Appendix F

Water Quality Improvement Plan

Water Quality Improvement Plan

Hills M2 Biolink Reserve

Macquarie Park

Document Control

Project Name

HILLS M2 BIOLINK RESERVE

		Date
Prepared by	Shane Norrish	29/2/2016
Reviewed by	Alastair Jones	1/3/2016
Approved by	Shane Norrish	1/3/2016

Revision date	**Amendment Description**
29/2/2016	Draft Version 1

Acknowledgements

This document has been prepared by Landcare Australia and includes a commissioned report from GHD Pty Ltd.

Cover Photos: L-R; Table drain, Shrimptons Creek riparian vegetation, Industrial Creek bank erosion.

Contents

1 Introduction

1.1 Background

The Hills M2 Motorway (M2) is a multi-lane tolled road operated by Transurban that extends from the intersection of Abbott Road and Old Windsor Road at Winston Hills to the Lane Cove Tunnel at North Ryde over a distance of 21 kilometres. The Subject Property is part of the Hills M2 Motorway Corridor at Macquarie Park (Figure 1). Transurban leases the site from NSW Roads and Maritime Services (RMS) under the Hills M2 Motorway Agreement and will manage the site until the lease agreement expires in 2048. Transurban advises that part of the site was recently occupied by a works compound used to upgrade Hills M2 infrastructure.

The majority of the site has been significantly modified from its original condition. The vegetation and bushland condition is now strongly ecologically degraded and is a major source of noxious weed infestation for the adjoining Lane Cove National Park (LCNP). Three watercourses draining the property also carry gross pollutants and contaminants from upstream of the site into the LCNP and the Lane Cove River.

Transurban has requested Landcare Australia to implement a bushland rehabilitation and water quality improvement initiative on approximately 5.4 hectares of the site to create the M2 Biolink Reserve. In consultation with community stakeholders, the project will improve native bushland condition, native habitat and conservation values of the site. The environmental amenity of the area will be greatly improved by re-establishing native bushland communities consistent with pre-European conditions.

The site's strategic location will assist to increase community awareness about protecting threatened species and managing the interface between urban areas and the Lane Cove National Park. The project will be supported by targeted communications and appropriate signage.

Pending results of feasibility studies, Transurban will construct a prominent cultural installation to highlight the significance of the site, improve visual amenity and further engage the wider community. The installation will be visible to passing traffic and neighbouring properties, and will complement the environmental assets of the location (Figure 2).

The surrounding rehabilitation work will enhance the visual impact of the cultural installation, with some revegetated areas land-formed to a height of approximately 1.5-2m as a backdrop. Sightlines to the installation by passing traffic will be maintained through selection and planting of appropriate small shrub and groundcover species. For bushfire safety, an Asset Protection Zone will be maintained between dense revegetation and the cultural installation.

Riparian and aquatic habitat on Shrimptons Creek and Industrial Creek will be improved by stabilising the creek banks with rock revetment to reduce erosion and sediment transport downstream. In combination with the revetment, the riparian rehabilitation works will include installation of gross pollutant traps on each Creek.

The table drain adjoining the M2 will be rehabilitated to minimise the currently eroding banks and reduce sediment movement downslope towards Shrimptons Creek. In addition, small berms will be installed to act as a retention barrier to any contaminants washing in from the M2 pavement, and preventing their movement downslope.

Additional work will remediate the poorly functioning inlet structure for the retention basin to redirect flows away from Shrimptons Creek and into the basin. The channel will also be modified to improve aeration of flows.

In conjunction with major improvement in riparian vegetation on both Shrimptons and Industrial Creeks, the water quality improvement work will greatly benefit native habitat of the M2 Biolink Reserve.

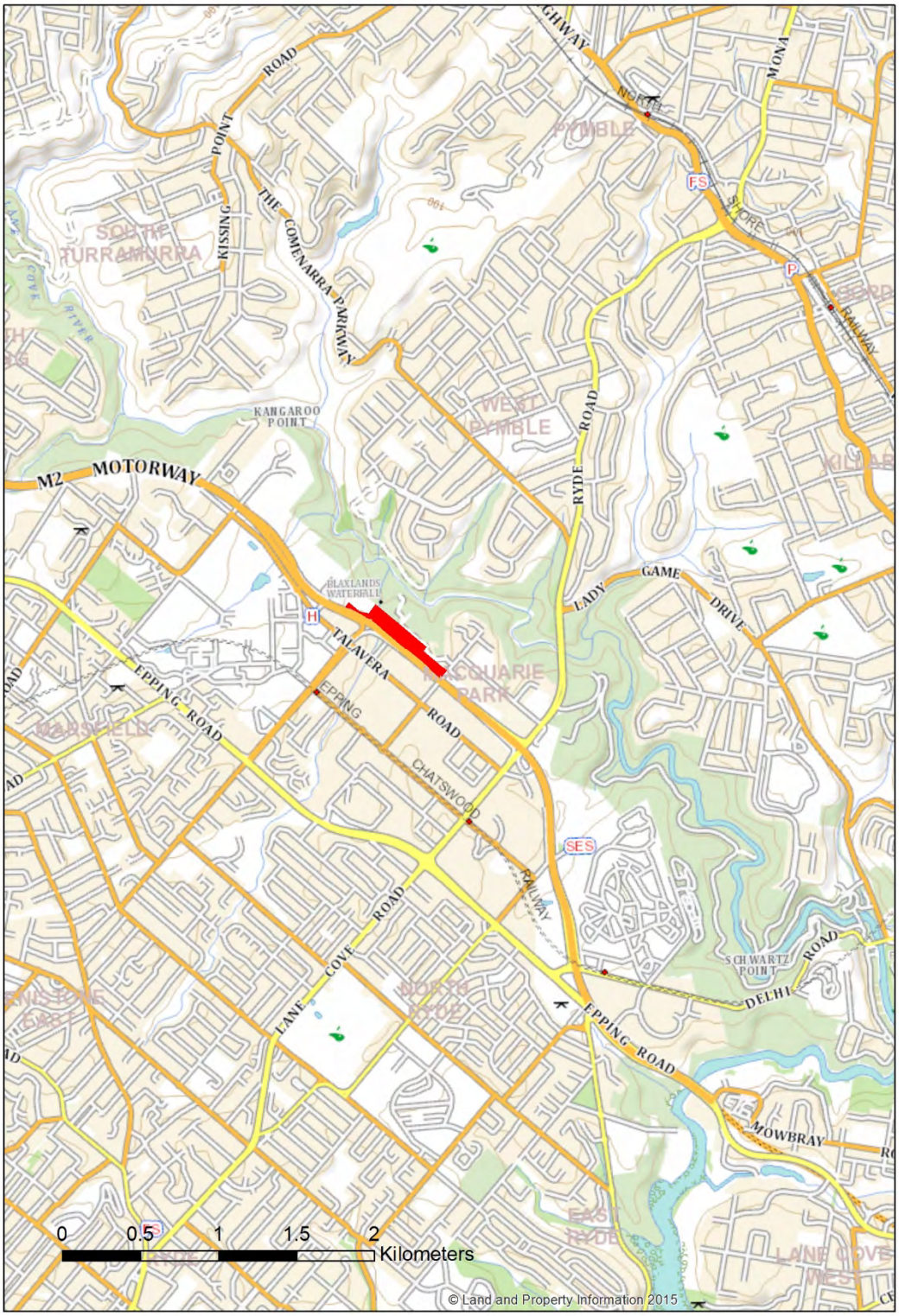


Figure 1: Regional location of the M2 Biolink Reserve at Macquarie Park (NSW Land and Property Information, 2015)

