confined to physical evidence and are commonly referred to as Aboriginal sites.

Aboriginal objects are protected under section 86 of the Act. It is an offence to harm or desecrate an Aboriginal object, either knowingly [section 86 (1)] or unknowingly [section 86 (2)].

There are offences and penalties relating to harm to, or desecration of, an Aboriginal object or declared Aboriginal place. Harm includes to destroy, deface, damage or move. Penalties are tiered according to offences, which include:

[...]
Figure 1. Project area location
• a person must not harm or desecrate an Aboriginal object that the person knows is an Aboriginal object;
• a person must not harm an Aboriginal object (strict liability offence);
• a person must not harm or desecrate an Aboriginal place (strict liability offence);
• failure to notify Office of Environment and Heritage of the location of an Aboriginal object (existing offence and penalty); and
• contravention of any condition of an Aboriginal Heritage Impact Permit.

Section 87 (2) of the Act provides a defence against prosecution under section 86 (2) if “the defendant exercised due diligence to determine whether the act or omission constituting the alleged offence would harm an Aboriginal object and reasonably determined that no Aboriginal object would be harmed”.

Under section 87 (1) it is also a defence if “(a) the harm or desecration concerned was authorised by an Aboriginal heritage impact permit, and (b) the conditions to which that Aboriginal heritage impact permit was subject were not contravened”.

Section 89A of the Act relates to the notification of sites of Aboriginal objects, under which it is an offence if the location of an Aboriginal object is not notified to the Director-General in the prescribed manner within a reasonable time.

Under section 90 (1) of the Act “the Director-General may issue an Aboriginal heritage impact permit”. The regulation of Aboriginal heritage impact permits is provided in Part 6 Division 2 of the Act, including regulations relating to consultation (section 90N).

An Aboriginal Heritage Impact Permit is required for an activity which would harm an Aboriginal object.

1.5 Objectives of the Aboriginal cultural heritage assessment report

The objectives of the Aboriginal cultural heritage assessment are in accordance with the PACHCI. The results of detailed consultation and assessment are integrated into this report. The report comprises:

• a description of the location and scope of the proposed project, including ancillary works (chapter 1);
• description and map of the project area (chapters 1 and 2);
• details of Aboriginal stakeholder identification, consultation and participation in the cultural and archaeological assessments (chapter 4);
• description of the methodologies and results of the archaeological assessments (chapter 3);
• statement of significance, incorporating assessed cultural and archaeological values (chapter 6);
• an assessment of the potential impacts of the proposed upgrade works on identified cultural heritage values (chapter 7); and
• management and mitigation measures recommended for cultural and archaeological values identified through the assessment (chapters 8, 9 and 10).

The project area has been subject to an Aboriginal archaeological assessment and has been found to contain some Aboriginal objects (sites) which would be impacted by the proposed activities. Approval obtained under the National Parks and Wildlife Act 1974 is required for these Aboriginal objects prior to any impact or harm. The proponent is applying for an AHIP under section 90A of the Act.

Recent amendments to the National Park and Wildlife Act 1974 and National Parks and Wildlife Regulation 2009 have resulted in a number of changes to the process of applying for an AHIP. Clause 80D of the Regulation requires that an application for an AHIP is accompanied by a cultural heritage assessment report. The cultural heritage assessment report is to provide information on:

• the significance of the Aboriginal places that are the subject of the application;
• the actual or likely harm to those Aboriginal objects or Aboriginal places from the proposed activity that is the subject of the application;
• any practical measures that may be taken to protect and conserve those Aboriginal objects or Aboriginal places; and,
• any practical measures that may be taken to avoid or mitigate any actual or likely harm to those Aboriginal objects or Aboriginal places.

The OEH Guide to Investigating, assessing and reporting on Aboriginal, assessing and reporting on Aboriginal cultural heritage in NSW (OEH 2011) provides further guidance on the preparation of a cultural heritage assessment report. This report has been prepared in accordance with the requirement of the Regulation and the OEH guidelines.

This CHAR has been prepared to accompany an application for an AHIP made by Roads and Maritime for Aboriginal objects within the proposed project area corridor.
2 Description of the Area

2.1 Landform, geology and soils

The project area is located on the Cumberland Plain, a physiographic region of the Sydney Basin characterised by low lying, gently undulating low hills and plains atop the Wianamatta Group of Triassic Period sedimentary shales. The Sydney Basin is a large geological feature stretching from Batemans Bay in the south to Newcastle in the north and Lithgow in the west. The formation of the basin began between 250 to 300 million years ago when river deltas gradually replaced the ocean that had extended as far west as Lithgow (Clark and Jones 1991).

Topography within the project area is characterised by gentle to moderate gradient slopes tending west, terminating at the flats and floodplains of Ropes Creek to the west. Unnamed 1st order and 2nd order tributary creeks cross the project area. These creeks are waterways with intermittent flow and occasional pools that occur after periods of rain. Ropes Creek is a permanent watercourse and major landscape feature of the region and is located 300 to 400 metres west of the project area.

The underlying geology of the project area consists mainly of Bringelly Shale (Figure 2). Bringelly Shale is part of the Late Triassic Wianamatta Group of shales common to the Cumberland Plain. Bringelly Shale (Rwb) is composed of shale, carbonaceous claystone, claystone, laminate, fine to medium-grained lithic sandstone, rare coal and tuff (Clark and Jones 1991). Quaternary Alluvium (Qal) is present near Lenore Drive in the western portion of the project area. Quaternary Alluvium is a more recent deposit of fine-grained sands, silts and clays. Quaternary alluvial deposits across the Cumberland Plain occur in association with more permanent waterways and cyclical episodes of fluvial erosion and deposition, in this case occurring along Ropes Creek and the associated floodplain.

Soils located within the project area are exclusively from the Blacktown Soil landscape (Figure 3). Blacktown soils generally consist of shallow to moderately deep hard setting red, brown, and yellow podzolic soils. Erosional susceptibility of this soil landscape is relatively low, but is increased where surface vegetation is not maintained (Bannerman, Hazleton, and Tille 1990). Blacktown soils are conducive to artefact survivability, however their acid chemistry quickly removes organics and their deflationary tendency often results in a temporal collapse where archaeological objects from multiple time periods accumulated within a single cultural soil layer (e.g. A1-A2 horizon).

Past land use within the project area has generally been limited to pastoral practices with some mining activity associated with the diatreme (breccia and basalt). The majority of the project area has been extensively cleared of its original vegetation which would have included eucalypt, spotted gum and ironbark species typical of the Cumberland Plain Woodland group. Introduced pasture grasses, scrub and regrowth native trees currently dominate the area.

Contemporary Soils

Contemporary soils (Blacktown Soils) are recent formations over the majority of the project area. In most instances the soils are completely modified and are less than 150 years old (KNC 2012, KNC in prep), with the older soils being removed by substantial erosion from flooding, clearing and uphill mining. Most unusual was the finding that due to clearing and the loose diatreme regolith, the slopes apart from the creek terraces have suffered from extensive sheet, splash and mass erosion resulting in no intact archaeological surfaces (ibid, cf Lu et al 2001, 2003). The archaeological signature of this erosion cycle is what exists across most of the project area: subsurface archaeological objects are outnumbered by surface objects, which are displaced spatially by erosion. This is the converse finding for most of the Cumberland Plain, where flood energy tends to trump water sheeting (gradient fuelled erosion). As a result, remnant archaeological deposit for the project area only exists in narrow strips along creek terraces – where the toe of slope funnels erosion energy across the face of creek terraces, which themselves are situated high enough to avoid fluvial energy. Interestingly, the increase in sheet and splash erosion (stemming from tree clearing) also increased the focus of fluvial energy acerbating the creek incision, which tended to eat into terraces, while at the same time demarcating any remnant archaeological deposit by reducing inundation event (terrace formation events). The result is that only very narrow terraces defined by incised creeks and toe-slopes contain intact soils within the project area. No areas of archaeological potential exist outside of these remnant narrow strips of land.
2.2 Ethnohistoric context

Although the specific project area is not recorded directly in any ethnographical accounts, it lies in a landscape which was important to and intensively used by Aboriginal people in the past (cf. Attenbrow 2002).

Kohen (1986:77) records that Aboriginal people living between Parramatta and the Blue Mountains relied on small animals and plant foods in addition to seasonally available freshwater mullet and eels. Tench (1793:230) observed that ‘they depend but little on fish, as the river yields only mullets, and that their principal support is derived from small animals which they kill, and some roots (a species of wild yam chiefly) which they dig out of the earth’. These wild yams were found in considerable quantities along the banks of the Nepean and Hawkesbury Rivers. A particularly important plant food was the Burrawong (*Macrozamia communis*), which provided a nutritious nut that was pounded and soaked in running water to leach out toxins then made into small cakes and baked over a fire (Kohen 1993:8).

Small animals provided the protein component of the Aboriginal diet on the Cumberland Plain, with hunting comprising a major economic role of the men. Along the river, traps and snares were set for bandicoots and wallabies, while decoys for snaring birds were also a commonly employed technique, ‘these are formed of underwood and reeds, long and narrow, shaped like a mound raised over a grave, with a small aperture at one end for the admission of the prey’ (Tench 1793). Possums and gliders were particularly common in the open woodland across the Cumberland Plain and were hunted in a number of ways, including climbing trees using purpose cut toe-holds to catching them, smoking out the animals by lighting a fire in the base of a hollow tree and burning large tracts of land in order to gather the stranded animals (Kohen 1993:10; Tench 1793:82).
Figure 2. Geology of the project area
Figure 3. Soil landscapes of the project area
3 Previous Archaeological Assessments

A number of previous archaeological investigations have been conducted within the project area and surrounding lands. These have primarily been in response to development and associated infrastructure projects related to the rapid growth of western Sydney. Archaeological investigations encompassing the entirety of the project area (and directly related to the current project) have been undertaken as part of the Stage 2 PACHCI assessment for the proposed Archbold Road extension and upgrade. A summary of the pertinent studies is presented in this section.

3.1 Local archaeological context

One of the earlier investigations of the local area took place in 1992 and included an archaeological survey of lands to the north of the current study area, bounded by the M4 to the south, Archbold Road to the east, Park Hill/Sargents Road to the north and Ropes Creek to the west (Corkill and Edgar 1992). As a result of the survey two Aboriginal archaeological sites were recorded: RC-1 and RC-2. While both sites were low density surface scatters, RC-2 (seven surface artefacts) was considered to display some potential for sub-surface deposit. A subsequent small scale test excavation at RC-2 recovered nine additional artefacts. Due to the low number of artefacts and high degree of disturbance resulting from erosion, vegetation clearance and track construction no further assessment was recommended.

In 2003 Dominic Steele Consulting undertook an archaeological assessment of lands on Sargents Road to the north of the current study area. Along with relocating two previously recorded sites (CO-2 and CO-3), Steele identified an additional eight artefacts located on the surface between the two sites. All artefacts were of red or yellow silcrete. Steele concluded that these artefacts were unlikely to be in situ or representative of a subsurface deposit at this location. Erosion and development had contributed to disturbance of the area and the artefacts were considered likely to have been introduced to this location by these processes (Steele 2003).

In 2004 and 2005 Jo McDonald Cultural Heritage Management (JMCHM) completed surveys as part of a strategic conservation study of lands under State Environmental Planning Policy No. 59 (SEPP 59). The SEPP 59 lands include a small portion of the current project area and additional lands to the east, bounded by the M4 motorway to the north and the Warragamba-Prospect pipeline to the south. These lands were divided into eastern and western precincts, with the eastern precinct surveyed in 2004 (JMCHM 2004) and the western precinct (which includes a small portion of the current project area) being surveyed in 2005 (JMCHM 2005). The results of the surveys indicated that approximately 75% of the lands exhibited low to moderate archaeological sensitivity and varying degrees of disturbance. The survey also resulted in the identification of 42 sites consisting of 22 artefact scatters, 19 isolated artefact finds and one scarred tree with associated surface artefacts. No sites were identified within the current project area by this assessment.

JMCHM undertook salvage excavations of the Wonderland Surplus lands east of the project area. The salvage area encompassed two areas of potential archaeological deposit (PAD), EC3-PAD1 (AHIMS 45-S-3201) and EC3-PAD2 (AHIMS 45-S-3202). A low density subsurface archaeological deposit was confirmed at both locations. The predominant artefact raw material was silcrete and the assemblage included flakes, flake fragments, retouched flakes, backed blades and cores. Based on the low density and dispersed nature of the deposit, it was suggested that artefact accumulation occurred gradually over time, indicating that the area was most likely used intermittently rather than being the focus of sustained activity (JMCHM 2006).

To the east of the project area, Kelleher Nightingale Consulting (KNC) conducted salvage excavations in 2011 on lands previously surveyed by JMCHM in 2004 as part of the conservation study of SEPP 59 lands. The Heritage Conservation Strategy adopted for this portion of the SEPP 59 lands required investigations in the form of salvage excavation in areas of high sensitivity and a representative sample of landscapes to be investigated within areas of moderate sensitivity. A total of 40 1m x 1m squares were excavated over two areas referred to as AEC1 and AEC2, incorporating the identified area of high archaeological sensitivity and landforms with moderate sensitivity. The majority of excavated areas showed signs of disturbance. Ten artefacts were retrieved from the excavations, resulting in a very low mean artefact density of 0.25/m². The majority of artefacts were located in areas down slope of the elevated relatively flat crests, indicating artefact movement. It was concluded that artefacts that once were buried in areas prone to erosion (crests and upper slopes) were either exposed on the surface or gradually migrated down slope due to gravity and consistent water runoff from repeated sheet washing (KNC 2012). Distribution of artefacts, raw materials and artefact types were consistent with findings of nearby sites in similar landform contexts. The land was considered to exhibit low archaeological significance based on low artefact densities and highly disturbed nature of the deposits.

Immediately to the west of the project area to the south of the M4 Motorway, Abel Archaeology undertook an archaeological survey and test excavation program at Lot 102 DP 1189012 (Abel Archaeology 2015). A total of twenty test areas were selected for excavation based on landform and identified surface concentrations of artefacts. Testing
revealed that a very low density subsurface artefactual deposit (19 artefacts) existed across the tested area. Soil profiles were highly deflated with surface disturbances associated with livestock grazing and vehicle movement. The entire study area had also been extensively cleared of vegetation in the past. Archaeological survey and test excavations resulted in the identification of twenty Aboriginal archaeological sites comprised of eight artefact scatters and twelve isolated finds. None of the sites within Lot 102 contained intact or significant archaeological deposit.

South west of the project area, Navin Officer conducted a test excavation program within part of the Erskine Park Employment Area (Navin Officer 2007). The excavations focused on three previously identified sites, EPRC1 (AHIMS 45-S-3234), EPRC 2 (AHIMS 45-S-3312) and EPRC3. The test program consisted of 112 test pits and resulted in the retrieval of 261 artefacts. Silcrete was the dominant raw material and the assemblage included flakes, flake fragments, cores and backed blades. Out of the areas tested, the two areas closest to Ropes Creek contained the highest number of artefacts. The findings are consistent with the idea that major creek lines were focal points of past human activity. Most relevant for the current CHAR, the finding underscored previous assessments which found little to no intact subsurface deposit outside of the terraces immediately associated with Ropes Creek and its tributaries.

East of the southern portion of the project area, Archaeological & Heritage Management Solutions (AHMS) undertook an archaeological survey along Old Wallgrove Road between the M7 and Roberts Road (AHMS 2012). The area was found to be disturbed as a result of road maintenance and no Aboriginal sites or objects were recorded.

An Aboriginal archaeological survey and cultural heritage assessment of the M4 Motorway corridor was undertaken by KNC (2013; KNC 2016) as part of the M4 Managed Motorway (M4MM) project and included a portion of the current project area (Figure 4). The investigation identified 30 Aboriginal archaeological sites within the M4MM corridor including two previously unrecorded artefact scatters. The majority of sites were found to be highly disturbed with no intact archaeological deposit due to modern landuse practices and natural processes. AHIP C0002113 was granted to Roads and Maritime by OEH in September 2016 for impact to 30 identified sites and for other Aboriginal objects within the construction corridor.

Three Aboriginal sites (M4-4A Chatsworth Road, M4-4B Chatsworth Road and M4-4C Chatsworth Road) were identified within the portion of the current project area that overlaps the AHIP C0002113 area. The sites were isolated finds located in highly disturbed contexts and were assessed as having low archaeological potential. As Roads and Maritime is the AHIP holder, the status of the conditions of the AHIP will be established prior to any works taking place within the AHIP area. Works related to the current project will be required to comply with the AHIP conditions.

In 2014 Abel Archaeology (2015) conducted an archaeological survey and subsequent test excavation program at Lot 103 DP 1189012 which included a portion of the current project area (Figure 4). The area had been subject to numerous disturbances associated with wide scale tree clearing and sheet erosion. The test excavation program resulted in the identification of fourteen previously unrecorded sites including site Archbold Isolated Artefact 15 (AHIMS 45-S-4410) which was identified within the boundaries of the current project area. An AHIP was subsequently issued by OEH in September 2015 for impacts to Aboriginal objects (sites) in Lot 103 in association with construction of a pie factory (AHIP C0000965). An agreement with the AHIP holder and confirmation of the conditions of the AHIP will be established prior to any works taking place within the AHIP area. Works will be required to comply with the AHIP conditions.

AHIP C0000965 also included provision for archaeological salvage at impacted sites, which was carried out by KNC in February 2016 (KNC in prep). Salvage excavation took place at three previously identified artefact scatters and comprised a total of 60 1m x 1m excavation squares. None of the sites within Lot 103 were found to contained intact or significant archaeological deposit. A total of 55 artefacts were recovered from the salvage excavations, giving a mean artefact density of 0.8/m². Subsurface artefact distribution across the three salvage areas returned very low densities with no localised artefact concentrations identified. The artefacts recovered during excavations came from 25 salvage squares, with 35 salvage squares containing no artefacts.

The soil profile of the excavation units consisted of a highly deflated compact silty clay loam with basal (B horizon) clays on average 15 centimetres below the surface. The profiles exhibited sheets of erosion and erratics (rubble) material, characteristic of a gradient wash in a disturbed context. Overall, the salvage results from Lot 103 were consistent with previous excavation data near the project area, showing no subsurface intactness and high levels of disturbance, with only a scatter of archaeological objects displaying no context.

**Summary**

Archaeological investigations of the surrounding area have demonstrated that the landscape retains evidence of Aboriginal landscape use. However, in most instances surface evidence is greater than subsurface evidence due to strong deflationary pressures. Relatively high levels of disturbance have been identified from historic land use practices resulting in highly eroded soils. Intact soils and archaeological deposit only exists on creek terraces situated above fluvial impacts and beyond the slide of sheet erosion.
3.2 Archbold Road Stage 2 PACHCI

In 2015 Artefact Heritage completed an archaeological survey of the current project area in accordance with the Stage 2 PACHCI for the Archbold Road upgrade project. The Stage 2 PACHCI study area encompassed the current project area and a broad corridor of lands on either side, and included background research and an archaeological field survey. Variable disturbance levels were identified across the survey area, ranging from severe to minor. Areas along the tributaries of Ropes Creek were considered to have higher archaeological potential and the potential for intact subsurface deposit in areas of low disturbance.

Following design modifications and refinements by Roads and Maritime, only four of the identified sites in the Stage 2 PACHCI are impacted by the current project area: AIF-06 (AHIMS 45-5-4599), Archbold Road 1 (AHIMS 45-5-4492), RCAS 1 (AHIMS 45-5-3165) and Ropes Creek AS3 (AHIMS 45-5-3937). An additional six sites/PADs are no longer being impacted or have existing AHIPs: Archbold Isolated Artefact 15 (AHIMS 45-5-4410) covered by AHIP C0000965; M4-4A Chatsworth Road (AHIMS 45-5-4580), M4-4B Chatsworth Road (AHIMS 45-5-4581) and M4-4C Chatsworth Road (AHIMS 45-5-4582) covered by AHIP C0002113; Archbold Road PAD-01 and Archbold Road 2 (45-5-4493) not impacted by refined current design.

Aboriginal heritage sites within the Project Area

Isolated find AIF-06 (AHIMS 45-5-4599) is located in the central portion of the project area and consists of a single silcrete flake located on the exposed surface of a dirt bike trail. Based on the highly disturbed context that the site is located in, AIF-06 was assessed as having low scientific potential and low archaeological significance.

Archbold Road 1 (AHIMS 45-5-4492) is partially located within the project area southeast of the M4 Motorway. This site incorporates three previously unregistered sites. The site was found to exhibit similar soil deposits to the highly disturbed Lots 102 and Lot 103 immediately to the west. The refined project area impacts on only a small and disturbed portion of Archbold Road 1. No significant archaeological deposits exist in the impacted portion of Archbold Road 1.

RCAS 1 (AHIMS 45-5-3165) is located on a narrow terrace above a tributary to Ropes Creek, within the central portion of the project area. The site is a surface scatter consisting of five artefacts, originally recorded by ERM in 2005, consisting of chert, mudstone and silcrete flakes within an area of exposure along the southern bank of a small tributary to Ropes Creek. The exposed soil profile containing the artefacts exhibited a structured A horizon dissimilar to the erosion profiles on the surrounding slopes. Based on soil assessments from nearby archaeological excavations, the combination of relatively intact soils and artefacts give the site a moderate level of significance as such remnant deposit is somewhat rare in the general area.

Ropes Creek AS3 (AHIMS 45-5-3937) is located on a terrace-bank above a tributary to Ropes Creek, at a junction of tributaries, within the southern portion of the project area. The site is a surface scatter of 10 flakes, blades, cores and a basalt chopper. The site extends for 270 metres along the creek bank. The exposed soil profile, resulting from a sharp recent incision is similar to RCAS 1 and displays a relatively intact soil structure. While the surrounding area is disturbed, the terrace-like bank of the tributary remains intact. Survey in 2016 identified a range of silcrete and chert cobbles in the creek bank. The identified Aboriginal objects and stability of the soils within Ropes Creek AS3 give the site a moderate level of significance. This site is partially located within the current project area.
3.3 Summary

Eight Aboriginal archaeological sites have been identified within the current project area (Table 1). Four of the eight Aboriginal archaeological sites are either covered by an existing AHIP or within a pre-existing AHIP application area. Therefore only the four remaining Aboriginal archaeological sites are addressed in this CHAR.

Table 1. Aboriginal archaeological sites within the project area

<table>
<thead>
<tr>
<th>Site Name</th>
<th>AHIMS Number</th>
<th>Coordinates (GDA 94 Zone 56)</th>
<th>Site Type</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>M4-4A Chatsworth Road</td>
<td>45-5-4580</td>
<td>298726E 6258823N</td>
<td>Isolated Artefact</td>
<td>Covered by existing AHIP # C0002113</td>
</tr>
<tr>
<td>M4-4B Chatsworth Road</td>
<td>45-5-4581</td>
<td>298578E, 6258823N</td>
<td>Isolated Artefact</td>
<td>Covered by existing AHIP # C0002113</td>
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<td>298470E, 6258825N</td>
<td>Isolated Artefact</td>
<td>Covered by existing AHIP # C0002113</td>
</tr>
<tr>
<td>Archbold Isolated Artefact 15</td>
<td>45-5-4410</td>
<td>298262E, 6258278N</td>
<td>Isolated Artefact</td>
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</tr>
<tr>
<td>Archbold Road 1</td>
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<td>298388E, 6258728N</td>
<td>Artefact Scatter</td>
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</tr>
<tr>
<td>RCAS 1</td>
<td>45-5-3165</td>
<td>298026E, 6257394N</td>
<td>Artefact Scatter</td>
<td>Within the current project area</td>
</tr>
<tr>
<td>AIF 06</td>
<td>45-5-4599</td>
<td>298148E, 6256779N</td>
<td>Isolated Artefact</td>
<td>Within the current project area</td>
</tr>
<tr>
<td>Ropes Creek A53</td>
<td>45-5-3937</td>
<td>298214E, 6256217N</td>
<td>Artefact Scatter</td>
<td>Within the current project area</td>
</tr>
</tbody>
</table>
Figure 4. Aboriginal archaeological sites within the project area

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4 Aboriginal Community Consultation and Participation

4.1 Aboriginal stakeholder consultation

Roads and Maritime is committed to effective consultation with Aboriginal communities regarding Roads and Maritime activities and their potential for impact on Aboriginal cultural heritage. The Roads and Maritime PACHCI was developed to provide a consistent means of effective consultation with Aboriginal communities regarding activities which may impact on Aboriginal cultural heritage and a consistent assessment process for Roads and Maritime activities across NSW.

The aim of consultation is to integrate cultural and archaeological knowledge and ensure registered stakeholders have information to make informed decisions. For the preparation of this CHAR, consultation with Aboriginal people has been undertaken in accordance with the OEH Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010 (OEH 2010a) and the requirements of Clause 80C of the National Parks and Wildlife Regulation 2009.

Roads and Maritime advertised (Appendix A) and contacted potential Aboriginal stakeholders identified from government agency notification responses. Roads and Maritime invited Aboriginal people who hold knowledge relevant to determining the cultural heritage significance of Aboriginal objects and Aboriginal places in the area in which the proposed activity was to occur to register an interest in a process of community consultation. Investigations for the Archbold Road extension and upgrade—PACHCI Stages 3 have included consultation with 41 Aboriginal community groups and individuals as listed in Table 2 below.

Table 2. Registered Aboriginal Stakeholders

<table>
<thead>
<tr>
<th>REGISTERED STAKEHOLDER GROUPS AND INDIVIDUALS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Group</strong></td>
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<tr>
<td>A1 Indigenous Services</td>
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<tr>
<td>Aboriginal Archaeology Services</td>
</tr>
<tr>
<td>Amanda Hickey Cultural Services</td>
</tr>
<tr>
<td>Badu</td>
</tr>
<tr>
<td>Biamanga</td>
</tr>
<tr>
<td>Bilinga</td>
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<td>Cullendulla</td>
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<tr>
<td>Darug Aboriginal Land Care</td>
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<tr>
<td>Darug Custodian Aboriginal Corporation</td>
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<td>Darug Land Observations</td>
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<tr>
<td>Darug Tribal Aboriginal Corporation</td>
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<td>Deerubbin LALC</td>
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<td>Gangangarra</td>
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<tr>
<td>Gwynyu Cultural Heritage Technical Services</td>
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<td>Wingikara Cultural Heritage Technical Services</td>
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</tbody>
</table>
The formal consultation process has included:

- advertising for registered stakeholders (refer Appendix A);
- government agency notification letters;
- notification of closing date for registration;
- provision of proposed archaeological assessment methodology (allowing 28 day review) outlining the methodology to prepare the CHAR;
- ongoing compilation of registrants list, through continuing to register individuals and groups for consultation on the project;
- provision of draft CHAR for review;
- Aboriginal focus group meeting to discuss assessment methodology, investigation results, CHAR and detailed mitigation strategies (Appendix B);
- ongoing consultation with the local Aboriginal community.

4.2 Aboriginal Stakeholder Comments

A copy of the draft CHAR was provided to Aboriginal stakeholders for a 28 day review and comment period. Four Aboriginal stakeholder commented on the CHAR: Aboriginal Archaeological Service (AAS), Darug Land Observations Pty Ltd (DLO); Darug Aboriginal Land Care (DALC); Darug Custodian Aboriginal Corporation (DCAC); Kamilaroi-Yankuntjatjara Working Group (KYWG) (Appendix B).

All comment received support the CHAR’s findings and mitigation methodology.

DLO commented that they would like recovered artefacts reburied within the study area.
5 Summary and Analysis of Background Information

Analysis of the background information presented in the preceding chapters allows an assessment of the cultural heritage values within the project area to be made. Combining data from historical/ethnographic sources, landscape evaluation and archaeological context provides an insight into how the landscape was used and what sort of events took place in the past.

Archaeology within the project area and immediate surrounds is typified by substantial erosion, high levels of disturbance, low frequency artefact scatters and even lower frequency subsurface artefact deposits. Current archaeological evidence within the area is indicative of intermittent occupation sites as Aboriginal people moved across the landscape, however the true picture of past Aboriginal life remains masked by sheets of erosion.

The reliability of fresh water sources would have influenced Aboriginal landscape use within and around the project area. Permanent water ways, such as nearby Ropes Creek and its tributaries, would have provided a focus for Aboriginal activities such as resource procurement and access to varied raw materials. Archaeological evidence is further constrained by a literal washing of the landscape by floods and gradient erosion (exacerbated by land clearing and mining). In this light, significant Aboriginal archaeology will likely only survive in a narrow terrace strips above dynamic flood zones (high energy corridors) and outside of slopewash (sheeting and splash erosion).

Four Aboriginal archaeological sites are located within the proposed AHIP Project Area (see section 7, Figure 5) and are described in section 5.1 and listed in Table 3 below. Significance assessment, impact assessment and management recommendations for these four sites are outlined in the following chapters.

Table 3. Aboriginal archaeological sites within the current project area

<table>
<thead>
<tr>
<th>Site Name</th>
<th>AHIMS Number</th>
<th>Coordinates (GDA 94)</th>
<th>Site Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Archbold Road 1</td>
<td>45-5-4492</td>
<td>298388E, 6258728N</td>
<td>Artefact Scatter / PAD</td>
</tr>
<tr>
<td>AIF 06</td>
<td>45-5-4599</td>
<td>298148E, 6256779N</td>
<td>Isolated Artefact</td>
</tr>
<tr>
<td>RCAS 1</td>
<td>45-5-3165</td>
<td>298026E, 6257394N</td>
<td>Artefact Scatter / PAD</td>
</tr>
<tr>
<td>Ropes Creek AS3</td>
<td>45-5-3937</td>
<td>297972E, 6256918N</td>
<td>Artefact Scatter</td>
</tr>
</tbody>
</table>
5.1 Aboriginal sites within the project area – site descriptions

Archbold Road 1 (AHIMS 45-5-4725)
Archbold Road 1 is a low density surface scatter partially located in north eastern portion of the project area, south of the M4 Motorway. The area has been cleared in the past and is now vegetated with regrowth eucalypts. Archaeological testing of the land immediately west of the sites (on the same landform) revealed the presence of a highly eroded, low density and dispersed subsurface artefact deposit (KNC 2012, KNC in prep). Based on the extensive clearing of the area in the past, similar landform context and the lack of intact archaeological deposits within the immediate area the portion of the impacted by Roads and Maritime works site has been assessed as having low archaeological s. Only a small sliver of the disturbed western portion of the site is impacted by the proposed works (Figure 5).

AIF 06 (AHIMS 45-5- 4599)
This site is an isolated artefact site consisting of a single silcrete flake located on one of the many dirt bike trails that cross the project area. The ground surrounding the artefact is highly disturbed. Based on high level of disturbance (erosion) the site has been assessed as having low archaeological potential. The site is fully impacted by the proposed works (Figure 5).

RCAS 1 (AHIMS 45-5-3165)
Located on the exposed banks and southern terraces of a tributary to Ropes Creek, this site consisted of a scatter of five artefacts. The extended site area away from the creek channel displays a moderate level of intactness, with no evidence of high energy flooding or sheet erosion. Based on the soil matrix, terraced landform, proximity to water and known archaeological deposit the site has been assessed as having a moderate archaeological potential. The site is partially impacted by the proposed works (Figure 5).

Ropes Creek AS3 (AHIMS 45-5-3937)
This site is located along the banks and terraces of a tributary to Ropes Creek and consisting of a scatter of 10 artefacts across an area approximately 270 metres in size. The site is situated at the junction of three tributary systems. Land clearing and erosion have impacted much of the surrounding lands, however, the tributary terraces retain a relatively intact soil matrix. Silcrete and chert cobbles are noted within the creek channel. Based on soil structure, terraced landform, proximity to resources and known archaeological deposit the site have been assessed as having a moderate archaeological potential. The site is partially impacted by the proposed works (Figure 5). The remainder of the site is conserved within an identified riparian corridor as part of the long term development plan for the property. Information obtained through the mitigation of the impacted portion of the site will assist in the management the conserved portion by highlighting the nature of the archaeological deposit.
6 Cultural Heritage Values and Statement of Significance

6.1 Significance assessment criteria

One of the primary steps in the process of cultural heritage management is the assessment of significance. Not all sites are equally significant and not all are worthy of equal consideration and management (Sullivan and Bowdler 1984; Pearson and Sullivan 1995:7). The determination of significance can be a difficult process as the social and scientific context within which these decisions are made is subject to change (Sullivan and Bowdler 1984). This does not lessen the value of the heritage approach, but enriches both the process and the long term outcomes for future generations as the nature of what is conserved and why, also changes over time.

The assessment of significance is a key step in the process of impact assessment for a proposed activity as the significance or value of an object, site or place will be reflected in resultant recommendations for conservation, management or mitigation.

The Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales (OEH 2010b) requires significance assessment according to criteria established in the Australia ICOMOS Burra Charter, 1999. The Burra Charter and its accompanying guidelines are considered best practice standard for cultural heritage management, specifically conservation, in Australia.

Guidelines to the Burra Charter set out four criteria for the assessment of cultural significance:

- Aesthetic value - relates to the sense of the beauty of a place, object, site or item;
- Historic value - relates to the association of a place, object, site or item with historical events, people, activities or periods;
- Scientific value - scientific (or research) value relates to the importance of the data available for a place, object, site or item, based on its rarity, quality or representativeness, as well as on the degree to which the place (object, site or item) may contribute further substantial information; and
- Social value - relates to the qualities for which a place, object, site or item has become a focus of spiritual, political, national or other cultural sentiment to a group of people. In accordance with the OEH Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW, the social or cultural value of a place (object, site or item) may be related to spiritual, traditional, historical or contemporary associations. “Social or cultural value can only be identified though consultation with Aboriginal people” (OEH 2011:8).

The assessment of these values are brought together to form a comprehensive assessment of significance.
6.2 Statements of Significance

The project area has cultural value for the local Aboriginal community. The identified cultural value is a feeling of attachment and responsibility for the land. These values become tangible when tied to identified Aboriginal objects found at the archaeological sites. In this way, the Aboriginal objects can be seen as exhibiting both scientific information and cultural meaning, knowledge about the past tied with social values and belief systems.

The proposed AHIP area contains four identified Aboriginal archaeological sites. Because the majority of the project area is highly disturbed, any intact deposit is significant as it offers insights into past events otherwise lost to time. The following assessments are based on a consideration of the research value, connectivity (association with other sites), representativeness, intactness and rarity of sites in a local and regional context. Significance of sites is outlined below. Specific Aboriginal stakeholder comments and cultural values will be incorporated into the overall significance assessment as provided.

Archbold Road 1 (AHIMS 45-5-4492)
Archbold Road 1 is a low density surface scatter south of the M4 Motorway. The site has been extensively cleared in the historic past and is disturbed by modern land use practices, which has resulted in a remnant artefact scatter. The site features are not rare and unique. The site demonstrates low scientific value and it is unlikely that further investigation of the impact area would contribute to our understanding of Aboriginal landscape use in the region or local area. Based on the intactness, representativeness and research potential, the site is determined to have low archaeological significance.

AIF 06 (AHIMS 45-5-4599)
AIF 06 consists of a single silcrete flake located on the exposed surface of a dirt bike trail that crosses the central portion of the project area. The site has been extensively disturbed by modern land use practices. Site features are not rare or unique. The site demonstrates low scientific value and is unlikely to further our understanding of Aboriginal landscape use in the region. Based on the intactness, representativeness and research potential, the site is determined to have low archaeological significance.

RCAS 1 (AHIMS 45-5-3165)
RCAS 1 is an artefact scatter located on the exposed bank and terraces of a small Ropes Creek tributary in the central portion of the project area. Disturbance of the area appears to be largely limited to natural surface deflation. Although the site location is a commonly occurring site type in the region, it is rare for the local area due to extensive erosion and disturbance of the lands east of Ropes Creek. Further investigation will contribute to our understanding of Aboriginal landscape use of the local area and region as it relates to the smaller creek tributaries and drainage lines. The site has been determined to have moderate archaeological significance.

Ropes Creek AS (AHIMS 45-5-3937)
This site is an artefact scatter located at the junction of three tributaries to Ropes Creek in the southern portion of the project area and situated on a series of banks and terraces. The creek junction has exposed silcrete and chert cobbles with at least 10 artefacts, including a rare basalt chopper, identified from the eroding terraces. The soil profile, exposed in creek cuttings, displayed a relatively intact matrix. The wider area is heavily impacted by land clearing and erosion, thus it is rare to find even moderately intact archaeological deposits. Further investigation will contribute to our understanding of Aboriginal landscape use of the local area and region as it relates to the smaller creek tributaries and drainage lines. In addition, further investigation regarding the location as a potential source for breccia artefacts (basalt) is of scientific interest as surface diatreme exposures (cut by the tributary) are rare in Sydney. The site has been determined to have moderate archaeological significance.
7 The proposed activity and impact assessment

Roads and Maritime proposes to upgrade and extend Archbold Road in order to service the expected traffic growth generated by the continuing rapid development of western Sydney.

The proposed project would extend the road south from the M4 Motorway at Minchinbury to the proposed Southern Link Road in Horsley Park. Activities associated with the road upgrade and extension include earthworks associated with the duplication of the existing carriageway, the construction of a new dual four lane carriageway and installation of associated infrastructure.

The entirety of the project area will be impacted by road construction and associated activities.

Assessed impact to Aboriginal sites identified within the proposed AHIP Project Area is shown in Table 4 and Figure 5 below.

Table 4. Impact assessment

<table>
<thead>
<tr>
<th>Site name</th>
<th>AHIMS ID</th>
<th>Type/ degree of harm</th>
<th>Consequence of harm</th>
<th>Significance of harm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Archbold Road 1</td>
<td>45-5-4492</td>
<td>Direct/ Partial</td>
<td>Partial loss of value</td>
<td>Low</td>
</tr>
<tr>
<td>AIF-06</td>
<td>45-5-4599</td>
<td>Direct/Total</td>
<td>Total loss of value</td>
<td>Low</td>
</tr>
<tr>
<td>RCAS 1</td>
<td>45-5-3165</td>
<td>Direct/ Total</td>
<td>Partial loss of value</td>
<td>Moderate</td>
</tr>
<tr>
<td>Ropes Creek AS3</td>
<td>45-5-3937</td>
<td>Direct/ Partial</td>
<td>Partial loss of value</td>
<td>Moderate</td>
</tr>
</tbody>
</table>
Figure 5. Project area, proposed AHIP area and location of impacted Aboriginal archaeological sites
8 Avoiding and/or mitigating harm

All identified Aboriginal archaeological sites recorded within the project area have been considered by Roads and Maritime in relation to the proposed road upgrade/extension and associated activities. While conservation is the best approach when considering Aboriginal heritage, some level of impact is unfortunately unavoidable due to the requirements of the road works. An Aboriginal heritage impact permit (AHIP) issued by the Office of Environment and Heritage under section 90(1) of the National Parks and Wildlife Act 1974 is required prior to any activity which may harm an Aboriginal object.

The CHAR evaluated the potential harm of the project on Aboriginal archaeological heritage in terms of Ecologically Sustainable Development (ESD). The ESD assessment of Aboriginal heritage evaluated: long-term and short-term considerations, precautionary environmental impacts, maintenance and enhancement for future generations and cost/benefit of impacting on archaeological objects. In this regard, alternative designs and conservation principles have been considered by Roads and Maritime to limit the cumulative harm of Aboriginal heritage.

Early identification of archaeological sites led to the refining of the project boundary in relation to Archbold Road 1 and Ropes Creek AS3. The portion of Ropes Creek AS3 outside of the Roads and Maritime project boundary is situated within a conservation/riparian corridor, excluded from development by current development plans. Additionally, the results of the proposed mitigation program for Ropes Creek AS3 will assist in the short term and long term management of the site by assisting decision making with empirical evidence.

Mitigation measures are recommended where sites of moderate significance or higher are to be impacted. Mitigation would take the form of an archaeological salvage excavation in order to retain a representative sample of the site’s archaeology and inform future management planning for the area. The recommended mitigation measures for the sites within the proposed AHIP area are shown in Table 5.

Table 5. Impact of project and mitigation measures

<table>
<thead>
<tr>
<th>Site Name</th>
<th>AHIMS ID</th>
<th>Assessed Significance</th>
<th>Impact Assessment</th>
<th>Mitigation Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Archbold Road 1</td>
<td>45-5-4492</td>
<td>Low</td>
<td>Direct / Partial</td>
<td>Archaeological mitigation not required. AHIP required prior to commencement of works affecting the site.</td>
</tr>
<tr>
<td>AIF-06</td>
<td>45-5-4599</td>
<td>Low</td>
<td>Direct/ Total</td>
<td>Archaeological mitigation not required. AHIP required prior to commencement of works affecting the site.</td>
</tr>
<tr>
<td>RCAS 1</td>
<td>45-5-3165</td>
<td>Moderate</td>
<td>Direct / Partial</td>
<td>Given the moderate significance of the site and degree of proposed impact, salvage excavation of a representative sample of the site is required before impact. AHIP required prior to commencement of works affecting the site.</td>
</tr>
<tr>
<td>Ropes Creek AS3</td>
<td>45-5-3937</td>
<td>Moderate</td>
<td>Direct/ Partial</td>
<td>Given the moderate significance of the site and degree of proposed impact, salvage excavation of a representative sample of the site is required before impact. AHIP required prior to commencement of works affecting the site.</td>
</tr>
</tbody>
</table>
9 Summary of Aboriginal sites for which an AHIP is being sought

A total of four Aboriginal archaeological sites are situated within the boundary of the proposed AHIP Project Area (Figure 5) for the Archbold Road extension and upgrade. All four sites would be at least partially impacted by the proposed activities. An AHIP is sought for the land and Aboriginal objects within the boundaries of the proposed road upgrade and extension (Figure 6).
Figure 6. AHIP application area
### Table 6. Coordinates for AHIP Application Area

<table>
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<th>Point ID</th>
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10 Recommendations

Four archaeological sites are situated within the boundary of the proposed AHIP Application Area for the Archbold Road extension and upgrade. These four sites will be impacted by the proposed activities.

AHIP
An application for an AHIP should be made under section 90A of the National Parks and Wildlife Act 1974 for four Aboriginal archaeological sites.

The AHIP is sought for specified Aboriginal sites and objects contained within Table 7 below:

Table 7. Aboriginal archaeological sites and scope for which an AHIP is being sought

<table>
<thead>
<tr>
<th>Site Name</th>
<th>AHIMS ID</th>
<th>Scope of AHIP</th>
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<td>Archbold Road 1</td>
<td>45-5-4492</td>
<td>Partial impact</td>
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<tr>
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<td>45-5-3165</td>
<td>Partial impact</td>
</tr>
<tr>
<td>Ropes Creek AS3</td>
<td>45-5-3937</td>
<td>Partial impact</td>
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</table>

An AHIP is sought for the land and associated objects within the boundaries of the construction corridor.

The land to which the AHIP application applies is shown in Figure 6.

Salvage Excavation
The AHIP would include mitigation through salvage excavation. Salvage excavation would be required at the impacted portions of sites RCAS 1 and Ropes Creek AS3. Salvage excavation must be completed prior to any activities which may harm Aboriginal objects at these site locations. Salvage excavation activities would be undertaken in accordance with the methodology attached as Appendix D.

Procedure for unexpected archaeological finds
Roads and Maritime Unexpected Archaeological Finds Procedure (Roads and Maritime 2012) will be used in the event of uncovering an unexpected archaeological find during Roads and Maritime activities.

Collected-Salvaged Aboriginal objects
The short term management of collected Aboriginal objects is as follows:

- Any Aboriginal objects that are removed from the land by actions authorised by an AHIP, must be moved as soon as practicable to the temporary storage location (see below) pending any agreement reached about the long term management of the Aboriginal objects.
- Any Aboriginal objects stored at the temporary storage location must not be further harmed, except in accordance with the conditions of the AHIP.

The long term management of collected Aboriginal objects is as follows:

- Recovered objects will be lodged with the Australian Museum in the first instance in accordance with the Australian Museum Archaeological Collection Deposition Policy (January 2012, available online at: http://australianmuseum.net.au/document/Protocols-for-the-deposition-of-archaeological-materials). If required, a variation will be sought for recovered objects to be held by the Aboriginal community or reburied.
References

Abel Archaeology, 2015. Addendum to Aboriginal Cultural Heritage Assessment – Lot 102 DP1189012 and Lot 103 DP1189012, Archbold Road, Minchinbury, Sydney, New South Wales. Report to John Brogan and Associates Pty Ltd.

Archaeological & Heritage Management Solutions (AHMS), 2012. Aboriginal Archaeological Survey Report: Old Wallgrove Road Upgrade (Roberts Road-M7 Motorway), Eastern Creek, Sydney. Report to Aurecon Australia


Brayshaw, H.C., and Haglund, L., 1996. M4 Upgrade, Aboriginal Survey for Aboriginal Sites for Proposal to Upgrade the M4 Motorway from Church Street Parramatta to Coleman Street Mays Hill and Prospect to Emu Plains. Unpublished Report for SWR Constructors Pty Ltd through Environmental Planning Pty Ltd.


Corkill, T., and Edgar, J., 1992. Survey for Aboriginal Archaeological Sites Between Archbold Road, Park Hill Rd., Ropes Creek and Western Motorway, Minchinbury, NSW. Unpublished report prepared for Sargents Pies Pty Limited


KNC, 2016. M4 Managed Motorway, from Lapstone (western end) to Church Street, Parramatta (eastern end) Review of Environmental Factors: Cultural heritage assessment report. Prepared for Jacobs Group (Australia) Pty Ltd on behalf of Roads and Maritime Services


Lu, Hua; Prosser, Ian; Moran, Chris; Gallant, John; Priestley, Graeme; and Stevenson, Janelle. 2001. Prediction of sheet and rill erosion over the Australian continent, incorporating monthly soil loss distribution. CSIRO Land and Water, Technical Report 13/01.


Sullivan, S. and Bowdler, S. 1984. Site Survey and Significance Assessment in Australian Archaeology Canberra: RSPacS, Australian National University

Appendix A  Advertisement for Registration for Interest

Transport
Roads & Maritime Services

Aboriginal Heritage
Archbold Road Upgrade and Extension

Roads and Maritime Services invites Aboriginal people and Aboriginal groups who hold cultural knowledge relevant to determining the significance of Aboriginal objects and places for Archbold Road, Eastern Creek to register to be consulted.

To register your interest, please contact:

Mark Lester
Roads & Maritime Services, Aboriginal Cultural Heritage Officer
P: PO Box 973 Parramatta CBD NSW 2124
E: mark.w.lester@ rms.nsw.gov.au
T: (02) 8849 2583

Registrations must be received by phone or in writing by Wednesday 9 March 2016.

Roads and Maritime Services is proposing to carry out a Stage 3 Aboriginal Heritage Investigation for proposed work to Archbold Road between Old Wallgrove Road, Eastern Creek and the Great Western Highway, Minchinbury.

The proposal may result in the Roads and Maritime Services:
• Applying for an Aboriginal Heritage Impact Permit (AHIP) under Part 6 of the National Parks and Wildlife Act 1974, and/or
• Undertaking investigations in accordance with the Code of practice for archaeological investigations in NSW 2010, and/or
• Undertaking an environmental impact assessment under the Environmental Planning & Assessment Act 1979.

Publication and Date
Blacktown Sun 16/2/16
Mt Druitt – St Mary’s Standard 17/2/16
Penrith Press 18/2/16
Appendix B  Aboriginal Community Comments and AFG Minutes
MEETING MINUTES

Name of meeting: Archbold Road Aboriginal Focus Group
Location of meeting: Novotel Hotel, Church Street, Parramatta
Meeting facilitator: Mark Lester
Date: 10th May 2016 Time: 10.00am to 12.00pm

Attendees: Chris Page (Gumagura); Athol Murray (Thungutti); A Williams (AAS); Philip Khan (KYWG); Carolyn Hickey (A1 Indigenous Services); Steven Hickey (Widescope); Amanda Hickey (Amanda Hickey Cultural Services); Darren Johnson (MBMAC); Ryan Johnson (MBMAC); Darlene McKenzie (Mirramajah Group); Matty Mathivanar (RMS Project Manager); Mark Lester (RMS); Matthew Kelleher (Project Archaeologist)

Apologies: None


2. Housekeeping & Introduction – Mark Lester
   Thanked all for attending. All participants introduced themselves.

3. Project Proposal – Matty Mathivanar
   Roads and Maritime Services is proposing to build a north-south access road (Archbold Road) into the Western Sydney Employment Area (WSEA). It would connect Old Wallgrove Road at Eastern Creek and the Great Western Highway at Minchinbury. It would also provide direct access to and from the M4 Motorway. The proposal is being progressed by Roads and Maritime at the request of the NSW Department of Planning and Environment to support the development of the WSEA.

   This proposal was first identified in 2007 under the Erskine Park Link Road Network Concept Plan, which identified the need to build a number of roads to service development of the WSEA. The proposal was extended at the request of the NSW Department of Planning and Environment to provide an access road across land that has been approved for development as an Industrial Estate. The above concept plan was approved by the NSW Department of Planning and Environment in 2009.

   The key features of the proposal include:
   • Building a new dual carriageway between Old Wallgrove Road and Archbold Road
   • Widening Archbold Road from two-lanes to four-lanes
   • Building a road bridge over two major water supply pipelines close to Old Wallgrove Road
   • Building a road bridge and separate pedestrian/cycle bridge over the M4 Motorway
   • Building east-facing ramps to and from the M4 Motorway.

   The above components would be supplemented by:
   • Building a new combined footpath and cycleway along the western side of the road throughout its entire length
   • Building seven new four-way intersections to access the WSEA
   • Creating two new intersections to support the east-facing ramps to the M4 Motorway
• Upgrading an existing road bridge over the M4 Motorway associated with Archbold Road
• Upgrading five existing intersections.

4. Presentation of the Methodology – Matthew Kelleher
The project site is located on the Cumberland Plain, a physiographic region of the Sydney Basin characterised by low-lying undulating low hills and plains atop Wanamatta Group of Triassic Period sedimentary shales. Topography within the site is characterised by gentle to moderate gradient slopes tending west, terminating at the flats and floodplains of Ropes Creek to the west. The underlying geology of the site consists of Bringelly Shale. Soils located within the site are exclusively from the Blacktown Soil landscape. These soils generally consist of shallow to moderately deep hard setting red, brown and yellow podzolic soils. Erosional susceptibility of this soil landscape is relatively low. Past land use within the project area has generally been limited to pastoral and mining activities. The majority of the area has been extensively cleared of its original vegetation including Cumberland Plain Woodland group. Pasture grasses and regrowth native trees currently dominate the area.

Archaeological investigations of the surrounding area have demonstrated that the landscape retains evidence of Aboriginal landscape use. However, in most instances surface evidence is greater than subsurface evidence due to strong deflationary pressures.

Following the Stage 2 investigation by Artefact Heritage, ten Aboriginal archaeological sites have been identified within the current project site. Six of the ten sites are either covered by an existing AHIP or within a pre-existing AHIP application area. Therefore, only the four sites have been addressed in the CHAR.

Two of the four sites are located on creek terraces, exhibit relatively intact soil matrices including a range of Aboriginal objects and represent moderate archaeological significance, while the remaining two sites are highly disturbed and exhibit low archaeological significance. Mitigation through salvage excavation is recommended for the two moderately significant sites. Salvage excavation will be completed prior to any activities that may harm Aboriginal objects at these locations.

An AHIP will be required for the land within the project boundary and specifically for Aboriginal objects within the impacted sites.

5. Questions/Community Comments – All
• Why not test all sites? The majority of the sites have been subject of previous AHIP application and out of the remaining sites only two are considered to be of moderate significance. There have also been test excavations carried out for previous projects in the general vicinity of the site.
• Aboriginal cultural significance of the area should also be recognised in any assessment.

6. General business – All
• All attendees were encouraged to respond and have input into the methodology by the closing date. They can provide this in any format (eg letter, email) and either indicate support or suggest changes.
• Stakeholders were encouraged to submit Aboriginal Site Officer Applications.

7. Meeting Closed
11th May 2016

Archbold Road Extension and Upgrade Great Western Highway To Southern Link Road.

Aboriginal Archaeology agrees with the above draft report for Archbold Road Extension and Upgrade Great Western Highway To Southern Link Road. Kelleher Nightingale Consulting has taken a professional approach in the consultation process when dealing with the Aboriginal stakeholders. I would like it know that this area has spiritual and cultural significance to my family and my ancestors passed and present. AAS would like to be involved in any site work to investigate of the area and to present if there are any significant findings present in the location.

All A.A.S Staff have a Work cover and are qualified in Senior First Aid. Aboriginal Archaeology Service has been protecting Aboriginal heritage and culture for the past 40 years.

AAS is able to assist with input that can be incorporated into a written assessment of cultural values of the area. We are also able to provide site staff to assist with work that may involve physical labour. We can provide our schedule of rates and copies of relevant certificates of currency for business insurances on request. We have no objection to our information being provided to the Office of Environment and Heritage and the Local Aboriginal Land Council.

Aboriginal Archaeology Service is seeking primary involvement in all consultation meetings and fieldwork for the above mentioned project. AAS immediate family has lived in the area from 1897 and retains local and oral history on behalf of its first nation people. We have no objection to our information being provided to the Office of Environment and Heritage and the Local Aboriginal Land Council.

All correspondence should be emailed to AAS_info@bigpond.com or to the above postal address. The area is an important part of our culture and valued by our family.

Yours Truly

[Signature]

Thank You For Your Business.
10th May 2016

Matthew Kelleher
Kelleher Nightingale Consulting Pty Ltd
Level 10, 25 Bligh Street
SYDNEY NSW 2000

Dear Matthew,

RE: ARCHBOLD ROAD EXTENSION AND UPGRADE: GREAT WESTERN HIGHWAY TO SOUTHERN LINK ROAD

Aboriginal Cultural Heritage Assessment Report

Darug Land Observations Pty Ltd has reviewed the proposed draft Aboriginal Cultural Heritage Assessment Report and Methodology, and supports the draft methodology for the proposed extension of Archbold Road between the Great Western Highway at Marskbourne and the proposed Southern Link Road at Kersley Park.

In relation to the long-term storage of recovered artefacts, if any, Darug Land Observations Pty Ltd strongly believes that recovered artefacts should be re-buried on Country (the study area).

Darug Land Observations Pty Ltd would like to receive a copy of the Section 90 Aboriginal Heritage Impact Permit (AHIP).

Furthermore, Darug Land Observations Pty Ltd would be involved in the monitoring of the topsoil removal and all other form of works to be carried out on the site.

Yours sincerely,

Jamie Woldman
Uncle Gordon Woldman
Cristany Milicich

From: desmond dyer <desmond6552@hotmail.com>
Sent: Tuesday, 31 May 2016 10:34 AM
To: Cristany Milicich
Subject: Re: Archbold Road Upgrade and Extension - CHAR Review

Follow Up Flag: Follow up
Flag Status: Flagged

Dear Cristany,

The Darug Aboriginal Land care/ Uncle Des Dyer has read the report and we agree with the recommendations and have no objections to the proposed development.

Des Dyer

---

Cristany Milicich <cristany.milicich@knconsult.com.au>
Sent: Tuesday, 3 May 2016 5:38:13 PM
To: Cristany Milicich
Subject: Archbold Road Upgrade and Extension - CHAR Review

Dear Registered Aboriginal Stakeholder,

RE: ARCHBOLD ROAD EXTENSION AND UPGRADE: GREAT WESTERN HIGHWAY TO SOUTHERN LINK ROAD
DRAFT ABORIGINAL CULTURAL HERITAGE ASSESSMENT REPORT

Thank you for your contributions and involvement in this project to date. Please find attached a draft cultural heritage assessment report for the proposed Archbold Road Upgrade and Extension project for your review.

As a registered Aboriginal stakeholder you are invited to review and provide comment on the cultural heritage assessment report. This report will accompany an application for an Aboriginal Heritage Impact Permit (AHIP) for Aboriginal objects harmed by the proposed development of the Industrial Estate.

Please forward any information on the Aboriginal cultural heritage significance of the study area you would like to include in the cultural heritage assessment report by 31 May 2016 to: Matthew Kelleher
Kelleher Nightingale Consulting Pty Ltd
Level 10, 25 Bligh Street, Sydney NSW 2000
Phone: 9232 5373
Fax: 9232 0690

If you have any questions or require further information, please don’t hesitate to contact the office on 02 9232 5373.

Yours sincerely,

Matthew Kelleher

Sent on behalf of Dr. Kelleher by
DARUG CUSTODIAN
ABORIGINAL
CORPORATION

PO BOX 81 WINDSOR 2756
PHONE: 0245775181 FAX: 0245775098
MOBILE: 0415770163 Leanne Watson
0414962766 Justine Coplin
EMAIL: mulgokwil@bigpond.com / justinecoplin@optusnet.com.au

Attention: KNC

Subject: ARCHBOLD ROAD EXTENSION AND UPGRADE: GREAT WESTERN HIGHWAY TO SOUTHERN LINK ROAD

Dear Matthew

Our group is a non-profit organisation that has been active for over forty years in Western Sydney, we are a Darug community group with over three hundred members. The main aim in our constitution is the care of Darug sites, places, wildlife and to promote our culture and provide education on the Darug history.

The Aboriginal cultural heritage consultation requirements for proponents Section 4.1.8 refers to “Aboriginal organisations representing Aboriginal people who hold cultural knowledge”. Recent consultation meetings have revealed that many of these Aboriginal organisations and individuals do not hold cultural knowledge of the Western Sydney area. The increasing involvement of such parties in cultural heritage management means that genuine local Aboriginal organisations are unable to properly care for our cultural heritage.

Many Aboriginal organisations listed in the OEH response letter do not contribute to the Aboriginal community of Western Sydney. Individuals listed in the OEH response letter do not represent the community and while they may be consulted with, should not be employed for their own personal financial benefit.

Our organisation is committed to providing benefits back to our local Aboriginal community through such measures as funding the local Aboriginal juniors’ touch football team, painting classes for the local children and donating money to various charities. Employment in cultural heritage activities is source of income that organisations such as ours can use to contribute to beneficial activities and support within the community.
Danug Custodian Aboriginal Corporation’s site officers have knowledge of Danug land, Danug Culture, Oral histories, landforms, sites, Danug history, wildlife, flora and legislative requirements. We have worked with consultants and developers for many years in Western Sydney (Danug Land) for conservation, site works, developments and interpretation/education strategy.

Danug Custodian Aboriginal Corporation have received and reviewed the report for ARCHBOLD ROAD EXTENSION AND UPGRADE, GREAT WESTERN HIGHWAY TO SOUTHERN LINK ROAD

We support the recommendations set out in this report.

Please contact us with all further enquiries on the above contacts.

Regards

[Signature]

Justine Coplin
Pollowan Phillip Khan  
78 Forbes Street  
Emu Plains NSW 2750  
11.05.16,  
mobile: 0434545982

Kelleher Nightingale  
Consulting Pty Ltd  
Level 10,25 Bligh Street , Sydney NSW 2000

Dear Matthew Kelleher

Thank you for the Cultural Heritage Assessment Report and Methodology Report Archbold Road Extension Upgrade Great Western Highway to Southern Link Road. I understand what you are saying. That there is a lot of soil movement over 100 years and in that 100 years there has been a lot of Aboriginal people killed and buried all over this country and no one knows where they are buried. We have the opportunity to test, feel there should be further testing in-between the four sites that are to be impacted by the proposed activities of the extension of the road. As you are aware this area is part of the flood plains of Ropes creek and is highly significant to the Aboriginal people as these areas where camping areas for them and also could be burial grounds as well. As the Old People say once its gone its gone forever and cannot be replaced. I have read your report and am happy with it and am looking forward to be working with you and your team on this project in protecting our cultural heritage regards Philip Khan

As Senior Aboriginal person who has for the past forty of so years (40) actively participated in the Protection Aboriginal Cultural Heritage throughout the Sydney Basin, and particularly throughout Western Sydney, I, on behalf of the Kamilaroi- Yankuntjatjara Working Group, wish to provide to you my organisations’ registration of interest.

Information in my registration of interest:

1. I am a Senior Aboriginal and Principal of the Kamilaroi-Yankuntjatjara Working Group, and all Aboriginal entity (ABN33979702507).

2. I prefer communicating by, Mail, Telephone, and; and I am, the Principal, person to contact, and;

   My contact details are:
   Phillip Khan
   78 Forbes Street, Emu Plains NSW 2750
   Mobile 043 454 5 982

3. I wish to be involved and participate in all levels of consultation/project involvement. I wish to attend all meetings, and, participate in available field work; and would receive a copy of the report.

4. I attach to this letter a copy of Kamiloroi- Yankuntjatjara Working Group’s; GIO Public Liability Insurance; GIO Workers Compensation Certificate.

Should you wish me to provide further information, please do not hesitate to contact me on 0434545982.

[Signature]
Appendix C Archaeological Salvage Methodology

Research Aims
The main aims of the proposed salvage excavation program are:

- To salvage a representative sample of the identified archaeological sites RCAS 1 (AHIMS 45-5-3165) and Ropes Creek AS3 (AHIMS 45-5-3937) prior to construction impact.
- Analysis of the salvaged archaeological material to gain and conserve knowledge and understanding of the scientific and cultural information exhibited by the activities associated with minor tributary creeklines of the Ropes Creek catchment, between Ropes Creek and Eastern Creek.

The further scientific aim of the salvage excavation program will be to determine the subsurface integrity, extent, spatial distribution and nature of the cultural deposit and the specific types of associated archaeological/cultural activities.

- Determining the integrity of a deposit involves assessing the degree of disturbance which is present.
- Determining the statistical extent of the site and/or activity areas involves identifying the boundaries associated with the identified archaeological deposit.
- Assessing the spatial distribution involves identifying the presence/absence of archaeological material across.
- The nature of the site refers to the type of activities indicated by the artefactual material (e.g. primary production, domestic knapping, hunting camps). The goal would be to retrieve entire assemblages from specific activities if such activities were present.
- Retrieved assemblages would be compared with the results from other relevant archaeological projects in the local and regional area in order to assess significance.

Research Question
The results of the proposed salvage excavation would increase our understanding of subsurface archaeology of the project area. In particular, research would focus on the landforms adjacent to the two minor tributaries and explore the effect of soil formation processes and disturbance on the identified subsurface archaeological deposit. The effects of flooding and modern land use have been documented as detrimental factors in the preservation of archaeological sites in the local and regional area, particularly open context surface sites.

**Question 1:** What cultural activities are archaeologically identifiable on landforms adjacent to minor creek tributaries and how does the identified archaeology compare to locations closer to the major landscape features of Ropes Creek and Eastern Creek?

**Question 2:** What is the effect of natural process and modern land use practices on the preservation of the Aboriginal archaeological sites? What implications does this have for future management of Aboriginal archaeological sites in similar landscape contexts?

What can we expect?
It is anticipated that differences in stone tool assemblages may be related to different cultural activities (e.g. primary reduction vs maintenance flaking). The science of archaeology is paramount to any research question and it is important to stress that the goal for the salvage program for all excavated sites is straightforward: to retrieve a viable sample for comparative analysis using established techniques (see Field Methods below). In this regard interpretation would not precede data collection. The proposed archaeological program would systematically sample the relevant areas using standard techniques with the outcome being a viable, robust and comparable sample. Analysis of the sample would follow and interpretations would be made distinctly separate from the results.
FIELD METHODS
The goal of the field excavation program is to recover significant assemblages of artefacts and investigation of contributing geomorphic processes.

Archaeological Salvage Areas
Salvage excavation would be undertaken on identified archaeological sites RCAS 1 and Ropes Creek AS3. Salvage excavation of these sites would focus on the extraction of collections of artefacts related to activity areas and geomorphic information.

Salvage Program
In order to achieve the most robust and comparable result, KNC advocates an open area salvage excavation at the two locations. The first phase in open area salvage is to establish the statistical boundaries of the previously identified archaeological deposit. This approach is designed to salvage the spatial properties of the site as shown in the lithic continuum. In other words, recording the spread of activities across the site/landscape.

Phase 1
A series of 1 m² squares are excavated on a transect grid overlain on each site to mark the spread of lithics and related geomorphic activity. Distribution/density data from the 1m² salvage excavation squares would be used to effectively encapsulate the boundaries of the identified deposit (‘site area’) or spread of specific activity areas.

Geocentric Datum of Australia 1994 (GDA94) coordinates would be recorded for each square to enable three dimensional modelling. Statistical salvage following this method is highly beneficial because it creates a robust inter-site sample, sufficiently random, critical for regional comparative analysis. No other method is as efficient or effective.

Phase 2
Next open salvage will occur where information bearing deposits are identified by triggers such as: significant quantities of artefacts, variations in raw material, unusual artefacts, chronological material and/or taphonomic indicators. In this context chronologic material is anything that can be used to date artefacts or deposit: charcoal or charcoal bearing deposit (e.g. hearth ash), sandy deposit, gravels (e.g. aluminium feldspar). Open area salvage of significant deposit will expand to encompass entire activity areas. It is anticipated that a total of 100m² (combining Phase 1 and Phase 2 squares) will be excavated at each site location.

Individual excavation squares measuring 1 m² would be hand excavated in stratigraphic units (Unit A, Unit B, etc.). Squares would be excavated until the basal layer or culturally sterile deposit is reached (usually 25-35 cm). Previous excavation of the podzolic soils associated with the local area indicates no archaeological stratigraphy within units. As such the A1 and A2 soil layers are culturally one layer (suffering from cyclical soil transfer resulting in a mixed cultural profile within the soil) and can be salvaged as one unit where possible. All excavated deposit would be wet sieved using nested 5.0 mm, 2.5 mm and 1.0 mm sieves to determine the intactness of the deposit.

The location of each excavated square would be identified on a surveyed plan of the site. Stratigraphic sections detailing the stratigraphy and features within the excavated deposit would be drawn and all squares would be photographed. Soil samples as well as thin section profiles (where feasible) would also be collected. The stratigraphy of all excavated areas would be fully documented and appropriate records archived.

Core samples measuring at least .5m deep will be collected and archived using a 50mm hand corer to describe a cross section of the project area (around 10 samples will be required). In addition, thin section profiles (where feasible) would also be collected from open areas. The stratigraphy of all areas would be fully documented and appropriate records would be archived.

Carbon samples will be collected and analysed for material relating to both the archaeology and geomorphology. Where appropriate cosmogenic and radiometric dating of soils and rock surfaces will be applied (Nishiizumi et al. 1986, 1993).
Analysis

Artefacts would be analysed on a comparable level with previous analyses of excavated assemblages. Information derived from this analysis; in particular the identification of specific artefact types and their distributions and associations; would be used to put together interpretations about how sites were used, where sites were located across the landscape, the age of sites and to assess cultural heritage values. By comparing different areas it would be possible to determine whether there were differences in the kinds of activities carried out and if different activities were related to different landforms.

A range of stone artefacts may be present across the salvage areas and the analysis would expand accordingly to account for artefact variability. All information would be recorded in database form (MS Excel). Various types of evidence would be used to determine the kinds of activities that were carried out. A short description of the proposed analysis in outlined below.

- Field analysis would record basic data, such as material type, number and any significant technological characteristics, such as backing or bipolar techniques; added to this would be any provenance data such as pit ID and spit number. The purpose of the field recording is twofold: 1) establish a basic recording of artefacts retrieved and 2) to allow on-going assessment of the excavation regime (e.g. whether higher stratigraphic resolution is required while digging).

- Detailed (laboratory) analysis would entail recording a larger number of characteristics for each individual artefact. These details would be recorded in matrices suitable for comparative analysis (e.g. multivariate and univariate) of the excavated assemblage on a local and regional basis.

- Lithic characteristics to be recorded cover a range of basic information but are not limited to these categories (see example below). For transparency, terms and category types would in large part be derived from Holdaway and Stern (2004).

<table>
<thead>
<tr>
<th>Sample Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Record Number</td>
</tr>
<tr>
<td>% Cortex</td>
</tr>
<tr>
<td>Flake Type</td>
</tr>
<tr>
<td>Pit ID</td>
</tr>
<tr>
<td>Length</td>
</tr>
<tr>
<td>Termination Type</td>
</tr>
<tr>
<td>Spit Number</td>
</tr>
<tr>
<td>Width</td>
</tr>
<tr>
<td>Core Type</td>
</tr>
<tr>
<td>Count</td>
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<tr>
<td>Thickness</td>
</tr>
<tr>
<td>Number of Scars (Core)</td>
</tr>
<tr>
<td>Raw Material</td>
</tr>
<tr>
<td>Weight</td>
</tr>
<tr>
<td>Scar Type (Core)</td>
</tr>
<tr>
<td>Colour</td>
</tr>
<tr>
<td>Modification</td>
</tr>
<tr>
<td>Shape of Flake</td>
</tr>
<tr>
<td>Quality</td>
</tr>
<tr>
<td>Reduction Type</td>
</tr>
<tr>
<td>Platform Type</td>
</tr>
</tbody>
</table>

Minimum Number of Flake (MNF) calculations formulated by Hiscock (2002) would be undertaken where applicable (although past experience indicates MNF calculations would not be required for this excavation program).

The analysis of artefacts recovered during the excavation program would be undertaken in a transparent and replicable fashion so as to permit the comparison of the entire excavated assemblage with data from other areas. This would also allow for an interpretation of the project area’s archaeological significance.

KNC directors, Dr Matthew Kelleher and Alison Nightingale, would be responsible for the salvage excavation program. Dr Matthew Kelleher would direct the excavation component of the Aboriginal archaeological assessment. Matthew has extensive experience in managing archaeological excavations and research projects throughout the Cumberland Plain. Matthew would also be the principal contact for the overall Aboriginal archaeological assessment for the project. The geoarchaeological assessment will be undertaken by Dr Kelleher.
Appendix I

Non-Aboriginal statement of heritage impact technical paper
Archbold Road

Statement of Heritage Impact

July 2016
EXECUTIVE SUMMARY

NSW Roads and Maritime Services (Roads and Maritime) are proposing an upgrade and southern extension of Archbold Road between the Great Western Highway, Minchinbury and to the proposed Southern Link Road, Eastern Creek (the proposal). The proposal is part of a network of roads within the Western Sydney Employment Area. This network includes Archbold Road, the Erskine Park Link Road (EPLR) and Old Wallgrove Road between EPLR and Wallgrove Road.

In 2009 the Minister for Planning granted concept plan approval under the then Part 3A of the EP&A Act for the EPLR Network. Further assessment is required for approval to construct components of the concept plan, including the Archbold Road upgrade as assessed in the concept plan.

Artefact Heritage has been engaged by Parsons Brinckerhoff to prepare a Statement of Heritage Impact (SoHI) for the proposal to inform the Archbold Road Review of Environmental Factors (REF).

Overview of Findings

- Historically the study area was associated with the early 19th century estates of William Cox, John Thomas Campbell and Henry Kable. It has typically been associated with pastoralism and horticulture, including orchards of the Chatsworth Estate during the mid-19th century. By the late 20th century the northern and southern extents of the study area had become high urbanised and industrialised. The central portion has largely been used for cattle grazing since the mid-19th century and as such is not as highly disturbed as the northern and southern portions.
- There are no listed heritage items located within the study area.
- There is one unlisted heritage item (Warragamba-Prospect Pipeline) located within the study area. The proposal would have a negligible impact on the Warragamba-Prospect Pipeline.
- One potential archaeological site is located with the central part of the study area. The shed and yard complex site potentially dates from the 19th century and could be associated with the Chatsworth Estate. The archaeological remains are potentially of local heritage significance and relics as defined by the Heritage Act. The proposal would result in at least partial direct impact on the shed and yard complex site. Further archaeological investigation would manage and mitigate the potential impact.

Recommendations

- Impacts to the Warragamba-Prospect Pipeline would be avoided. The location of the pipeline would be marked on environmental control maps for the project.
- Further archaeological investigation of the shed and yard complex site where it is to be impacted should be undertaken. The investigation would include:
  - Test excavation to clarify the nature of the remains and determine if they are significant, have research potential and be considered relics under the Heritage Act.
  - Detailed archaeological survey of the visible remains as part of the test excavation program.
• The archaeological testing and survey program should be undertaken with a section 139(4) exception approval from the NSW Heritage Division. The application would require a report which outlines the proposed archaeological test excavation and survey methodology.

• Should the archaeological testing program identify relics, a section 140 excavation permit and further archaeological investigation, such as salvage excavation and recording, would be required to impact or remove them.

• The remainder of the area identified as having archaeological potential should be protected by an exclusion zone and should be marked on environmental control maps for the project.

• In those areas of the site having nil-low potential, it is recommended that the Roads and Maritime Services Procedure: Unexpected Heritage Finds is implemented.
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1.0 INTRODUCTION

1.1 Background

NSW Roads and Maritime Services (Roads and Maritime) are planning an upgrade and southern extension of Archbold Road between the Great Western Highway, Minchinbury and to the proposed Southern Link Road, Eastern Creek (the proposal). The proposal is part of a network of roads within the Western Sydney Employment Area. This network includes Archbold Road, the Erskine Park Link Road (EPLR) and Old Wallgrove Road between EPLR and Wallgrove Road.

In 2009 the Minister for Planning granted concept plan approval under the then Part 3A of the EP&A Act for the EPLR Network. The concept plan identified further assessment requirements for approval to construct components of the concept plan, including the Archbold Road upgrade as assessed in the concept plan.

Artefact Heritage has been engaged by Parsons Brinckerhoff to prepare a Statement of Heritage Impact (SoHI) for the proposal to inform the Archbold Road Review of Environmental Factors (REF). The aim of this report is to:

- Identify listed and unlisted heritage items which within the study area,
- Assess the study area’s archaeological potential,
- Assess the non-Aboriginal heritage and archaeological impact of the proposal,
- Provide recommendations for heritage impact mitigation and management.

1.2 Structure of the report

Section 1 provides the background for the study. Section 2 details the relevant statutory context. Section 3 includes the result of background research on historical context, while Section 4 discusses the results of the site inspection. Section 5 assesses heritage values, including non-Aboriginal archaeology. Section 6 includes a statement of heritage impacts for the work, with Section 7 listing conclusions of the investigation and recommendations.

1.3 Study Area

The study area is delineated by an offset buffer of approximately 120 m from the centreline of the proposed road alignment. In areas where roads already exist, the study area is contained within the road corridor; including Archbold Road (north of the M4) and Old Wallgrove Road in the south (Figure 1).

1.4 Proposal

The key features of the proposal include:

- Building a new dual carriageway between Old Wallgrove Road and Archbold Road
- Widening Archbold Road from two-lanes to four-lanes
- Building a road bridge over two major water supply pipelines (the Warragamba Pipelines) close to Old Wallgrove Road
• Building a road bridge and separate pedestrian/cycle bridge over the M4 Motorway
• Building east-facing ramps to and from the M4 Motorway.

The above components would be supplemented by:

• Building a new combined footpath and cycleway (called a shared-use path) along the western side of the road throughout its entire length
• Building seven new four-way intersections to access the WSEA
• Creating two new intersections to support the east-facing ramps to the M4 Motorway
• Upgrading an existing road bridge over the M4 Motorway associated with Archbold Road
• Upgrading five existing intersections.

1.5 Authorship and Contributions

This report was prepared by Claire Rayner (Heritage Consultant). The Historical Context chapter was prepared by Alexander Timms (Senior Heritage Consultant). The site inspection was conducted by Claire Rayner and Jenny Winnett (Senior Heritage Consultant). Management input and review was provided by Abi Cryerhall (Principal, Historic Heritage).

1.6 Limitations and Constraints

This report provides an assessment of the non-Aboriginal heritage located within the study area defined in Figure 1 only. This report does not include assessment of any ancillary roads or compound areas that may be proposed in the future.

This report does not include Aboriginal heritage. A separate Procedure for Aboriginal Cultural Heritage Consultation and Investigation (PACHCI) Stage 2 report has been produced for the proposed works (Artefact Heritage 2015).
Figure 1: Location of study area
2.0 STATUTORY CONTEXT

This section presents the statutory and planning context relating to heritage items and archaeological relics in NSW relevant to the proposed development.

2.1 Heritage Act 1977

The NSW Heritage Act 1977 (Heritage Act) is the primary item of State legislation affording protection to items of environmental heritage in NSW. The Heritage Act is designed to protect both listed heritage items, such as standing structures, and potential archaeological remains or relics. Under the Heritage Act, 'items of environmental heritage' include places, buildings, works, relics, moveable objects and precincts identified as significant based on historical, scientific, cultural, social, archaeological, architectural, natural or aesthetic values. State significant items are listed on the NSW State Heritage Register (SHR) and are given automatic protection under the Heritage Act against any activities that may damage or affect its heritage significance.