Figure 2: Plan layout of works and relevant infrastructure for the M2 Biolink Reserve

Figure 3: Location of the M2 Biolink Reserve at Macquarie Park (NSW Land and Property Information, 2015)

1.2 Objectives

The site Water Quality Improvement Plan should be reviewed in combination with the Vegetation Management Plan and other documentation for the project.

The general objective is to facilitate rehabilitation of degraded areas of the M2 Biolink Reserve and restore bushland condition that reflects cover, diversity and density of native habitat of high conservation value, inclusive of riparian and aquatic ecosystems. The project also involves infrastructure that contributes to the rehabilitation such as fencing, access points; relevant water quality works, drainage, erosion and sediment control works.

Key objectives are to

- Rehabilitate the Subject Property (approximately 5.4 ha) to improve the native bushland condition, ecological functionality and community engagement;
- Reduce current off-site impacts on adjoining properties, particularly Lane Cove National Park, through including actions for weed control, revegetation, vertebrate pest management, creek riparian zone stability and improvements to site drainage; and
- Improve water quality in Shrimptons and Industrial Creeks which drain the M2 Biolink Reserve.

2 Site Description

2.1 Location and site characteristics

Table 1: Site details (extracted from the Ecological Investigations report, UBM 2016)

TITLE INFORMATION	Lot 181 DP 1150938
LOCATION	North of M2 Hills Motorway between Christie Street and Khartoum Road, Macquarie Park
TOTAL AREA	Rehabilitation Area ~5.4 ha
TOPOGRAPHIC MAP	Parramatta 9130-3N 1: 25 000 series
GRID REFERENCE	Latitude: -33.774595, Longitude: 151.124495 (centroid)
OWNERSHIP	Roads & Maritime Services (leased by Transurban until 2048)
LOCAL GOVERNMENT AREA	Ryde City Council
BUSHFIRE PRONE LAND	Not mapped as bushfire prone
ZONING (Ryde LEP 2014)	SP2 Infrastructure: adjoining E1 National Parks & Nature Reserves
CURRENT LAND USE	Vacant land: previously works compound for M2 Motorway
PROPOSED DEVELOPMENT	Site rehabilitation to create an indigenous plant community with a cultural installation

The Subject Property is located on the northern side of the M2 Hills Motorway between Christie and Khartoum Roads. It is separated from the Macquarie Park commercial and residential centre by the M2 Motorway, which forms the southern boundary. The site is bounded to the east by Khartoum Road and a small nature reserve in the west.

The Lane Cove National Park adjoins the majority of the northern boundary. The eastern end of the northern boundary adjoins two unit blocks and a small parcel of Dunholm Reserve, which is disconnected from the main parcel by Leisure Close.

There are three natural watercourses draining the site. All flow in a northerly direction from pipes and a culvert under the M2, approximately 300 metres from the Lane Cove River. The riparian zones of Shrimptons and Industrial Creeks are severely degraded by woody weeds, with an understorey of exotic ground covers such as *Tradescantia fluminensis* (Wandering Jew). In some sections, the banks of both creeks are being undercut and eroding.

Stormwater runoff from the Hills M2 Motorway road surface is collected by pipe and table drain and directed to a retention basin on the north-western site boundary, located approximately 50m from Shrimptons Creek. Another retention basin is located at the far western end of the property. Other stormwater run-off from the M2 site will eventually drain to the creeks and Lane Cove River.

An underground sewer main is located on the eastern bank of Shrimptons Creek and crosses the creek approximately 60m from the culvert. This may have implications for the rehabilitation works and require additional approvals from Sydney Water.

The M2 Biolink Reserve is bounded by a 1.8m high chain mesh fence along its northern boundary, with access gates behind the apartment blocks on Leisure Close and approximately 200m along the National Park fire trail.

Topography

The centre of the site contains the Deck, an area of approximately one hectare. The Deck comprises a relatively level site created from compacted fill of unknown stability. Overall site relief is approximately 25m, and the higher areas, inclusive of the Deck, are flanked by relatively steep slopes on the northern (~1:3m), western sides (~1:2.5m) and eastern sides (~1:5m) (Figure 4). The embankments grade towards the watercourses, and the north-eastern boundary adjoining the Lane Cove National Park. On the western side of Shrimptons Creek there is a relatively steep rise to a smaller plateau adjoining the M2.