State Heritage Register

The SHR was established under Section 22 of the Heritage Act and is a list of places and objects of particular importance to the people of NSW, including archaeological sites. The SHR is administered by the Heritage Division of the Office of Environment and Heritage (OEH). This includes a diverse range of over 1500 items, in both private and public ownership.

There are no items listed on the SHR located within the study area.

s170 register

Under the Heritage Act all government agencies are required to identify, conserve and manage heritage items in their ownership or control. Section 170 requires all government agencies to maintain a Heritage and Conservation Register that lists all heritage assets and an assessment of the significance of each asset. They must also ensure that all items inscribed on its list are maintained with due diligence in accordance with State Owned Heritage Management Principles approved by the Government on advice of the NSW Heritage Council. These principles serve to protect and conserve the heritage significance of items and are based on NSW heritage legislation and guidelines.

There are no items listed on current s170 registers located within the study area.

Archaeological relics

Part 6 Division 9 of the Heritage Act protects archaeological 'relics' from being exposed, moved, damaged or destroyed. This protection extends to situations where a person has reasonable cause to suspect that archaeological remains may be affected by the disturbance or excavation of the land. It applies to all land in NSW that is not included in the SHR. Section 4(1) of the Heritage Act (as amended 2009) defines 'relic' as follows:

"relic means any deposit, artefact, object or material evidence that:

(a) relates to the settlement of the area that comprises New South Wales, not being Aboriginal settlement, and

(b) is of State or local heritage significance."
Sections 139-145 of the Heritage Act prevent the excavation or disturbance of land known or likely to contain relics, unless in accordance with an excavation permit. Excavation permits are issued under Section 140 of the Heritage Act, or Section 60 for sites listed on the SHR. Excavation Permit Applications must be supported by an Archaeological Research Design. Section 146 of the Heritage Act requires that any discovery or location of a ‘relic’ is reported to the Heritage Council.

Works

The Heritage Act identified ‘works’ as being in a separate category to archaeological ‘relics.’ ‘Works’ refer to past evidence of infrastructure. ‘Works’ may be buried, and therefore archaeological in nature, however, exposure of a ‘work’ does not trigger reporting obligations under the Heritage Act. ‘Works’, as items of environmental heritage, have the potential to provide information that contributes to our knowledge of past practices, and good environmental practice recognises this. Roads and Maritime, for example, uses its Standard Management Procedure: Unexpected Heritage Items (Roads and Maritime 2015) to manage the discovery of such items.

2.2 Environmental Planning and Assessment Act 1979

The Environmental Planning and Assessment Act 1979 (the EP&A Act) establishes a framework for cultural heritage values to be formally assessed in the land use planning and development consent process. The EP&A Act requires that environmental impacts are considered before land development; this includes impacts on cultural heritage items and places as well as archaeological sites and deposits. The EP&A Act also requires that Local Governments prepare planning instruments (such as Local Environmental Plans [LEP] and Development Control Plans [DCP]) in accordance with the EP&A Act to provide guidance on the level of environmental assessment required.

The study area is located within the Blacktown and Fairfield LGAs.

There are no heritage items within or near the study area which are listed in Schedule 5 (Environmental Heritage) of the Blacktown LEP (2015) or Schedule 5 (Environmental Heritage) of the Fairfield LEP (2013).

2.3 Environment Protection and Biodiversity Conservation Act 1999

The Environment Protection and Biodiversity Conservation Act 1999 (the EPBC Act) provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places. These are defined in the EPBC Act 1999 as matters of national environmental significance. Under the EPBC Act 1999, nationally significant heritage items are protected through listing on the Commonwealth Heritage List or the National Heritage List.

There are no heritage items within or near the study area listed on the Commonwealth Heritage List or the National Heritage List.

2.4 Non-statutory registers

A number of non-statutory registers were searched including the Register of the National Trust and the Register of the National Estate.

There are no heritage items within or near the study area listed on the Register of the National Trust or Register of the National Estate.
3.0 HISTORICAL CONTEXT

3.1 Early Settlement of the Region

Settlement of the Eastern Creek area occurred in the late 18th and early 19th century; when large amounts of native vegetation was cleared for agricultural purposes. The earliest European land use in the study area was likely to have been associated with timber getting, grazing and pastoralism from the early 19th century onwards.

Early residential settlement in the broader Penrith area was driven by the availability of fertile soil and easily accessible water sources such as creeks and river beds. For example, the Nepean River (to the west of the study area) provided the most fertile soil in the region and occupation and farming took place along its banks and alluvials from 1789 onwards. Over the following decade, frequent flooding forced settlement to spread inland, to the east of the river. At this time, Eastern Creek became associated with smaller allotments, often given to emancipated convicts while land surrounding the study area, further inland and less fertile, was issued to free settlers in the form of large acreages.

Windsor Road and Great Western Road (Great Western Highway) were constructed in the early 19th century to provide access to the region. Accessibility of the region increased further with the advent of rail line extensions in the 1860s. The Great Western Line was extended to Blacktown in 1860, and later extended further northwest to Windsor in 1864.

The area between Prospect and South Creek along the Western Highway was granted to free settlers and ex-convicts between 1818 and 1920. The study area is located within the 800 acres granted to William Cox Junior and extends south into John Thomas Campbell’s 1100 acre grant, Henry Kable’s 200 acre grant and ends on the boundaries of Lochwood and King’s Gift Estates (Figure 2).

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1 Reference to the Crown requiring timber for ship building purposes is noted in the Register Book 8, p94 for Lockwood (see Grants Index 1792-1826 Vol. 1) in AMBS, 2007. p. 11.
4 Tod 2014
5 GML 2014 p. 19
3.2 History of Study Area

3.2.1 Colyton Estate

The northern portion of the study area is located within the former ‘Colyton Estate’. William Cox Junior was granted the 800-acre property in August 1819 (Figure 2). Cox took up the land grant and named it after his wife’s birthplace; Colyton in Devon, England.  

William Cox was well known for supervising the road over the Blue Mountains, which connected the Nepean River to Bathurst in 1814. His primary residence was ‘Hobartville’ near Richmond NSW.

Cox appears to have made minimal use of the land on the south side of the Western Road. An article from 1823 details the cessation of a treaty between Cox and his neighbour Major Druitt to graze cattle on the Colyton Estate indicating that any persons were forbidden to:

“suffer their Cattle, Sheep, or other animals to feed on the said farm, or to make roads, cut down timber, or in any other way to trespass”

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10 The Sydney Gazette and New South Wales Advertiser, Thursday, 6 March 1823
By the 1840's Australia was undergoing an economic depression predominately due to low wool prices, collapse of the grain and livestock market, and the British recession.\textsuperscript{11} It was during this time that Cox created the Village of Colyton. Cox subdivided the Colyton property into various sized lots; with a concentration of smaller residential blocks in the northwest section, near the Western Road bridge over Ropes Creek. The subdivision included road easements to allow access to the larger allotments. One of the new roads connected the southern Campbell Estate to the Western Road (See Section 3.2.2). This road was originally referred to as Chatsworth Road and later became known as Archbold Road (Figure 3). Initially only the blocks fronting the Western Road were sold, with the majority of the estate remaining intact.\textsuperscript{12}

A sales advertisement for the Colyton land published in 1842 indicates that the land was best suited for the rearing of stock. The lands were described as being partially alluvial deposits covered in nutritious grass, forested by Blue Gum, Box, Ironbark and Swamp Oak with an ample supply of water from Ropes Creek and its tributaries.\textsuperscript{13}

The Village of Colyton was largely superseded by Mount Druitt after the introduction of a railway station there in 1881. A number of local businesses disappeared after the widening of the Western Road.\textsuperscript{14} where areas were further impacted during the same period. The study area itself appears to have been left as open agricultural land, with no further development.

During the 19\textsuperscript{th} and 20\textsuperscript{th} centuries the boundaries of allotments changed a number of times. Ray Fitzpatrick Quarries bought land to the east side of Archbold Road (including a portion of the current study area) to establish a large opencut bluestone quarry.\textsuperscript{15} A large piece of the original Colyton Estate was purchased by developers and rezoned to light industrial land in the early 1960s. In 1966 a portion of the estate was resumed for the Sydney West 330kv transmission line, that ran southeast to the substation (Figure 4). The construction of the F4 Western Freeway (now M4 Western Motorway) between the late-1960s to mid-1980s effectively dissected the original property.

The portion of the study area located between the Western Road (Great Western Highway) and the M4 Motorway became associated with industrial development to the west side and residential subdivision of the suburb of Minchinbury to the east. The land to the south of the M4 Motorway was effectively isolated, allowing the continuance of agricultural land use; with the exception of a large bluestone quarry located to the east of the study area.


\textsuperscript{12} Nicolaidis, G. 2000. Eastern Creek and land settlers, p. 73.

\textsuperscript{13} The Sydney Morning Herald, March 1842. Reprinted in Nepean Times, Saturday, 31 January 1931.


Figure 3: Plan of the Village of Colyton, 1842.^{16} Study area in red.

Figure 4: Crown Plan 18133-3000. 330kv transmission easement. Archbold Road still refered to as ‘Chatsworth Road’.

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^{16} Source: HLRV online.
3.2.2 Mount Philo

The central portion of the study area is located within the former ‘Mount Philo’ estate. John Thomas Campbell was granted the 1100 acre property in 1819 (Figure 2).

John Thomas Campbell arrived in Sydney in 1810 and was appointed as Governor Macquarie’s secretary at the recommendation of the earl of Caledon. One notable incident to occur during his term under Macquarie was the publication of a letter in the Sydney Gazette which sarcastically discussed missionary activities in the south seas, signed off with ‘Philo Free’. The letter was a clear attack on Reverend Samuel Marsden, whom subsequently took Campbell to court for the libel. It is believed Campbell named his estate ‘Mount Philo’ as a further insult to Reverend Marsden.

Campbell advertised land within Mount Philo to let in 1821. At the time the estate was described as:

“An open forest estate… abundantly supplied with water, being bounded throughout its entire length, on the west by Ropes Creek.”

Campbell intended to subdivide the land into twenty-two allotments of 50 acres each, all of which would be adjoining the creek. The following year Campbell indicated that some cattle livestock was for sale, which could be viewed at Mount Philo. Included with the advertisement was Campbell’s notice for land to let at Mount Philo.

After Campbell’s death in 1830, Mount Philo was inherited by Reverend Charles Campbell and soon sold to Charles Roberts for £430. Roberts resided with his family at the nearby homestead of ‘Lucan Park’. Roberts and William Hayes had been purchasing numerous properties within the region, including ‘Wallgrove’. The property was then set up for the breeding of horses; including racehorses and carthorses. A number of stabling areas were established, as well as housing to accommodate the workers on the stud farm. However, due to financial difficulties; the Roberts family were forced to take out a number of mortgages and lease out portions of their land holdings. By 1856 Charles Roberts was forced to sell Mount Philo. The estate was sold in September 1856 by Messrs Mort and Co for £2900.

Mount Philo was purchased in 1856 by three brothers; Thomas, David and Patrick Shepherd. The brothers also purchased a 200-acre portion of the adjoining Erskine Park Estate, located on the west side of Ropes Creek. They consolidated the two landholdings and renamed the property ‘Chatsworth’ (Figure 5). David Shepherd lived on the Chatsworth estate with his wife and seven children. The family home is believed to have been located near Ropes Creek; however, the exact location is unknown (Figure 6).

The Shepherd family were responsible for the Darling Nursery in Chippendale and continued horticulture at Chatsworth. A newspaper article describes a visit to Chatsworth estate which indicates that approximately 50 acres of land was cultivated for the nursery; including 600 orange trees of

18 The Sydney Gazette, 4 January 1817.
20 The Sydney Gazette, Saturday, 29 December 1821.
21 The Sydney Gazette, Friday, 4 January 1822.
22 Nicolaidis, G. 2000. Eastern Creek and land settlers, p. 27.
24 The Sydney Morning Herald, Thursday, 25 September 1856.
25 Nicolaidis, G. 2000. Eastern Creek and land settlers, p. 44.
numerous varieties. The Chatsworth orchards utilised an extensive earthenware subsoil drainage network; which purportedly allowed for earlier cultivation, as it kept the roots warm. Around 120 head of cattle were being kept on the estate during this time.\textsuperscript{27}

In 1909, Chatsworth began to be sold off. David Shepherd sold off his portion of the property to Thomas Baker, including the homestead near Ropes Creek. Baker was an experienced timber man, who started clearing the trees across Chatsworth; which were taken to his timber mill near Rooty Hill railway station.\textsuperscript{28}

Baker sold Chatsworth to Burfield Pty Ltd in 1955, which then transferred to Ray Fitzpatrick Quarries. A portion of the estate was purchased for the Sydney West 330kv. Sub-Station in 1966 which created the irregular lot boundaries across the area that exist today\textsuperscript{29}. Throughout this time Archbold Road remained unsealed until the construction of the M4 Motorway\textsuperscript{30}.

\textbf{Figure 5: Parish of Melville (detail), 1898.}\textsuperscript{31} Study area in red, Chatsworth Estate in orange.

\textsuperscript{27} Evening News, Tuesday, 15 August 1871.
\textsuperscript{28} Nicolaidis, G. 2000. \textit{Eastern Creek and land settlers}, p. 49.
\textsuperscript{29} Annotation on Parish of Melville Map
\textsuperscript{30} GML 2014, p 6
\textsuperscript{31} Source: HLRV online.
Figure 6: Chatsworth homestead near Ropes Creek

Figure 7: Crown Plan 18133-3000. Substation and transmission easement which dissects Chatsworth.

32 Source: Nicolaidis 2000:48
3.3 Henry Kable’s Estate

The southern portion of the study area is located within a 700 acre property granted to Henry Kable in 1819 (Figure 2).

Henry Kable was convicted of burglary and transported to Sydney on the First Fleet ship, the Friendship. He was made an overseer by Governor Arthur Phillip. Later he became a constable and nightwatchman and eventually rose to chief constable. However, he was dismissed in 1802 for illegally importing pigs.

Kable was able to accumulate a number of land holdings within NSW. He held land at Petersham Hill, Eastern Creek and a number of farms in the Hawkesbury region. He also purchased a variety of real estate in Sydney; which is where he resided.

There appears to be no evidence of how Kable utilised his land holding at Eastern Creek when it was first granted. By 1834 it was leased to George Roberts Nichols and then transferred to G. Weston by 1836. An investigation into Kable’s land holdings by Commissioner John Thomas Bigge in 1820, reveals that the land grant was no longer owned by Kable.

A reconnaissance map of the region of the Liverpool army camp from 1906 indicates that the general region had been partially cleared, with areas of thick sapling scrub and woodlands. The Kable Estate is marked as an area of ‘cultivation’; with a structure located on a rise within the central-west portion, outside of the study area (Figure 8).

In 1919, the land associated with Kable Estate was resumed by the Crown for the Closer Settlement Scheme. The Closer Settlement Scheme (1919–1936) was an initiative set up by the Australian government at the end of World War One as part of the Returned Soldier Settlement Act of 1916. The scheme was designed to boost the Australian economy by developing the rural sector. From its establishment in 1919, over 8,819 soldier settlers were granted an estimated four million acres of land in NSW.

Land to be reserved for the Lenore Estate Closer Settlement was surveyed in 1919 and included the Kable Estate (the study area), Lochwood and portions of Erskine Park. In 1920 the surveyed land was resumed and subdivided into seven separate lots. These lots were titled Farms A–G and were all roughly the same size, however their shapes differed. Farms associated with the Lenore Estate were designed around existing farming infrastructure in order to allow for soldiers to easily settle on the land. The study area is located within Farm E, which maintained the same boundaries as the original land grant (Figure 9). The Penrith Council valuation list from 1935 records the owner of Farm E as Arthur Renwick Poolman. In 1939 Farm E was transferred to Arthur Stockman and by 1950 it was purchased by Harrie Davis.

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35 Hainsworth 1967. Online.
37 Hainsworth 1967. Online.
Figure 8: Reconnaissance map of the neighbourhood of Liverpool camp, 1906.  

Figure 9: Crown Plan 32917-2030 Farm E Closer Settlement. Study area in red.  

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41 Source: SLNSW, Slate Library of NSW, M 981.2/A.
3.4 The Warragamba–Prospect Pipeline

The Warragamba–Prospect pipeline runs through the southern portion of the study area. The construction of the Warragamba–Prospect pipeline was part of planning to provide Sydney with water. Construction of the prospect reservoir located 5.5 kilometres east of the current study area was completed in 1888. It was constructed to store water from the Upper Nepean scheme for use in Sydney. However, by 1930 it was recognised that the Upper Nepean Scheme was unable to supply all of Sydney’s water needs. This was particularly evident following the drought of 1934-1942 which left prospect reservoir almost depleted.

In order to construct the pipeline large tracts of land were reclaimed including portions of both Chatsworth and Henry Kable’s Estate. Within these allotments land for the pipeline was reclaimed between 1940 and 1943. Construction of the pipeline began in 1938 which consisted of a single pipeline with a 48-inch diameter. This was replaced in 1957 with an 84 inch pipeline with a second 84 inch pipeline constructed in 1959.

3.5 Aerial Imagery Analysis

Analysis of aerial imagery for the study area indicates that a number of structures were formerly standing adjacent to and within the study area. The ruins of some of these structures are still visible today. The 1947 aerial indicates that the study area was largely cleared of native vegetation and used for agricultural purposes (Figure 10 and Figure 11). The only structure visible on the 1947 aerial located within the study area appears to be a series of three yards. The various structures adjacent to the study area appear to be a mix of sheds and houses with associated yards. All of the dams in the area were established by 1947. Archbold Road appears to follow the same alignment it does today although it is unsealed. The original alignment of Old Wallgrove Road is shown in the 1947 aerial and is also unsealed.

Between 1947 and 1977 there does not appear to be any substantial changes to the central portion study area (Figure 12). The M4 Motorway has been constructed by this time and several other smaller roads extend to the east and west of Archbold Road in the northern portion of the study area. The establishment of the southern portion of the study area as an industrial estate appears to have begun by the 1970s with a large warehouse complex visible on the 1977 aerial. Old Wallgrove Road has been sealed by this time.

Between the 1947 and 1977 aerials some of the buildings in the central region appear to have been demolished and the cultivated fields disappear. It appears that the central portion of the study area became largely focused on grazing at this point. A shed appears on the 1977 aerial in association with the yard complex located within the study area. This appears to have been demolished by 2006. It appears that the northern extent of Archbold Road was sealed between 1947 and 1977.

The main changes to have occurred in the study area over the last 70 years are to the northern and southern extents of the study area where intense residential and industrial development has occurred. Between 1977 and the present the only changes to the central portion of the study area appear to be the demolition of former structures.

42 Based on 1948 Melville Parish Map, Map no 14016301, SixMaps Historical Viewer
Figure 10: 1947 Aerial, northern section of study area shown in red\textsuperscript{44}

Source: LPI

Figure 11: 1947 aerial, southern section of study area shown in red\textsuperscript{45}

\textsuperscript{44} Source: LPI

\textsuperscript{45} Ibid
Figure 12: 1977 aerial, study area shown in red\textsuperscript{46}

\textsuperscript{46} Source: Blacktown MapsOnline
4.0 SITE INSPECTION

4.1 Brief Overview

A site inspection was conducted by Claire Rayner and Alex Timms (Artefact) in order to locate any visible archaeological remains or potential heritage items, to understand the site topography, assess the condition of the study area and identify any areas of previous disturbance. The survey area was covered on foot and undertaken in accordance with best practice standards.

The study area generally consists of open undulating green fields. The northern and southern portions include industrial and residential areas that have been heavily built up. The study area is currently used for grazing cattle. Tracks meander through the study area in a generally north-south direction. A number of dams are located throughout the area. Various buildings were identified during the background research for this assessment. Only one of these is located within the study area.

4.2 Shed and Yard Complex

This item consists of a row of three yards and a collapsed shed (Plate 1 at right of frame). The shed appears to have been demolished and/or collapsed sometime in 2004. The yards are surrounded by dilapidated timber fencing (Plate 2). The easternmost yard features a sandstone block floor and is slightly raised above the level of the other yards (Plate 3). This yard measures approximately 22 metres by 24 metres. The sandstone blocks varied in size but generally measured around 20 centimetres long, 15 centimetres wide and 10 centimetres deep. The construction of this yard surface represents a substantial effort and given the materials used, it could date from the 19th century.

A concrete slab associated with two circular well / cistern features is located next to the southern border of the central yard (Plate 4). The concrete feature is 20th century in date and would have been used to seal the well / cistern features once they went out of use. Many of the timbers associated with the site appear to have been burnt suggesting a fire went through the area at some point.

Plate 1: View east across yards
Plate 2: Dilapidated fence line
4.3 Archbold Road and Old Wallgrove Road

Background research has indicated that the alignment of Archbold Road and Old Wallgrove Road has been in place since at least the 1840s. The northern portion of Archbold road features modern bitumen surfaces, concrete kerbing and stormwater drains. A bridge has been constructed spanning the M4 Motorway. The road is sealed for approximately 780 metres south of the bridge. This portion of the road has not been as well maintained as the northern portion. Several large pot holes were observed during the site visit. Archbold Road continues south east from the sealed section as a dirt track towards a tributary of Ropes Creek. This section of the road is clearly visible in the 1947 aerial.

Old Wallgrove Road has been significantly modified and modernised since it was originally established. Like the northern section of Archbold Road, it features sealed bitumen surfaces, concrete kerbing and stormwater drains.
4.4 Warragamba-Prospect Pipeline

A small section of the Warragamba-Prospect Pipeline is located within the southern portion of the study area. The pipeline consists of two pipelines with a sealed road running between them and associated infrastructure. The Pipeline runs along across the southern portion of the study area for approximately 300 metres before running underneath Milner Avenue.
5.0 HERITAGE AND ARCHAEOLOGICAL ASSESSMENT

5.1 Heritage Items

The desktop analysis identified four potential heritage items / archaeological sites within the study area:

- Shed and Yard Complex
- Archbold Road
- Old Wallgrove Road
- Warragamba-Prospect Pipeline

These items were inspected during the site survey and it was found that the former shed and yard complex was in a collapsed and dilapidated condition, therefore it is assessed as a potential archaeological site rather than a built heritage item.

5.1.1 Archbold Road

Archbold Road remained an unsealed dirt track until the mid to late-20th century. The alignment of Archbold road is associated with the early 1840s subdivisions of the Village of Colyton. The section of road north of the M4 Motorway has been modernised with bitumen surfaces, concrete kerbing and drains. The construction of the M4 Motorway would have disturbed a section of the original alignment of the road and a bridge over this motorway connects the southern and northern portions of Archbold Road. Immediately south of the M4 Motorway the road is sealed for approximately 780 metres after which it becomes an unsealed track. It is unlikely that Archbold Road contains any heritage fabric or archaeological potential. Aerial imagery suggests that the plantings lining the road are recent. Therefore, whilst the alignment of the road is associated with the 1840s Village of Colyton it does not have aesthetic value and is not considered to be intact. The physical remains of Archbold Road within the study area do not reach the threshold of local significance.

5.1.2 Old Wallgrove Road

Old Wallgrove Road remained an unsealed dirt track until the mid to late-20th century. It is associated with the original Wallgrove Estate and Lochwood Estate dating to the early-mid nineteenth century. The section of Old Wallgrove Road within the study area provides access to the industrial area located to the south of the study area. It features modern bitumen surfaces and concrete kerbing and drains. The road is heavily used by large trucks entering and exiting the industrial estates. It is likely that the road is regularly maintained to withstand such high traffic by heavy vehicles. There were no original plantings identified along the roadway. Old Wallgrove Road is not considered to have aesthetic value and is highly disturbed. It is unlikely that Old Wallgrove Road contains any heritage fabric or archaeological potential. The physical remains of Old Wallgrove Road within the study area do not reach the threshold of local significance.

5.1.3 Warragamba-Prospect Pipeline

The Warragamba-Prospect Pipeline was originally included on the Draft Sydney Catchment Authority (now WaterNSW) s170 register as an item of local significance. The register searches conducted for this assessment have identified that the pipeline is currently not listed on the WaterNSW s170 register, the Blacktown LEP or the SHR. A full assessment of significance has not been provided as the following statement of significance was included in the previous listing.
The statement of significance is as follows:

The Warragamba Pipelines are significant in their relationship to Warragamba Dam and its role in delivering drinking water to the ever increasing population of Sydney. The pipelines are the means by which the water is delivered from the Dam to the Prospect Water Filtration Plant.

During the record drought which lasted from 1934 to 1942 construction of the Warragamba Emergency Scheme was initiated to deliver water to the city of Sydney. This scheme also ensured that water was delivered to the city during the Second World War. The Emergency Scheme was the result of rapid engineering response to the water crisis.

The visual curtilage of the pipeline is extensive extending from Warragamba to Prospect. The pipeline is a major feature of the landscape along which it runs. The physical and operational curtilage includes the pipeline and the accompanying/supporting structures. Operational curtilage would extend the distance along the route of the pipeline along SCA owned property and a three metre buffer zone around the pipeline.

5.2 Archaeological Potential

Historical archaeological potential is assessed by identifying former land uses and associated features through historical research, and evaluating whether subsequent actions (either natural or human) may have impacted on evidence for these former land uses.

The following discussion of the historical archaeological potential of the study area is not intended to be exhaustive. Based on the history of the site and the likely lack of disturbance that has occurred in some areas, there is always some probability that unexpected historical archaeological remains may be encountered during works.

5.2.1 Land Use Summary

Following land clearance, the majority of the study area was subject to pastoral and other rural land uses. Analysis of mid-20th century aerial imagery indicates the presence of sheds and yards in the central portion of the study area. These have since been demolished. The northern and southern portions of the study area have been heavily modified by residential and industrial development since the mid to late 20th century. Land use within the study area can be separated into three phases:

- Phase 1 (1819 – mid-19th century). This phase is associated with land clearance, low intensity pastoral / agricultural uses, early subdivisions and animal rearing.
- Phase 2 (mid-19th century – mid-20th century). This phase is associated with low intensity pastoral / agricultural uses, further subdivisions, the Chatsworth Estate and horticulture.
- Phase 3 (Mid-20th century - present). This phase is associated cattle grazing and increased urbanisation and industrialisation of the northern and southern extents of the study area.

47 Taken from the Draft Warragamba-Prospect Pipeline listing in the draft Sydney Catchment Authority Heritage and Conservation Register
Previous impacts to the northern and southern extents of study area have been substantial. Previous
impacts to the central portion of the study area have been limited to the demolition of shed and yard
complex and possible fire through this area.

5.2.2 Shed and Yard Complex

The shed and yard complex consists of the ruins of three yards, a collapsed shed, two circular well /
cistern structures and a concrete pad (Figure 13, Figure 14 and Figure 17). The easternmost yard
features a relatively intact sandstone block floor. This yard measures approximately 22 metres by 24
metres. The sandstone blocks are substantial in size and the floor would have required a
considerable effort in its construction. It is likely that the yards were used to keep large hoven animals
such as horses and cattle.

Given the materials used in the construction of the eastern yard floor the item is likely to date from the
19th century. The presence of concrete pads would suggest continued use into the 20th century. The
potential 19th century date of the complex could associate the site with the Chatsworth Estate. The
exact location of the Chatsworth homestead is unknown however documentary sources place it near
Ropes Creek to the west of the shed and yard complex. The aerial imagery analysis indicates that the
yards were added to over time from 1947. This includes the addition of a shed on the western side of
the yards between 1947 and 1977 and concrete slabs identified during the site inspection to the south
of the yards.

There is high potential for the shed and yard complex to contain archaeological remains. These
remains may include:

• Structural remains, such as footings and postholes associated with the yard fencing and shed,
• Water collection and storage features such as drains, wells and cisterns,
• Former yard surfaces.

As the site is not a domestic site, there is low potential for the site to contain artefact bearing deposits
which could demonstrate the use and activities taking place within the complex. Potential artefacts /
items which may be present include horse shoes, nails and tools.
Figure 13: Summary of archaeological potential

Legend
- Study Area
- Final concept design
- High potential for archaeological remains associated with Shed and Yard Complex
- Nil to low potential for archaeological remains
Figure 14: Detailed view of shed and yard complex
5.3 Archaeological Significance

5.3.1 Assessment Methodology

The Heritage Division of the Office of Environment and Heritage (OEH) issued a new set of guidelines in 2009: *Assessing Significance for Historical Archaeological Sites and ‘Relics’*. The following section presents a discussion of the potential archaeological resource’s research potential and an assessment against the NSW heritage significance criteria.

**Research Potential**

Consideration of archaeological research potential is required when undertaking a significance assessment of an historical archaeological site. Bickford and Sullivan espoused the principles and developed a framework to assess archaeological research potential. These principles have been incorporated into three questions and should be used as a guide for assessing the research potential of an archaeological site:

- Can the site contribute knowledge that no other site can?
- Can the site contribute knowledge that no other resource can?
- Is this knowledge relevant to general questions about human history or other substantive questions relating to Australian history, or does it contribute to other major research questions?

**NSW heritage significance criteria**

There are seven criteria for assessing heritage significance (table below). These are centred on the Burra Charter of Australia ICOMOS and the assessment process is outlined in the NSW Heritage Manual and the Archaeological Assessment Guidelines. If an item or archaeological site meets one of the seven heritage criteria, and retains the integrity of its key attributes, it can be considered to have heritage significance. The significance of a potential item or archaeological site can then be assessed as being of Local or State significance. If a potential relic is not considered to reach the local or State significance threshold, then it is not a relic under the Heritage Act.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A – Historical Significance</td>
<td>An item is important in the course or pattern of the local area’s cultural or natural history.</td>
</tr>
<tr>
<td>B – Associative Significance</td>
<td>An item has strong or special associations with the life or works of a person, or group of persons, of importance in the local area’s cultural or natural history.</td>
</tr>
<tr>
<td>C – Aesthetic Significance</td>
<td>An item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in the local area.</td>
</tr>
<tr>
<td>D – Social Significance</td>
<td>An item has strong or special association with a particular community or cultural group in the local area for social, cultural or spiritual reasons.</td>
</tr>
<tr>
<td>E – Research Potential</td>
<td>An item has potential to yield information that will contribute to an understanding of the local area’s cultural or natural history.</td>
</tr>
<tr>
<td>F – Rarity</td>
<td>An item possesses uncommon, rare or endangered aspects of the local area’s cultural or natural history.</td>
</tr>
</tbody>
</table>

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48 Bickford, A and S Sullivan, pp. 23-24
49 NSW Heritage Office 1996; 25-27
### G - Representativeness
An item is important in demonstrating the principal characteristics of a class of NSW's cultural or natural places of cultural or natural environments (or the cultural or natural history of the local area).

### 5.3.2 Archaeological Research Potential

The archaeological resource associated with the shed and yard complex could contribute to research questions concerning pastoralism in the local region. The possible connection of the item to the Chatsworth Estate and continued use from Phase 2 to Phase 3 highlights the potential of the item to provide information on changes to the pastoral practices from the early 19th century onwards. This may in turn provide information on rural economies and trade during this time period.

Information on the early land uses of the study area is not readily available from other sources. Similar sites have recently been investigated within the vicinity of the study area. Artefact Heritage conducted excavations of outbuildings associated with the former Lochwood Estate to the south west of the study area. The outbuildings were found to be within a similarly undisturbed context. The excavations identified artefact bearing deposits and remains associated with the outbuildings. The proximity of these sites within similar contexts provides an opportunity to compare findings associated with similar practices during similar time periods. This would in turn enable a comparison of the methods employed within two neighbouring estates. Such comparisons may indicate the nature of the local economy and perhaps the exchange of knowledge between early estates in the mid-19th century.

### 5.3.3 NSW Heritage Significance Criteria

The significance assessment for the archaeological potential of the shed and yard complex potential archaeological remains is as follows:

**Table 1: Heritage significance of the shed and yard complex potential archaeological remains**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A – Historical Significance</td>
<td>The shed and yard complex potential archaeological remains are associated with the historical development of the local area. The site is located within the original Mount Philo Estate. The area was later acquired by Charles Roberts who established a stud farm on the property. The Chatsworth Estate was established during the 1850s. It is likely that the yards were established in association with this period. The appearance of the item in the 1947 aerials indicates that it was maintained up until the mid-20th century. Therefore, the use of the item is related to Phase 2 and Phase 3. The potential archaeological remains are associated with the local area’s history, development and rural economy. If the potential archaeological resources were confirmed to be associated with 19th century occupation and the Chatsworth Estate, the archaeological remains would meet the local significance threshold for this criterion</td>
</tr>
<tr>
<td>B – Associative Significance</td>
<td>The site is located within the former estates of John Thomas Campbell, Charles Roberts and the Chatsworth Estate. It is unlikely that the archaeological resource would contain remains easily associated with these land owners.</td>
</tr>
</tbody>
</table>
Criteria | Description
---|---
**C – Aesthetic Significance** | Although it is recognised that exposed in situ archaeological remains may have distinctive/attractive qualities, only rarely are these considered ‘important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW’.

The potential archaeological remains do not meet the local significance threshold for this criterion.

**D – Social Significance** | Community consultation was not undertaken for this assessment. It is unlikely the remains would have social significance as their whereabouts are not well known to the public.

The potential archaeological remains do not meet the local significance threshold for this criterion.

**E – Research Potential** | Documentary sources for the early land uses of the study area are scarce. The archaeological resource has the potential to provide information on early pastoral practices within the region. The evidence of modifications to the site indicates its continued use through time therefore the archaeological resource may reflect changing agricultural practices through time. This in turn could contribute to research questions concerned with rural economies and trade. The proximity of this site with others of a similar nature present an opportunity to compare the archaeological resources at both sites. This may provide insights as to the methods employed at different estates and perhaps the sharing of knowledge and trade between rural estates in the mid-19th century.

Depending on their nature and extent, the potential archaeological remains may meet the local significance threshold for this criterion.

**F – Rarity** | The archaeological resource is not considered rare as there are potentially many similar archaeological sites in NSW.

The potential archaeological remains do not meet the local significance threshold for this criterion.

**G - Representativeness** | The archaeological resource is unlikely to demonstrate any particular characteristics of NSW’s cultural or natural places of cultural or natural environments or for the local area.

The potential archaeological remains do not meet the local significance threshold for this criterion.

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5.3.4 Preliminary Statement of Significance

The shed and yard complex site is potentially associated with the Chatsworth Estate and the 19th century rural history and development of the local area. Depending on the nature of the archaeological remains, in particular if there were artefacts or remains indicating specific activities within the complex, they could provide evidence of the site’s former uses and answer research questions regarding rural practices of the Chatsworth Estate and the local area. Therefore, potential archaeological resource of the shed and yard complex site may have research potential and could be considered to be of local significance. Further archaeological investigation would clarify whether the remains were of local significance and therefore considered relics under the Heritage Act.
6.0 HERITAGE IMPACT ASSESSMENT

6.1 Proposed works

The proposed works will include (see Figure 15 and Figure 16):

- Upgrade of the existing 2km of the road south of the Great Western Highway from 2 to 4 lanes including bridge duplication over the M4 Motorway and east facing M4 ramps.
- Extend Archbold Road further south by another 2km with a 4-lane dual carriageway to meet with EPLR.
- Extend Archbold Road further south by another 1km with a 4-lane dual carriageway to meet the Old Wallgrove Road southern extension near the Warragamba-Prospect Pipeline including a bridge over the Pipelines (85 metre).
- Includes a kerb to dimension of 21 metres. 4.5 metre wide kerb side lane; 3.5 metre wide inside lane and a 5m wide median. The footway reservation is 4.5 metre on both sides to make it a 30m wide road corridor plus batters.
- Provide cross drainage structures along creek crossings.
- The existing bridge over the M4 Motorway to be part of future north bound carriageway. The bridge duplication would take place to the east of the existing bridge over the M4.
- Provide signalised intersections at key nodes to access existing and proposed employment generating precincts.
- Provide bus priority measures.
- Provide a three metre wide shared path along the western side of the road.

6.2 Heritage Impact Assessment

6.2.1 Warragamba-Prospect Pipeline

The proposed works include the construction of an 85 metre bridge connecting the proposed Archbold Road extension to Old Wallgrove Road spanning the Warragamba-Prospect Pipeline. The construction of the bridge is would not have direct physical impacts on the heritage fabric of the pipeline. The bridge and road would be an additional item within the visual curtilage of the pipeline. However, as it is localised, it would result in negligible impact to the overall significance of the item.

As the item would not be subject to impacts a full SoHI under the Heritage Council Statements of Heritage Impacts guidelines is not provided.

6.3 Archaeological Impact Assessment

6.3.1 Shed and Yard Complex

The initial impacts to the shed and yard complex site would be bulk earthworks involved in levelling the terrain prior to road construction. According to the current concept design the road would run directly through the sandstone paved yard and the middle unpaved yard (Figure 17). Works such as bulk earthworks and excavations would result in the complete removal of the sandstone yard and associated features such as the surrounding timber fenceline.
The well/cistern feature, the remnants of the shed and the western unpaved yard are all located outside of the footprint of the proposed works. The area of archaeological potential outside the prosed impact footprint should be protested by an exclusion zone. If impacts were to occur within the area of potential archaeological management would be required.

6.4 Summary of Impacts

The following table summarises the Proposal’s heritage impact.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Significance</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Archbold Road</td>
<td>Part of mid-19th century road alignment</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Old Wallgrove Road</td>
<td>Part of mid-19th century road alignment</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Warragamba-Prospect Pipeline</td>
<td>Mid-20th century engineering item</td>
<td>Local</td>
<td>No direct impact to fabric</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Negligible impact to views / vistas</td>
</tr>
<tr>
<td>Shed and Yard Complex</td>
<td>Potential 19th century archaeological site</td>
<td>Potentially Local (relics)</td>
<td>Direct impact (partial)</td>
</tr>
</tbody>
</table>

6.5 Management and Mitigation Measures

6.5.1 Built Heritage Items

The impacts to the Warragamba-Prospect Pipeline have been assessed as negligible. Therefore, there are no mitigation measures recommended for works near the pipeline. The location of the pipeline should be marked on environment management maps for the project.

6.5.2 Potential Archaeological Site

There is high potential for archaeological remains within the shed and yard complex site (Figure 17). Potentially these remains date from the 19th century and could have research potential and local heritage significance, depending on their nature and extent. Therefore, the proposal could potentially impact archaeological ‘relics’ which are protected under the Heritage Act.

Archaeological test excavation and survey should be undertaken to further clarify the research potential and significance of the site, and to determine whether the archaeological remains would be considered ‘relics’ as defined by the Heritage Act. The archaeological test excavation and survey should be undertaken within the curtilage defined in Figure 14. A section 139(4) exception from the NSW Heritage Division would be required to undertake archaeological test excavation.

If determined to be relics, a section 140 archaeological excavation permit from the NSW Heritage Division would be required to impact the relics. Further archaeological investigation, such as salvage excavation and recording, would mitigate impacts to archaeological relics. A section 140 permit would be required to undertake archaeological excavation.
Figure 15: Proposed impacts to northern section of the study area
Figure 16: Proposed impacts to the southern section of the study area
Figure 17: Proposed impacts to the shed and yard archaeological site
7.0 CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

- Historically the study area was associated with the early 19\textsuperscript{th} century estates of William Cox, John Thomas Campbell and Henry Kable. The study area has typically been associated with pastoralism and horticulture, including orchards of the Chatsworth Estate during the mid-19\textsuperscript{th} century. By the late 20\textsuperscript{th} century the northern and southern extents of the study area had become high urbanised and industrialised. The central portion has largely been used for cattle grazing since the mid-19\textsuperscript{th} century and as such is not as highly disturbed as the northern and southern portions.

- There are no listed heritage items located within the study area.

- There is one unlisted heritage item (Warragamba-Prospect Pipeline) located within the study area. The proposal would have a negligible impact to the Warragamba-Prospect Pipeline.

- One potential archaeological site is located with the central part of the study area. The shed and yard complex site potentially dates from the 19\textsuperscript{th} century and could be associated with the Chatsworth Estate. The archaeological remains are potentially of local heritage significance and relics as defined by the Heritage Act. The proposal would result in at least partial direct impact on the shed and yard complex site. Further archaeological investigation would manage and mitigate the potential impact.

7.2 Recommendations

- Impacts to the Warragamba-Prospect Pipeline would be avoided. The location of the pipeline would be marked on environmental control maps for the project.

- Further archaeological investigation of the shed and yard complex site where it is to be impacted should be undertaken. The investigation would include:
  - Test excavation to clarify the nature of the remains and determine if they are significant, have research potential and be considered relics under the Heritage Act.
  - Detailed archaeological survey of the visible remains as part of the test excavation program.

- The archaeological testing and survey program should be undertaken with a section 139(4) exception approval from the NSW Heritage Division. The application would require a report which outlines the proposed archaeological test excavation and survey methodology.

- Should the archaeological testing program identify relics, a section 140 excavation permit and further archaeological investigation, such as salvage excavation and recording, would be required to impact or remove them.

- The remainder of the area identified as having archaeological potential should be protected by an exclusion zone and should be marked on environmental control maps for the project.

- In those areas of the site having nil-low potential, it is recommended that the Roads and Maritime Services Procedure: Unexpected Heritage Finds is implemented.
8.0 REFERENCES


Nicolaidis, G. 2000. Eastern Creek and land settlers. Blacktown City Council, Blacktown NSW


Appendix J

Businesses local to the proposal footprint
<table>
<thead>
<tr>
<th>Local Businesses</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Courier/ Logistics</strong></td>
<td></td>
</tr>
<tr>
<td>Star Track Express</td>
<td>Sargents Road</td>
</tr>
<tr>
<td>Woolworths distribution centre</td>
<td>Sargents Road</td>
</tr>
<tr>
<td><strong>Retail</strong></td>
<td></td>
</tr>
<tr>
<td>Bunnings Warehouse</td>
<td>John Hines Avenue</td>
</tr>
<tr>
<td>National Storage</td>
<td>Carlisle Avenue</td>
</tr>
<tr>
<td>Budget and Upmarket Tiles</td>
<td>Purdy Street</td>
</tr>
<tr>
<td>Minchinbury Forklifts</td>
<td>Purdy Street</td>
</tr>
<tr>
<td>Reece Plumbing</td>
<td>Eddie Road</td>
</tr>
<tr>
<td>Doors Plus</td>
<td>Sterling Road</td>
</tr>
<tr>
<td>Swimart</td>
<td>Sterling Road</td>
</tr>
<tr>
<td>Dada Tiles</td>
<td>Sterling Road</td>
</tr>
<tr>
<td>Linfield Furniture</td>
<td>Sterling Road</td>
</tr>
<tr>
<td>Boresi Fencing</td>
<td>Colyton Road</td>
</tr>
<tr>
<td>Budget Camping</td>
<td>Colyton Road</td>
</tr>
<tr>
<td>Minchinbury Lighting</td>
<td>Colyton Road</td>
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<td>Middy’s</td>
<td>Colyton Road</td>
</tr>
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<td>My Baby Warehouse</td>
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<tr>
<td>Truck Parts Australia</td>
<td>Sargents Road</td>
</tr>
<tr>
<td>Lounge King</td>
<td>Sargents Road</td>
</tr>
<tr>
<td>Hot Springs Outlet</td>
<td>Eddie Road</td>
</tr>
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<td>Fencing and Gate Centre</td>
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</tr>
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<td>Natasha Marie Clothing</td>
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<td>Kingloc Commercial Equipment</td>
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</tr>
<tr>
<td>Estelle Frameless Fittings</td>
<td>Eddie Road</td>
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<td>Minchinbury Lounge Factory</td>
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<tr>
<td>Australian Outdoor Living</td>
<td>Grex Avenue</td>
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<td><strong>Food and Beverage</strong></td>
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<td>Colyton Road</td>
</tr>
<tr>
<td>Snatch Café</td>
<td>Sargents Road</td>
</tr>
<tr>
<td>Eddie Road Lunch Shop</td>
<td>Eddie Road</td>
</tr>
<tr>
<td><strong>Service stations</strong></td>
<td></td>
</tr>
<tr>
<td>BP Minchinbury</td>
<td>Great Western Highway</td>
</tr>
<tr>
<td>7-Eleven Minchinbury</td>
<td>Great Western Highway</td>
</tr>
<tr>
<td><strong>Car Dealerships</strong></td>
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</tr>
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<td>Car City Minchinbury</td>
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<tr>
<td>First Choice Autos Minchinbury</td>
<td>Carlisle Avenue</td>
</tr>
<tr>
<td>Mates Rates</td>
<td>Carlisle Avenue</td>
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<tr>
<td>Outwest Wholesale</td>
<td>Carlisle Avenue</td>
</tr>
<tr>
<td><strong>Manufacturing and Service Industry</strong></td>
<td></td>
</tr>
<tr>
<td>Big wheel Tyre &amp; Mechanical Repairs</td>
<td>Eddie Road</td>
</tr>
<tr>
<td>Bluey’s Crane and Float Repairs</td>
<td>Eddie Road</td>
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<tr>
<td>Hi Comp Performance Engines &amp; Tuning</td>
<td>Eddie Road</td>
</tr>
<tr>
<td>Cowling TV Services</td>
<td>Eddie Road</td>
</tr>
<tr>
<td>Liquid Intelligence</td>
<td>Eddie Road</td>
</tr>
<tr>
<td>Target Electronic Services</td>
<td>Marieanne Place</td>
</tr>
<tr>
<td>Sunnyfield</td>
<td>Eddie Road</td>
</tr>
<tr>
<td>Dunlop Minchinbury</td>
<td>Colyton Road</td>
</tr>
<tr>
<td>Extreme tyres</td>
<td>Sterling Road</td>
</tr>
<tr>
<td>TLE Electrical Minchinbury</td>
<td>Marieanne Place</td>
</tr>
<tr>
<td>Pace Farm</td>
<td>Kippist Avenue</td>
</tr>
<tr>
<td>Office</td>
<td>Aldi</td>
</tr>
</tbody>
</table>
Appendix K

Landscape character, visual impact and urban design technical paper
ARCHBOLD ROAD URBAN AND LANDSCAPE DESIGN REPORT

Prepared by

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Document Issue Date Status Reviewed Validated
S15-0082 A 27/05/16 DRAFT LC MK

Note: this document is preliminary unless validated.

Cover: Disused Archbold Road bridge over M4

This Page: Eucalypt tree standing in area of private farmland near proposed road corridor
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<td>57</td>
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Sydney Water Pipeline that crosses Project area
1.0

introduction
1.0 INTRODUCTION

The NSW Government is investigating the extension of Archbold Road from the Great Western Highway at Minchinbury to Old Wallgrove Road at Eastern Creek. This would support current and future traffic demands due to the growth of the Western Sydney Employment Area (WSEA).

Part of this proposal was first identified in 2007 under the Erskine Park Link Road Network Concept Plan, which identified the need to build a number of roads to service the development of the WSEA. The second part of the proposal was identified in 2010 under a concept plan application the landowner (Jacfin) made to the NSW Department of Planning and Environment to develop Ropes Creek Industrial Estate.

1.1 PURPOSE OF REPORT

CLOUSTON Associates has been commissioned by WSP Parsons Brinckerhoff on behalf of RMS to prepare the Urban Design and Landscape Report, including a Landscape Character and Visual Impact Assessment (LCVIA) for the proposed road extension and upgrade (hereafter, referred to as 'the Project').

The purpose of the report is to support the review of environmental factors (REF) for the Project and assist with the development of the concept design. The report will help inform the design direction, avoid / minimise impacts and set strategies to mitigate those impacts. The intent is to improve the physical design outcome through an integrated engineering and urban design response that is contextually sensitive.

This report is one of a number of technical reports supporting the REF for the Project.

1.2 METHODOLOGY

The concept design has been developed in accordance with the policy and guidelines set down in the following RMS urban design documents:

- Beyond the Pavement: Urban Design Policy, Procedures and Design Principles (2009)
- EIA Guidance Note: Guidelines for landscape character and visual impact assessment
- RMS Landscape Guidelines
- RMS Bridge Aesthetics

The objective of these reference documents is to ensure a positive urban design outcome is achieved by minimising the impact of infrastructure projects on natural, built and cultural landscapes. The aim is to develop an integrated physical design direction to achieve good physical, functional and aesthetic outcomes that are contextually sensitive.

The 9 Key Urban Design Principles outlined in RMS ‘Beyond the Pavement’ include:

- contributing to urban structure and revitalisation
- fitting into the built fabric
- connecting modes and communities
- fitting with the Landform
- responding to Natural Patterns
- incorporating heritage and cultural context
- designing an experience in movement
- creating self explaining Road environments
- achieving integrated and minimal maintenance design.
1.2 THE PROJECT

The project site is located near Eastern Creek within the City of Blacktown and Fairfield LGA, approximately 35Km west of the Sydney CBD. This area is strategically located in terms of its direct links into two of Sydney’s major regional transport corridors, the M4 and M7 Motorways, refer Figure 01.

The M4 links the area east to Sydney’s CBD and west to the Blue Mountains while the M7 links the area into Sydney’s orbital motorway network, north to the M2 and south to the M5.

The existing Archbold Road is a local road which runs in a north-south direction from the Great Western Highway to south of the M4 Motorway. The upgrade and extension of Archbold Road would provide a key route between the Great Western Highway and Old Wallgrove Road, providing access to the WSEA and the neighbouring residential suburbs of Mount Druitt, Minchinbury and Colyton.

The Project will include the following key features (refer Figure 2A):

- building a new dual carriageway between Old Wallgrove Road and Archbold Road
- widening Archbold Road from two-lanes to four-lanes
- building a road bridge over two major water supply pipelines close to Old Wallgrove Road
- building a road bridge and separate pedestrian/cycle bridge over the M4 Motorway
- building east facing ramps to and from the M4 Motorway.

The above components would be supplemented by:
- building a new combined footpath and cycleway along the western side of the road throughout its entire length
- building seven new four-way intersections to access the WSEA
- creating two new intersections to support the east-facing ramps to the M4 Motorway
- upgrading five existing intersections.

For a detailed description of Project elements, refer Figure 2B.
Figure 2A - Project general arrangement - source RMS 2016

- Preferred corridor option – Archbold Road upgrade and extension
- Proposed bridge over Water NSW Pipelines
- Intersections for future access roads
- Proposed M4 Motorway exit ramp
- Proposed M4 Motorway entry ramp
- Proposed traffic lights
- Upgrade existing intersection
- Proposed new bridge
- Retain existing bridge
- Proposed intersection with traffic lights
- Existing road upgraded
- Proposed extension
- Key
  - Road upgrade
  - Shared path
  - Medians

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Design criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>General specification</td>
<td></td>
</tr>
<tr>
<td>Horizontal alignment</td>
<td>Describes the route of the road.</td>
</tr>
<tr>
<td></td>
<td>Road: typically north south other than close to Old Wallgrove Road where it runs northwest to southeast</td>
</tr>
<tr>
<td>Vertical alignment</td>
<td>Describes the height of the road relative to the surrounding land. It describes where the road would be built below (cutting) or above (fill) the surrounding land</td>
</tr>
<tr>
<td></td>
<td>Bridges: up to 5.5 metres above ground level</td>
</tr>
<tr>
<td></td>
<td>Road: up to 1 metre above ground level (fill)</td>
</tr>
<tr>
<td></td>
<td>Road: up to 1 metre below ground level (cut)</td>
</tr>
<tr>
<td>Engineering specification</td>
<td></td>
</tr>
<tr>
<td>Cross section</td>
<td>Describes the width of the road. Figure 3.5 shows a typical cross section.</td>
</tr>
<tr>
<td></td>
<td>Main road: typically 30 metres wide</td>
</tr>
<tr>
<td></td>
<td>Intersections: up to 50 metres wide</td>
</tr>
<tr>
<td></td>
<td>Formation (main road): two footways, four traffic lanes and a median</td>
</tr>
<tr>
<td></td>
<td>Formation (bridges): as above, however only one footway on the new road bridge over the M4 Motorway</td>
</tr>
<tr>
<td>Lane width</td>
<td>Outside traffic lanes: 4.5 metres wide (including shoulder width)</td>
</tr>
<tr>
<td></td>
<td>Inside traffic lane: 3.5 metres wide</td>
</tr>
<tr>
<td></td>
<td>Turning lanes: 3.5 metres wide</td>
</tr>
<tr>
<td>Shoulder width</td>
<td>Describes the space between the solid white line and the inside and outside kerb</td>
</tr>
<tr>
<td></td>
<td>Outside traffic lane: 1 metre</td>
</tr>
<tr>
<td></td>
<td>Inside traffic lane: no shoulder</td>
</tr>
<tr>
<td>Grade (cross fall)</td>
<td>Describes the slope on the road to allow stormwater to run from the inside kerb to the stormwater drains on the outside kerb</td>
</tr>
<tr>
<td></td>
<td>Typically about 3 per cent from the inside kerb to the outside kerb</td>
</tr>
<tr>
<td>Footways</td>
<td>Describes the area of the road corridor between the kerb and the batter slope or retaining wall</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Design criteria</th>
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</thead>
<tbody>
<tr>
<td>Pavement type (road surface)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>New sections of road: composite pavement</td>
</tr>
<tr>
<td></td>
<td>Resurfaced sections of road: flexible pavement</td>
</tr>
<tr>
<td></td>
<td>Typical composite composition:</td>
</tr>
<tr>
<td></td>
<td>• Pavement: About 200 millimetres (mm) of asphalt</td>
</tr>
<tr>
<td></td>
<td>• Sub base: About 300 mm of selected material and 200 mm of concrete</td>
</tr>
<tr>
<td></td>
<td>Typical flexible composition:</td>
</tr>
<tr>
<td></td>
<td>• Pavement: About 200 mm of asphalt</td>
</tr>
<tr>
<td></td>
<td>• Sub base: About 300 mm of sealed material and 150 mm of gravel</td>
</tr>
<tr>
<td>Barriers</td>
<td>Main road: metal barriers about 0.5 m high on the inside and outside of the traffic lanes</td>
</tr>
<tr>
<td></td>
<td>Bridges (inside): metal barriers about 0.5 m high</td>
</tr>
<tr>
<td></td>
<td>Bridges (outside): security screen about 2 metres high</td>
</tr>
<tr>
<td>Speed</td>
<td>Main road (Section 1 to Section 5): 60 kilometres per hour (km/h)</td>
</tr>
<tr>
<td></td>
<td>Main road (Section 6 to Section 8): 60 km/h</td>
</tr>
<tr>
<td>Vehicle type</td>
<td>Design capacity: 26-metre long B-double traffic</td>
</tr>
<tr>
<td>Speed</td>
<td>Describes the distance people would need to see along the road to safely stop</td>
</tr>
<tr>
<td>Auxiliary design specification</td>
<td></td>
</tr>
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<td></td>
<td>On the approach to the intersections: 100 metres visibility</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Design criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Utilities</td>
<td>Protection: measures to identify, mark-out and avoid above or below ground utilities</td>
</tr>
<tr>
<td></td>
<td>Adjustment: move the alignment and/or depth/height of an above or below ground utility broadly in its current location</td>
</tr>
<tr>
<td></td>
<td>Relocation: move the alignment and/or depth/height of an above or below ground utility to a new location</td>
</tr>
<tr>
<td></td>
<td>Installation: utilities placed in a new location above or below ground, possibly inset</td>
</tr>
<tr>
<td>Drainage</td>
<td>Longitudinal drains comprising drains, pits and pipes</td>
</tr>
<tr>
<td></td>
<td>Cross drains comprising box or pipe culverts</td>
</tr>
<tr>
<td></td>
<td>Bridge drainage comprising scuppers</td>
</tr>
<tr>
<td></td>
<td>Water detention basins</td>
</tr>
<tr>
<td></td>
<td>Water quality basins</td>
</tr>
<tr>
<td>Batters and retaining walls</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Batters slopes: typically an increase of one metre in height for every four horizontal metres (1-in-4)</td>
</tr>
<tr>
<td></td>
<td>Retaining walls: typically formed of a precast concrete base, concrete panels and facing treatments. Typically 3.5 metres high</td>
</tr>
<tr>
<td>Traffic signals</td>
<td>Existing traffic lights: timing adjustments: Great Western Highway</td>
</tr>
<tr>
<td></td>
<td>New traffic lights: key intersections: Old Wallgrove Road, Lenore Drive, Sargent Road and Robinson Street</td>
</tr>
<tr>
<td></td>
<td>Electrical cabling and conduits (provisions included however actual lights excluded): access intersections: Access 1 to Access 7</td>
</tr>
<tr>
<td>Street lighting</td>
<td>Main road (new section): installation of white lights on both sides of the road</td>
</tr>
<tr>
<td></td>
<td>Main road (existing section): replacement with white lights on both sides of the road</td>
</tr>
<tr>
<td></td>
<td>Bridges: installation of white lights on both sides of the bridge</td>
</tr>
<tr>
<td></td>
<td>Intersections: installation of white lights around the intersection</td>
</tr>
<tr>
<td></td>
<td>Height, configuration, specification, height, and spacing would be confirmed along the detailed design</td>
</tr>
</tbody>
</table>

Figure 2B - Project elements
2.0

site context
2.1 SITE ANALYSIS

2.1.2 Land use
The majority of surrounding land use is zoned as General Industrial, making up an important part of the developing WSEA. Much of the area remains undeveloped at this time and is currently private farmland or open grassland. Several Transgrid powerline corridors cross the site.

Light industrial, warehouse and transport depot developments are envisaged for the future precinct, matching existing developments such as the Oakdale Industrial Estate to the south of the Project area.

Low density residential development can be found to the north of the Project area associated with the suburbs of Minchinbury and Erskine Park.

A significant riparian corridor, Ropes Creek, borders the western edge of the Project Area and is zoned for Environmental Conservation. Two small pockets of remnant vegetation either side of the proposed road corridor and adjacent to the M4 are also zoned for conservation, as is Everton Park, immediately to the east of Archbold Road.

2.1.3 Transport Network
A series of arterial and sub-arterial road corridors surround Project area. These include the M4 to the north, M7 to the east. The recently upgraded Erskine Park Link Road traverses the site from east to west and will connect to the proposed Archbold Road Extension.

2.1.3 Topography
The Project area is a series of low undulating hills and valleys with a ridgeline (70m) running north to south across Erskine Park Link Road. From this high point the topography falls west to Ropes Creek and east to the M7. The northern Project area is mostly flat with the proposed road extension rising over the M4 on a duplicated bridge.

2.1.3 Flora
Remnant vegetation of endangered ecological communities occur in proximity to the proposed road extension including:
- Cumberland Plain Woodland adjacent to the M4 corridor, either side of the proposed road alignment.
- River Flat Eucalypt Forest along the Ropes Creek riparian corridor.

For a more detailed ecological assessment, refer to the specialist study within the REF.
2.2 LANDSCAPE CHARACTER ZONES
The Project area and surrounds have been assessed and several landscape character zones identified.

Landscape character zones are defined as areas having a distinct, recognisable and consistent pattern of elements, be they natural (soil, vegetation, landform) and/or human built form, making one landscape different from another. The following landscape character zones have been established (refer Figure 04). Each zone is described in more detail within Chapter 5, including the impact of the Project on the character of each zone.

<table>
<thead>
<tr>
<th>Zone</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Open Grassland</td>
</tr>
<tr>
<td>2</td>
<td>Remnant Bushland</td>
</tr>
<tr>
<td>3</td>
<td>Low Density Residential</td>
</tr>
<tr>
<td>4</td>
<td>Industrial Development</td>
</tr>
</tbody>
</table>
3.0

urban design
3.0 URBAN DESIGN

3.1 URBAN DESIGN CONTEXT
The Project corridor passes through key WSEA employment zone precincts including the Ropes Creek Employment Precinct to the south of Erskine Park Link Road and the Eastern Creek Precinct to the north east - refer Figure 5A. A high quality of urban and landscape design for the Archbold Road Extension will enhance both precincts and ensure that the road corridor is contextually sensitive within this new industrial area.

3.1.1 Ropes Creek Precinct
The approved DA for The Ropes Creek Employment Precinct Concept Plan establishes a new precinct comprising approximately 81 hectares of developable land as well as local roads that will link into the Project. The concept plan includes the retention of the riparian corridor that crosses the Archbold Road corridor (refer Figure 5B).

3.1.2 Eastern Creek Precinct Plan
The Eastern Creek Precinct Plan is a large area of land given over to industrial development as part of the WSEA. Development will be initiated in stages. There are currently many elements in the precinct and adjoining lands that create a strong sense of place and identity for the area. Urban design principles developed as part of the Eastern Creek Precinct Plan to assist the retention of these elements included:
- retaining significant natural areas and tree canopy surrounding buildings
- creating buildings nestled into the landscape
- keeping high points within the precinct vegetated
- retaining heritage items and providing interpretation of these elements
- ensuring the palette of furniture and fixtures creates a sense of place
- landscape palette that in some cases reflects local elements such as undulating topography and vegetation
- retention of water courses that run across the site where feasible.

3.1.3 Erskine Park Link Road
Erskine Park Link Road is a recently upgraded sub-arterial route that connects the M7 motorway to Erskine Park Road and links into the Project north of the Ropes Creek Precinct.

To ensure a consistent design language for the wider area, the urban and landscape design for the Project will complement this road upgrade. The Erskine Park Link Road design constitutes street tree planting, riparian planting at creek crossings and three distinctive road intersections. The median is planted with low grasses where wide enough.

Four tree planting typologies/characters have been instigated along the road with planting intensification at intersections and riparian zones - refer Figure 5C and 5D.
Figure 5C - Erskine Park Link Road landscape concept

Figure 5D - Erskine Park Link Road tree planting typology diagram
3.2 URBAN DESIGN VISION
The vision for the Project is to create a sub-arterial road servicing the 'Employment Lands' within the greater WSEA. The road upgrade is designed to align with recent and future development of the precinct, including the Erskine Park Link Road and Old Wallgrove Road extension.

The landscape design will play a role in reducing the scale of the final infrastructure within a context of future 'big box' development either side of the road. The landscape will create visual and physical relief, enhancing the travellers experience by establishing a landscape identity that responds to the area. The design will match the design language of recently completed road projects in the area.

3.3 OBJECTIVES
The following urban design objectives were outlined for the project:

• develop an integrated engineering and urban design outcome
• sensitively fit road infrastructure works into the built, natural and community environments through which they pass
• contribute to the character and functioning of the area
• contribute to the accessibility and connectivity of people within regions and communities
• contribute to the overall quality of the public domain for the community and all road users.

3.4 DESIGN PRINCIPLES
3.4.1 Road Corridor
• create a single, unified design along the length of the road with subtle differences between landscape zones
• conserve significant remnant Cumberland Plain Woodland in proximity to the M4 crossing (image 1)
• structure planting along the road corridor to create visual cohesion and filter views of future 'big box' development (image 2)
• utilise low frangible planting in the median and between pedestrian/cycle paths and road to provide a physical buffer while retaining sight lines.
• utilise low planting (turf or shrub <1m) only around signalised traffic intersections to retain critical sight lines
• avoid conflicts between tree planting and utilities (surface and sub-surface) which run on either side of the road
• design integrated vertical elements within the road corridor (trees / lights / powerlines / transmission lines etc.) for aesthetic reasons and access / maintenance requirements.
3.4.2 Retaining Walls
A retaining wall will be required to the south of the M4 crossing as the road rises up to the proposed M4 bridge duplication. The wall will be flanked by retained vegetation and is unlikely to be visible to road users or pedestrians. The wall facade should therefore be as simple as possible.

3.4.3 Noise Wall
A noise wall will be required on the eastern side of the widened Archbold Road corridor in Minchinbury to reduce noise impacts to nearby residential dwellings.

The design of the noise wall is yet to be finalised but it should integrate with the design of the overall road corridor and complement other road structures.
- limit the height of the noise wall to balance noise, visual and overshadowing impacts
- ensure noise wall has a smooth and free flowing visual profile without any unnecessary steps
- select materials with consideration to acoustic performance, durability, weathering, ease of maintenance, vandal and graffiti resistance. Transparent materials will allow views through and reduce the perceived bulk of the structure, reducing overshadowing (refer image 4)
- ensure walls follow geometry of the road surface.

3.4.2 Bridges
The Project includes the construction of two new bridges:
- road bridge over major water supply pipelines close to Old Wallgrove Road
- road bridge and separate pedestrian/cycle bridge over the M4 Motorway.

Whilst the two bridges are not located within visually sensitive areas, the design of the bridges should be as simple and elegant as possible and based on the RMS guide ‘Bridge Aesthetics’:
- design bridge elements to read cohesively with consideration to materiality, pier positioning and barrier treatments
- design pier and headstock to be elegant and robust to improve bridge aesthetic
- avoid visual clutter and keep singular components of the structures simple and legible
- ensure profile and detailing of proposed M4 road bridge is similar in character and construction to that of the existing structure (refer image 3).
Bridge over Water NSW Pipeline

This bridge will carry Archbold Road over the Warragamba to Prospect Pipelines. There is currently no bridge in this location. To minimise the superstructure depth, the span is reduced by using Reinforced Soil Walls (RSW) abutments. The two piers comprise of a cast-in-place headstock beam which is supported on five cast-in-place columns.

The proposed bridge will:

- consist of a minimum 30.6m wide bridge that carries traffic over the top of the two pipelines
- have an overall length is 73m
- consist of two traffic lanes
- have a for a 3.0m shared path on the western side and 1.8m footway in the east
- have 1.3m high medium performance level barriers to minimise the risk of an errant vehicle damaging the pipeline
- have throw screens on both sides of the bridge.

The following urban design issues were discussed during the development of the bridge and incorporated into the design:

- ongoing discussion regarding resolution of RSW and how they interact with existing topography
- smaller precast panels to allow for smoother curve of bridge
- simplification of safety screen/safety barrier junction to ensure all elements integrate well
- extension of parapet skirt to extend lower to partially screen girders and headstock.
Bridge over M4

This bridge forms part of the upgrading of the existing Archbold Road which includes the duplication of the bridge over the M4 Motorway. It will carry the southbound Archbold road traffic over the M4 Motorway.

The proposed bridge will have:
- spans dictated by span arrangement of the old road bridge: 15m, 31m, 31m, 15m
- an overall length of 92m
- medium performance level traffic barriers with integrated safety screens on the eastern side and a raised median on the western side
- abutments comprising reinforced concrete headstocks supported on four 900mm diameter bored cast-in-place concrete piles with a spill-through embankment
- blade shaped columns
- a 4m wide median on the western side of the new bridge that is raised and aligned to the edge of the existing bridge
- a separate shared path bridge with safety screens and precast concrete parapet with 1.3m high railing to cater for cyclists.

The following urban design issues were discussed during the development of the bridge and incorporated into the design:
- matching the proposed spill through embankment profile with the adjacent existing bridge abutments.
- rationalisation of the median to reduce clutter
- alignment of pedestrian bridge at same level as road bridge to visually integrate the two.
landscape concept design
4.1 DESIGN INTENT

The concept design illustrated on the following plans and section is a physical design response to the Vision, Objectives and Principles outlined previously. A unified design with subtle differences in landscape treatment between zones ensures a 'whole of road' design approach to the Project.

These differences respond to the existing and future landscape character of the area once roads and 'employment lands' have been fully developed.

Landscape treatments create a unique road identity that enhances the road users experience both physically and visually. The proposed treatment for each area is described below. The planting palette is similar to the Erskine Park Link Road design and includes appropriate species from Cumberland Plain Woodland and River Flat Eucalypt Forest plant communities which fringe the road corridor.

A robust planting palette will be used, incorporating a selection of local species to reflect the landscape character. For safety reasons, only turf and low planting will be used around major intersections to ensure sight line requirements are achieved.

Remediation planting is to be implemented where the proposed road impacts upon areas of protected vegetation to the north, near the M4 intersection.

4.1.1 Avenue Planting

The majority of the road corridor will be lined by structured tree planting, providing a strong linear avenue to the road. Native species will be used such as Corymbia maculata and Eucalyptus amplifolia. Tall tree planting will not be utilised underneath the transmission line corridor. Low grasses will be planted between the back of road kerb and footpath on both sides of the carriageway, providing improved pedestrian amenity.

4.1.2 Feature Intersections

The numerous intersections along the road corridor would be marked by a change in tree species and groundcover planting, highlighting these important zones. The variation in colour and texture to the main road corridor will provide subtle wayfinding and add visual interest for road users.

4.1.3 Riparian Crossings

Two riparian corridors cross the road alignment and are likely to be retained as part of the precinct development. A subtle change in landscape character will mark these crossings providing visual interest and relief from the industrial development lining the road corridor. Tree and shrub species will be chosen from the endangered River Flat Eucalypt Forest community that can found within the Ropes Creek riparian corridor.

4.1.4 Road Batters

Road batters may be seeded with native grasses and shrubs to provide an economical landscape treatment. Where located in more visually sensitive locations (such as intersections), the batters should be mass planted.

4.1.5 Median Planting

Where space allows, the median will be planted with low grasses. This will maintain sight lines whilst providing visual separation between the two road carriageways.

4.1.6 Screen Planting

Where space allows, dense screening vegetation will be planted along the eastern edge of Millner Avenue to visually screen the Austral Bricks factory from the road corridor.

4.1.7 Cumberland Plain Woodland re-vegetation

The proposed road corridor passes through a section of Cumberland Plain Woodland to the south and north of the M4, as well as Everton Park.

A retaining wall on the approach to the M4 bridge will assist with reducing the impact to this endangered vegetation. Any vegetation lost during construction should be replaced and bolstered with appropriate species from the vegetation community.

<table>
<thead>
<tr>
<th>PLANTING TYPE</th>
<th>SUGGESTED SPECIES</th>
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</thead>
<tbody>
<tr>
<td>Avenue Planting</td>
<td>Corymbia maculata, Eucalyptus amplifolia, Eucalyptus crebra</td>
</tr>
<tr>
<td>Feature Intersections</td>
<td>Brachychiton acerifolium, Fraxinus excelsior, Jacaranda microsperma, Liquidambar styraciflua, Lagerstroemia indica</td>
</tr>
<tr>
<td>Riparian Crossings</td>
<td>Eucalyptus tereticornis, Angophora floribunda, Casuarina glauca, Acacia floribunda, Bursaria spinosa, Lomandra implexa, Themeda triandra</td>
</tr>
<tr>
<td>Median</td>
<td>Lomandra longifolia, Dianella caerulea, Imperata cylindrica, Poe labillardieri</td>
</tr>
<tr>
<td>Screen Planting</td>
<td>Callistemon citrinus ‘Captain Cook’, Leptospermum ‘Copper Glow’, Syzygium smithii</td>
</tr>
<tr>
<td>Cumberland Plain Woodland</td>
<td>Eucalyptus crebra, Eucalyptus eugenioides, Eucalyptus fibrosa, Eucalyptus maculata, Eucalyptus moluccana, Eucalyptus tereticornis, Acacia decurrens, Bursaria spinosa, Daviesia ulicifolia, Dillwynia sieberi, Indigofera australis, Aristida ramosa, Hardenbergia violacea, Microcarna stipoides, Themeda triandra</td>
</tr>
</tbody>
</table>

Suggested landscape species
ARCHBOLD ROAD - LANDSCAPE CONCEPT DESIGN
TYPICAL LANDSCAPE SECTION

Regional Road Section
Prepared for Jacfin Pty Ltd
6 August 2010
1:5000 @ A3

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Shared Pedestrian/Cycleway</td>
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</tr>
<tr>
<td>Carriageway</td>
<td>7500</td>
</tr>
<tr>
<td>Median Strip</td>
<td>4000</td>
</tr>
<tr>
<td>Carriageway</td>
<td>7500</td>
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<td>Landscape Setback</td>
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</table>

<table>
<thead>
<tr>
<th>Verge (1m Minimum)</th>
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</tr>
</thead>
<tbody>
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<td>1500</td>
</tr>
<tr>
<td>Footpath</td>
<td>10500</td>
</tr>
<tr>
<td>Regional Road Reserve</td>
<td>40000</td>
</tr>
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</table>

NTS
landscape character assessment
5.1 LANDSCAPE CHARACTER ASSESSMENT METHODOLOGY

This report has adopted the Guidelines for Landscape Character and Visual Impact Assessment as published by RMS.

The overall impact rating of the Project on any given landscape character zone is based on themes of magnitude and sensitivity. The severity of these impacts are calculated using Table 01 - based on a combination of magnitude and sensitivity.

Table 01: Landscape Character Impact Rating as a combination of Sensitivity and Magnitude. Source: RMS Guidelines for Landscape Character and Visual Impact Assessment

<table>
<thead>
<tr>
<th>MAGNITUDE</th>
<th>HIGH</th>
<th>MODERATE</th>
<th>LOW</th>
<th>NEGLIGIBLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH</td>
<td>HIGH</td>
<td>HIGH</td>
<td>MODERATE</td>
<td>NEGLIGIBLE</td>
</tr>
<tr>
<td>MODERATE</td>
<td>HIGH</td>
<td>MODERATE</td>
<td>MODERATE</td>
<td>NEGLIGIBLE</td>
</tr>
<tr>
<td>LOW</td>
<td>MODERATE</td>
<td>MODERATE</td>
<td>NEGLIGIBLE</td>
<td>NEGLIGIBLE</td>
</tr>
<tr>
<td>NEGLIGIBLE</td>
<td>NEGLIGIBLE</td>
<td>NEGLIGIBLE</td>
<td>NEGLIGIBLE</td>
<td>NEGLIGIBLE</td>
</tr>
</tbody>
</table>

5.1.1 Sensitivity
The degree to which a particular landscape type can accommodate change arising from a development, without detrimental effects on its character. This includes factors such as:
• existing land use
• the pattern and scale of the landscape
• visual enclosure, openness of views and distribution of visual receptors
• the value placed on the landscape.

Areas with a high sensitivity to change include zones with significant natural landscape features, natural landscape types with inherent natural values and landscapes with heritage or cultural values.

5.1.2 Magnitude
The magnitude of the effects of the development within the landscape. Consideration is given to existing built form in the landscape and how closely the development matches this in bulk, scale and form. Magnitude is a study of the scale or degree of change to the landscape resource, the nature of the effect and its duration including whether it is permanent or temporary.

5.1.3 Overall Impact Rating
The overall impact on any landscape character zone is based on an increasing scale from negligible to high.

Negligible – No part of the proposal, or work or activity associated with it, is discernible.

Low – The proposal constitutes only a minor component, which might be missed by the casual observer or receptor. Awareness of the proposal would not have a marked effect on the overall quality of the landscape zone.

Moderate – The proposal may form a visible and recognisable new element within the overall scene that affects and changes its overall character.

High – The proposal becomes the dominant feature of the scene to which other elements become subordinate, and significantly affects and changes the character.
LANDSCAPE ZONE 1 - OPEN GRASSLAND

**DESCRIPTION**
This landscape character zone is extensive and spreads to the north and south a
Erskine Park Link Road, bounded by industrial development in the south and the
M4 corridor in the north. Denser tree planting associated with Ropes Creek forms a
distinctive western edge to the character zone. The zone is mostly open with a gently
rolling landform. The overall landscape pattern is created by open grassland that is
smooth, regular and uniform. Trees are present in groups or as isolated individuals.

**ASSESSMENT**

**Sensitivity**
There is a general absence of built form throughout this landscape zone. Large
pylons associated with several transmission lines and several demolished
buildings are the only visible built form. Extensive views are available north and
south. The area is currently inaccessible to the public but has a scenic character
and provides a visual buffer from nearby industrial development. The zone is
rated as having a moderate sensitivity to change.

**Magnitude**
The upgrade to Archbold Road would see the removal of open space, bisecting
the character zone and forming a distinctive infrastructure element in an area
of little existing infrastructure. The magnitude of the Project within this zone is
rated as high.

**Summary**
Overall, a moderate/high impact would be expected on this character zone in
its current state.

The spatial quality of the area is, however, set to change dramatically in the short
to mid-term. This zone is zoned as industrial and will consist of large warehousing
and associated infrastructure as part of the WSEA. The road extension will fit
within the industrial context, providing accessibility to the new precinct. The
assessed impacts would likely diminish over time as the character of the precinct
and land uses change.