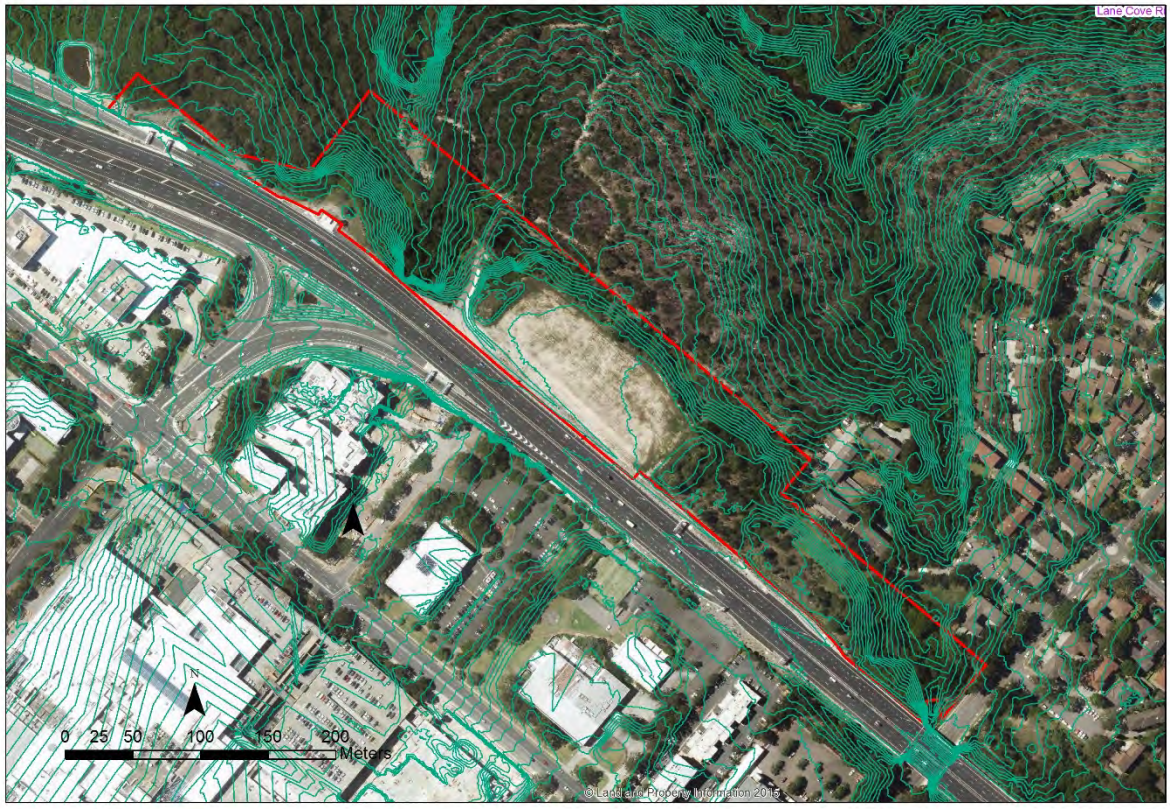


Figure 4: Contour intervals (1 metre) of site and surrounding area (source: Jacobs, 2016)

Hydrology

Shrimptons Creek flows under the M2 via a large culvert approximately 250 metres from the western boundary towards Blaxland waterfall in LCNP. Industrial Creek enters the south-eastern corner of the site near Khartoum Road via a 1.8m diameter pipe and exits via a box culvert under Dunholm Reserve. A third watercourse, an unnamed tributary of Shrimptons Creek, flows at the extreme western end of the property for approximately 15 metres before exiting the boundary.

3 Proposed water quality improvement works

3.1 Investigations and GHD report

GHD consultants visited the M2 site in January 2016 to review options to improve water quality. The following information has been provided by Guy Lampert (Fluvial Geomorphologist) and Ian Joliffe (Project Director) of GHD.

Our ref: 22/18213
112202
Your ref:

M2 Biolink Water Quality Work Options and Designs

Further to our site inspections of the M2 Biolink site with Landcare Australia representatives, we have examined the potential water quality improvement options at the site and provide the following comments and advice. For recommended works, preliminary design figures and drawings and a materials specification have been prepared and are attached to this letter.

We understand that proposed works include the removal of weed species and this will not be discussed in detail in the following. It is understood that removed vegetation may be mulched and retained on site while selected larger species may be poisoned and cut off above ground with root balls retained for soil stabilisation. To maintain watercourse bank stability while native revegetation establishes, the latter method is recommended for weed treatment growing on or immediately adjacent to the watercourse banks.

1 Site 1 – Adjacent to Leisure Close

This site is located west of Khartoum Road, south of Leisure Close and north of M2 Motorway and represents the area between the M2 formation and the corridor fence to the north. Industrial Creek discharges through this location. At this location the main channel of the creek is relatively small (Figure 1(a)) with it discharging into a box culvert near the northern corridor fence line (Figure 1(b)).

The creek channel is considered to be fairly stable with well-vegetated banks (dominantly weed species) and a gravel and cobble bed forming a natural pool-riffle sequence. There are some sections of bank where there is evidence of bank toe scour, particularly along the eastern bank. While this level of erosion is considered to be within the natural functioning of the system, the proposed vegetation management works may lead to additional scouring. As a result, toe rock protection is recommended to be placed along the higher banks where toe erosion is evident (refer attachment A – Figure 1 for typical detail for bank protection).

The *Macquarie Park Floodplain Risk Management Study and Plan* indicated design flow rates through the Industrial Creek at this location as being approximately 11 m^3/s for the 5 year ARI event and approximately 18 m^3/s for the 100 year ARI 2 hour design event.

GHD Pty Ltd ABN 39 008 488 373
Level 3 GHD Tower 24 Honeysuckle Drive Newcastle NSW 2300 PO Box 5403 Hunter Region Mail Centre NSW 2310 Australia
T 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com

(a) Looking upstream from near fence

(b) Looking toward the downstream box culvert

Figure 1 Views of Industrial Creek

To the west of the creek there is a relatively low lying area (Figure 2) of approximately 20 m by 30 m where a wetland could be created. Urban debris was observed on this low lying area indicating that it does flood with significant flows in the creek. This low lying area also contained some relatively large vegetation that could potentially could be retained as habitat after removal of the weed species.

Figure 2 Low lying area west of low flow channel of Industrial Creek

Two potential works options have been considered for this area. They are:

- Small wetland west of the main channel
- Trask rack across the main channel.

1.1 Small wetland west of the main channel

Construction elements of this facility would include:

- Clearing and excavation of the low lying area on the western side of the low flow channel of

the creek. Disposal of the spoil off site is anticipated. The depth of excavation should be to a level no higher than the invert of the low flow channel

- Connection of the creek channel to the wetland area as close to the toe of the Motorway embankment as practical
- Placement of rock stabilisation along the connection to the creek channel
- Placement of the larger timber elements to form woody log habitat.

The wetland would be quite small with a surface area of the order of 500 to 600 m^2 and would thus have a limited water quality improvement functionality.

The wetland would form a stagnant pool of water unless a second connection to the low flow channel was constructed near the box culvert headwall near the northern boundary. Even allowing for through flow, circulation within the wetland would be limited due to the low magnitude flows that dominate the flow regime of Industrial Creek.

The wetland would overtop in significant flow events, as the area currently does, and this would impact on the potential maintenance requirements.

It is very likely that the soils requiring excavation would have at least a low level of contamination and may potentially require offsite disposal at an approved waste management facility.

It is therefore considered that a wetland would provide limited benefit for the potential costs in construction.

1.2 Trash rack on Industrial Creek

The most appropriate location for construction of a trash rack would be approximately 2 to 3 m upstream of the inlet to the box culvert. This location is nominated so that, should complete blockage of the trash rack occur, stormwater could still enter the box culvert to minimise the potential for additional downstream flooding issues.