**From Table 01, using a combination of sensitivity and magnitude ratings.**

<table>
<thead>
<tr>
<th>Element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topography</td>
<td>Gently undulating topography</td>
</tr>
<tr>
<td>Hydrology</td>
<td>Rainfall drains to local creeks</td>
</tr>
<tr>
<td>Ecology/vegetation</td>
<td>Grasses and native stands of trees</td>
</tr>
<tr>
<td>Land use</td>
<td>Grazing</td>
</tr>
<tr>
<td>Built form</td>
<td>Transmission line infrastructure</td>
</tr>
<tr>
<td>Spatial</td>
<td>Mostly open with far reaching views to middle distance where not screened by vegetation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sensitivity</th>
<th>MODERATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnitude</td>
<td>HIGH</td>
</tr>
<tr>
<td>Overall Landscape Character Impact Rating</td>
<td>MODERATE/HIGH</td>
</tr>
</tbody>
</table>

From Table 02, using a combination of sensitivity and magnitude ratings.
LANDSCAPE ZONE 2 - REMNANT BUSHLAND

DESCRIPTION
This landscape character zone occurs in fragmented sections across the study area including four areas directly impacted by the Project alignment. The darker coloured foliage of the trees contrast against the surrounding backdrop of lighter toned grassland.

Vegetation is predomnately native and occurs in dense stands with little understory. This zone is concentrated along Ropes Creek and on the southern edge of the M4 corridor.

ASSESSMENT

Sensitivity
A ecological survey of the site indicated the presence of two endangered ecological communities (EECs) listed under the NSW Threatened Species Conservation Act 1995 (TSC Act)
• Cumberland Plain Woodland adjacent to the M4 corridor, either side of the proposed road alignment.
• River Flat Eucalypt Forest along the Ropes Creek riparian corridor and two small tributaries.

This zone has a low ability to accommodate change - removal of vegetation could alter its character significantly leading to a high sensitivity rating.

Magnitude
The road alignment has the potential to impact a limited section of ECC vegetation. This will include the east facing access ramp adjacent to the M4 corridor, widening along Millner Avenue and two creek crossings that feed into Ropes Creek. Impacts should be reduced on the southern approach to M4 crossing by the use of retaining walls, reducing the need for vegetation clearance. A low magnitude rating has been recorded.

Summary
Overall, a moderate impact rating has been recorded to a limited section of this character zone. The Project will require the clearance of a portion of endangered vegetation.

The reduction in batter widths, use of retaining walls, tree protective fencing and a limitation of the construction footprint will assist in the reduction of the impacts on this zone.

<table>
<thead>
<tr>
<th>Element</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Topography</td>
<td>Gently undulating</td>
</tr>
<tr>
<td>Hydrology</td>
<td>Rainfall drains to creeks</td>
</tr>
<tr>
<td>Ecology/vegetation</td>
<td>The vegetation is dense consisting of a large variety of chiefly native trees, shrubs and grasses</td>
</tr>
<tr>
<td>Land use</td>
<td>State land/Private farmland</td>
</tr>
<tr>
<td>Built form</td>
<td>No built form</td>
</tr>
<tr>
<td>Spatial</td>
<td>Mostly enclosed with views blocked by dense vegetation</td>
</tr>
</tbody>
</table>
This character zone is concentrated within the suburbs of Minchinbury and Erskine Park, consisting of low density residential dwellings. Properties are generally one or two storey and located on small sized blocks. Properties are set back slightly from the road and surrounded by a leafy streetscape.

**ASSESSMENT**

**Sensitivity**

Residential development within the study area is set within an urban context. The presence of existing transport infrastructure and built form reduces the sensitivity of this zone to change. Any large infrastructure development, however, does have the potential to alter the character of this zone. The zone is described as having a moderate sensitivity to change.

**Magnitude**

The Project is of a slightly increased scale and bulk compared to existing road developments within the suburb of Minchinbury (where the Project is closest to residential dwellings). Several properties in close proximity to the road corridor are likely to experience a moderate magnitude of change associated with the widened road infrastructure including signage, noise wall, lighting and increased traffic.

**Summary**

Overall, a moderate impact rating has been recorded on a very localised section of this character zone. The Project will not be directly visible from the majority of properties within the study area, although the widening of the road and associated vegetation removal will contribute to a moderate change in character to the immediate residential area surrounding the Project.

**Sensitivity** M=

**Magnitude** M=

**Overall Landscape Character Impact Rating** M=

From Table 01, using a combination of sensitivity and magnitude ratings.

<table>
<thead>
<tr>
<th>Element</th>
<th>Description</th>
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<tbody>
<tr>
<td>Topography</td>
<td>Mostly flat</td>
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<tr>
<td>Hydrology</td>
<td>Rainfall drains to subsurface urban drainage</td>
</tr>
<tr>
<td>Ecology/vegetation</td>
<td>Native and exotic planting within property boundaries and as part of streetscape</td>
</tr>
<tr>
<td>Land use</td>
<td>Residential</td>
</tr>
<tr>
<td>Built form</td>
<td>Single and double storey dwellings</td>
</tr>
<tr>
<td>Spatial</td>
<td>Linear pattern formed by streetscapes. Mostly enclosed by built form</td>
</tr>
</tbody>
</table>
LANDSCAPE ZONE 4 - INDUSTRIAL DEVELOPMENT

DESCRIPTION
Existing light industrial and commercial developments are found to the north, south and east of the study area. Development consists primarily of larger buildings including box-like warehouses, depots and storage facilities up to 15m in height.

ASSESSMENT

Sensitivity
This landscape zone constitutes a medium density of urban development with associated infrastructure and large commercial and industrial buildings. This character zone has no sensitive receptors and a high ability to absorb change, leading to a low sensitivity rating.

Magnitude
The road extension will fit within the existing industrial context and a low magnitude of change is expected.

Summary
Overall, a low impact rating has been recorded on this landscape zone. The Archbold Road corridor will not adversely impact the character of the zone.

As the industrial precincts associated with the WSEA develop, the Archbold Road extension will become part of a wider industrial setting, further reducing the expected impact.

Sensitivity
LOW

Magnitude
LOW

Overall Landscape Character Impact Rating
LOW

From Table 01, using a combination of sensitivity and magnitude ratings.

<table>
<thead>
<tr>
<th>Element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topography</td>
<td>Mostly flat landform</td>
</tr>
<tr>
<td>Hydrology</td>
<td>Rainfall drainage falls to an urban drainage system</td>
</tr>
<tr>
<td>Ecology/vegetation</td>
<td>Fragmented native and exotic vegetation</td>
</tr>
<tr>
<td>Land use</td>
<td>Commercial and light industrial</td>
</tr>
<tr>
<td>Built form</td>
<td>Low rise warehousing</td>
</tr>
<tr>
<td>Spatial</td>
<td>Linear pattern formed by streetscape. Varies between enclosed and open depending on vegetation and built form</td>
</tr>
</tbody>
</table>
2.5 LANDSCAPE CHARACTER SUMMARY

The landscape character surrounding the Project is typical of this growth area with large swathes of open grassland, pockets of native vegetation, transport corridors, residential suburbs and large industrial estates.

The stands of remnant vegetation and open grassland contribute strongly to the spatial quality of the area, despite having very limited public accessibility.

The overall impact of the Project on landscape character is rated as:

- low across one character zone (industrial)
- moderate across two character zones (residential and remnant bushland)
- moderate/high across one character zones (open grassland).

The Project will have the highest impact on the open grassland to the east and west of the proposed road corridor. Although not publicly accessible, the zone contributes strongly to the spatial quality of the area and offers extensive scenic views from Erskine Park Link Road. The road will bisect the grassland and introduce a bold infrastructure element within an otherwise undeveloped zone.

A moderate impact is expected on the endangered remnant woodland found within the immediate vicinity of the Project site. Removal of this vegetation has the potential to reduce its quality and fragment habitat, although the quantum of affected vegetation is small.

A very limited area of residential development will also be moderately impacted by the Project as the road widening encroaches on several properties and provides a larger scale road corridor with associated infrastructure elements and an increase in traffic.

The spatial quality of the area either side of the proposed road corridor is set to change dramatically in the short to mid-term. Zoned as industrial, if developed, the road extension will fit within the proposed industrial context, providing accessibility to the new precinct. The assessed impacts would likely diminish over time as the character of the precinct and land uses change.

### SUMMARY OF LANDSCAPE CHARACTER IMPACTS

<table>
<thead>
<tr>
<th></th>
<th>OPEN GRASSLAND</th>
<th>REMNANT BUSHLAND</th>
<th>RESIDENTIAL</th>
<th>INDUSTRIAL</th>
</tr>
</thead>
<tbody>
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<td>MODERATE</td>
<td>MODERATE</td>
<td>LOW</td>
</tr>
<tr>
<td>Magnitude</td>
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<td>LOW</td>
<td>MODERATE</td>
<td>LOW</td>
</tr>
<tr>
<td>Overall Rating</td>
<td>MODERATE/HIGH</td>
<td>MODERATE</td>
<td>MODERATE</td>
<td>LOW</td>
</tr>
</tbody>
</table>
6.0

visual impact assessment
6.0 VISUAL IMPACT ASSESSMENT

6.1 VISUAL ENVIRONMENT

6.1.1 Study Area
The study area specific to the visual impact assessment comprises the area of land within and surrounding the proposed and extended Archbold Road corridor that could potentially be visually affected by the Project.

Through a desktop analysis and site visit, a study area of approximately 500m offset from the road alignment was identified based on topography, vegetation, receptor location and viewing distance.

Given that substantial areas of land adjacent to the Project site are currently undeveloped, the visual catchment to and from the proposed road corridor is much larger than would be anticipated post precinct development.

6.2.2 Private Domain
The study area is characterised by a lack of sensitive residential receptors. Residential dwellings with visual accessibility to the Project are limited to the north of the study area within the suburb of Minchinbury. In this location, residential receptors can be found along the eastern edge of the road corridor.

The residential suburb of Erskine Park is approximately 700m from the proposed road corridor and visually separated from the Project by a dense band of riparian vegetation associated with Ropes Creek. This suburb will not have views towards the Project and has been excluded from further assessment.

Oakdale industrial estate is located along Millner Avenue and may have filtered views of the Project.

The majority of the study area comprises farm and state land, zoned for industrial development associated with the WSEA. These areas are currently little visited with few receptors. Whilst the Project would be highly visible from this land in its current form, the visual environment can be expected to alter dramatically within the short to mid-term. It is therefore expected that the magnitude of change due to the proposal would be expected to be less within the future planned industrial context.

6.1.3 Public Domain
Publicly accessible land with views of the Project site are limited to the surrounding road network (including Millner Avenue, Erskine Park Link Road, M4 and Sargents Road), Everton Park in Minchinbury and a strip of land zoned as public recreation along Ropes Creek. This public open space currently has poor accessibility but will be embellished as the adjacent industrial precinct develops.

6.2 REPRESENTATIVE VIEWPOINTS
The following representative viewpoints have been chosen for further analysis (refer Figure 05 - viewpoint location map). The visual receptors encompassed by these viewpoints have the potential to be visually impacted by some element of the Project.

The locations identified are:
- **Public Viewpoints**
  - PU1 - Millner Avenue
  - PU2 - Erskine Park Link Road
  - PU3 - Everton Park
  - PU4 - M4 Motorway
  - PU5 - Junction Sargents/Archbold Road
- **Private Viewpoints**
  - PR1 - Austral Bricks Factory, Millner Avenue
  - PR2 - Private Farmland off Erskine Park Link Road
  - PR3 - Minchinbury - adjacent to Archbold Road

6.3 METHODOLOGY
This report has adopted the Guidelines for Landscape Character and Visual Impact Assessment as published by the Roads and Maritime Service, RMS. The overall impact rating of the Project on any given receptor is based on factors of magnitude and sensitivity.

**Sensitivity**
Each visual receptor type has an inherent and varied sensitivity to change in the visual scene based on their personal context in which the view is being experienced. This would have a direct bearing on the perception of visual impact experienced by the receptor and qualifies the quantitative impacts. Appendix A describes the levels of sensitivity for each receptor type.

**Magnitude**
The magnitude of the visual effects of the development within the landscape. A series of quantitative assessments are studied, including distance from development, quantum of view, duration of view and scale of change. Appendix A describes the ratings assigned to these quantitative assessments.

**Overall impact rating**
The severity of these impacts is calculated using matrix Table 01 - based on a combination of magnitude and sensitivity.

<table>
<thead>
<tr>
<th>SENSITIVITY</th>
<th>MAGNITUDE</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH</td>
<td>HIGH</td>
</tr>
<tr>
<td>MODERATE</td>
<td>MODERATE</td>
</tr>
<tr>
<td>LOW</td>
<td>LOW</td>
</tr>
<tr>
<td>NEGLIGIBLE</td>
<td>NEGLIGIBLE</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NEGLIGIBLE</th>
<th>NEGLIGIBLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MODERATE</td>
<td>MODERATE</td>
</tr>
<tr>
<td>LOW</td>
<td>LOW</td>
</tr>
<tr>
<td>NEGLIGIBLE</td>
<td>NEGLIGIBLE</td>
</tr>
</tbody>
</table>

*Table 01: Visual impact rating as a combination of Sensitivity and Magnitude. Source: RMS Guidelines for Landscape Character and Visual Impact Assessment*
Figure 05 - Viewpoint location map - not to scale
6.4 VISUAL ANALYSIS

The following section assesses the visual impact of the Project on each of the selected viewpoints. This includes a description of the current view from each viewpoint followed by a discussion of the potential visual impacts of the Project on that view. Each viewpoint is accompanied by a location map and photograph of the current view.

For residential receptors, access was not always possible to the property itself and so a photograph was taken at the closest publicly accessible point. The description of visual impact is estimated from the property’s main dwelling area.

For a detailed description of the assessment factors and impact ratings used see Appendix A.

EXAMPLE

VIEWPOINT X

VISUAL IMPACT

RECEPTOR TYPE

RECEPTOR IDENTIFICATION

RECEPTOR SENSITIVITY

MAGNITUDE

DISTANCE

QUANTUM OF VIEW

PERIOD OF VIEW

SCALE OF CHANGE

SUMMARY OF MAGNITUDE RATINGS

Public X L H M L L M

Visual Impact Rating MODERATE/LOW

Receptor sensitivity rating

Overall magnitude rating

Overall visual impact rating

Viewpoint number

Location map

Photo location and direction marker

Proposed works

View photo

Description of expected visual impact
PUBLIC VIEWPOINT 1 (PU1)

Viewpoint location

Location of bridge crossing

Proposed works

Viewpoint photo A (source: google street view)
**LOCATION**
Millner Avenue, looking north and south.

**Distance to Project**
0 metres

**Receptors**
Users of Millner Avenue, travelling in both directions.

**Current View**
As shown in viewpoint photo A, the road is bounded by industrial warehousing on either side. Views are available north along the road corridor to open fields in the middle distance. Numerous transmission lines are also visible with minimal vegetation screening views out from the road corridor.

### VISUAL IMPACT

The proposed road extension and elevated bridge crossing of the Water NSW Pipeline will be highly visible from sections of the road. The presence of existing transport infrastructure, industrial setting, low sensitivity of the receptors and short duration of view have lead to an overall visual impact rating of low.

<table>
<thead>
<tr>
<th>RECEPTOR TYPE</th>
<th>RECEPTOR IDENTIFICATION</th>
<th>DISTANCE</th>
<th>QUANTUM OF VIEW</th>
<th>PERIOD OF VIEW</th>
<th>SCALE OF CHANGE</th>
<th>SUMMARY OF MAGNITUDE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public</td>
<td>PU1</td>
<td>L</td>
<td>M</td>
<td>L</td>
<td>L</td>
<td>LOW</td>
</tr>
</tbody>
</table>

Visual Impact Rating: **LOW**

From Table 01, using a combination of sensitivity and magnitude ratings.
PUBLIC VIEWPOINT 2 (PU2)

Viewpoint location

Proposed works

Viewpoint photo A (source: google street view)

Junction location

Erskine Park Link Road

Archbold Road extension
LOCATION
Erskine Park Link Road, looking north and south.

Distance to Project
0 metres

Receptors
Users of Erskine Park Link Road, travelling in both directions.

Current View
As shown in viewpoint photo A, the existing view from this elevated section of Erskine Park Link Road is far reaching, partially blocked by embankments either side of the road corridor. Vegetation and residential built form can be seen in the middle distance with the ridges of the Blue Mountains rising in the distance. Views are available over open grassland to the east and west.

<table>
<thead>
<tr>
<th>VISUAL IMPACT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motorists will have clear views of the proposed junction of Archbold Road and Erskine Park Link Road, as well as views over the extended road corridor to the north and south. The presence of existing transport infrastructure within the viewframe, combined with the low sensitivity of receptors and short duration of view have led to a low overall visual impact rating.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RECEPTOR TYPE</th>
<th>RECEPTOR IDENTIFICATION</th>
<th>MAGNITUDE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public</td>
<td>PU2</td>
<td>L H M L M M</td>
</tr>
</tbody>
</table>

Visual Impact Rating: MODERATE/LOW*

*The visual context of this area is set to change to light commercial/industrial with numerous warehouses and associated infrastructure. The presence of this future development is likely to diminish the level of visual impact experienced from this viewpoint.
PUBLIC VIEWPOINT 3 (PU3)

Viewpoint location

Proposed works

Viewpoint photo A
**LOCATION**  
Everton Park, Minchinbury, looking south.

**Distance to Project**  
20 metres

**Receptors**  
Users of public open space

**Current View**  
The existing view south is to dense native vegetation associated with the edge of the M4 corridor. The park curves round to the west where views are available to the existing Archbold Road corridor.

**VISUAL IMPACT**  
As an area of public recreation, this area has a high sensitivity to visual change. The proposed western M4 ramp will be in close proximity to the southern edge of the park but is unlikely to be visible due to the retention of a large screening buffer of vegetation.

The widened Archbold Road corridor will be visible to the west from limited sections of the park. Infrastructure elements such as streetlights, road signage, noise wall, traffic signals and increased vehicle movements may be clearly visible.

Overall a moderate visual impact is expected, limited to the western most end of the park.

---

**RECEPTOR IDENTIFICATION**

<table>
<thead>
<tr>
<th>RECEPTOR TYPE</th>
<th>RECEPTOR IDENTIFICATION</th>
<th>MAGNITUDE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private</td>
<td>PU3</td>
<td></td>
</tr>
</tbody>
</table>

**Visual Impact Rating**  
MODERATE

From Table 02, using a combination of sensitivity and magnitude ratings.
PUBLIC VIEWPOINT 4 (PU4)

Viewpoint location

Proposed works

Approx. location of motorway off ramp

Bridge duplication including pedestrian bridge

Approx. location of motorway on ramp

Archbold Road

Viewpoint photo A
LOCATION
M4 motorway, looking west.

Distance to Project
0 metres

Receptors
Users of M4 motorway, travelling in both directions.

Current View
As shown in viewpoint photo A, the existing visual environment is of a large, six lane road corridor with grass median and densely vegetated embankments. This vegetation blocks views either side of the road. The existing (unused) Archbold Road bridge is visible crossing the M4 carriageway with the Blue Mountains rising in the distance.

VISUAL IMPACT

The proposed Archbold Road bridge duplication and on/off ramps will be the most visible elements of the Project in this location. Construction of these elements will require the removal of vegetation on either side of the road carriageway. These changes will increase the scale of infrastructure elements along this section of the M4 although due to the low sensitivity of receptors and short duration of view, a major impact on visual amenity is not expected.

<table>
<thead>
<tr>
<th>RECEPTOR TYPE</th>
<th>RECEPTOR IDENTIFICATION</th>
<th>MAGNITUDE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Public PU4 M H M L M L</td>
<td></td>
</tr>
</tbody>
</table>

Visual Impact Rating: MODERATE/LOW

From Table 01, using a combination of sensitivity and magnitude ratings.
LOCATION
Junction of Sargents Road and Archbold Road, looking north and south.

Distance to Project
0 metres

Receptors
Users of Archbold Road, travelling in both directions.

Current View
As shown in viewpoint photo A, the existing view from the road is towards industrial and residential land uses either side of the road corridor. The streetscape is moderately vegetated with turf nature strips backed by native grasses and street trees.

VISUAL IMPACT
Motorists will have views of the upgraded Sargents and Archbold Road junction, as well as the widened Archbold Road. Infrastructure elements such as streetlights, road signage and traffic signals will be clearly visible.

The presence of existing transport infrastructure within the view frame as well as the low sensitivity of receptors and short duration of view have lead to an overall visual impact rating of low.

<table>
<thead>
<tr>
<th>RECEPTOR TYPE</th>
<th>RECEPTOR IDENTIFICATION</th>
<th>MAGNITUDE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public</td>
<td>PUS</td>
<td>L</td>
</tr>
<tr>
<td>Visual Impact</td>
<td></td>
<td>M</td>
</tr>
</tbody>
</table>

From Table 01, using a combination of sensitivity and magnitude ratings.
PRIVATE VIEWPOINT 1 (PR1)

Viewpoint location

Proposed works

Viewpoint photo A
LOCATION
Austral Bricks factory, looking north west.

Distance to Project
50 metres

Receptors
Workers at the Austral Bricks factory

Current View
As shown in viewpoint photo A, the factory is partially screened from Millner Road by tree planting. Filtered views are available through these trees to open fields to the north.

VISUAL IMPACT
Filtered views will be available from the factory to the proposed intersection of Archbold and Millner Avenue, as well as the bridge structure across the Water NSW Pipeline.

The industrial nature of this viewpoint combined with the presence of similar existing infrastructure elements within the landscape ensures a low overall impact to visual amenity.

From Table 02, using a combination of sensitivity and magnitude ratings.

<table>
<thead>
<tr>
<th>RECEPTOR TYPE</th>
<th>RECEPTOR IDENTIFICATION</th>
<th>ASPECT</th>
<th>DISTANCE</th>
<th>QUANTUM OF VIEW</th>
<th>PERIOD OF VIEW</th>
<th>SCALE OF CHANGE</th>
<th>SUMMARY OF MAGNITUDE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private PR1</td>
<td></td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>LOW</td>
</tr>
</tbody>
</table>
PRIVATE VIEWPOINT 2 (PR2)

Viewpoint location

Proposed works

Viewpoint photo A

Oakdale Industrial Estate

Approx. road alignment
LOCATION
Private farmland, looking south.

Distance to Project
10 metres

Receptors
Land holder

Current View
This viewpoint is located within a large area of private farmland. Views are open and far reaching, stretching over undulating topography to industrial warehouses associated with Oakdale Industrial Estate in the middle distance. Built form is limited to several transmission line corridors that traverse the area.

Whilst currently a semi-rural setting, the majority of this land has been zoned as ‘General Industrial’ within the Blacktown Council LEP and will shortly be developed into an industrial precinct with an urban character.

VISUAL IMPACT
The magnitude of change to the current visual scene will be marked, with direct views of the new road infrastructure. Elements such as streetlights, road signage, traffic signals and increased vehicle movements may be clearly visible. Overall, a moderate visual impact is expected.

From Table 02, using a combination of sensitivity and magnitude ratings.

*The visual context of this area is set to change to light commercial/industrial with numerous warehouses and associated infrastructure. The presence of this future development is likely to diminish the level of visual impact experienced from this viewpoint.
VISUAL IMPACT
Road widening will bring the Archbold Road corridor to within a couple of metres of the dwellings adjoining the road. It will also require the removal of the earth bund and several trees along the eastern side of the road, as well as the construction of a noise wall of 1.8m or higher.

Boundary fencing will block the majority of views of the widened road corridor from single storey properties, however some direct views will be available from second storey dwellings. Infrastructure elements such as streetlights, road signage, noise wall, traffic signals and increased vehicle movements may be clearly visible.

Despite the existence of transport infrastructure within the current viewframe, the widened road will be noticeable with an increase in width and scale. A moderate/high impact on visual amenity is expected for a limited number of dwellings that have visual accessibility to the Project.

<table>
<thead>
<tr>
<th>RECEPTOR TYPE</th>
<th>RECEPTOR IDENTIFICATION</th>
<th>MAGNITUDE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private</td>
<td>PR3</td>
<td>H H M M M M M</td>
</tr>
</tbody>
</table>

Visual Impact Rating: MODERATE/HIGH

From Table 02, using a combination of sensitivity and magnitude ratings.

LOCATION
Minchinbury, adjacent to Archbold Road, looking west

Distance to Project
10 metres

Receptors
Residents of properties along the east side of Archbold Road.

Current View
As seen in viewpoint photo A, the dwellings along the eastern side of Archbold Road are currently set back approximately 20m from the road corridor and separated from the road by an earth bund and boundary fencing. The majority of properties are single storey which do not have views of the existing road. Several double storey dwellings have direct views of the road corridor from their upper storeys.

Boundary fence screens ground floor views of road corridor

Viewpoint photo B

Location of widened Archbold Road corridor including views of noise wall

Screening vegetation

Some direct views of road corridor from second storey windows
6.4 VISUAL IMPACT SUMMARY

The visual impacts of the Project on the studied viewpoints range from negligible to moderate/high (refer summary table and plan).

- Three viewpoints received an impact rating of low
- Two viewpoint received an impact rating of moderate/low
- Two viewpoint received an impact rating of moderate
- One viewpoint received an impact rating of moderate/high

Overall, the Project has a limited visual impact on the surrounding area due to the lack of sensitive visual receptors and inaccessibility of much of the land that surrounds the road corridor.

The new bridge and ramp structures connecting the M4 will be visible to motorists with some associated vegetation removal required; however, these proposed elements are in keeping with the existing transport infrastructure already present.

Moderate/high visual impacts are limited to a small number of double story dwellings in Minchinbury that are located in close proximity to Archbold Road. The widened road, associated signage, noise wall, tree removal and increased traffic volumes may all be visible from the top floor of these properties.

Although there will be some noticeable changes in the visual scene from public roads that pass close to the Project (Millner Avenue, Erskine Park Link Road), the low sensitivity of these receptors and short duration of views have lead to low impacts to visual amenity.

In the short to mid-term, the land surrounding the Archbold Road extension will transition from open grassland to an urban industrial precinct. Within this context, the visual impacts recorded within this assessment are likely to diminish as the new road corridor integrates with the proposed industrial precinct.

6.4.1 Construction Period

Visual impacts during the construction period will include:

- presence of plant and equipment on site
- temporary construction compounds and ancillary facilities
- temporary stockpiles
- vegetation removal.

Construction activities and plant would be visible from surrounding land uses and road corridors, however these impacts would be short term and are not expected to lead to any additional significant impacts on visual amenity.

<table>
<thead>
<tr>
<th>RECEPTOR LOCATION</th>
<th>Impact Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Millner Avenue</td>
<td>LOW</td>
</tr>
<tr>
<td>Erskine Park Link Road</td>
<td>MODERATE/LOW</td>
</tr>
<tr>
<td>Everton Park, Minchinbury</td>
<td>MODERATE</td>
</tr>
<tr>
<td>M4 Motorway</td>
<td>MODERATE/LOW</td>
</tr>
<tr>
<td>Sargents Road/Archbold Road Junction</td>
<td>LOW</td>
</tr>
<tr>
<td>Austral Bricks Factory, Millner Avenue</td>
<td>LOW</td>
</tr>
<tr>
<td>Farmland to south of Erskine Park Link Road</td>
<td>MODERATE</td>
</tr>
<tr>
<td>Minchinbury - dwellings to eastern edge of Archbold Road</td>
<td>MODERATE/HIGH</td>
</tr>
</tbody>
</table>

Summary of visual impacts of the Project across the study area
Summary of visual impacts across the study area

Views (existing)
- Direct
- Filtered
- Heavily filtered/screened

Views (future)
- Approx. future viewshed

Impact
- Negligible Impact
- Low Impact
- Moderate/Low Impact
- Moderate Impact
- Moderate/High Impact
- High Impact

Viewpoint

Archbold Road Upgrade UDLR ISSUE A

Hanson Wulagrove Quarry

Proposed Archbold road alignment

Minchinbury

ERSKINE PARK

Oakdale Industrial Estate

Transgrid substation

Millner Avenue

MINCHINBURY

Water NSW Pipeline
6.5 TYPES OF MITIGATION
Effective mitigation measures for any form of potential visual impact are those that entail:
- Avoidance
- Reduction
- Alleviation

6.6 AVOIDANCE
A thorough site selection process has been undertaken. Once set, the ability to avoid impact is reduced. Location is key to the functioning of the road corridor and so avoidance measures have not been considered applicable in this report.

6.7 REDUCTION
The principal forms of reduction are associated with refinements and modifications that address the siting and scale of built form. Measures to be implemented include:
- Restrict vegetation clearing to areas where it is necessary. Opportunities to minimise clearing should be part of the developed concept design.
- Avoid stockpiling materials in areas supporting vegetation.
- Trim rather than remove trees where possible. To be conducted by a qualified arborist.
- Rehabilitate vegetated areas where ground is disturbed.

6.8 ALLEVIATION
Options to alleviate impacts are usually associated with design features such as materials, finishes, reflectivity, planting character and the like. Measures to be implemented include:

6.8.1 Vegetation
- Plant endemic species along the road verges to reflect the remnant landscape character of the road corridor including species from the River Flat Eucalypt Forest and Cumberland Plain Woodland plant communities. This will help to establish a landscape identity, provide shade and assist with screening of the existing transmission lines and future industrial developments.
- Planting palette to be similar to recent local road upgrades such as Erskine Park Link Road, ensuring consistency of road character.
- Consider replacement tree planting along road corridor in Minchinbury where space allows to screen residential properties.
- Use advanced tree stock at major intersections to create scale and emphasise intersection.
- Plant low frangible planting and turf within the median strip to provide visual and physical relief to the extent of road pavement. Median planting creates an opportunity to develop a consistent landscape identity along the road upgrade extents.

6.8.2 Finishes
The aesthetic quality of the urban design elements is key to reduce the visual impacts of the Project.
- Bridges should be as simple and elegant as possible.
- Retaining walls should have an architectural treatment that enhances the urban design of the road environment and experience.
- Noise wall finish should be considered to reduce visual impact.
APPENDIX A

An explanation of the rating categories used within this report to determine the level of visual impact on each viewpoint/receptor studied. These rating categories have been developed by CLOUSTON Associates and follow national and international best practice.

<table>
<thead>
<tr>
<th>SENSITIVITY</th>
<th>Qualitative Assessment Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receptor sensitivity</td>
<td>Each visual receptor type has an inherent and varied sensitivity to change in the visual scene based on their personal context in which the view is being experienced. This would have a direct bearing on the perception of visual impact experienced by the receptor and qualifies the quantitative impacts:</td>
</tr>
<tr>
<td>Public Reserve, Parks, Reserves, Public walkways: the purpose of visiting and using reserves largely relates to an enhanced sense of well-being. Receptor is more sensitive to both positive and negative visual experiences, especially where the reserve is the destination for leisure and relaxation.</td>
<td></td>
</tr>
<tr>
<td>Residential: view from dwelling or garden may be experienced regularly over extended periods of time; residents may have chosen the location specifically for the view and/or develop a strong familiarity and association with the view and have high sensitivity to change.</td>
<td></td>
</tr>
<tr>
<td>Public Roads/Transport: the view experienced can be important to the driver/passenger but is sometimes a brief experience and the driver is usually focused on the road.</td>
<td></td>
</tr>
<tr>
<td>Commercial Property - Work: view can enhance the work or education experience but focus of activity is not principally on the view.</td>
<td></td>
</tr>
<tr>
<td>Semi-Private property - Work/Education/Service provider: view can enhance the work or education experience but focus of activity is not principally on the view.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MAGNITUDE</th>
<th>Quantitative assessment definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance</td>
<td>The effect the Project has on the view relating to the distance between the Project and the visual receptor. The distances are from the approximate boundary of the site and categorised as:</td>
</tr>
<tr>
<td>H</td>
<td>Within 0 - 100 metres - high impact.</td>
</tr>
<tr>
<td>M</td>
<td>100 to 500 metres - high to moderate impact.</td>
</tr>
<tr>
<td>L</td>
<td>Further than 500 metres - low impact.</td>
</tr>
<tr>
<td>Quantum of view</td>
<td>The Quantum of view relates to the openness of the view and the angle of the view to the visual receptor. A development located in the direct line of sight has a higher impact than if it were located obliquely at the edge of the view. Whether the view of the Project is filtered by vegetation etc. also affects the impact, as does the nature of the view (panoramic, restricted etc.). A small element within a panoramic view has less impact than the same element within a restricted or narrow view. The effects can be categorised as:</td>
</tr>
<tr>
<td>H</td>
<td>A direct view of the Project or its presence (sometimes in a very narrow or highly framed view), where the Project occupies the greater proportion of the view cone.</td>
</tr>
<tr>
<td>M</td>
<td>A direct view of the Project within a panoramic view where the Project occupies a large proportion of the view cone.</td>
</tr>
<tr>
<td>L</td>
<td>A direct or slightly oblique view of the Project within a broad or panoramic view cone.</td>
</tr>
<tr>
<td>N</td>
<td>An oblique, highly filtered or largely obscured view of the Project.</td>
</tr>
<tr>
<td>Period of view</td>
<td>The length of time the visual receptor is exposed to the view. The duration of view affects the impact of the Project on the viewer - the longer the exposure the more detailed the impression of the proposed change in terms of visual impact. Significant part of the day - high impact: usually residential property.</td>
</tr>
<tr>
<td>H</td>
<td>5 minutes to several hours - high to moderate impact: often from a garden or park or commercial property and work places.</td>
</tr>
<tr>
<td>L</td>
<td>10 seconds to 1 minute - moderate impact: usually from a road/rdeway entrance, walking past or entrance to commercial property.</td>
</tr>
</tbody>
</table>

| Scale of change | A summary rating that combines all of the quantitative ratings. This is rated either high, moderate to high, moderate, moderate to low, low or none, where none implies no visible change based on the above criteria and high implies significant visible change in terms of the combined quantitative criteria. |
| H | Scale of change is a quantitative assessment of the change in compositional elements of the view. If the proposed development is largely similar in nature and scale to that of existing elements in the vicinity, the scale of change is low. If the development radically changes the nature or composition of the elements in the view, the scale of change is high. |
| L | Distance from the development would accentuate or moderate the scale and variety of visible elements in the overall view and hence influence this rating. |
| N | Elements within the view would be partly or slightly at odds with existing features in the landscape. |
| M | Elements within the view would be at odds with existing features in the landscape. |
| H | Elements within the view would be at odds with existing features in the landscape and elements and composition of the view would remain largely unaltered. |

<table>
<thead>
<tr>
<th>SUMMARY</th>
<th>Combined Rating</th>
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</thead>
<tbody>
<tr>
<td>H</td>
<td>The nature of the visual impact may be beneficial or adverse, based on a transparent professional assessment of the combined traits of qualitative and quantitative ratings and comments as outlined above. The final rating is derived using the RMS matrix table - 01:</td>
</tr>
<tr>
<td>M</td>
<td>Highly adverse.</td>
</tr>
<tr>
<td>H</td>
<td>Moderately to Highly adverse.</td>
</tr>
<tr>
<td>L</td>
<td>Moderately adverse.</td>
</tr>
<tr>
<td>M</td>
<td>Slightly adverse.</td>
</tr>
<tr>
<td>L</td>
<td>Neutral or Beneficial.</td>
</tr>
</tbody>
</table>
Appendix L

Flooding and drainage investigation technical paper
ARCHBOLD ROAD
FLOODING AND DRAINAGE INVESTIGATION

VOLUME 1 - REPORT

May 2016
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<td>INTRODUCTION</td>
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<td>1.3</td>
<td>Outline of Report</td>
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<td>Existing Archbold Road</td>
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S1 SUMMARY AND RECOMMENDATIONS

An investigation was carried out by Lyall & Associates Consulting Water Engineers on behalf of the NSW Roads and Maritime Services to assess requirements for the control of stormwater runoff along the upgrade and extension of Archbold Road in Minchinbury south through the Western Sydney Employment Area (WSEA) to Old Wallgrove Road in Horsley Park.

Based on the findings of the investigation, conceptual plans were prepared showing the recommended upgrade of existing cross drainage structures and provision of new structures. The concept drainage strategy also included recommended measures to control runoff from the pavement of the new road.

The recommended measures contained in this report will in most areas improve the level of flood immunity of the existing section of road and provide a minimum 100 year average recurrence interval (ARI) hydrologic standard. However, a key finding of this present investigation is that due to constraints imposed by the existing piped drainage system, a 100 year ARI hydrologic standard is impractical to achieve at the Sargents Road intersection in Minchinbury. As a result, the recommended drainage strategy will only provide a minimum hydrologic standard of about 20 year ARI at this location.

The recommended measures contained in this report will also mitigate the adverse impacts of the road upgrade works in existing development and the existing drainage lines into which the new pavement drainage system will discharge.

The assessment of drainage requirements for Archbold Road was based on flow estimates for present day catchment conditions. During detailed design it will be necessary for the designers of the road upgrade to liaise with Blacktown City Council to confirm the extent of measures which will be incorporated into future development to control the rate of flow discharging to the project corridor to no larger than present day conditions.