Construction elements of a trash rack (refer Attachment A – Figure 1) would include:

- Providing access through the boundary fence to the west of the culvert for construction and ongoing maintenance.
- Clearing and excavation of a small area upstream of the rack
- Installation of support posts and a trash rack at a location of approximately 2 to 3m upstream of the box culvert. The posts could potentially be, without detailed design, 100 mm RHS sections with the rack having vertical bars of around 80 mm by 8 mm at approximately 150 mm centres with horizontal top and bottom members of approximately 100 mm by 50 mm RHS form. The height of the trash rack would be approximately 800 mm to 1,000 mm high and the trash rack would extend approximately 3 m perpendicular to the low flow channel centreline.
- Construction of a concrete slab upstream of, and including the support posts. The slab would extend approximately 3 to 4m upstream of the trash rack. An access slab would be constructed on the western side of the low flow channel to facilitate cleaning of the collected debris and organic material.

The trash rack would provide a benefit to the broader community and be a relatively low cost works option for implementation.

2 Site 2 – Adjacent to M2 Pavement

This site is located north of the M2 Motorway pavement and east of an extension of Herring Road. At this location water sheds off the pavement toward the north and then travels westward along the existing drain prior to passing into, or bypassing, a water quality facility. The drain is shown in Figure 3.

Figure 3 Drain adjacent to M2 pavement

Three small drainage outlets were observed to discharge into this drain, which grades downward toward the west, from under the M2 pavement.

The drain is lined with crushed shale rock and is poorly vegetated, representing a potential ongoing source of fine sediment to downstream environments.

2.1 Options

The potential options for improving the swale include:

- Convert the drain to a linear bioretention system to filter out granular materials, oils, particulates from the runoff. The bioretention would also remove some nutrients from the stormwater runoff.
- Regrading of the drain batters, particularly the steeper northern batter, and placement of 200 to 300 mm of imported top soil over the drain to provide an improved medium for establishment of vegetation.

With conversion of the drain to a bio-retention system, periodic maintenance works would be required and include:

- Litter collection and removal from the bioretention area
- Removal and replacement of the upper layer (approximately 200 mm deep as a minimum) of the free draining soil layer to maintain the soil permeability and replanting of the selected species

Regrading, topsoiling and revegetating the drain would improve its resilience to erosion during flow events. Low berms could be incorporated into drain, running perpendicular across the invert at 10 to 20 metre spacing. These berms would provide some litter capture capacity as well as the potential to retard spills from the M2. Maintenance would be limited to periodic litter removal.

The latter option of regrading, topsoiling and revegetating the swale (with low berms) is considered the preferred option given the less onerous ongoing maintenance requirements associated with this option. As topsoil will raise the profile of the channel invert a drop structure would be required at the downstream end to transition the invert to the existing shotcrete lined drain. Preliminary drawings for this option are provide in Attachment A (Drawings 22-18213-C01, 22-18213-C010 and 22-18213-C011).

3 Site 3 – Water quality basin Inlet channel

This site is the discharge from the drain discussed as Site 2. The primary issue identified at this site, and advised by the operator, is the potential for stormwater that flows down the concrete channel, primarily shown in Figure 4(a) to pass direct into the overflow pipe, shown in Figure 4(b), rather than draining into the water quality basin.

(a) Inlet channel (b) Discharge pipe and transition

Figure 4 Concrete drain into water quality basin

3.1 Design Options

Three main design options exist for this area. They are:

- Placement of blocks on the chute – these would facilitate reaeration of the stormwater entering the water quality basin.
- Realigning the chute to better direct flow toward the water quality basin – this could better direct flows into the water quality basin so as to restrict the frequency of discharge into the overflow pipe
- Construction of a low height weir across near the entrance of the outlet pipe – this could better

direct flows into the water quality basin so as to restrict the frequency of discharge into the overflow pipe.

3.1.1 Placement of blocks on the chute

While not specifically identified within the brief there would be advantages, if the concrete is realigned, to include embedded rocks to facilitate reaeration of the stormwater as it flows downstream along the chute and improve the water quality and oxygen concentration within the water quality basin.

Should the chute not be realigned, it would still be possible to achieve this objective by anchoring rock or similar blocks irregularly within the chute (refer Attachment A Figure 2).

3.1.2 Realigning the chute to better direct flow toward the water quality basin

Realignment of approximately the last 5 m of the chute could be undertaken to better direct stormwater toward the water quality basin inlet.

Construction works would need to include:

- Demolition of the most downstream section of the existing chute
- Excavation of a relatively uniform realignment for the chute
- Reconstruction of the chute on the new alignment.

3.1.3 Construction of a low height weir across near the entrance of the outlet pipe.

Construction of a low height, approximately 150 mm to 200 mm high, weir across the formed channel near the inlet of the overflow pipe would direct stormwater runoff preferentially into the water quality basin whenever the water level in the basin was below the weir level. Indicative works are shown diagrammatically in Figure 5(b). Construction works would need to include:

- Demolition of the most downstream section of the existing chute
- Excavation of a relatively uniform realignment for the chute
- Reconstruction of the chute on the new alignment.

Comparison of options

The works described in Sections 4.1.2 and 4.1.3 could both achieve the objective of reducing the frequency of flow into the overflow outlet pipe and channel. The weir option described in Section 3.1.3 would be easiest to install (refer Attachment A – Figure 2).

4 Site 4 - Shrimptons Creek

This site is effectively at the downstream end of the arch under the M2 Motorway. Figure 6 provides two images of the area. This area is characterised by having some relatively large trees, relatively thick understorey, a small dry weather flow channel and an area which appears as if resulting from deposition of granular materials around and within vegetated area.

The creek channel is considered to be fairly stable with well-vegetated banks (dominantly weed species) and a bed comprising gravel, cobbles and bedrock. There are some sections of bank where there is evidence of bank toe scour, particularly along the eastern bank. While this level of erosion is considered to be within the natural functioning of the system, the proposed vegetation management works may lead to additional scouring. Toe rock protection is recommended to be placed along the higher banks where toe erosion is evident (refer attachment A – Figure 1 for typical detail for bank protection).

An inspection of access options to this location considered:

- Access from the southern side of the motorway – not practical due to narrow and steep corridor on the upstream end of the arch and the sewer through the arch would need to be avoided
- Access off the track leading to the water quality basin discussed above.

The latter access option would be the most suitable but it would involve undertaking relatively significant earthworks to form the access track.

(a) View downstream of arch (b) View across downstream end of arch

Figure 2 Creek form at Bebo® arch on Shrimpons Creek

4.1 Works options

Two works options have been considered for this area. They are:

- Wetland downstream of the arch
- Trash rack near the downstream end of the arch

4.1.1 Wetland downstream of the arch

Works required to construct a wetland would involve:

- Formation of the access track from near the water quality basin

Removal of the large vegetation from the proposed wetland area – the most suitable wetland area would be an area largely on the western side of the low flow channel and extending for a distance of approximately 40 m downstream of the arch

- Excavation of material shown in Figure 6(a) to enhance the opportunity for formation of wetland habitat
- Most probably a low height weir would be constructed across the downstream end of the wetland area to restrict the potential for the wetland substrate to be eroded

The *Macquarie Park Floodplain Risk Management Study and Plan* indicated design flow rates through the Shrimptons Creek arch of between being approximately 66 m^3/s for the 5 year ARI event and approximately 128 m^3/s for the 100 year ARI 2 hour design event.

The capacity of any wetland in this area would be substantially less than that required to provide any significant water quality improvements. As a result, a wetland here would have extremely limited influence on water quality. Additionally, the associated flow velocities would be expected to wash the wetland out and cause significant damage to the developed ecosystem. The benefits are therefore considered to be minimal relative to the likely construction cost and construction difficulties.

4.1.2 Trash rack near the downstream end of the arch

The flow rates identified in Section 5.1.2 would pass over/through any trash rack constructed across the full width of the watercourse at this location. To minimise the potential upstream impacts of a trash rack at this location it would be prudent to limit the trash rack to be within the low flow channel and keep the height limited to around a maximum of 1 m.

The upstream hydraulic impacts of construction of a trash rack of this height would be expected to be minimal due to the slope of the invert through the arch.

GHD is of the opinion that the benefits that would be gained from construction of a trash rack at this site would be modest relative to the costs and broader environmental issues created by the construction.
However, it would provide some capacity to capture gross pollutants during low to moderate flow events (ie up to flow events just beyond the capacity of the low flow channel).

To facilitate cleaning of the litter and collected debris from the upstream side of the trash rack it is anticipated that a levelled concrete slab would be constructed immediately upstream of the vertical trash rack. Based upon that assumption the slab would pass over the Sydney Water sewer and approval from Sydney Water would be required to construct such a structure. We would also anticipate that Sydney Water would require consideration of potential impacts of traffic movements on the sewer (for maintenance and construction).

A review of topographic survey was undertaken to determine potential options for accessing the trash rack for maintenance. These options and their limitations are:

- Vehicle access track
  - Steep grades (>25%) with safety (vehicle roll over) and erosion issues.

  - Very restricted turn around space for vehicles at the toe of slope and at the basin.
- Walk-in access track
  - Safety concerns with manual handling of collected debris (eg needle stick injuries)

Given the steep grade and limited turn around space for vehicles, walk in access to the trash rack is considered best for maintenance purposes. This option also has a smaller disturbance footprint minimising potential erosion issues. The safety concerns with manual handling of the trash can be reduced by using appropriate Personal Protective Equipment (eg gloves, safety glasses) and using equipment for removing and transporting (eg rakes and direct placement into plastic containers that can be carried out to a truck parked near the water quality basin).

A proposed route for the track is indicated in Drawing 22-18213-C01. While this route does not comply with walking track standards for disabled access, it is considered suitable for the intended use (ie access by competent workers to maintain the trash rack).

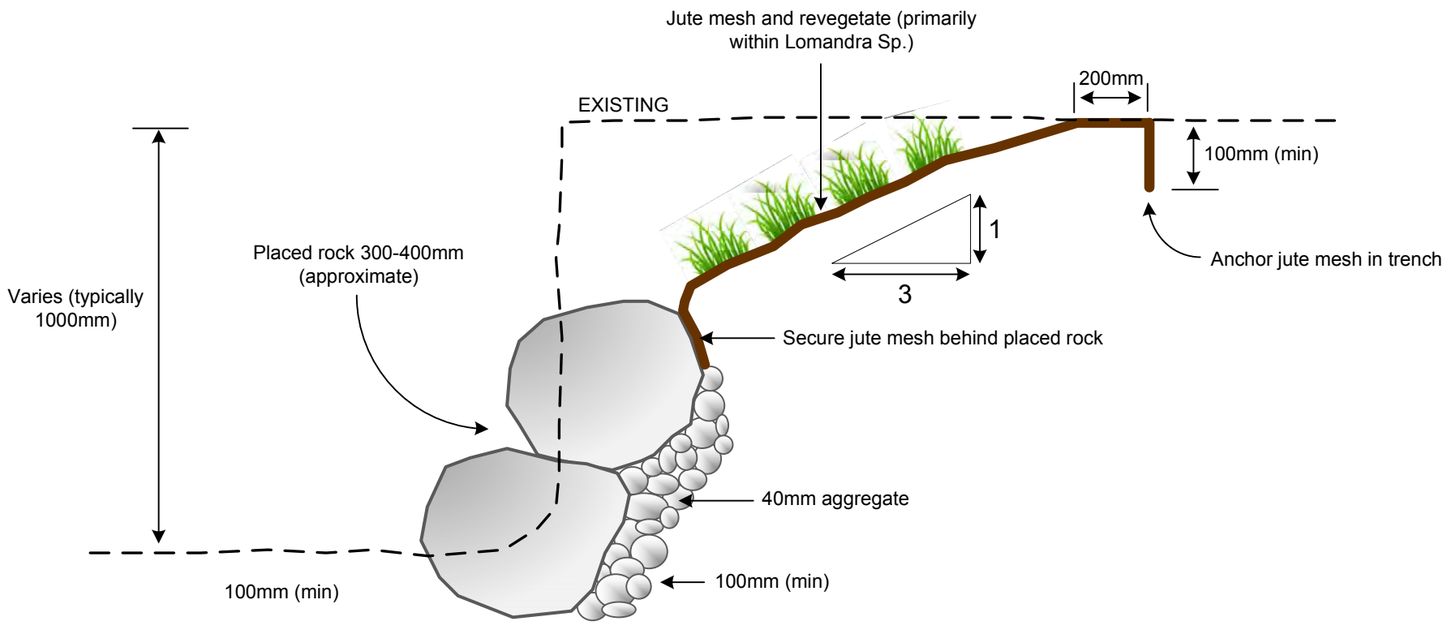
The track would be 1200 mm wide and consist of a 100 mm compacted 15 mm aggregate. On the steeper slope steps may be required. These have not been considered in this current design.

5 Summary

In summary, the following works are considered to be viable options for improving water quality at the M2 Biolink site:

- Site 1
  - Revetment to protect bank toe scour
  - Small trash rack on Industrial Creek upstream of the culvert on the M2 boundary fence.
- Site 2
  - Regrading, topsoiling and revegetating the table drain along M2 pavement.
- Site 3
  - Provide blocks along the shotcrete channel running from the earthen swale to the basin.
  - Increasing frequency and volume of flows into the existing water quality basin by providing a small weir structure to restrict the passage of flow into the overflow pipe and channel.
- Site 4
  - Revetment to protect bank toe scour
  - Small trash rack across the low flow channel approximately 10 metres downstream of the arch.
  - Walkway access to the trash rack from near the water quality basin for maintenance.