Table S1 over the page summarises the key findings and recommendations of the investigation at each location where cross drainage will be required, while Table S2 summarises the key findings of the investigation in regards the recommended concept pavement drainage strategy.
**TABLE S1**

**SUMMARY OF CROSS DRAINAGE REQUIREMENTS**

<table>
<thead>
<tr>
<th>Location</th>
<th>Cross Drainage Structure</th>
<th>Cross Drainage</th>
<th>Existing Pipe/Culvert Dimensions</th>
<th>Catchment Area</th>
<th>Peak Flows 100 year ARI</th>
<th>U/S Invert Level</th>
<th>D/S Invert Level</th>
<th>Length</th>
<th>Slope</th>
<th>C/W Adjacent to Inlet</th>
<th>Central Median</th>
<th>C/W Adjacent to Outlet</th>
<th>Central Median</th>
<th>C/W Adjacent to Outlet</th>
<th>Critical Level for Overtopping New Road</th>
<th>Approximate Minimum Cover over New Cross Drainage</th>
<th>Freeboard to Road Level</th>
<th>100 year ARI</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sargents Road</strong></td>
<td>XD01</td>
<td>4800</td>
<td>2 off 1650 RCP's</td>
<td>Maintain existing 2 off 1650 RCP's and augment with 1 off 1350 RCP</td>
<td>43.9</td>
<td>12.5</td>
<td>45.2</td>
<td>44.7</td>
<td>56</td>
<td>0.8</td>
<td>48.7</td>
<td>48.9</td>
<td>1.8</td>
<td>2.2</td>
<td>2.2</td>
<td>49.0</td>
<td>0.0</td>
<td>49.0</td>
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</tr>
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</table>

- **Discharges into Major Drainage Line 1.**
- **The upgrade of the drainage system would involve:**
  - Augmentation of existing cross drainage structure XD01 with a 1 off 1350 RCP to increase the capture of overland flow and offset the impact of the proposed road upgrade on increased flood levels in Robinson Street and Bament Place.
  - Additional inlet pits in Robinson Street to capture overland flow and direct it to new 2 off 1350 RCP's located along the upgraded section of road between Robinson Street and Sargents Road.
  - Additional inlet pits in Bament Place to capture overland flow and direct it to 2 off 1200 RCP's located along the drainage reserve between Bament Place and Archbold Road.
- **Increases in 100 year ARI flood levels to a maximum of 0.01 m would be experienced in the front of the properties on the corner of Robinson Street and Archbold Road.**
- A reduction in 100 year ARI flood levels of 0.1 m or less would be experienced in Bament Place.
- The upgrade of the drainage system between Robinson Street and Sargents Road would provide a 20 year ARI hydrologic standard and lead to a reduction in overland flow that presently discharges from the project corridor west of Robinson Street. During a 100 year ARI event, flows in excess of the culvert capacity would pond across the full width of the southbound carriageway but would not overtop the centreline of the road.
- The abovementioned diversion of flow will lead to an increase in peak flow discharging into the grass lined channel in Sargents Road. Peak 100 year ARI flood levels along Sargents Road would be increased by a maximum of 0.06 m, but these impacts would be confined to the in-bank area of the grass lined channel.

Refer over page for footnotes.

Continued over page
**SUMMARY OF CROSS DRAINAGE REQUIREMENTS**

<table>
<thead>
<tr>
<th>Location</th>
<th>Existing Drainage System</th>
<th>Design Road Configuration</th>
<th>Existing Pipe/Culvert Dimensions</th>
<th>Proposed Design</th>
<th>Culvert Discharge</th>
<th>Surcharge over Road</th>
<th>Peak Flows 100 year ARI</th>
<th>U/S Invert Level</th>
<th>D/S Invert Level</th>
<th>Length</th>
<th>Slope</th>
<th>Width of Minimum Road Level</th>
<th>C/W Adjacent to Inlet</th>
<th>Central Median</th>
<th>C/W Adjacent to Outlet</th>
<th>Central Median</th>
<th>C/W Adjacent to New Road</th>
<th>Critical Level for Overlapping New Road</th>
<th>100 year ARI</th>
<th>Comments</th>
</tr>
</thead>
</table>
| 20 m south of Sargents Road Intersection | XD02 | 4740 | 1 off 1800 RCP | 2 off 1350 RCP's | 32.4 | 5.5 | - | 47.3 | 46.8 | 32 | 1.5 | 49.8 | 49.7 | 49.2 | 1.1 | 1.3 | 1.0 | 52.9 | 0.2 | | Discharges into Major Drainage Line 1.  
> The upgrade of the drainage system would involve:  
> - Extending the existing 1800 RCP with 2 off 1350 RCP's to suit widened road formation.  
> - Providing 2 off 1200 RCP's along widened road formation between M4 Western Motorway and Sargents Road to capture and direct runoff to inlet of extended cross drainage structure.  
> The upgrade of the drainage system would maintain the 100 year ARI hydrologic standard provided by the existing drainage line discharging to XD02 from the M4 Western Motorway. |
| Immediately north of M4 Western Motorway | XD03 | 4470 | 1 off 525 RCP | 1 off 525 RCP | 0.6 | 0.2 | - | 51.3 | 50.9 | 62 | 0.8 | 59.3 | 59.7 | 59.8 | 7.4 | 8.0 | 8.3 | 57.5 | 5.0 | | Extension of existing culvert to accommodate the proposed road widening for the new east facing on-ramp. |
| Crosses proposed east facing off-ramp | XD03a | 4440 | n/a | 1 off 450 RCP | 0.5 | 0.2 | - | 53.0 | 52.6 | 22 | 1.8 | 59.3 | 59.2 | 59.2 | 5.8 | 5.9 | 6.1 | 57.5 | 4.0 | | New culvert to drain trapped low point created by the embankment for the new east facing on-ramp. |
| Crosses M4 Western Motorway, 260 m east of Archbold Road | XD04 | 310 | 3 off 1050 RCP's | Extends existing 3 off 1050 RCP's | 20.2 | 5.8 | - | 55.0 | 53.8 | 127 | 1.0 | 60.2 | 58.8 | 58.9 | 4.1 | 3.3 | 4.0 | 58.7 | 2.5 | | Extension of existing culvert to accommodate the proposed road for the new east facing on- and off-ramps. |
| Immediately South of M4 Western Motorway | XD05 | 4275 | 1 off 600 RCP | 1 off 600 RCP | 1.2 | 0.3 | - | 54.5 | 53.0 | 57 | 2.6 | 61.1 | 61.3 | 61.3 | 6.0 | 6.9 | 7.6 | 59.4 | 4.4 | | Extension of existing culvert to accommodate the proposed road widening for the new east facing off-ramp. |
| Crosses proposed east facing on-ramp | XD05a | 4300 | n/a | 1 off 525 RCP | 0.5 | 0.4 | - | 55.0 | 54.6 | 37 | 1.1 | 61.2 | 61.2 | 61.2 | 5.6 | 5.8 | 5.9 | 58.7 | 3.1 | | New culvert to drain trapped low point created by the embankment for the new east facing on-ramp. |
| 200 m south of M4 Western Motorway | XD06 | 4180 | 1 off 450 RCP | 1 off 750 RCP | 4.6 | 0.6 | - | 53.1 | 52.8 | 44 | 0.7 | 55.9 | 56.1 | 55.9 | 2.0 | 2.3 | 2.3 | 55.7 | 1.8 | | Upgrade of existing culvert. |
| 400 m south of M4 Western Motorway | XD07a | 3960 | n/a | 4 off 900 RCP's | 13.0 | 4.1 | - | 51.8 | 51.6 | 44 | 0.5 | 53.8 | 54.1 | 53.8 | 1.0 | 1.4 | 1.2 | 53.7 | 1.0 | | Controls runoff from Major Drainage Line 2 across the project corridor. |
| 440 m south of M4 Western Motorway | XD07 | 3920 | 2 off 450 RCP | 1 off 1050 | 1.7 | - | 51.9 | 51.6 | 46 | 0.7 | 54.0 | 54.3 | 54.1 | 1.0 | 1.5 | 1.4 | 53.3 | 0.4 | | Controls runoff from Major Drainage Line 3 across the project corridor. |
| Immediately north of Intersection with Old Walgrove Road | XD08 | 660 | 3 off 1200 RCP's | 1 off 3000 x 1200 RCBC | 20.8 | 7.7 | - | 66.6 | 66.3 | 68 | 0.5 | 69.2 | 69.1 | 69.1 | 1.1 | 1.2 | 1.4 | 69.4 | 1.3 | | Replacement of existing culvert to accommodate new intersection between Archbold Road and Old Walgrove Road. |

Refer over page for footnotes.
<table>
<thead>
<tr>
<th>Location</th>
<th>Design Road Chainage</th>
<th>Existing Pipe/Culvert Dimensions</th>
<th>Approximate Road Elevations</th>
<th>Culvert Discharge (m³/s)</th>
<th>Surcharged over Road (m)</th>
<th>U/S Invert Level (m AHD)</th>
<th>D/S Invert Level (m AHD)</th>
<th>Length (m)</th>
<th>Slope (%)</th>
<th>C/W Adjac. to Inlet (m AHD)</th>
<th>Central Median (m AHD)</th>
<th>C/W Adjac. to Outlet (m AHD)</th>
<th>Central Median (m AHD)</th>
<th>C/W Adjac. to Outlet (m AHD)</th>
<th>Critical Level for Overtopping New Road (m AHD)</th>
<th>Freeboard to Road Level (m AHD)</th>
<th>Comments</th>
</tr>
</thead>
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<tr>
<td>590 m South of M4 Western Motorway XD09 3750 n/a 3 off 1500 x 600 RCBC's 11.8 4.9 54.6 54.5 34 0.5 56.9 57.1 56.9 1.3 1.6 1.5 57.3 1.8 Controls runoff from a tributary to Major Drainage Line 4 across the project corridor. Height of culvert is constrained by minimum cover requirements under pavement. Equivalent roadway area would be provided by 4 off 900 RCP's.</td>
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<td>1230 m south of M4 Western Motorway XD10 3090 n/a 3 off 3600 x 1200 RCBC's 100.0 27.0 49.1 48.5 65 0.9 53.0 53.3 53.7 2.4 3.0 3.7 53.2 2.5 Controls runoff from Major Drainage Line 4 across the project corridor. BCC, 2005 identified a riparian corridor along Major Drainage Line 4 where it crosses the project corridor at XD09.</td>
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<td>650 m north of Lenore Drive XD11 2670 n/a 3 off 1200 x 600 RCBC's 16.2 4.0 55.5 55.3 38 0.6 58.5 58.7 58.4 2.2 2.5 2.3 58.8 2.4 Height of culvert is constrained by minimum cover requirements under pavement. Equivalent roadway area would be provided by 4 off 900 RCP's.</td>
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<td>180 m north of Lenore Drive XD12 2210 n/a 1 off 1350 RCP 9.0 2.8 59.3 58.5 44 1.9 64.2 63.6 63.4 3.5 3.3 3.5 63.0 2.3 Controls runoff from Major Drainage Line 8 across the project corridor.</td>
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<td>390 m south of Lenore Drive XD13 1660 n/a 7 off 2700 x 1500 RCBC's 113.5 41.9 51.3 51.1 55 0.4 55.9 56.0 56.4 2.9 3.1 3.6 55.5 2.7 Controls runoff from Major Drainage Lines 7 and 8 across the project corridor. Channel realignment proposed to divert Major Drainage Line and provide one cross drainage structure.</td>
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<td>760 m south of Lenore Drive XD14 1260 n/a 2 off 750 RCP's 5.9 1.3 56.5 55.9 47 1.4 58.6 58.3 57.7 1.3 1.3 1.0 58.2 1.0 Controls runoff from Major Drainage Line 9 across the project corridor. Realignment of Major Drainage Line 9 is required where it presently runs along the proposed road alignment. The concept stormwater management strategy presented in Brown Consulting, 2010 shows the area draining to XD14 is to be diverted away from Archbold Road and toward Ropes Creek. It is therefore recommended that during detailed design the designers liaise with Blacktown City Council (BCC) to ensure consistency with the stormwater management strategy for the Lot 5 DP 262213 (Ropes Creek South Precinct).</td>
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(1) Refer Figure 5.1 for locations of Cross Drainage Structure Identifiers.  
(2) RCP = Reinforced Concrete Pipe, RCBC = Reinforced Concrete Box Culvert  
(3) Design Road Chainage on M4 Western Motorway  
(4) Assumed culvert dimension.
### TABLE S2
**SUMMARY OF PAVEMENT DRAINAGE STRATEGY**

<table>
<thead>
<tr>
<th>Section</th>
<th>Key Findings and Recommendations</th>
</tr>
</thead>
</table>
| **Existing Archbold Road** (DRC 4500 – DRC 5200) | - The existing drainage system in Archbold Road would be upgraded to accommodate the widened road formation. The upgraded drainage system would discharge to the existing outlet in Sargents Road.  
- There would be an increase in flow discharging into Sargents Road across the full range of storm events. This is primarily due to the upgrade of the drainage system between Robinson Street and Sargents Road which will divert flow that presently discharges from the project corridor in a westerly direction opposite Robinson Street toward the grass lined channel which is located in the road reserve of Sargents Road. While peak 100 year ARI road levels along Sargents Road would be increased by a maximum of 0.06 m, these impacts would be confined to the grass lined channel. |
| **Archbold Road Overpass and M4 Western Motorway** (DRC 4300 – DRC 4500) | - The existing stormwater detention basin draining the eastbound and westbound carriageways of the M4 Western Motorway will need to be relocated approximately 180 m west to accommodate the proposed alignment of the new east facing on-ramp. The existing pavement drainage system along the M4 Western Motorway would be diverted to the new stormwater detention basin which would also control runoff from the new east facing on-ramp. The volume provided by the new basin would be increased to 1,820 m³ (currently 1,210 m³) to offset the increase in runoff from the new east facing on- and off-ramps. A concept layout of the new basin is shown on Figure 6.1, sheet 1. The new basin has a total footprint of about 2,400 m², including the extent of access tracks and batters.  
- There would be a minor increase in peak flows along the open channel downstream of the new basin. While peak 100 year ARI event peak flows would be increased from 5.3 m³/s to 5.6 m³/s, the impacts would still be confined to the downstream reach of channel. |
| **WSEA Precincts** (DRC 800 – DRC 4300) | - It is recommended that the pavement drainage system be discharged at the location of each cross drainage structure, with the exception of cross drainage structure XD06 where it is recommended that the pavement drainage system be directed to XD07a in order to limit the increase in peak flows at XD06 which would otherwise impact on the area of high ecological value west of the project corridor. Similarly, it is recommended that the pavement drainage system at XD09 be directed to the outlet of the larger cross drainage structure XD10 to limit the increase in discharge at XD09.  
- For the purpose of the present investigation it has been assumed that the control of runoff from the project corridor will be provided through regional basins that form part of the broader precinct strategy. However, it is recommended that water quality and spill containment measures be provided at the outlet of pavement drainage systems at cross drainage structures XD10 and XD13 which discharge directly into riparian corridors identified in BCC, 2005 and Brown Consulting, 2010. Figure 6.1, sheets 2 and 3 show the concept layouts for water quality basins at XD10 and XD13 which have a total footprint of about 1,460 m² and 1,920 m² respectively including the extent of access tracks and batters. Sketch 7.1 in Chapter 7 of this report shows the key features of the water quality basins, which would comprise a sediment basin and a bio-retention zone to provide the retention of pollutants in accordance with the water quality targets set out in BCC’s Development Control Plan (Part R – Water Sensitive Urban Design).  
- It is recommended that further liaison be undertaken with BCC during detailed design to confirm the need for water quality and spill containment at other pavement drainage outlets based on the latest precinct development plans. |
| **Sydney Water Supply Pipeline and Old Wallgrove Road** (DRC 4600 – DRC 5200) | - The assessment of pavement drainage requirements was based on the design drawings for the Old Wallgrove Road upgrade (AT&L, 2015), which is understood to be under construction at the date of writing. A concept layout for the upgrade of the pavement drainage to accommodate the proposed intersection with Archbold Road is shown on Figure 6.1, sheet 3.  
- When compared to the Old Wallgrove Road upgrade currently under construction, the proposed extension of Archbold Road will result in a minor increase in peak flows discharging into the grass lined channel west (downstream) of the project corridor at cross drainage structure XD08. For example, the peak flow discharging from the project corridor would increase from 8.5 m³/s to 8.8 m³/s in a 100 year ARI event. While the impact of this increase in flow is expected to be negligible, during detailed design it will be necessary to collect detailed ground survey along the grass lined channel to confirm its capacity and the impact of the road works. |
1 INTRODUCTION

1.1 Background

The NSW Roads and Maritime Services (Roads and Maritime) is currently developing a concept design for the upgrade and extension of Archbold Road in Minchinbury south through the Western Sydney Employment Area (WSEA) to Old Wallgrove Road in Horsley Park.

Figure 1.1 shows the extent of the corridor along which Archbold Road will extend (project corridor), which will be about 5 km in length and comprise a four-lane dual carriageway. The upgrade of the existing section of Archbold Road will extend from a location 230 m south of the Great Western Highway to a location 800 m south of the M4 Western Motorway. The upgrade would include the section of Archbold Road south of Sargents Road, including the Archbold Road Overpass at the M4 Western Motorway, which is presently closed to public access. Archbold Road will be extended south through the WSEA Precincts, including a connection to the recently constructed Lenore Drive, to connect with Old Wallgrove Road at a location immediately south of the Sydney Water Supply Pipeline (SWSP) corridor. The extension of Archbold Road will run parallel and a short distance to the east of the main arm of Ropes Creek, a tributary of South Creek. The extended section of road will also cross a number of watercourses which discharge to the main arm of Ropes Creek along its eastern bank.

The objective of this present investigation was to undertake an assessment of flooding and drainage requirements associated with the proposed road works. The findings of the investigation will assist in the development of the concept road design and preparation of an environmental assessment for the road works. The scope of work for the investigation broadly involved:

- definition of flooding behaviour along the project corridor and adjacent main arm of Ropes Creek under present day conditions;
- assessment of the impacts the road works will have on flooding behaviour;
- assessment of cross drainage requirements;
- development of a pavement drainage strategy, including assessment of water quality and quantity control requirements; and
- preliminary assessment of erosion and sediment control requirements.

This report deals with the findings of these investigations and recommends a series of measures which should be incorporated into the detailed design in order to mitigate the drainage and flood related impacts associated with the road works during both the construction and operational phases of the project.

1.2 Study Tasks

The study tasks were as follows:

- Review of previous studies and available data along the project corridor.
- Liaise with Blacktown City Council to collect available data on the local stormwater drainage system within the catchment.
- Develop a hydrologic model of the catchments draining to and through the project corridor to generate discharge hydrographs for input to the hydraulic model.
- Develop a hydraulic model of Ropes Creek and the various drainage lines which cross the project corridor to define flooding patterns under present day conditions, including data on peak flood levels, depths of inundation and flow velocities.
- Undertake hydrologic and hydraulic analyses for post-project conditions to assess changes in flood behaviour and determine cross drainage requirements.
- Assess the impact of future development, climate change and a partial blockage of hydraulic structures on flood behaviour in the vicinity of the project corridor.
- Develop a strategy for discharging runoff from the new pavement drainage system aimed at mitigating the impacts of the road works on existing development.
- Identify opportunities for the treatment of stormwater runoff captured by the new pavement drainage system including the provision of spill containment measures.
- Assess requirements for temporary sediment retention basins which may be needed along the project corridor to treat runoff from the project corridor during the construction phase of the project.

1.3 Outline of Report

Section 2 of this report provides a brief description of the catchments which presently contribute runoff to existing cross drainage structures and drainage lines along the project corridor.

Section 3 provides a brief description of the road upgrade works. This section also contains an overview of the project within the context of development in the WSEA Eastern Creek and Ropes Creek Precincts.

Section 4 contains an overview of the methodology and findings of an investigation which was undertaken to assess peak flow rates at key locations along the project corridor and within the broader Ropes Creek catchment under present day conditions.

Section 5 deals with the development of the TUFLOW hydraulic models and details the results of the hydraulic modelling of the design floods under present day climatic conditions. Results are presented for existing topographic conditions (i.e. pre-road upgrade), as plans showing peak water surface elevation contours and indicative extents and depths of inundation for the 5, 20 and 100 year Average Recurrence Interval (ARI) events.

Section 6 sets out the key criteria which were adopted for sizing cross drainage along Archbold Road and presents the findings of the investigation into the upgrade requirements of existing cross drainage structures as well as the provision of new cross drainage structures along the new section of road.

Section 7 presents a strategy for the capture and treatment of runoff from the road pavement prior to its discharge to the receiving drainage lines.

Section 8 provides a summary of the approach which was adopted in developing an erosion and sediment control strategy for the construction phase of the road upgrade works. This includes requirements for, and preliminary design of temporary sediment retention basins that will be required along the length of the project corridor.

Section 9 contains a list of references which were used during the course of the investigation.
Volume 2 of the report contains all referenced figures.

Appendix A contains a plan showing the extent of the WSEA, which includes Eastern Creek and Ropes Creek Precincts.

Appendices B and C contain drawings that show the concept detention basin layout for the Eastern Creek Precinct and Lot 5 DP 262213 (Ropes Creek South Precinct), respectively.

Appendix D contains a series of photographs that show the recently constructed drainage measures for Lenore Drive.

1.4 Available Data

The following data were made available by Roads and Maritime for this present investigation:

- Ortho-rectified aerial photography covering the study area.
- Airborne laser scanning (ALS) survey data covering the study area, which was flown in 2011.
- Detailed ground survey along the project corridor.
- Preliminary horizontal and vertical alignments for the proposed road upgrade works.
- Property boundary information in GIS format.

The following additional information was obtained from other sources (as noted):

- GIS datasets containing details of drainage networks (pits and pipes), provided by Blacktown City Council (BCC).
- Information sourced from BCC relating to its proposed stormwater management strategy for the Eastern Creek Precinct, including the Employment Land Precinct Plan – Eastern Creek Precinct (BCC, 2005).
- Environmental Assessment Report - Lot 5 DP 262213, Ropes Creek Industrial Estate (JBA Planning, 2010), obtained from the NSW Planning and Environment website.
- Stormwater Management and Trunk Drainage Strategy - Lot 5 DP 262213, Ropes Creek Employment Precinct (Brown Consulting, 2010), obtained from the NSW Planning and Environment website.
- Updated South Creek Flood Study (WorleyParsons, 2015) undertaken on behalf of Penrith, Liverpool and Blacktown City Councils, obtained from the Penrith City Council website.
2 CATCHMENT DESCRIPTION

2.1 General

This section of the report contains a brief description of the catchments which presently contribute runoff to the existing drainage systems that are located along the project corridor.

Figure 2.1 (2 sheets) shows the location of existing cross drainage structures, drainage lines and other key features along the project corridor, and should be referred to when reading this section of the report. Note that for the purpose of this report, the locations of key features are identified by their approximate Design Road Chainage (DRC).

Table 2.1 provides details of the existing cross drainage structures which are located along the route of the proposed road upgrade.

For the purpose of the following discussion the project has been divided into the following sections:

- Existing section of Archbold Road – DRC 4500 to DRC 5200
- M4 Western Motorway corridor including the Archbold Road overpass – DRC 4300 to DRC 4500
- WSEA Precincts of Eastern Creek and Ropes Creek – DRC 800 to DRC 4300
- Old Wallgrove Road Intersection – DRC 500 to DRC 800

### TABLE 2.1
DETAILS OF EXISTING CROSS DRAINAGE

<table>
<thead>
<tr>
<th>Cross Drainage Structure Identifier(1)</th>
<th>Design Road Chainage</th>
<th>Dimensions / Type(5) (mm)</th>
<th>Upstream Invert Level (m AHD)</th>
<th>Downstream Invert Level (m AHD)</th>
<th>Adjacent Road Level (m AHD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>XD01</td>
<td>DRC 4800</td>
<td>2 off 1650 RCP’s</td>
<td>45.07(3)</td>
<td>44.72</td>
<td>48.4</td>
</tr>
<tr>
<td>XD02</td>
<td>DRC 4750</td>
<td>1 off 1800 RCP</td>
<td>47.17(3)</td>
<td>45.01</td>
<td>49.7</td>
</tr>
<tr>
<td>XD03</td>
<td>DRC 4460</td>
<td>1 off 525 RCP</td>
<td>51.19</td>
<td>50.44</td>
<td>59.2</td>
</tr>
<tr>
<td>XD04</td>
<td>DRC 260 (2)</td>
<td>3 off 1050 RCP’s</td>
<td>54.96</td>
<td>54.19</td>
<td>60.0</td>
</tr>
<tr>
<td>XD05</td>
<td>DRC 4280</td>
<td>1 off 600 RCP</td>
<td>54.24</td>
<td>52.96(3)</td>
<td>61.1</td>
</tr>
<tr>
<td>XD06</td>
<td>DRC 4150</td>
<td>1 off 450 RCP(3)</td>
<td>52.25</td>
<td>51.86(3)</td>
<td>55.4</td>
</tr>
<tr>
<td>XD07</td>
<td>DRC 3930</td>
<td>2 off 450 RCP’s(3)</td>
<td>51.52</td>
<td>51.70</td>
<td>52.5</td>
</tr>
<tr>
<td>XD08</td>
<td>DRC 660</td>
<td>3 off 1200 RCP’s(4)</td>
<td>66.90(4)</td>
<td>66.50(4)</td>
<td>69.1</td>
</tr>
</tbody>
</table>

(1) Refer Figure 2.1 for locations of Cross Drainage Identifiers.
(2) Design Road Chainage on M4 On-Ramp
(3) Assumed dimension/elevation.
(4) Based on design drawings for the Old Wallgrove Road upgrade (AT&L, 2015).
(5) RCP = Reinforced Concrete Pipe
2.2 Existing Archbold Road (DRC 4500 – DRC 5200)

Runoff from a 44 hectare residential catchment that lies to the east of Archbold Road is controlled by two piped drainage lines that discharge to the low point in Archbold Road at DRC 4800, opposite Sargents Road. The northernmost of these piped drainage lines comprises a 1350 reinforced concrete pipes (RCP’s) that runs from Robinson Street along the eastern kerb line of Archbold Road, while the southernmost piped drainage line comprises a 1200 RCP that runs along a drainage easement from Bament Place.

Runoff that collects at the low point in Archbold Road at DRC 4800 is drained across the project corridor via 2 off 1650 RCP’s (refer cross drainage structure XD01 on Figure 2.1, sheet 1).

An 1800 RCP also crosses Archbold Road immediately south of XD01 and discharges into Major Drainage Line 1 in Sargents Road (refer cross drainage structure XD02 on Figure 2.1, sheet 1). Runoff from a portion of the M4 Western Motorway and the undeveloped catchment that lies to its south is controlled by cross drainage structure XD02 (refer Section 2.3 for a preliminary overview of drainage arrangements within the M4 Western Motorway corridor).

Stormwater discharging from XD01 and XD02 flows in a westerly direction via an open channel with a 600 mm RCP low flow pipe along the central median of Sargents Road (denoted Major Drainage Line 1 on Figure 2.1, sheet 1). Major Drainage Line 1 ultimately discharges into Ropes Creek approximately 1200 m west of Archbold Road.

2.3 M4 Western Motorway Corridor (DRC 4300 – DRC 4500)

Runoff from two small catchments that lie to the east of the Archbold Road overpass is conveyed across the project corridor by culvert structures that are located to the north and south of the M4 Western Motorway (refer cross drainage structures XD03 and XD05 on Figure 2.1, sheet 1).

An undeveloped catchment that lies to the south of the M4 Western Motorway is drained via 3 off 1050 RCP’s that cross the M4 Western Motorway at DRC 300 (refer cross drainage structure XD04 on Figure 2.1, sheet 1).

An existing stormwater detention basin that is located on the northern side of the M4 Western Motorway at DRC 260 controls runoff from the eastbound and westbound carriageways (refer Figure 2.1, sheet 1 for location). The basin, which has a vegetated base with a 300 mm diameter outlet pipe, is approximately 1.3 m deep and provides a storage volume of about 1,200 m$^3$ at top of basin level. The outlet pipe from the basin discharges into a grass lined channel at the outlet to cross drainage structure XD04.

2.4 WSEA Precincts (DRC 800 – DRC 4300)

Runoff from a relatively small undeveloped catchment drains to a dam that is located to the east of the project corridor at DRC 4180. Flow from the dam discharges across the existing road via a culvert of unknown dimensions at DRC 4150.

Runoff from a catchment comprising the western portion of the Pioneer Quarry drains to a series of dams that lie immediately to the east of the project corridor between DRC 3600 and DRC 4050. Flow that surcharges these dams drains to a cross drainage structure of unknown dimensions that crosses the existing road at DRC 3930 and discharges into two drainage lines that are
located at DRC 3920 and DRC 3960 (denoted Major Drainage Lines 2 and 3 on Figure 2.1, sheet 1).

**Major Drainage Line 4** runs in a westerly direction and crosses the project corridor at DRC 3070 (refer Figure 2.1, sheet 2). The catchment draining to Major Drainage Line 4 is predominantly undeveloped at present but also includes the southern portion of Pioneer Quarry.

**Major Drainage Lines 5 and 6** cross the project corridor at DRC 2680 and DRC 2210 respectively and drain relatively small undeveloped catchments that lie immediately to its east (refer Figure 2.1, sheet 2).

The recently constructed Lenore Drive crosses the project corridor at DRC 2050. Runoff from Lenore Drive is controlled by 450 RCP drainage lines that run in a westerly direction along both sides of the road and discharge into a water quality basin that is located immediately upstream (east) of Ropes Creek.

**Major Drainage Lines 7, 8 and 9** run in a westerly direction and discharge across the project corridor between Lenore Drive and the SWSP (refer Figure 2.1, sheet 2). The larger of these is Major Drainage Line 7, which drains a catchment that extends east of Old Wallgrove Road and includes the Sydney West Substation.

### 2.5 Old Wallgrove Road Intersection (DRC 500 – DRC 800)

The Sydney Water Supply Pipeline (SWSP) comprises two above ground pipelines separated by a service road where it crosses the project corridor at DRC 750. Runoff from two small catchments drains in a westerly direction along the two pipelines, which are located in cuttings where they cross the project corridor.

At the date of writing, the upgrade of Old Wallgrove Road was currently under construction. Design drawings for the Old Wallgrove Road upgrade project (AT&L, 2015) have been used to define site conditions under pre-Archbold Road upgrade conditions. The extent of the Old Wallgrove Road upgrade project is shown on Figure 2.1, sheet 2.

The western portion of the Austral Bricks Plant drains to the low point in Old Wallgrove Road at DRC 640. The design drawings for the Old Wallgrove Road upgrade show that runoff which collects at the low point in Old Wallgrove Road is drained across the project corridor via a 3 off 1200 RCP (refer cross drainage structure XD08 on Figure 2.1, sheet 2). XD08 discharges into a grass lined channel that runs in a westerly direction for approximately 700 m along the western boundary of the Oakdale Industrial Estate where it joins Major Drainage Line 10 at the location where it crosses the SWSP. Major Drainage Line 10 runs north for a further 500 m before discharging into Ropes Creek.
3 PROPOSED ROAD UPGRADE AND FUTURE INDUSTRIAL SUBDIVISION LAYOUT

3.1 General

The proposed upgrade and extension of Archbold Road will provide an arterial road link through the WSEA precincts of Eastern Creek and Ropes Creek. The following sections provide an overview of the road project and the future industrial subdivision layouts within the WSEA Eastern Creek and Ropes Creek precincts.

3.2 Archbold Road Upgrade

The upgrade and extension of Archbold Road will involve:

- upgrade and widening of the existing section of Archbold Road from a location 230 m south of the Great Western Highway to a location 800 m south of the M4 Western Motorway;
- duplication of the existing Archbold Road Overpass and the provision of new east facing on- and off-ramps;
- extension of Archbold Road to connect with Old Wallgrove Road at a location immediately south of the SWSP corridor;
- provision of new intersections with Robinson Street, Sargents Road, Lenore Drive and Old Wallgrove Road; and
- provision of intersection stubs for future connections to local road networks in the Eastern Creek and Ropes Creek Precincts of WSEA.

The extent of the proposed road works is shown on Figure 3.1 (2 sheets).

3.3 Western Sydney Employment Area

3.3.1 Eastern Creek Precinct

Figure 3.1 (2 sheets) shows the extension of Archbold Road runs in a north-south direction through the WSEA Eastern Creek Precinct between DRC 3350 and DRC 4300. BCC has developed a stormwater management strategy as part of its Employment Land Precinct Plan – Eastern Creek Precinct (BCC, 2005) to cater for staged development within the precinct.

BCC, 2005 requires future development of the WSEA Eastern Creek Precinct to include detention basins to limit peak discharges from the development to no greater than those under rural conditions for events ranging between 2 and 100 year ARI. BCC, 2005 also requires that future development does not result in an increase in the frequency of bank full flows along existing drainage lines that lie downstream of the development.

Appendix A contains the stormwater management plan presented in BCC, 2005, which shows the layout of regional type stormwater detention basin/wetlands which will control runoff from future development within the precinct. The location of the proposed stormwater detention basins/wetlands have been overlaid onto Figure 3.1 to show their location in relation to the project corridor.
Figure 3.1 shows that a stormwater detention basin/wetland is proposed upstream of cross drainage structure XD04 on Major Drainage Line 1. A stormwater detention basin/wetland is also proposed at the confluence of Major Drainage Lines 2 and 3, downstream of the project corridor while a series of detention basin/wetlands are proposed to control runoff from catchments draining to Major Drainage Line 4 upstream of the project corridor.

3.3.2 Ropes Creek Precinct

Figure 3.1, sheet 2 shows the extension of Archbold Road runs through the WSEA Ropes Creek Precinct, which is located between the WSEA Eastern Creek Precinct in the north, and the SWSP in the south.

Stormwater Management and Trunk Drainage Strategy - Lot 5 DP 262213, Ropes Creek Employment Precinct (Brown Consulting, 2010) was prepared to support the concept plan and environmental assessment for development of Lot 5 DP 262213 which comprises the southern portion of the WSEA Ropes Creek Precinct.

Brown Consulting, 2010 contains a preliminary basin location and stormwater masterplan showing the proposed layout of stormwater detention basins which will control runoff from the subdivision. This plan, which is reproduced in Appendix B, shows that the project corridor has been included in the catchment areas assigned to each stormwater detention basin. The location of the proposed stormwater detention basins relative to the project corridor is also shown on Figure 3.1, sheet 2.

In BCC’s submission to the Environmental Assessment for Lot 5 DP 262213 (letter to Department of Planning, 23 December 2010), BCC rejected the proposed methodology of all water quality being controlled in regional type detention basins. BCC advised that at-source controls were required for individual lots, with only runoff from open space and roads treated in regional type detention basins. In either case, it is assumed that runoff from the future Archbold Road extension would be controlled by the regional basins within Lot 5 DP 262213.

While no details are presently available on the future development of the northern portion of the Ropes Creek Precinct, for the purpose of the present investigation it has been assumed that the control of runoff would be generally consistent with the strategy developed for Lot 5 DP 262213.
4 CATCHMENT HYDROLOGY

4.1 General

The assessment of the runoff characteristics of the catchments which contribute flow to the drainage systems along the project corridor was based on hydrologic models that were developed using the DRAINS software.

DRAINS is a simulation program which converts rainfall patterns to stormwater runoff and generates discharge hydrographs. These hydrographs are then routed through networks of piped drainage systems, culverts, storages and open channels to calculate hydraulic grade lines and analyse the magnitude of overflows. Alternatively, discharge hydrographs generated by DRAINS can be used as inflows to hydraulic models (such as the TUFLOW two-dimensional hydraulic modelling software used in the present study) to determine flooding patterns. The latter approach is particularly appropriate for modelling complex flood behaviour involving multiple flow paths and has been used in the present study. Chapter 5 describes the development of the TUFLOW hydraulic model used to define flood behaviour along the project corridor.

The extents of the catchments that contribute flow to the existing drainage systems that cross the project corridor are shown on Figure 4.1 (3 sheets). The following sections of the report contain a brief description of the DRAINS models that were developed as part the investigation. As none of the catchments are gauged, it was not possible to calibrate model parameters to reproduce recorded flows. A comparison of the peak flows generated by the hydrologic models developed as part of the present investigation was therefore made with both the Urban Rational Method (URM) and Probabilistic Rational Method (PRM) of flood estimation as described in Australian Rainfall and Runoff (ARR) (Institute of Engineers Australia, 1998).

4.2 DRAINS Model Development

4.2.1 General

A number of hydrologic sub-models are available within the DRAINS software to simulate the conversion of rainfall to runoff. The ILSAX sub-model was selected for the sub-catchments north of and including the M4 Western Motorway, as it is well suited to the urbanised nature of this area. The RAFTS sub-model was used for the sub-catchments south of the M4 Western Motorway, which are largely undeveloped and semi-rural in nature.

Figure 4.1 (3 sheets) shows the layout of the ILSAX and RAFTS sub-catchments which comprise the DRAINS model developed for the study area. Sub-catchment boundaries were digitised based on contour information derived from the available ALS survey data. Sub-catchment slopes applied as input data for the ILSAX and RAFTS sub-catchments were derived using the average sub-catchment slope and vector averaged slope methods, respectively. Aerial photography and site observations were used to assess the degree of urbanisation present in the study catchments.

4.2.2 Design Storms

Rainfall intensities for the 5, 20 and 100 year ARI events were derived using procedures outlined in ARR for storm durations ranging between 15 minutes and 36 hours. The design rainfalls were converted into rainfall hyetographs using the temporal patterns presented in ARR.
For catchments draining to the project corridor, no Areal Reduction Factor (ARF) was applied to the design rainfall intensities obtained from ARR due to the size of the catchments draining to the project corridor (the largest of which is Major Drainage Line 6 with an area of 0.3 km² where it crosses the project corridor).

For the Ropes Creek catchment, data in ARR, 1998 indicates that a small reduction in design rainfall intensities of about 2 per cent (i.e. an ARF of about 0.98) is applicable for a catchment area of about 29 km² and a storm duration of 9 hours (the critical duration for the catchment). However, as this reduction is quite small, a conservative approach was adopted for design purposes by adopting an ARF = 1.0.

4.2.3 Model Parameters

Adopted ILSAX sub-model parameters comprised initial losses of 2 and 10 mm for paved and grassed areas, respectively. ILSAX uses the Hortonian loss modelling approach which does not require the user to input a continuing loss rate. Instead, a soil type and antecedent moisture condition (AMC) are used to define the continuing loss over time. The soil type was set equal to 3, which corresponds with a soil of comparatively high runoff potential while an AMC of 3 was adopted reflecting rather wet conditions prior to the onset of runoff producing rainfall.

Adopted RAFTS sub-model parameters comprised initial losses of 2 and 15 mm for paved and grassed areas, respectively, while continuing loss rates of 0 and 2.5 mm/h were adopted for paved and grassed areas, respectively.

A storage routing coefficient multiplier (Bx factor) of 0.8 was adopted after comparison of peak discharges from a range of sub-catchments with those derived from the PRM approach.

Lagging was used to model the translation of the discharge hydrographs between sub-catchment outlets within the ILSAX and RAFTS sub-models (referred to as links). This approach required a flow velocity to be assumed in each link. The sensitivity of the results to assumed flow velocities ranging between 1 and 2 m/s was tested for the 100 year ARI critical storm. After consideration of flow path slopes and comparison of results with those derived from the PRM approach, a flow velocity of 1 m/s was adopted for design flood estimation.

4.3 Comparison of Results

Table 4.1 over the page compares peak discharges derived from the present investigation with those from the URM and PRM approaches at select locations along Ropes Creek and within catchments draining to the project corridor. Results from the RAFTS sub-model were compared with the PRM due to the largely undeveloped nature of this area. Conversely, results from the ILSAX sub-model were compared with the URM due to the developed nature of catchments within this area.

Table 4.1 also provides a comparison with peak discharges from Brown Consulting, 2010 and WorleyParsons, 2015.¹

¹ WorleyParsons, 2015 developed a RAFTS model for hydrologic modelling of the catchments draining to South Creek and its tributaries, including Ropes Creek. Brown Consulting, 2010 also developed a RAFTS model for hydrologic modelling of the catchments draining to and through the proposed subdivision of Lot 5 DP 262213.
### TABLE 4.1
COMPARISON OF PEAK FLOW ESTIMATES
100 YEAR ARI

<table>
<thead>
<tr>
<th>Catchment</th>
<th>Peak Flow Location Identifier$^{(1)}$</th>
<th>Location</th>
<th>DRAINS Sub-Model</th>
<th>Catchment Area (ha)</th>
<th>Peak Flow (m$^3$/s)</th>
<th>Present Study$^{(2)}$</th>
<th>Rational Method</th>
<th>Previous Study</th>
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</thead>
<tbody>
<tr>
<td>Major Drainage Line 1</td>
<td>D1</td>
<td>Archbold Road</td>
<td>ILSAX</td>
<td>59</td>
<td>16.6</td>
<td>19.7$^{(3)}$</td>
<td>-</td>
<td></td>
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<tr>
<td>Major Drainage Line 4</td>
<td>D2</td>
<td>1300 m south of M4</td>
<td>RAFTS</td>
<td>95</td>
<td>25.7</td>
<td>12.2$^{(4)}$</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Major Drainage Line 7</td>
<td>D3</td>
<td>400 m south of Lenore Drive</td>
<td>RAFTS</td>
<td>113</td>
<td>32.9</td>
<td>13.1$^{(5)}$</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Ropes Creek</td>
<td>RC1</td>
<td>SWSP</td>
<td>RAFTS</td>
<td>1,694</td>
<td>135</td>
<td>108$^{(6)}$</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RC2</td>
<td>North of Lenore Drive</td>
<td>RAFTS</td>
<td>2,139</td>
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<td>130$^{(6)}$</td>
<td>260$^{(3)}$</td>
<td></td>
</tr>
<tr>
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<td>RAFTS</td>
<td>2,826</td>
<td>180</td>
<td>161$^{(6)}$</td>
<td>164$^{(3)}$</td>
<td></td>
</tr>
</tbody>
</table>

1. Refer Figure 4.1 (sheets 2 and 3) for Peak Flow Location Identifier.
2. Values in brackets are based on an undeveloped catchment and are presented for the purpose of comparison with peak discharges derived using the Probabilistic Rational Method.
3. Peak flow derived using the URM approach
4. Peak flow derived using the PRM approach
Results from the ILSAX and RAFTS sub-models generally produced a reasonable comparison to the corresponding URM and PRM estimates, with the exception of catchments draining to Major Drainage Lines 4 and 7, where peak flows derived by RAFTS were found to be 40 to 50 per cent higher than the corresponding results from the PRM approach. The reason for the higher flows in RAFTS is attributed to the relatively steep nature of these catchments, with catchment slopes typically greater than 5 per cent.

The peak 100 year ARI flow in Ropes Creek at the Great Western Highway (location RC3) derived by RAFTS during the present investigation compared closely with the value presented in WorleyParsons, 2015. It is noted that WorleyParsons, 2015 determined the storm critical duration to be 36 hours, in comparison to a critical duration of 9 hours from the present investigation. However, the difference between peak flows from the 9 and 36 hour storms derived by RAFTS during the present investigation is less than 10 per cent.

The peak 100 year ARI flow derived by RAFTS during the present investigation in Ropes Creek north of Lenore Drive (location RC2) is almost half the corresponding value presented in Brown Consulting, 2010. It is noted that the catchment area presented in Brown Consulting, 2010 (2,122 hectares) compares closely with the catchment area calculated in the present investigation (2,139 hectares). It is also noted that the PRM estimate presented in Brown Consulting, 2010 (228 m$^3$/s) differs significantly to the PRM estimate calculated in the present investigation (130 m$^3$/s). The PRM estimate in Brown Consulting, 2010 is higher than would be expected for the catchment area draining to location RC2.

In summary, the peak 100 year ARI flows in Ropes Creek derived by RAFTS during the present investigation compared closely with those derived by the PRM approach and WorleyParsons, 2015. Based on the findings of the present investigation and WorleyParsons, 2015, the relatively large peak flow estimates presented in Brown Consulting, 2010 are considered to be an overestimate.
5 ASSESSMENT OF PRESENT DAY FLOODING CONDITIONS

5.1 General

Detailed two-dimensional hydraulic modelling was undertaken using the TUFLOW software to define flooding behaviour along the drainage lines which cross the project corridor between Robinson Street and the SWSP. For the local catchment south of the SWSP, an assessment of the magnitude of flow in the various overland flow paths and receiving drainage lines was undertaken using the DRAINS model described in Chapter 4.

The TUFLOW and DRAINS models were initially developed to define flooding behaviour in the vicinity of the project corridor under present day conditions. Chapter 6 describes how the structure of these models was adjusted to enable an assessment of the impacts the proposed works will have on flooding behaviour and an evaluation of potential mitigation measures to be carried out.

5.2 The TUFLOW Modelling Approach

TUFLOW is a two-dimensional hydraulic model which does not rely on a prior knowledge of the pattern of flood flows in order to set up the various fluvial and weir type linkages which describe the passage of a flood wave through a drainage system.

The basic equations of TUFLOW involve all of the terms of the St Venant equations of unsteady flow. Consequently the model is “fully dynamic” and once tuned will provide an accurate representation of the passage of the flood wave through a drainage system in terms of extent, depth, velocity and distribution of flow.

TUFLOW solves the equations of flow at each point of a rectangular grid system which represent overland flow on the floodplain and along streets. The grid system may also be used to describe the waterway area available in the channel system. Channel systems can also be modelled as one-dimensional elements embedded in the larger two-dimensional domain which typically represents the wider floodplain. Flows are able to move between the one and two-dimensional elements of the model depending on the capacity characteristics of the drainage system being modelled.

The approach adopted in the present investigation was to model culverts and piped reaches as one-dimensional elements with open channels, roads and other topographic features of the broader floodplain included in the larger two-dimensional domain. The choice of grid point spacing depends on the need to accurately represent features on the floodplain which influence hydraulic behaviour and flow patterns (e.g. buildings, streets, changes in floodplain dimensions, hydraulic structures which influence flow patterns, etc.).
5.3 Development of the TUFLOW Model

5.3.1 Model Layout

The layout of the TUFLOW model which was developed as part of the present investigation is shown on Figure 5.1.

A grid spacing of 2 m was adopted as it provided an appropriate level of definition of features which influence the passage of flow over the natural surface (e.g. roads, buildings and drainage paths) whilst maintaining a reasonable simulation run time.

Grid elevations were based on ALS survey data which was flown in 2011. Ridge and gully lines were added to the model where the grid spacing was considered too coarse to accurately represent important topographic features which influence the passage of overland flow.

The stormwater drainage network in Archbold Road north of the M4 Western Motorway was defined based on detailed ground survey. This information generally included the dimensions of pipes and invert levels at pits and headwalls. The stormwater drainage network within areas upstream and downstream of Archbold Road was defined using GIS based data obtained from BCC, which included dimensions of pit inlets and pipes, as well as locations of pits and headwalls.

Where invert levels were not available, pit surface levels were estimated based on ALS survey data, while an assumed cover of 700 mm was adopted for setting invert levels of individual pipe reaches (which applied to most of the system). This assumed cover was then adjusted where necessary to ensure that the drainage system had positive fall in the downstream direction.

The footprints of a large number of individual buildings located in the two-dimensional model domain were digitised and assigned a high hydraulic roughness value which accounted for their blocking effect on flow while maintaining storage in the model.

The recently constructed bridge crossing over Ropes Creek at Lenore Drive was defined using work-as-executed drawings provided by Roads and Maritime.

The bridge crossing over Ropes Creek at the M4 Western Motorway was defined using a combination of ALS survey data (to set the bridge deck level) and an assumed deck thickness of 2 metres (to set the underside of the bridge structure). This was considered appropriate for the purpose of the present investigation as the M4 Western Motorway bridge is located a sufficient distance downstream for these assumptions not to influence flooding behaviour in the vicinity of the project corridor.

Details of the drainage elements along the M4 Western Motorway and the existing section of Archbold Road south of the M4 Western Motorway between DRC 3500 and DRC 4300 were obtained from detailed ground survey.

Details of the existing cross drainage structures set out in Table 2.1 were incorporated into the TUFLOW model.
5.3.2 Model Boundary Conditions

Discharge hydrographs generated by DRAINS were applied at the inflow boundaries of the TUFLOW model. These comprised both inflows applied at the external TUFLOW model boundary and internal point source and region inflows as shown on Figures 5.1.

The downstream boundary of the TUFLOW model comprised a tailwater level based on normal depth flow conditions. The model extent was selected to ensure the downstream boundary was located a sufficient distance downstream of the project corridor to prevent any influence on flow behaviour within the vicinity of the proposed road works.

5.3.3 Model Parameters

The main physical parameter represented in TUFLOW is hydraulic roughness, which is required for each of the various types of surfaces comprising the overland flow paths in the two-dimensional domain, as well as for the culverts and pipes which were incorporated in the model as one-dimensional elements. In addition to the energy lost by bed friction, obstructions to flow also dissipate energy by forcing water to change direction and velocity, and by forming eddies. Hydraulic modelling traditionally represents all of these effects via the surface roughness parameter known as “Manning’s n”.

Hydraulic roughness values adopted for design purposes were selected based on site inspection, past experience and values contained in the engineering literature (refer Table 5.1).

<table>
<thead>
<tr>
<th>Surface Treatment</th>
<th>Manning’s n Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reinforced concrete pipes and box culverts</td>
<td>0.015</td>
</tr>
<tr>
<td>Roads</td>
<td>0.02</td>
</tr>
<tr>
<td>Grassed channels and reserves</td>
<td>0.035 - 0.045</td>
</tr>
<tr>
<td>Remnant cleared pasture land</td>
<td>0.045</td>
</tr>
<tr>
<td>Dense vegetation</td>
<td>0.10 – 0.12</td>
</tr>
<tr>
<td>Ropes Creek – in bank areas</td>
<td>0.06 – 0.08</td>
</tr>
<tr>
<td>Ropes Creek – over bank areas</td>
<td>0.045 – 0.10</td>
</tr>
<tr>
<td>Allotments</td>
<td>0.1</td>
</tr>
<tr>
<td>Buildings</td>
<td>10</td>
</tr>
</tbody>
</table>

2 In parts of the model area, inflow hydrographs were applied over individual regions called “Rain Boundaries”. The Rain Boundaries act to “inject” flow into the one and two-dimensional domains of the TUFLOW model, firstly at a point which has the lowest elevation, and then progressively over the extent of the Rain Boundary as the grid in the two-dimensional model domain becomes wet as a result of overland flow.
5.4 Model Results

Figures 5.2, 5.3 and 5.4 show flooding patterns along the drainage lines that cross the project corridor for design storms of 5, 20 and 100 year ARI, while Table 5.2 gives the approximate hydraulic capacity of each cross drainage structure in ARI terms.

### TABLE 5.2
CAPACITY OF EXISTING DRAINAGE INFRASTRUCTURE
ALONG PROJECT CORRIDOR

<table>
<thead>
<tr>
<th>Cross Drainage Structure Identifier(1)</th>
<th>Design Road Chainage</th>
<th>Location</th>
<th>Existing Cross Drainage Configuration</th>
<th>Assessed Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>XD01</td>
<td>DRC 4800</td>
<td>Archbold Road north of Sargents Road</td>
<td>2 off 1650 RCP's</td>
<td>5 - 20 year ARI</td>
</tr>
<tr>
<td>XD02</td>
<td>DRC 4750</td>
<td>Archbold Road south of Sargents Road</td>
<td>1 off 1800 RCP</td>
<td>100 year ARI</td>
</tr>
<tr>
<td>XD03</td>
<td>DRC 4460</td>
<td>North of Archbold Road Overpass</td>
<td>1 off 525 RCP</td>
<td>100 year ARI</td>
</tr>
<tr>
<td>XD04</td>
<td>DRC 260 (2)</td>
<td>M4 Western Motorway, 260 m east of Archbold Road</td>
<td>3 off 1050 RCP</td>
<td>100 year ARI</td>
</tr>
<tr>
<td>XD05</td>
<td>DRC 4280</td>
<td>South of Archbold Road overpass</td>
<td>1 off 600 RCP</td>
<td>100 year ARI</td>
</tr>
<tr>
<td>XD06</td>
<td>DRC 4150</td>
<td>200 m south of M4 Western Motorway</td>
<td>1 off 450 RCP(3)</td>
<td>&lt; 5 year ARI</td>
</tr>
<tr>
<td>XD07</td>
<td>DRC 3930</td>
<td>400 m south of M4 Western Motorway</td>
<td>2 off 450 RCP’s(3)</td>
<td>&lt; 5 year ARI</td>
</tr>
<tr>
<td>XD08</td>
<td>DRC 660</td>
<td>Old Wallgrove Road, south of SWSP</td>
<td>3 off 1200 RCP’s(4)</td>
<td>20 - 100 year ARI</td>
</tr>
</tbody>
</table>

(1) Refer Figure 2.1 for locations of Cross Drainage Identifiers.
(2) Design Road Chainage on M4 On-Ramp.
(3) Assumed dimension.
(4) Based on design drawings for the Old Wallgrove Road upgrade (AT&L, 2015).

The key findings of the investigation were as follows:

- The existing 1350 RCP draining to XD01 from Robinson Street has a hydrologic standard of between 5 and 20 year ARI.
- Flows in excess of the capacity of the 1350 RCP in Robinson Street discharges south along Archbold toward the low point in the road at XD01, with a portion of this flow overtopping the road and discharging in a westerly direction through the commercial property located opposite Robinson Street.
- Depths of overland flow at the corner of Archbold Road and Robinson Street reach up to 0.6 m during a 100 year ARI event.
- Depths of overland flow along the grass lined channel downstream of XD04 reach up to 1 m during a 100 year ARI event. Flow along the grass lined channel discharges to an
existing 1200 RCP that runs along the western side of Archbold Road between DRC 4600 and DRC 4760 and discharges across Archbold Road at XD02.

- Flows in excess of the capacity of XD06 discharge south along the existing section of Archbold Road toward XD07, with a portion of this flow overtopping the road and discharging in a westerly direction opposite XD06.

- Flows that surcharge XD07 combine with overflow from XD06 and discharge across the low point in the existing section of road at DRC 3990. Depths of overland flow across the road reach up to 0.3 m during a 100 year ARI event.

- Flows that surcharge the 3 off 1200 RCP’s at XD08 discharge across Old Wallgrove Road at its low point at DRC 630 toward the grass lined channel to the west.

- Backwater flooding from Ropes Creek does not impact on the project corridor during a 100 year ARI event.
6 CROSS DRAINAGE REQUIREMENTS

6.1 General

The requirements for upgrading existing cross drainage structures and the provision of new cross drainage structures along the project corridor were identified as part of the investigation and are summarised in Table S1 at the front of this report.

Figure 6.1 shows the recommended cross drainage upgrade requirements along Archbold Road and should be referred to when reading Table S1 and the following sections of the report. [Note that these figures also show the recommended pavement drainage strategy along the length of the proposed road upgrade]. Figure 6.1 also shows the indicative location and direction of both table and catch drains that will be required to intercept runoff along the upslope side of Archbold Road and direct it to the proposed cross drainage structures. It should be noted that these drains will require the road works to extend beyond the footprint of Roads and Maritime's current concept road design model.

Section 6.2 provides a brief summary of key design considerations that were taken into account when assessing the cross drainage requirements for the project. A number of recommendations are also provided to assist in future design development for the road upgrade.

Section 6.3 provides an overview of the changes that were made to the hydrologic and hydraulic models representing present day conditions to assess the impact of the proposed road works on flooding and drainage patterns.

Section 6.4 deals with the specific cross drainage upgrade requirements along the length of Archbold Road.

Section 6.5 presents the findings of an assessment into the impact of future development, climate change and a partial blockage of major hydraulic structures on flooding and drainage patterns along the project corridor.

The assessment of cross drainage requirements has been based on the concept road design model provided by Roads and Maritime in February 2016. The designers of the Archbold Road upgrade will need to review the road design model in light of the recommendations contained in this report to ensure the intent of the proposed measures is maintained in the final design of the roadworks.

6.2 Design Considerations

6.2.1 Hydrologic Standard for the Road Upgrade

In accordance with Roads and Maritime standards, cross drainage structures are to be configured to achieve a 100 year ARI level of flood immunity to Archbold Road. However, a key finding of this investigation was that it is not practicable to achieve this standard at XD01 due to constraints imposed by the existing piped drainage system. As a result, the recommended drainage strategy only provides a hydrologic standard of about 20 year ARI at this location.
6.2.2 Minimum Cover Requirements

A minimum cover of 1 m has been adopted where possible beneath each carriageway to all cross drainage structures. This minimum cover has been set based on past project experience and would allow for a 300 mm depth of cover below the base of a nominal 700 mm thick pavement. Cover has therefore been assessed for each cross drainage structure and is reported at both kerb line locations in Table S1.

6.2.3 Impact of Future Development on Peak Flow Estimates

For the purpose of the present investigation, sizing of the cross drainage was based on peak flow estimates for a level of development consistent with present day conditions. However, consideration has also been given to the potential for uncontrolled development within the catchments which drain to the cross drainage structures. A summary of the potential impact of future development on peak flows in cross drainage is outlined below.

Cross drainage structures XD01, XD02, XD03, XD05 and XD08

These cross drainage structures are located along the existing sections of Archbold Road and Old Wallgrove Road and drain catchments that comprise existing residential and industrial development. As a result there is limited scope for additional infill development that could result in a significant increase in catchment runoff draining to these cross drainage structures.

Cross drainage structures XD04, XD10 and XD13

These cross drainage structures drain relatively large (greater than 20 hectares) catchments within the WSEA Eastern Creek and Ropes Creek Precincts. Given the size of the upstream catchments, it has been assumed that measures will be incorporated into future development of the WSEA precincts which will control the rate of flow discharging to the project corridor to no larger than present day conditions. This assumption is supported by the stormwater management strategies presented in BCC, 2005 and Brown Consulting, 2010, which show stormwater detention basins are proposed upstream of these cross drainage structures (refer to Figure 3.1 for locations of stormwater detention basins presented in BCC, 2005 and Brown Consulting, 2010).

Cross drainage structures XD06, XD07, XD07A, XD09, XD11, XD12 and XD14

These cross drainage structures drain catchments which are less than 20 hectares in area within the WSEA Eastern Creek and Ropes Creek Precincts. These relatively small catchments were deemed to be at greater risk of future development occurring without incorporation of an effective stormwater detention system. This assumption is supported by the stormwater management strategies presented in BCC, 2005 and Brown Consulting, 2010 which show detention basins are proposed downstream of these cross drainage structures (refer to Figure 3.1 for locations of detention basins presented in BCC, 2005 and Brown Consulting, 2010).

Section 6.5 presents the findings of an assessment of the impact of future development on flows discharging to cross drainage structures XD06, XD07, XD07A, XD09, XD11, XD12 and XD14.
6.2.4 Consideration of Climate Change

Scientific evidence shows that climate change impacts on flood producing rainfall events show a trend for larger scale storms and resulting depths of rainfall to increase. The significance of these effects on flood behaviour will vary depending on geographic location and local topographic conditions.

OEH recommends that its guideline Practical Considerations of Climate Change (DECC, 2007) be used as the basis for examining climate change induced increases in rainfall intensities in projects undertaken under its State Floodplain Management Program, according to procedures set out in the FDM. The guideline recommends that until more work is completed in relation to the climate change impacts on rainfall intensities, sensitivity analyses should be undertaken based on increases in rainfall intensities ranging between 10 and 30 per cent. Under present day climatic conditions, increasing the 100 year ARI design rainfall intensities by 10 per cent would produce a 200 year ARI flood; and increasing those rainfalls by 30 per cent would produce a 500 year ARI event. On current projections the increase in rainfalls within the service life of developments or flood management measures is likely to be around 10 per cent, with the higher value of 30 per cent representing an upper limit. Based on this understanding, the impact a 10 per cent increase in 100 year ARI design rainfall intensities would have on flooding has been assessed. Details on the climate change assessment are set out in Section 6.5.

6.2.5 Culvert Blockage

In assessing the cross drainage requirements for the road upgrade a sensitivity analysis was undertaken whereby the impact a 50% reduction in waterway area due to a partial blockage of the structure by debris was assessed. Details on the blockage assessment are set out in Section 6.5.

6.2.6 Utilities

The location and depth of utilities and their impact on the proposed drainage measures have not been considered as part of this investigation. Detailed investigations will therefore need to be carried out during the preparation of the detailed design for the road upgrade project to identify any conflicts and to scope any utility relocation requirements.

6.3 Assessment of Post-Road Upgrade Flooding Behaviour

The DRAINS and TUFLOW models representing present day conditions were modified in order to assess the impact of the proposed road works on flooding and drainage patterns.

The DRAINS model representing present day conditions was modified by adjusting catchment boundaries and characteristics such as percentage impervious and overland flow path lengths. Areas of road pavement were modelled using the ILSAX sub-model. Figure 6.2 shows the layout of the ILSAX and RAFTS sub-catchments which comprise the DRAINS model developed for post-road upgrade conditions.

The TUFLOW model representing present day conditions was modified by adjusting the drainage systems at XD01 to XD07 to accommodate the proposed road works, while new cross drainage structures were provided at XD09 to XD14. Catch drains were included in the model to intercept
runoff upslope of Archbold Road. Figure 6.3 shows the layout of the TUFLOW model representing post-road upgrade conditions.

6.4 Cross Drainage Strategy

6.4.1 General

The following sections of this report provide a summary of the concept cross drainage strategy along Archbold Road which is presented in Figure 6.1.

Figures 6.4, 6.5 and 6.6 show flood impacts of the proposed road works will have on flooding behaviour in terms of changes in peak flood levels for design storms of 5, 20 and 100 year ARI, respectively. These figures should also be referred to when reading the following sections of this report.

6.4.2 Existing Archbold Road (DRC 4500 – DRC 5200)

Recommended upgrades to the cross drainage and contributing drainage lines along the existing section of Archbold Road are shown on Figure 6.1, sheet 1 and involve:

- Augmentation of cross drainage structure XD01 to increase the capture of overland flow and offset the impact of the proposed road upgrade on peak flood levels in Robinson Street and Bament Place.
- Provision of additional inlet pits in Robinson Street to capture overland flow and direct it to a new drainage line comprising 2 off 1350 RCP’s that will run along the southbound kerb and discharge into cross drainage structure XD01.
- Provision of additional inlet pits in Bament Place to capture overland flow and direct it to a new drainage line comprising 2 of 1200 RCP’s that will run along the drainage reserve between Bament Place and Archbold Road and discharge into cross drainage structure XD01.
- Extension of the existing 1800 RCP at XD02 with 2 off 1350 RCP’s to accommodate the widened road formation.
- Realignment of the existing drainage line between DRC 4600 and DRC 4740 to discharge into cross drainage structure XD02.

The upgrade of the drainage system between Robinson Street and Sargents Road would provide a 20 year ARI hydrologic standard and lead to a reduction in overland flow that presently discharges from the project corridor west of Robinson Street. During a 100 year ARI event, flows in excess of the culvert capacity would pond across the full width of the southbound carriageway but would not overtop the centreline of the road.

The diversion of flows that presently discharge from the project corridor opposite Robinson Street will result in an increase in flows and flood levels in Sargents Road. Figure 6.6, sheet 1 shows that 100 year ARI flood levels along the Sargents Project corridor will be increased by a maximum of 0.06 m. However, these impacts would be confined to the grass lined channel that runs along the centre of Sargents Road.
6.4.3 M4 Western Motorway Corridor (DRC 4300 – DRC 4500)

A concept arrangement for the upgrade of the existing cross drainage to accommodate the new east facing on- and off-ramps to the M4 Western Motorway is shown on Figure 6.1, sheet 1.

Existing cross drainage structure XD04 has a 100 year ARI hydrologic standard. Subject to a condition assessment it is therefore proposed to extend XD04 downstream to accommodate the road widening for the east facing on-ramp. From inspection of Figure 6.6, sheet 1 there will be a minor reduction in peak 100 year ARI flood levels upstream of XD04. This is due to the slight improvement in hydraulic efficiency provided by the proposed table drains discharging to the inlet of the culvert.

Existing cross drainage structures XD03 and XD05, which also have a 100 year ARI hydrologic standard, will need to be realigned or alternatively extended in order to accommodate the east facing on- and off-ramps, respectively.

Two additional cross drainage structures (XD03a and XD05a) will be required to drain the trapped low points which will be created by the embankments associated with the east facing on- and off-ramps, respectively.

6.4.4 WSEA Precincts (DRC 800 – DRC 4300)

Figure 6.1, sheet 1 shows the recommended cross drainage arrangements which will be required to accommodate the extension of Archbold Road through the WSEA Eastern Creek and Ropes Creek Southern Precincts.

Cross drainage structures XD06, XD07 and XD09 to XD12 have been located to maintain existing flow paths and minimise impacts on existing flooding behaviour in the drainage lines downstream of the project corridor. During detailed design it is recommended that the designers review the location of these cross drainage structures in line with latest development layouts within the WSEA Eastern Creek and Ropes Creek Precincts.

The layout of cross drainage structures XD13 and XD14, which are located within Lot 5 DP 262213 (Ropes Creek South Precinct), is generally consistent with the proposed stormwater management strategy presented in Brown Consulting, 2010. The main exception is the location of cross drainage structure XD14, which has been designed to control runoff from the catchment draining to the project corridor from the south under present day conditions. However, the proposed stormwater management strategy presented in Brown Consulting, 2010 shows this area is to be drained to the west toward Ropes Creek, and away from Archbold Road. During detailed design it is recommended that the designers consult with BCC to confirm the proposed stormwater management strategy for Lot 5 DP 262213. Depending on the timing of the road works and the development of the Lot 5 DP 262213, an interim drainage arrangement may be required until the ultimate subdivision earthworks are completed.
6.4.5 Old Wallgrove Road Intersection (DRC 500 – DRC 800)

A concept arrangement for the upgrade of the existing drainage system in Old Wallgrove Road to accommodate the new intersection with Archbold Road is shown on Figure 6.1, sheet 3.

Existing cross drainage structure XD08 will need to be replaced to accommodate the new level and extent of the road footprint due to the proposed intersection between Archbold Road and Old Wallgrove Road. The inlet to XD08 would comprise a 6 m x 2 m raised grated inlet pit to drain the table drains discharging to the low point on the southern corner of the new intersection. A 3000 by 1200 RCBC will be required to control runoff from the catchment west of the project corridor and provide a 100 year ARI hydrologic standard. The culvert would need to include a skewed section in order to align its outlet with the channel on the western (downstream) side of the project corridor.

6.5 Assessment of the Impact of Future Development, Future Climate Change and Culvert Blockage

Hydrologic/hydraulic analyses were undertaken to assess the impact of the following scenarios on flooding behaviour at cross drainage structures along Archbold Road during a 100 year ARI event:

- **Scenario 1** – areas of imperviousness increased to 80 per cent within catchments draining to cross drainage structures XD06, XD07, XD07a, XD09, XD11, XD12 and XD14 to assess the impact of uncontrolled development in these catchments.
- **Scenario 2** – a 10 per cent increase in rainfall intensities to assess the potential impact of future climate change on flooding behaviour.
- **Scenario 3** – a 50 per cent reduction in waterway area to assess the impact of a partial blockage of the upgraded/new cross drainage structures.

Table 6.1 provides a comparison of peak flows and available freeboard to the road under Scenarios 1, 2 and 3 against baseline conditions (i.e. present day climatic and development conditions and assuming no blockage of cross drainage structures).

From inspection of Table 6.1:

- An increase in impervious area due to uncontrolled development upstream (**Scenario 1**) would result in increases in peak 100 year ARI discharges that are typically between 25 and 75 per cent. The main exception would be XD14 which would experience an increase of 87 per cent in peak 100 year ARI discharge. The maximum increase in flood levels is over 0.5 m at XD11 and XD12. However, 100 year ARI flood immunity would be maintained along the road.
- A 10 per cent increase in rainfall intensity due to future climate change (**Scenario 2**) would result in an increase in peak 100 year ARI discharges of between 5 and 15 per cent in the cross drainage structures along Archbold Road. Freeboard to the 100 year ARI flood level would be reduced by between 0.01 m and 0.29 m. Surcharge of flow across the road would occur at XD01 and XD02.
- A 50 per cent blockage to the inlet of the proposed cross drainage structures (**Scenario 3**) would reduce freeboard to the 100 year ARI flood level by a maximum of 1.1 m. Surcharge of flow across the road would occur at cross drainage structure XD07.
## TABLE 6.1
### COMPARISON OF RESULTS – 100 YEAR ARI

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Culvert Configuration</th>
<th>Design Road Change</th>
<th>Culvert Discharge ( (m^3/s) )</th>
<th>Surchage over Road ( (m^3) )</th>
<th>Freeboard to Road ( (m) )</th>
<th>Culvert Discharge ( (m^3/s) )</th>
<th>Surchage over Road ( (m^3) )</th>
<th>Freeboard to Road ( (m) )</th>
<th>Culvert Discharge ( (m^3/s) )</th>
<th>Surchage over Road ( (m^3) )</th>
<th>Freeboard to Road ( (m) )</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>XD01</td>
<td>2 off 1650 RCP’s and 1 off 1350 RCP</td>
<td>-</td>
<td>12.49</td>
<td>0.03</td>
<td>12.49</td>
<td>0.00</td>
<td>13.70</td>
<td>0.04</td>
<td>-12.12</td>
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<td>0.00</td>
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<td>XD02</td>
<td>2 off 1350 RCP’s</td>
<td>-</td>
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<td>5.53</td>
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<td>5.79</td>
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<td>1 off 525 RCP</td>
<td>-</td>
<td>0.21</td>
<td>5.05</td>
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<td>0.23</td>
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<td>-</td>
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<tr>
<td>XD04</td>
<td>3 off 1050 RCP’s</td>
<td>-</td>
<td>5.85</td>
<td>2.48</td>
<td>5.85</td>
<td>2.48</td>
<td>6.15</td>
<td>2.33</td>
<td>3.23</td>
<td>1.81</td>
<td></td>
<td></td>
</tr>
<tr>
<td>XD05</td>
<td>1 off 600 RCP</td>
<td>-</td>
<td>0.29</td>
<td>4.44</td>
<td>0.29</td>
<td>4.44</td>
<td>0.33</td>
<td>4.40</td>
<td>0.26</td>
<td>4.36</td>
<td></td>
<td></td>
</tr>
<tr>
<td>XD05a</td>
<td>1 off 525 RCP</td>
<td>-</td>
<td>0.37</td>
<td>3.06</td>
<td>0.37</td>
<td>3.06</td>
<td>0.41</td>
<td>3.01</td>
<td>0.37</td>
<td>2.68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>XD06</td>
<td>1 off 750 RCP</td>
<td>-</td>
<td>0.62</td>
<td>1.81</td>
<td>0.88</td>
<td>1.57</td>
<td>0.69</td>
<td>1.75</td>
<td>0.44</td>
<td>1.64</td>
<td></td>
<td></td>
</tr>
<tr>
<td>XD07a</td>
<td>4 off 900 RCP</td>
<td>-</td>
<td>4.13</td>
<td>1.00</td>
<td>4.23</td>
<td>0.98</td>
<td>4.72</td>
<td>0.91</td>
<td>3.47</td>
<td>0.22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>XD07</td>
<td>1 off 1050</td>
<td>-</td>
<td>1.69</td>
<td>0.36</td>
<td>1.98</td>
<td>0.16</td>
<td>1.84</td>
<td>0.25</td>
<td>1.15</td>
<td>-0.06</td>
<td></td>
<td></td>
</tr>
<tr>
<td>XD08</td>
<td>1 off 3000 x 1200 RCBC's</td>
<td>-</td>
<td>7.70</td>
<td>1.33</td>
<td>7.71</td>
<td>1.33</td>
<td>8.53</td>
<td>1.27</td>
<td>7.71</td>
<td>-1.33</td>
<td></td>
<td></td>
</tr>
<tr>
<td>XD09</td>
<td>3 off 1500 x 600 RCBC's</td>
<td>-</td>
<td>4.86</td>
<td>1.76</td>
<td>5.92</td>
<td>1.51</td>
<td>5.54</td>
<td>1.60</td>
<td>4.29</td>
<td>0.65</td>
<td></td>
<td></td>
</tr>
<tr>
<td>XD10</td>
<td>3 off 3600 x 1200 RCBC's</td>
<td>-</td>
<td>26.99</td>
<td>2.50</td>
<td>26.94</td>
<td>2.50</td>
<td>30.62</td>
<td>2.37</td>
<td>22.06</td>
<td>-1.52</td>
<td></td>
<td></td>
</tr>
<tr>
<td>XD11</td>
<td>3 off 1200 x 600 RCBC's</td>
<td>-</td>
<td>4.02</td>
<td>2.36</td>
<td>6.03</td>
<td>1.80</td>
<td>4.56</td>
<td>2.24</td>
<td>2.72</td>
<td>0.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>XD12</td>
<td>1 off 1350 RCP</td>
<td>-</td>
<td>2.82</td>
<td>2.35</td>
<td>4.64</td>
<td>1.82</td>
<td>3.18</td>
<td>2.24</td>
<td>2.43</td>
<td>-1.93</td>
<td></td>
<td></td>
</tr>
<tr>
<td>XD13</td>
<td>7 off 2700 x 1500 RCBC's</td>
<td>-</td>
<td>41.85</td>
<td>2.65</td>
<td>42.94</td>
<td>2.83</td>
<td>48.31</td>
<td>2.50</td>
<td>40.00</td>
<td>1.94</td>
<td></td>
<td></td>
</tr>
<tr>
<td>XD14</td>
<td>2 off 750 RCP’s</td>
<td>-</td>
<td>1.29</td>
<td>0.95</td>
<td>2.20</td>
<td>0.48</td>
<td>1.51</td>
<td>0.87</td>
<td>1.05</td>
<td>-0.48</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**
1) Results quoted to two decimal places for the comparison purposes.
2) Values in [ ] represent change relative to base case conditions. With regard to Culvert Discharge and Surchage over Road, a negative value represents a reduction in flow. With regard to Freeboard to Road a negative value represents a reduction in freeboard.
3) Freeboard to Road is the difference in level between the point of overtopping of the road and the flood level. A negative value represents the depth of overtopping.
7 PAVEMENT DRAINAGE REQUIREMENTS

7.1 General

A strategy aimed at mitigating the adverse impacts of the road upgrade works on existing development and the existing drainage lines into which the new pavement drainage system will discharge was developed as part of the present investigation.

Table S2 at the front of this report summarises the findings and recommendations of the investigation carried out into the pavement drainage strategy for the road upgrade works. Figure 6.1 shows the recommended pavement drainage strategy along Archbold Road and should be referred to when reading Table S2 and the following sections of the report.

7.2 Design Considerations

7.2.1 WSEA Precincts (DRC 800 – DRC 4300)

The extension of Archbold Road through the WSEA Precincts of Eastern Creek and Ropes Creek represents a significant increase in the impervious area in what is presently a largely undeveloped area. Uncontrolled development can have an adverse impact on both the quantity and quality of stormwater runoff discharging into the receiving drainage lines. However, the strategy for the control of stormwater runoff from the project corridor also needs to be consistent with the strategies that have been developed for the precincts through which the upgraded Archbold Road will run.

Stormwater Quantity

As noted in Section 3.3 of this report, regional stormwater detention basins are proposed to control the quantity of stormwater discharging from the Eastern Creek Precinct and Lot 5 DP 262213 within the Ropes Creek Precinct, including runoff from the project corridor. On this basis it has been assumed that the quantity of runoff from the project corridor will be controlled by these stormwater detention basins which will be constructed as part of the precinct developments.

While no details are presently available on the future development of the northern portion of the Ropes Creek Precinct, it is assumed that the control of runoff would be generally consistent with the strategy developed for Lot 5 DP 262213. Accordingly, it has also been assumed that the quantity of runoff from the project corridor where it runs through this area will also be controlled by stormwater detention basins which will be constructed as part of the future precinct development.

Stormwater Quality

The regional stormwater detention basins proposed for the Eastern Creek Precinct and Lot 5 DP 262213 are to also incorporate water quality measures. It has therefore been assumed that stormwater runoff from the project corridor will be treated in these basins.

The exception to the above is in locations where pavement runoff from Archbold Road will discharge directly to an identified riparian corridor or watercourse where treatment via the aforementioned regional stormwater detention basins is unlikely. Major Drainage Lines 4 and 7 at cross drainage structures XD10 and XD13 discharge directly into riparian corridors identified in
BCC, 2005 and Brown Consulting, 2010, respectively. On this basis, water quality measures will need to be provided at the pavement drainage outlets discharging into these drainage lines. The proposed water quality basins are to be designed to meet the following mean annual pollutant retention load targets in accordance with BCC’s Development Control Plan (Part R – Water Sensitive Urban Design):

- 90% retention of total gross pollutants (greater than 5 mm);
- 85% retention of Total Suspended Solids (TSS);
- 65% retention of Total Phosphorus (TP);
- 45% retention of Total Nitrogen (TN); and
- 90% retention of Hydrocarbons.

Further liaison will need to be undertaken with BCC during detailed design based on the latest details of the precinct developments to confirm locations where water quality and spill containment measures will be required to control runoff from the project corridor.

### 7.2.2 Existing Archbold Road, M4 Western Motorway and Old Wallgrove Road Intersection (DRC 500 – DRC 800 and DRC 4300 – DRC 5200)

In contrast to the extension of Archbold Road through the WSEA Precinct, the remainder of the project corridor runs through areas which have already been developed. Consequently, the road upgrade typically represents a relatively small increase in the overall imperviousness in the catchments through which it runs.