Preliminary design figures and drawings and a materials specification for the above recommended works have been prepared and are attached to this letter.



M2 Biolink Water Quality Improvement Works

Bank Protection – Typical Section

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Figure 1

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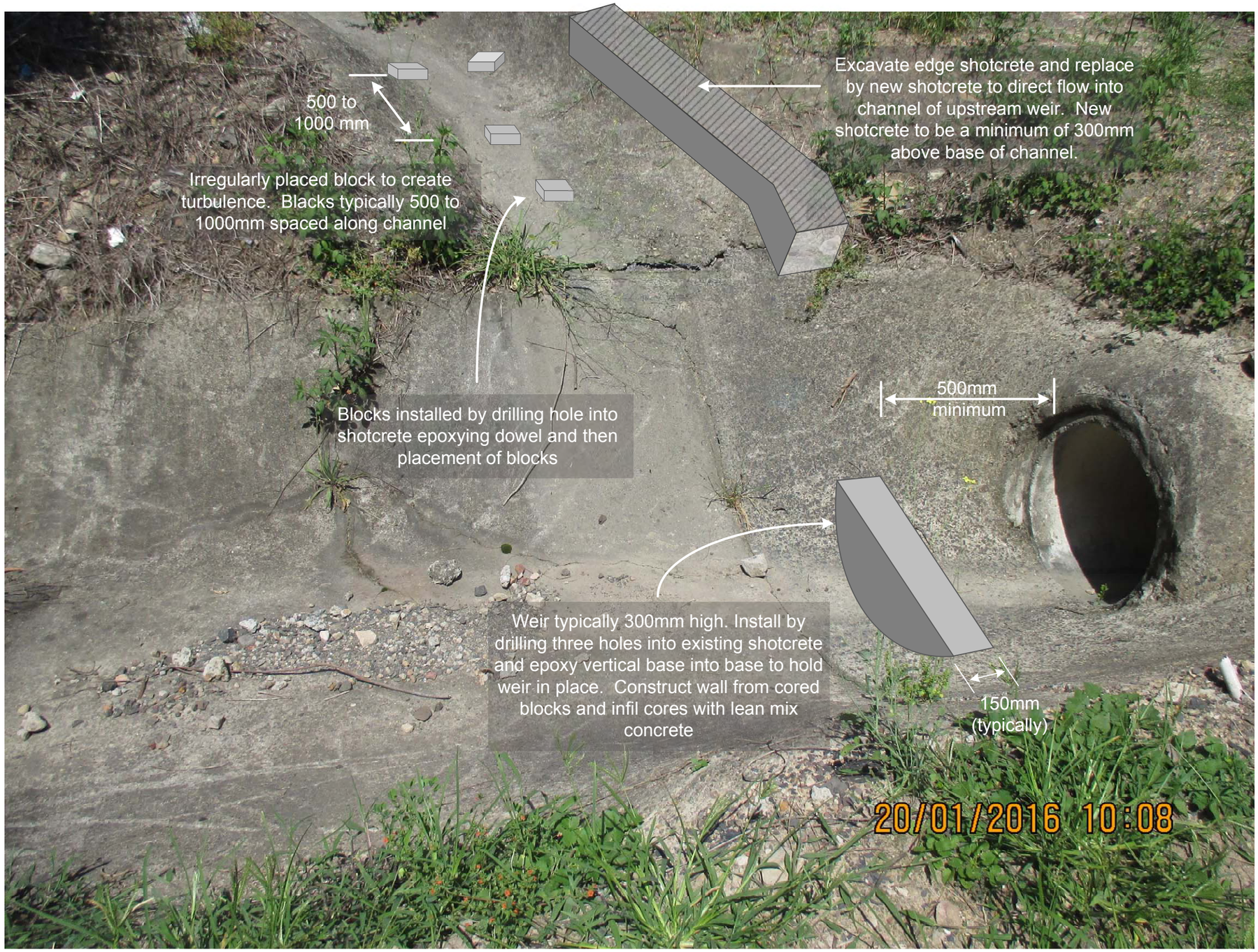

M2 Biolink Water Quality Improvement Works

Basin Inlet Channel Works

DATE 24/02/2016

Figure 2

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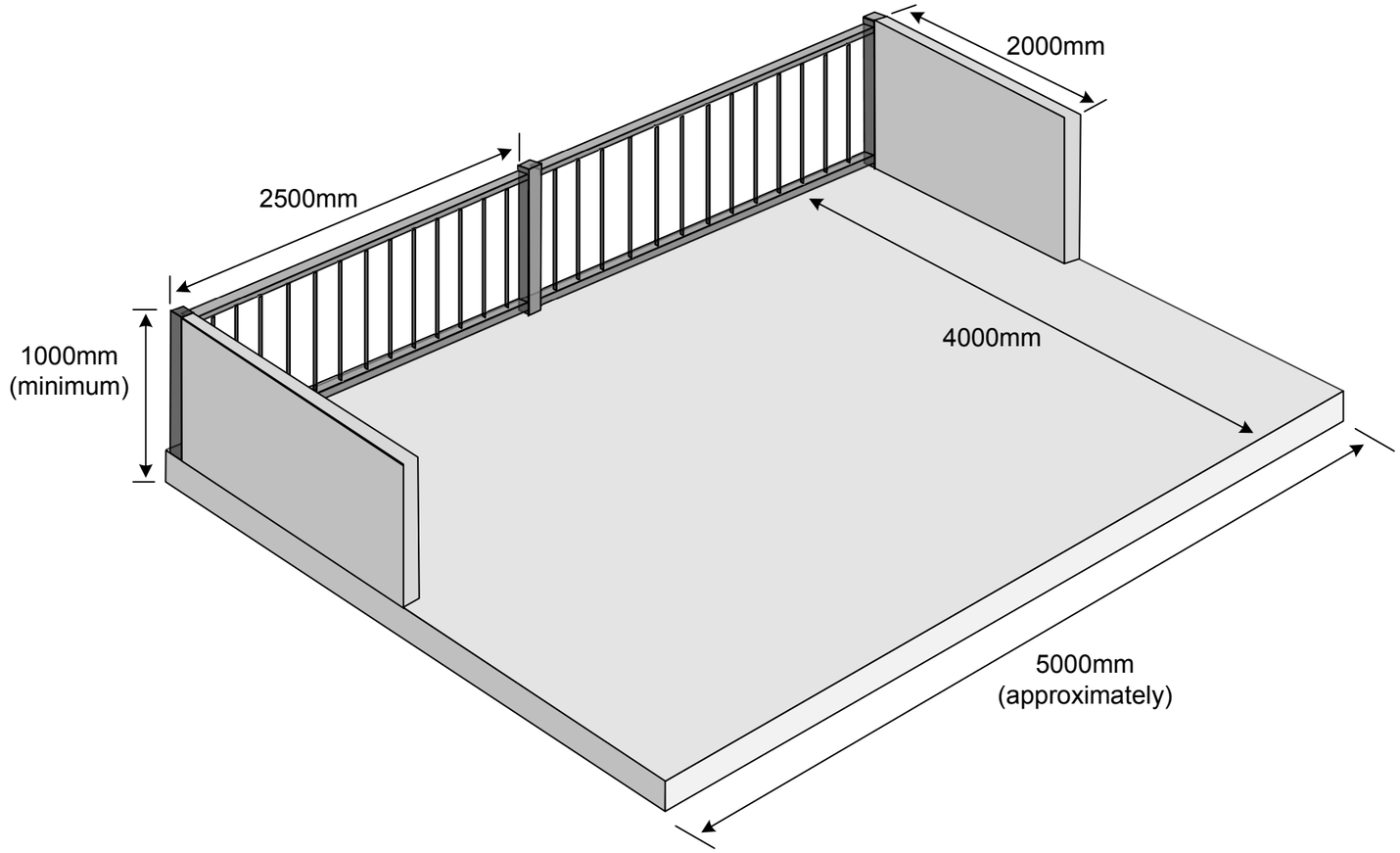

M2 Biolink Water Quality Improvement Works

Trash Rack Shrimptons Creek

DATE 24/02/2016

Figure 3

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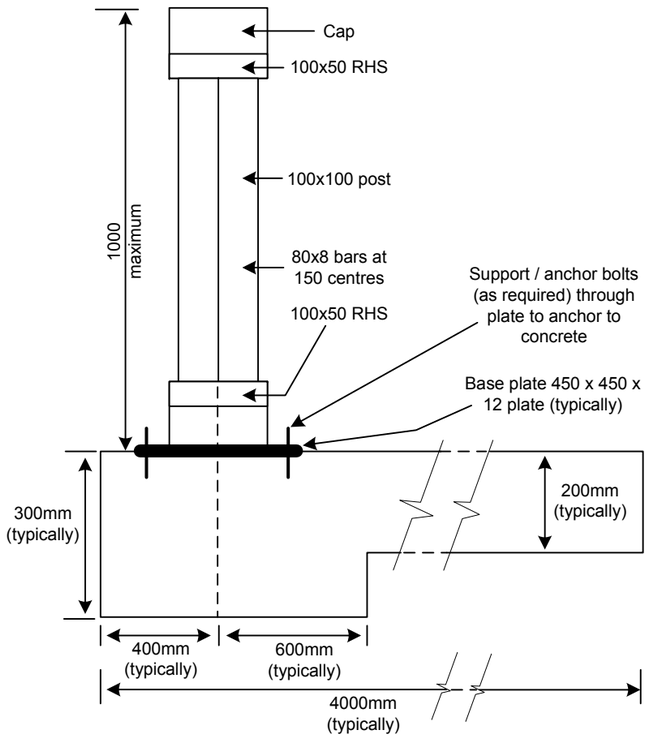
Detail of Rack



Note: All metal work to be hot dip galvanised

M2 Biolink Water Quality Improvement Works

Trash Rack Industrial Creek

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Figure 4

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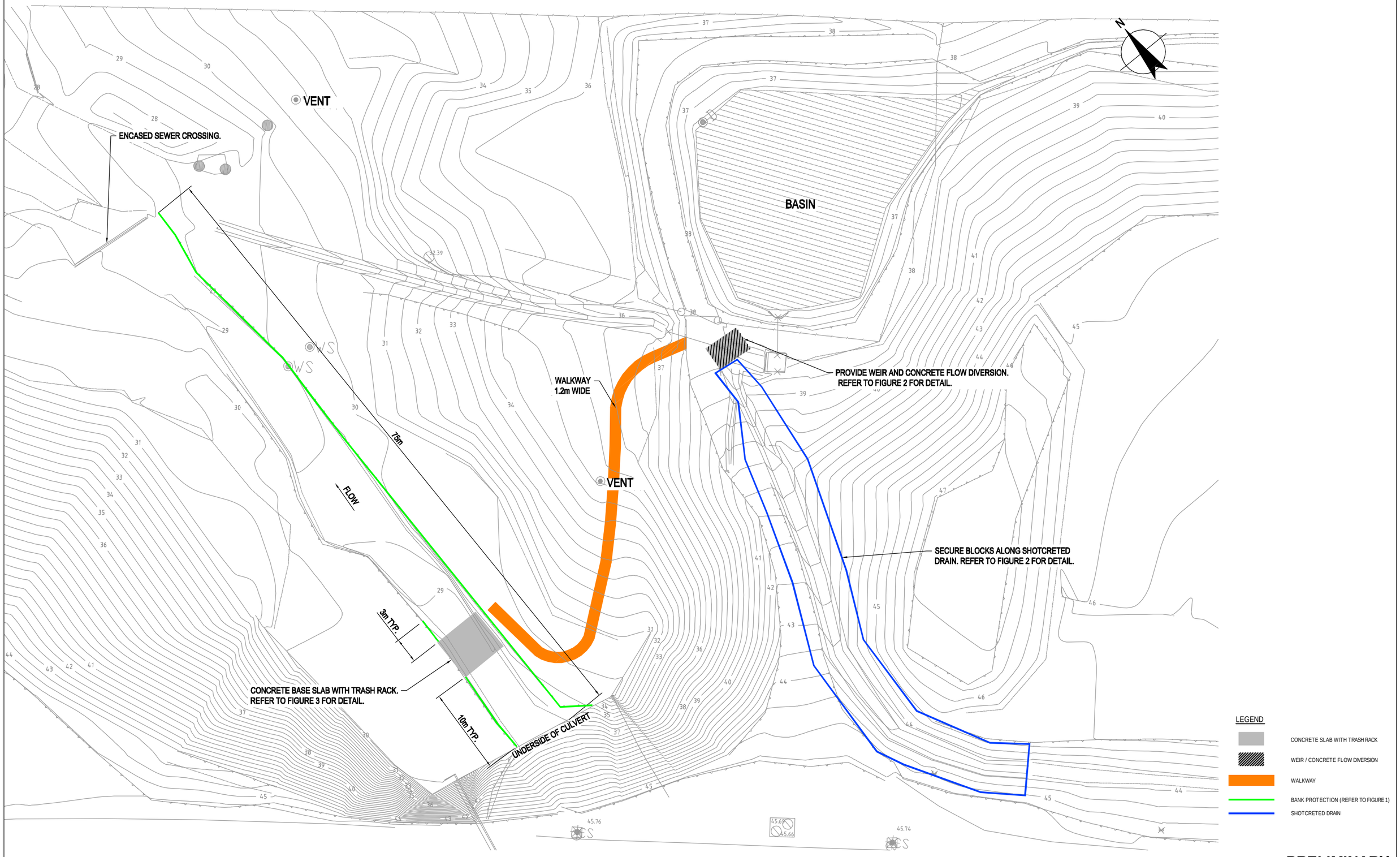