#### Stormwater Quantity

The proposed strategy along these sections of the project is aimed at minimising increases in stormwater runoff that would otherwise result in adverse impacts on existing development and the receiving drainage lines.

The existing stormwater detention basin that controls runoff from the M4 Western Motorway is to be relocated to accommodate the proposed east facing on-ramps. Additional detention storage has been provided within the relocated basin to offset the impacts of increased runoff from the east facing on- and off-ramps.

#### Stormwater Quality

The upgrade of the existing section of Archbold Road and modifications to Old Wallgrove Road at its intersection with the new road represent relatively minor increases in the overall imperviousness of the contributing catchment. Furthermore, opportunities for the treatment of stormwater runoff captured by new and upgraded pavement drainage systems at these locations are limited by both space constraints within the existing project corridor and the configuration of the existing road drainage system. For these reasons, no water quality measures are proposed along the existing section of Archbold Road north of the M4 Western Motorway or at the Old Wallgrove Road Intersection.
7.3 Assessment of Post-Upgrade Stormwater Conditions

7.3.1 Stormwater Quantity

The investigation into the impact the road upgrade will have on peak flows in the receiving drainage lines was undertaken using the DRAINS and TUFLOW models described in Section 6.3.

The changes in peak flow which will result from the road upgrade works for selected locations downstream of the project corridor are summarised in Table 7.1 at the end of this chapter. These locations are shown on Figure 6.1 and are referenced in Table S2 where applicable.

7.3.2 Stormwater Quality

To quantify the average annual pollutant loads discharging from the project corridor into Major Drainage Lines 4 and 7, an investigation was carried out using the MUSIC rainfall-runoff modelling software. A MUSIC model was established to reflect the contributing area of project corridor discharging to Drainage Lines 4 and 7. The model was then used to assess the pollutant removal efficiency of proposed water quality measures and to determine the size and configuration required to meet BCC’s stormwater quality targets as set out in Section 7.2.1 of this report.

Rainfall records from the Liverpool pluviograph recorder (Station Number 67035) for the period 1967 to 1976 were selected for use in the investigation, and a six minute time step was adopted. Rainfall losses, as well as base and stormwater flow pollutant concentrations were based on values recommended in the Draft NSW MUSIC Modelling Guidelines (BMT WBM, 2010).

7.4 Pavement Drainage Strategy

Locations along Archbold Road where the runoff conveyed by the new pavement drainage system is proposed to be discharged to the receiving drainage lines are described below.

7.4.1 Existing Archbold Road (DRC 4500 – DRC 5200)

The existing pavement drainage system along Archbold Road will need to be upgraded to accommodate the proposed road widening. The upgraded pavement drainage system would be integrated with the new drainage lines required to control overland flow discharging to cross drainage structures XD01 and XD02 (refer Section 6.4.2) and would maintain the existing outlet in Sargents Road.

While the increase in pavement area due to the proposed road widening is minor relative to the total area draining to Sargents Road, Table 7.1 shows that there would be an increase in peak flows discharging into Sargents Road across the full range of storm events assessed (refer location identifier F02). This is due to the upgrade of the drainage system between Robinson Street and Sargents Road which will divert flows that presently overtop Archbold Road and discharge from the project corridor in a westerly direction opposite Robinson Street (refer location identifier F01). The investigation found that the impacts relating to the increase in peak flow would be confined to the open channel that runs along the centre of the Sargents Project corridor (refer Section 6.4.2 for further details).

7.4.2 M4 Western Motorway Corridor (DRC 4300 – DRC 4500)

The existing stormwater basin at DRC 300 on the northern side of the M4 Western Motorway would need to be relocated approximately 180 m further west to accommodate the proposed
alignment of the east facing on-ramp. The existing drainage system along the eastbound and westbound carriageways of the M4 Western Motorway would be redirected to the new basin which would also control runoff from the proposed east facing on-ramp. The volume provided by the new basin would be increased to 1,820 m$^3$ (currently 1,200 m$^3$) to offset the increase in runoff from the proposed east facing on- and off-ramps. Figure 6.1, sheet 1 shows a concept layout of the new basin which has a total footprint of about 2,400 m$^2$ (150 m long by 16 m wide) including the extent of access tracks and batters. An alternative basin footprint is also shown on Figure 6.1, sheet 1 which measures about 65–85 m long and 35 m wide. The shape and dimensions of the basin would be subject to further design development during detailed design.

Table 7.1 shows that there would be a minor increase in flows along the open channel downstream of the new basin (refer location identifier F04). For example, peak 100 year ARI flows would be increased from 5.3 m$^3$/s to 5.6 m$^3$/s. However, it is noted that this minor increase in peak flow would not result in surcharge of the channel. There would be a slight reduction in peak flows that discharge from cross drainage structure XD05 toward the area of high ecological value which is located to the west of the project corridor across the full range of storm events.

### 7.4.3 WSEA Precincts (DRC 800 – DRC 4300)

It is recommended that the pavement drainage system be discharged at the location of each cross drainage structure, with the exception of cross drainage structures XD06 and XD09. It is recommended that the pavement drainage system at XD06 be directed to XD07a to limit the increase in discharge at XD06 which would otherwise impact on the area of high ecological value identified in BCC, 2005. Similarly, it is recommended that the pavement drainage system at XD09 be directed to the outlet of the larger cross drainage structure XD10 to limit the increase in discharge at XD09.

Water quality basins are proposed to control the quality of runoff discharging into Major Drainage Lines 4 and 7 at cross drainage structures XD10 and XD13. Sketch 7.1 shows the typical layout and key features of the water quality basins, which would comprise a sedimentation zone to target gross pollutants and TSS, and a bio-retention zone to target TP and TN. The sedimentation zone would include a baffle on the outlet for spill containment. Figure 6.1, sheets 2 and 3 show the concept layouts for water quality basins at cross drainage structures XD10 and XD13, while the size of the sedimentation and bio-retention zones of each basin are provided in Table 7.2. The basins at XD10 and XD13 have a total footprint of about 1,460 m$^2$ and 1,520 m$^2$ respectively, including the extent of access tracks and batters.

Table 7.2 shows that the proposed water quality basin arrangements would provide pollutant retention efficiencies for TSS, TP, TN and gross pollutants that meet or exceed the stormwater targets in BCC’s Development Control Plan. While not directly quantified within the MUSIC model, the proposed arrangement of sedimentation and bio-retention zones in series would also provide for the retention of hydrocarbons which are typically associated with gross pollutants and fine sediments. A baffle arrangement has also been incorporated in the layout of the water quality basin which is aimed at preventing oil and petroleum based spill materials from discharging to the receiving drainage lines.
Sketch 7.1  Typical Water Quality Basin Layout (not to scale)
7.4.4  Old Wallgrove Road Intersection (DRC 500 – DRC 800)

Figure 6.1, sheet 3 shows the proposed adjustments to the pavement drainage system along Old Wallgrove Road which are required to accommodate the new intersection to Archbold Road. The upgrade of the pavement drainage system will discharge into the grassed lined channel at XD08 as per the existing arrangement (refer location F22 on Figure 6.1, sheet 3).

Table 7.1 shows that there would be a minor increase in peak flows that discharge from the project corridor at location F22 over the full range of design storm events. For example, the peak flow discharging from the project corridor would increase from 8.5 m$^3$/s to 8.8 m$^3$/s in a 100 year ARI event. While the impact of this increase in flow is expected to be negligible, during detailed design it will be necessary to collect detailed ground survey along the grass lined channel to confirm its capacity and the impact of the road works. [Note that the ALS data was flown prior to the construction of the grass lined channel downstream of location F22.]
## TABLE 7.1
IMPACT OF ROAD UPGRADE ON PEAK FLOWS (1)

<table>
<thead>
<tr>
<th>Location Description</th>
<th>Location Identifier (2)</th>
<th>Location Identifier (3)</th>
<th>5 year ARI</th>
<th>20 year ARI</th>
<th>100 year ARI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Present Day</td>
<td>Post Upgrade</td>
<td>Present Day</td>
</tr>
<tr>
<td>West of Archbold Road opposite Robinson Street.</td>
<td>F01</td>
<td></td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Discharge from Archbold Road at Sargents Road into Major Drainage Line 1</td>
<td>F02</td>
<td></td>
<td>8.66</td>
<td>9.64</td>
<td>0.98</td>
</tr>
<tr>
<td>Discharge from cross drainage structure XD within M4 Western Motorway corridor</td>
<td>F03</td>
<td></td>
<td>0.13</td>
<td>0.08</td>
<td>-0.06</td>
</tr>
<tr>
<td>Discharge from cross drainage structure XD into Major Drainage Line 2.</td>
<td>F04</td>
<td></td>
<td>2.55</td>
<td>2.87</td>
<td>0.32</td>
</tr>
<tr>
<td>Downstream of cross drainage structure XD05 within M4 Western Motorway corridor</td>
<td>F05</td>
<td></td>
<td>0.15</td>
<td>0.14</td>
<td>-0.01</td>
</tr>
<tr>
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<td>F06</td>
<td></td>
<td>0.25</td>
<td>0.32</td>
<td>0.07</td>
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<tr>
<td>Discharge from existing dam downstream of cross drainage structure XD06.</td>
<td>F07</td>
<td></td>
<td>0.26</td>
<td>0.42</td>
<td>0.15</td>
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<td>Downstream of cross drainage structure XD07A.</td>
<td>F08</td>
<td></td>
<td>2.49</td>
<td>3.68</td>
<td>1.20</td>
</tr>
<tr>
<td>Major Drainage Line 2.</td>
<td>F09</td>
<td></td>
<td>2.10</td>
<td>2.46</td>
<td>0.35</td>
</tr>
<tr>
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<td></td>
<td>0.55</td>
<td>0.98</td>
<td>0.43</td>
</tr>
<tr>
<td>Major Drainage Line 3.</td>
<td>F11</td>
<td></td>
<td>1.46</td>
<td>1.91</td>
<td>0.45</td>
</tr>
<tr>
<td>Confluence of Major Drainage Lines 2 and 3.</td>
<td>F12</td>
<td></td>
<td>3.42</td>
<td>4.14</td>
<td>0.73</td>
</tr>
<tr>
<td>Downstream of cross drainage structure XD09.</td>
<td>F13</td>
<td></td>
<td>1.42</td>
<td>1.44</td>
<td>-0.02</td>
</tr>
<tr>
<td>West of project corridor at DRC 3320.</td>
<td>F14</td>
<td></td>
<td>0.33</td>
<td>0.00</td>
<td>0.33</td>
</tr>
<tr>
<td>Downstream of cross drainage structure XD10.</td>
<td>F15</td>
<td></td>
<td>12.09</td>
<td>13.58</td>
<td>1.49</td>
</tr>
<tr>
<td>Major Drainage Line 4.</td>
<td>F16</td>
<td></td>
<td>12.59</td>
<td>13.48</td>
<td>0.89</td>
</tr>
<tr>
<td>Downstream of cross drainage structure XD11.</td>
<td>F17</td>
<td></td>
<td>1.77</td>
<td>2.13</td>
<td>0.36</td>
</tr>
<tr>
<td>Major Drainage Line 5.</td>
<td>F18</td>
<td></td>
<td>1.29</td>
<td>1.46</td>
<td>0.18</td>
</tr>
<tr>
<td>Discharge from cross drainage structure XD12 into Major Drainage Line 6.</td>
<td>F19</td>
<td></td>
<td>1.51</td>
<td>1.55</td>
<td>0.04</td>
</tr>
<tr>
<td>Discharge from cross drainage structures XD13 into Major Drainage Line 7.</td>
<td>F20</td>
<td></td>
<td>18.69</td>
<td>18.01</td>
<td>0.68</td>
</tr>
<tr>
<td>Discharge from cross drainage structure XD14 into Major Drainage Line 9.</td>
<td>F21</td>
<td></td>
<td>1.34</td>
<td>0.95</td>
<td>-0.39</td>
</tr>
<tr>
<td>Discharge from cross drainage structure XD08 into grass lined channel south of Old Wallgrove Road.</td>
<td>F22</td>
<td></td>
<td>4.53</td>
<td>4.62</td>
<td>0.09</td>
</tr>
</tbody>
</table>

(1) Peak flows have been quoted to more than one decimal place for comparative purposes only.
(2) Refer Figure 6.1 (3 sheets) for reference to Location Identifier.
(3) Note that a negative value represents a decrease in peak flows when compared to present day conditions and conversely a positive value represents an increase in peak flows.
### TABLE 7.2
SUMMARY OF WATER QUALITY MEASURES

<table>
<thead>
<tr>
<th>Major Drainage Line(n)</th>
<th>Pavement Drainage Outlet Identifier(n)</th>
<th>Catchment</th>
<th>Basin Arrangement</th>
<th>Pollutant Retention Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Area (Ha)</td>
<td>Percentage Impervious (%)</td>
<td>Sedimentation Zone (m²)</td>
</tr>
<tr>
<td>[A]</td>
<td>[B]</td>
<td>[C]</td>
<td>[D]</td>
<td>[E]</td>
</tr>
<tr>
<td>4</td>
<td>P06</td>
<td>3.17</td>
<td>77</td>
<td>795</td>
</tr>
<tr>
<td></td>
<td>P07</td>
<td>3.26</td>
<td>81</td>
<td>830</td>
</tr>
<tr>
<td>7</td>
<td>P10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>P11</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(1) Refer Figure 6.1 for reference to Major Drainage Line and Pavement Drainage Outlet Identifiers.
8 EROSION AND SEDIMENT CONTROL STRATEGY

8.1 General

A strategy aimed at mitigating the adverse impacts of the construction phase of the road upgrade on water quality in existing downstream drainage lines and watercourses was developed as part of the present investigation.

Figure 8.1 (3 sheets) shows the recommended erosion and sediment control strategy along the route of the proposed road upgrade and should be referred to when reading the following sections of the report. The strategy addresses the increase in potential for both erosion and sediment mobilisation within the construction corridor, and transport of this sediment into downstream watercourses via sediment-laden runoff (herein referred to as ‘dirty water’) leaving areas disturbed by the road works.

It is recommended that the strategy presented in this section of the report be used as the starting point for preparation of the “Soil and Water Management Plan” (SWMP) (or similar) that will need to be developed as part of final design and/or construction documentation for the road upgrade works. However, it should be recognised that ultimate requirements for controlling erosion and sediment during construction will be dictated by final design of the road upgrade works, proposed construction methods, staging and site management practices, all of which are yet to be finalised.

The strategy has been developed based on the principles and design guidelines set out in the following documents:

- **Soils and Construction – Managing Urban Stormwater** series (herein referred to as the “Blue Book”), comprising:
  - Volume 1 (Landcom, 2004)
  - Volume 2D – Main Roads (DECC, 2008); and
- **Roads and Maritime Services Erosion and Sedimentation Management Procedure** (Roads and Maritime, 2008); and

8.2 Key Elements of the Strategy

The primary principles for effective erosion and sediment control are firstly to minimise erosion, and to then capture sediment from disturbed areas where erosion cannot be prevented.

Whilst this present investigation deals primarily with the control of sediment, and the structural measures that will be required to capture dirty water and bypass clean water through the construction site, a range of erosion control principles will need to be incorporated into the future SWMP including:

- appropriate location and treatment of site access and stockpile sites;
- conservation of existing topsoil for later site rehabilitation;
- minimisation of disturbed areas, and stabilisation using batter blanketing, surface mulching or vegetation;
- scour protection along drainage lines through the site;
- separation of clean and dirty water wherever possible;
- site maintenance requirements; and
- progressive site rehabilitation.

Key structural elements of the strategy for control of dirty water are outlined below.

**Temporary sediment retention basins and sumps**

One temporary sediment retention basin and a series of 21 temporary sediment sumps form the primary structural elements of the strategy. The locations of the temporary sediment basin and sumps are shown on Figure 8.1 (3 sheets).

The purpose of the sumps and basin is to provide temporary storage of dirty water for sufficient time to allow settling of fine particles from suspension. Treated water can then be released from the basins or sumps into the receiving drainage lines. A basin is required where the estimated annual soil loss is greater than 150 m$^3$ per annum, with smaller sumps appropriate for capturing sediment from smaller areas with an estimated annual soil loss of less than 150 m$^3$ per annum.

[Note that the catchment area draining to each basin has been colour-coded to match the basin footprint, with sub-catchment labels also consistent with basin identifiers.]

The location and sizing of the proposed sediment retention basin, was based on the guidelines and procedures set out in the *Blue Book*. Table 8.1 provides a summary of key parameters that were adopted for the conceptual design of the basin, while Appendix E contains further details regarding the sizing of the basin.

### TABLE 8.1
**SUMMARY OF TEMPORARY SEDIMENT RETENTION BASIN 1**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Basin 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total catchment area (ha) (1)</td>
<td>1.63</td>
</tr>
<tr>
<td>Runoff coefficient</td>
<td>0.75</td>
</tr>
<tr>
<td>Basin management period</td>
<td>5 days</td>
</tr>
<tr>
<td>Rainfall percentile (depth)</td>
<td>75$^{th}$ (20.4 mm)</td>
</tr>
<tr>
<td>Settling Zone Volume (m$^3$)</td>
<td>250</td>
</tr>
<tr>
<td>Storage Zone Volume Allowance (% of Setting Zone)</td>
<td>50%</td>
</tr>
<tr>
<td>Total Volume (m$^3$)</td>
<td>375</td>
</tr>
<tr>
<td>Maximum water depth (m)</td>
<td>1.5</td>
</tr>
<tr>
<td>Approximate Footprint (m$^2$) (2)</td>
<td>600</td>
</tr>
</tbody>
</table>

(1) Catchment area used for design corresponds to largest disturbed area draining to the basin during all stages of construction.

(2) Based on 1V:2H side slopes and a 3 m buffer around perimeter of basin.
Temporary diversion channels

A series of diversion channels and associated earth bunding would be used to control dirty water along the downslope side of disturbed areas and direct this water towards the temporary sediment retention basin and sumps. The location of the proposed channels is shown on Figure 8.1 (3 sheets).

Local erosion and sediment control measures

Localised erosion and sediment control measures may be provided to augment or replace sediment sumps for smaller disturbed catchments. Localised erosion and sediment control measures would include use of the following smaller scale elements:

- staging of works to minimise the extent of disturbance at any one time;
- temporary catch drains and earth bunding to divert on-site and off-site water toward receiving drainage lines
- temporary stabilisation or revegetation/rehabilitation works to reduce the extent of disturbed surfaces;
- application of temporary surface treatments or blanketing on exposed earth surfaces;
- sediment barriers in series where necessary;
- vegetative buffer strips; and
- stabilised drainage lines incorporating rock check dams at regular intervals.

8.3 Concluding Remark

The erosion and sediment control strategy set out in this chapter of the report does not constitute a detailed SWMP, but rather provides an initial guidance on the measures which will need to be implemented during construction of the road works. Additional erosion and sediment control measures, as well as standard maintenance measures which should be implemented during construction are outlined in Volumes 1 and 2D of the Blue Book. A detailed SWMP will therefore need to be prepared prior to the commencement of construction activities.
9 REFERENCES


APPENDIX A
PLAN SHOWING WESTERN SYDNEY EMPLOYMENT AREA
INCLUDING EASTERN CREEK AND ROPES CREEK PRECINCTS
APPENDIX B
DRAWING SHOWING CONCEPT DETENTION BASIN LAYOUT FOR THE
EASTERN CREEK PRECINCT
Figure 11 - Stormwater Management Plan
APPENDIX C
DRAWING SHOWING CONCEPT DETENTION BASIN LAYOUT FOR THE ROPES CREEK SOUTH PRECINCT
FIGURE 11
PRELIMINARY BASIN LOCATIONS & STORMWATER MASTERPLAN

Basin 1 - 23.7ha
Basin 2 - 26.0ha
Basin 3 - 6.9ha
Basin 4 - 10.4ha
Basin 5 - 19.6ha

Legend
- CADASTRE
- BASINS
- BUILDINGS
- RIPARIAN ZONE
- FLOW DIRECTION
- CREEK - Ropes

STORMWATER COLLECTION AREAS
- Basin 1 - 23.7ha
- Basin 2 - 26.0ha
- Basin 3 - 6.9ha
- Basin 4 - 10.4ha
- Basin 5 - 19.6ha

Details
- CLIENT REVIEW - JULY 2010

Drawing Title
FIGURE 11
PRELIMINARY BASIN LOCATIONS & STORMWATER MASTERPLAN

Scale
1:5000 @ A3

Drawn
TWC

Checked
SC

Job No.
X1034

Drawing No.
FIGURE 11

Issue
A
APPENDIX D
PHOTOGRAPHS OF THE RECENTLY CONSTRUCTED DRAINAGE MEASURES
FOR LENORE DRIVE
APPENDIX E
SIZING OF EROSION AND SEDIMENT CONTROL MEASURES
E1. Sizing of Temporary Sediment Retention Basins

The effective design and operation of a sediment retention basin from a water quality perspective depends primarily on the nature of soils likely to be eroded and washed off work areas. A “Type D” soil was assumed for the preliminary sizing of the sediment retention basins. A Type D soil is characterised by being fine grained, with a significant proportion of dispersible materials which, in the absence of sufficient time to settle particles from suspension, require the assistance of a flocculating agent.

The total basin volume required for Type D soils is the sum of two components – a Settling Zone and a Sediment Storage Zone.

Settling Zone Volume

Equation E1 is used to estimate the volume of stormwater which should be temporarily stored in a sediment retention basin in order to settle Type D soils.

\[
\text{Settling Zone Volume}_{(\text{Type D/F soils})} = 10 \times C_v \times A \times R_{(y \%ile, 5 \text{ day})}
\]

Eqn E1

(Source: Landcom, 2004)

Where:

- 10 is a unit conversion factor;
- \( C_v \) is a volumetric runoff coefficient, defined as that proportion of rainfall that runs off as stormwater;
- \( A \) is the catchment area of the basin in hectares; and
- \( R_{(y \%ile, 5 \text{ day})} \) is the 5-day total rainfall depth (mm) that is not exceeded in \( y \) percent of rainfall events.

For the purpose of this present investigation, it was assumed that a 5-day management period would be sufficient to allow a contractor to flocculate and release treated runoff (i.e. < 50 mg/L suspended solids) from each basin. The 75\(^{th}\), 80\(^{th}\), 85\(^{th}\) and 90\(^{th}\) percentile 5-day depths of rainfall for the construction site were estimated to be 20.4, 26.0, 33.6 and 45.4 mm, respectively.

The volume of runoff which will need to be temporarily stored in each basin is dependent on which percentile of 5-day rainfall one chooses to adopt and the runoff potential of the exposed soil/rock. The Blue Book recommends the use of the 80\(^{th}\) percentile rainfall when the duration of disturbance is likely to span 6 to 12 months and the downstream receiving environment is not of a particularly high conservation value, nor supportive of human usage.

However, in view of space constraints along the length of the proposed road upgrade works, in particular where the project corridor runs adjacent to the riparian corridor of Eskdale Creek, the 75\(^{th}\) percentile rainfall has been adopted for the purpose of this present investigation.

In terms of runoff potential, it was assumed that disturbed areas would have a high runoff potential, reflecting the level of compaction which will occur as a result of heavy machinery frequenting work areas. A runoff coefficient equal to 0.9 was generally adopted for this present assessment to account for disturbed areas and sections of new road pavement that would temporarily be drained into sediment basins, which is consistent with recommendations in The Blue Book.
A lower runoff coefficient of 0.5 was adopted for pervious upslope areas that would not be disturbed during construction, but could not be readily diverted around proposed basin locations.

Staging plans developed as part of the concept design were relied upon for the purpose of sizing the basins, with adopted catchment areas for each basin reflecting the worst-case scenario (i.e. the largest catchment area at any one time throughout the construction phase).

However, it is recognised that staging of the construction works could reduce the footprint of disturbed areas and thus lead to smaller basins than those indicated herein being required to treat sediment-laden runoff.

**Sediment Storage Zone Volume**

For the purpose of this present investigation, the sediment storage component for each basin was generally taken as 50% of the calculated settling zone volume, based on the recommendations of *The Blue Book*. Note that the available volume within Basin 1 provides a slightly reduced allowance of 40%.

**Total Basin Volume**

The total volume required for each basin was determined as the sum of the calculated *Settling Zone Volume* and *Sediment Storage Zone Volume*.

**Basin Footprint**

To assist in development of the strategic design for the road upgrade, an indicative footprint was calculated for each basin based on the following key assumptions:

- maximum basin depth of 2 m, allowing for a maximum water depth of 1.5 m plus 0.5 m freeboard to top of batter/embankment;
- minimum 3:1 basin length to width ratio (where possible);
- internal batter slopes and external embankment slopes of 1V:2H; and
- basins constructed in cut where possible (i.e. embankments minimised as far as practicable).

Note that it may be possible to reduce the volume (and therefore footprint) of temporary sediment retention basins by a number of means, including:

- Adopting a shorter basin management period (e.g. 2 days, rather than 5 days) where site conditions permit, which would result in reduced settling zone volumes.
- Increasing the frequency of removal of captured sediment from basins, which will reduce the necessary sediment storage volume.
- Undertaking more detailed analysis of sediment yield based on the RUSLE method outlined in *The Blue Book*, which may result in reduced sediment storage zone volumes.

Ultimate requirements for temporary sediment retention basins along the length of the project corridor will be dictated by final design of the road upgrade, proposed construction methods and staging plans, and site management practices.
ARCHBOLD ROAD
FLOODING AND DRAINAGE INVESTIGATION

VOLUME 2 – FIGURES

May 2016
LIST OF FIGURES

1.1 Location and Catchment Plan
2.1 Existing Drainage System in Vicinity of Road Project (2 sheets)
3.1 Proposed Road Upgrade and Future Subdivision Layout (2 sheets)
4.1 Sub-Catchment Plan – Pre-Road Project Conditions (3 sheets)
5.1 Hydraulic Model Layout – Pre-Road Project Conditions
5.2 Hydraulic Model Results – Pre-Road Project Conditions – 5 year ARI (2 sheets)
5.3 Hydraulic Model Results – Pre-Road Project Conditions – 20 year ARI (2 sheets)
5.4 Hydraulic Model Results – Pre-Road Project Conditions – 100 year ARI (2 sheets)
6.1 Concept Drainage Strategy (3 sheets)
6.2 Sub-Catchment Plan – Post-Road Project Conditions (3 sheets)
6.3 Hydraulic Model Layout – Post-Road Project Conditions
6.4 Impact of Project on Flooding Behaviour – Post-Road Project Conditions – 5 year ARI (2 sheets)
6.5 Impact of Project on Flooding Behaviour – Post-Road Project Conditions – 20 year ARI (2 sheets)
6.6 Impact of Project on Flooding Behaviour – Post-Road Project Conditions – 100 year ARI (2 sheets)
8.1 Erosion and Sediment Control Strategy (3 sheets)
Appendix M

Tool for roadside air quality calculations
Roads and Maritime Services
TRAQ: Emissions and Air Quality Screening Assessment Report (Version 1.2)

Date of report: 07-Apr-2016 10:57
User name: Sensonic

INPUT DATA:
Simulation name: TRAQ simulation
Road type: Arterial

Traffic data
Traffic per day  Speed (km/h)  Lane
Lane 1  7860  110  1
Lane 2  7890  87  1.25
Lane 3  31548  110  0  1
Lane 4  31548  110  0  1
Lane 5  31548  110  0  1
Lane 6  31548  110  0  1

Median strip: lane
Traffic split (%): 0.00 0.00 0.00 0.00 0.00 0.00

Annual average PM10 concentrations (μg/m3)
200 m from kerb  75  50  40  20  10
150 m from kerb
50 m from kerb
30 m from kerb
20 m from kerb
10 m from kerb
At kerb (0 m)

Maximum 24-hour average PM10 concentrations (μg/m3)
200 m from kerb  75  50  40  20  10
150 m from kerb
50 m from kerb
40 m from kerb
30 m from kerb
20 m from kerb
10 m from kerb
At kerb (0 m)

Annual average NO2 concentrations (μg/m3)

Maximum 1-hour average CO concentrations (mg/m3)

EMISSIONS (Greenhouse Gases)

EMISSIONS (Air Pollutants)

MEΤEOROLOGICAL CONDITIONS

Cold start emissions

Traffic mix (%)

Lane 6
Lane 4
Lane 3
Lane 2
Lane 1

TRAQ simulation

INPUT DATA

Date of report:

Roads and Maritime Services

TRAQ:

CO2-e emissions (t CO2-e/y)

CO2-e emissions factors (kg/L)

CO2-e emissions (t CO2-e/y)

PREDICTED ROADSIDE CONCENTRATIONS AND ASSESSMENT

Maximum 1-hour average CO2 concentrations (mg/m3)

Maximum 1-hour average NO2 concentrations (μg/m3)

Annual average NO2 concentrations (μg/m3)

Maximum 24-hour average PM10 concentrations (μg/m3)

Annual average PM10 concentrations (μg/m3)

END OF REPORT
Appendix N

Technical drawings of the concept design
PLAN VIEW - MC10

LONGITUDINAL SECTION - MC10

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DATUM R.L. 55.000
HORIZONTAL ALIGNMENT
VERTICAL ALIGNMENT
L=457.152
G=-0.995%

LEGEND
- MASTER STRING LABEL
- CADASTRAL BOUNDARY
- PROPOSED BOUNDARY

NOT FOR CONSTRUCTION

© Roads and Maritime Services
DATUM R.L. 47.010
HORIZONTAL ALIGNMENT

VERTICAL ALIGNMENT

DESIGN LEVELS

EXISTING LEVELS

CHAINAGE

LONGITUDINAL SECTION - MC10

LEGEND

MASTER STRING LABEL

CADASTRAL BOUNDARY

PROPOSED BOUNDARY

NOT FOR CONSTRUCTION

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ARCHBOLD ROAD
EXTENSION BETWEEN OLD WALLGROVE ROAD,
HORSLEY PARK AND THE GREAT WESTERN HIGHWAY

CONCEPT DESIGN

EASTERN CREEK & MINCHINBURY - CITIES OF BLACKTOWN AND FAIRFIELD

© Roads and Maritime Services
PLAN VIEW - MC10

HORIZONTAL ALIGNMENT
R = 333.33
L = 163.439
L = 41.859
R = 1700.00

VERTICAL ALIGNMENT
G = 3.554%

DESIGN LEVELS
52.951
53.221
53.612
54.123
54.753
55.462
56.173
56.851
57.562
58.164
58.866
59.567
60.269
60.961
61.663
62.334

EXISTING LEVELS
52.376
53.355
54.570
55.828
56.854
57.606
58.143
58.611
59.173
59.614
60.145
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61.149
61.611
62.143

CHAINAGE
3180
3200
3220
3240
3260
3280
3300
3320
3340
3360
3380
3400
3420

LONGITUDINAL - MC10

DATUM R.L. 50.000

G = 3.554%
L = 41.859
R = 1700.00

LOT 10
LOT 2

DRAWING FILE LOCATION / NAME
17-05-17 XXX

SCALE ON A3 SIZE DRAWING

CO-ORDINATE SYSTEM
HEIGHT DATUM
AHD
MGA ZONE 56

CLIENT
PREPARED FOR

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING
FILE NAME ; FILE NAME

VERTICAL SCALE 1:200m
HORIZONTAL SCALE 1:1000m

DRAWINGS / DESIGN PREPARED BY

TITLE
NAME

DESIGN LOT CODE

DESIGN MNGR

PROJECT MNGR

DATE

NOT FOR CONSTRUCTION

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ARCHITECT ROAD
EXTENSION BETWEEN OLD WALLGROVE ROAD,
HORSLEY PARK AND THE GREAT WESTERN HIGHWAY
CONCEPT DESIGN

EASTERN CREEK & MINCHINBURY - CITIES OF BLACKTOWN AND FAIRFIELD

© Roads and Maritime Services

NOT FOR CONSTRUCTION
**ARCHBOLD ROAD**

**EXTENSION BETWEEN OLD WALLGROVE ROAD, HORSLEY PARK AND THE GREAT WESTERN HIGHWAY**

**Descriptive Information**

- **Road Name:** Eastern Creek & Minchinbury - Cities of Blacktown and Fairfield
- **Lot Code:** MC10
- **Lot:** 3930 - 4180

**Design Details**

- **Length:** 355m
- **Max. Wall Height:** 3.36m
- **Approx. Height:**
  - LOT 2: 2.12m
  - LOT 3: 3.36m
- **Approx. Height Variations:**
  - LOT 2: 0.27m
  - LOT 3: 1.39m

**Co-ordinates System**

- **Datum R.L.:** 52.900

**Longitudinal Section - MC10**

- **Horizontal Alignment:**
  - Chainage: 3940 - 4180
  - Vertical Alignment:
  - R=4 726.478 L=107.303
  - G=1.328% L=102.764
  - R=1 421.428 L=57.793

**Legends**

- **Master String Label**
- **Existing Pavement**
- **Master String Label**
- **Proposed Boundary**
- **Retaining Wall**

**Not for Construction**

© Roads and Maritime Services
PLAN VIEW - MCC1

LONGITUDINAL SECTION - MCC1

DATUM R.L 51.000

HORIZONTAL ALIGNMENT

VERTICAL ALIGNMENT

DESIGN LEVELS

EXISTING LEVELS

STATION

L=1414.296

G=-3.092% L=101.368

R=1662.398 L=80.000

G=1.720% L=395.528

STN 0.000 R.L. 61.577

STN 141.368 R.L. 57.206

OVERPASS BRIDGE

LEGEND

MCC - MASTER STRING LABEL

EXISTING PAVEMENT

OVERPASS BRIDGE

CADASTRAL BOUNDARY

PROPOSED BOUNDARY

RETAINING WALL

FOR DETAILS REFER TO RA-0117

RA-0301

LENGTH = 95m

MAX. WALL HEIGHT = 7.50m

APPROX. HEIGHT = 3.80m

FOR DETAILS REFER TO RA-0117

LOT 1203

DP263722

LOT 1204

DP1180019

LOT 4213

DP264477

LOT 10

DP1180019

FOR DETAILS REFER TO RA-0117

LOT 3203

DP260722

LOT 4213

DP264477

MCC1

MC10

LENGTH = 95m

MAX. WALL HEIGHT = 7.50m

APPROX. HEIGHT = 3.80m

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NOT FOR CONSTRUCTION

PROJECT MGR

P.CAMPBELL

M.MATHIVANAR

DESIGN MNGR

P.CAMPBELL

D.CHUNG

S.HOLVAST

S.HOLVAST

CONCEPT DESIGN

EXTENSION BETWEEN OLD WALLGROVE ROAD, HORSLEY PARK AND THE GREAT WESTERN HIGHWAY

ARCHBOLD ROAD

EASTERN CREEK & MINCHINBURY - CITIES OF BLACKTOWN AND FAIRFIELD

Western Sydney Project Office

Transport Roads & Maritime Services

Technical and Project Services

Western Sydney Project Office

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NOT FOR CONSTRUCTION
**Plan View - MCC1**

**Longitudinal Section - MCC1**

### Datum R.L. 62.000

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### Horizontal Alignment

- **R=1500.000**
- **R=500.000**
- **R=2500.000**
- **R=300.000**

### Vertical Alignment

- **D1: 720% L=395.528**
- **D2: 60% L=210.929**

### Design Levels

- **4.000**
- **4.250**
- **4.500**
- **4.750**
- **5.000**
- **5.250**
- **5.500**
- **5.625**
- **5.750**
- **6.000**
- **6.250**
- **6.500**
- **6.750**
- **7.000**
- **7.250**
- **7.500**

### Existing Levels

- **4.125**
- **4.375**
- **4.600**
- **4.850**
- **5.100**
- **5.350**
- **5.600**
- **5.850**
- **6.100**
- **6.350**
- **6.600**
- **6.850**
- **7.100**
- **7.350**
- **7.600**

### Channage

- **500 - 750**

### Scales

- Vertical Scale: 1:200m
- Horizontal Scale: 1:1000m

### Notations

- **APPROX. HEIGHT = 3.26m**
- **DECLINE = 720%**
- **R=1500.000**
- **R=-1800.000**
- **R=4579.490**
- **R=28918.300**
- **R=1500.000**
- **R=-28918.300**

### Notes

- **Refer to RA-0022 for details**

---

**Scale on A3 Size Drawing**

**Client**

**Prepared For**

**Design Model File(s) Used for Documentation of this Drawing**

**Drawings/Design Prepared by**

**Design Lot Code**

**Western Sydney Project Office**

**NOT FOR CONSTRUCTION**

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**For Details Refer to RA-0202**
PLAN VIEW - MCC1

LONGITUDINAL SECTION - MCC1

DATUM R.L. 51.000
HORIZONTAL ALIGNMENT

VERTICAL ALIGNMENT

DESIGN LEVELS

EXISTING LEVELS

STATION

LENGTH = 95m
MAX. WALL HEIGHT = 7.50m
APPROX. HEIGHT = 3.80m

FOR DETAILS REFER TO RA-0117

NOT FOR CONSTRUCTION

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NOT FOR CONSTRUCTION

Transport Roads & Maritime Services

ARCHBOLD ROAD
EXTENSION BETWEEN OLD WALLGROVE ROAD,
HORSLEY PARK AND THE GREAT WESTERN HIGHWAY
PLANNED AND LONGITUDINAL SECTION - MCC1

PLAN AND LONGITUDINAL SECTION - MCC1

MCC1

LOT 1203

LOT 1204

LOT 10

LOT 4213

LOT 10

DP263722

DP263722

LOT 1203

LOT 1204

LOT 10

LOT 4213

DP1180019

DP264477

DP263722

LOT 1203

LOT 1204

LOT 10

LOT 4213

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EXISTING STOP LINE TO BE RETAINED

REFERENCE TO RA-0130 FOR DETAILS

EXISTING RIGHT TURN BAY

APPROX. 25m

GREAT WESTERN HIGHWAY

GREAT WESTERN HIGHWAY - RIGHT BAY EXTENSION

APPROX. 251m

3.3

EXCEPTING RIGHT TURN BAY

3.3

APPROX. 25m

EXISTING STOP LINE TO BE RETAINED

REFER TO RA-0130 FOR DETAILS

LEGEND

EXISTING PAVEMENT

CADASTRAL BOUNDARY

PROPOSED BOUNDARY