PRELIMINARY

No	Revision	Note: * indicates signatures on original issue of drawing or last revision of drawing	Drawn	Job Manager	Project Director	Date
A	PRELIMINARY ISSUE		CB		GL	26.02.16

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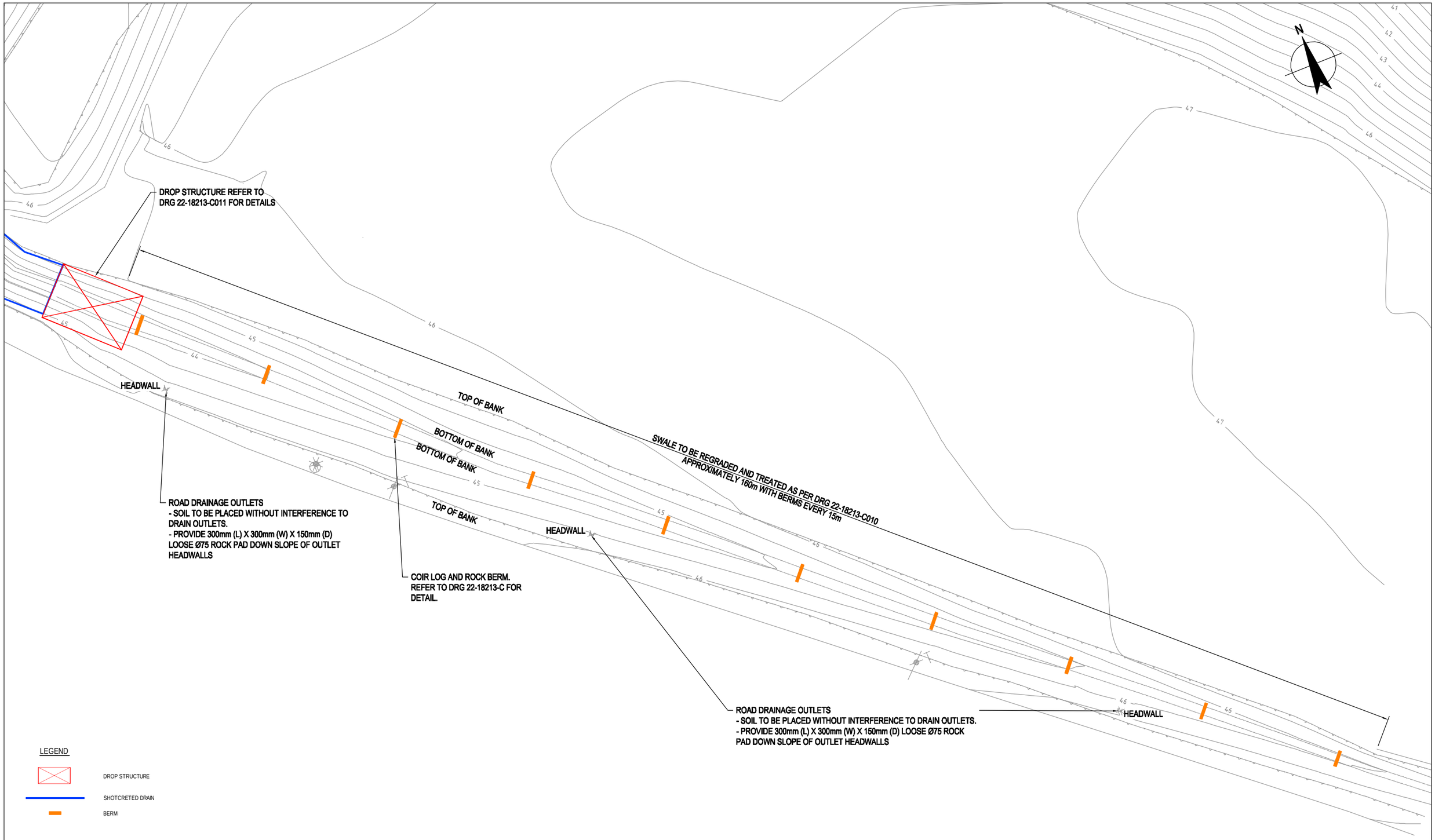
SCALE 1:200 AT ORIGINAL SIZE

GHD
Levels 2 & 3 GHD Tower, 24 Honeysuckle Drive
Newcastle NSW 2300 Australia
T 61 2 4979 9999 F 61 2 4979 9988
E ntlmail@ghd.com.au W www.ghd.com.au

Drawn I. HAY		Designer C. DAVIES	
Drafting Check		Design Check	
Approved (Project Director)			
Date			
Scale AS SHOWN	This Drawing must not be used for Construction unless signed as Approved	Original Size A1	Drawing No: 22-18213-C001 Rev: A

Client LANDCARE AUSTRALIA
Project M2 BIOILINK WATER QUALITY IMPROVEMENT WORK
Title GENERAL ARRANGEMENT PLAN SHEET 1 OF 3

Plot Date: 26 February 2016 - 3:25 PM Plotted by: Colin Bode Cad File No: G:\22\18213\CADD\Drawings\22-18213-C001.dwg



PRELIMINARY

No	Revision	Note: * indicates signatures on original issue of drawing or last revision of drawing	Drawn	Job Manager	Project Director	Date
A	PRELIMINARY ISSUE		CB		GL	26.02.16

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SCALE 1:200 AT ORIGINAL SIZE

Levels 2 & 3 GHD Tower, 24 Honeysuckle Drive
Newcastle NSW 2300 Australia
T 61 2 4979 9999 F 61 2 4979 9988
E ntlmail@ghd.com.au W www.ghd.com.au

DO NOT SCALE

Drawn I. HAY		Designer C. DAVIES	
Drafting Check		Design Check	
Approved (Project Director)			
Date			
Scale AS SHOWN	This Drawing must not be used for Construction unless signed as Approved		

Client LANDCARE AUSTRALIA
Project M2 BIOILINK WATER QUALITY IMPROVEMENT WORK
Title GENERAL ARRANGEMENT PLAN SHEET 2 OF 3

Original Size A1
Drawing No: 22-18213-C002
Rev: A

Plot Date: 26 February 2016 - 3:26 PM Plotted by: Colin Bode
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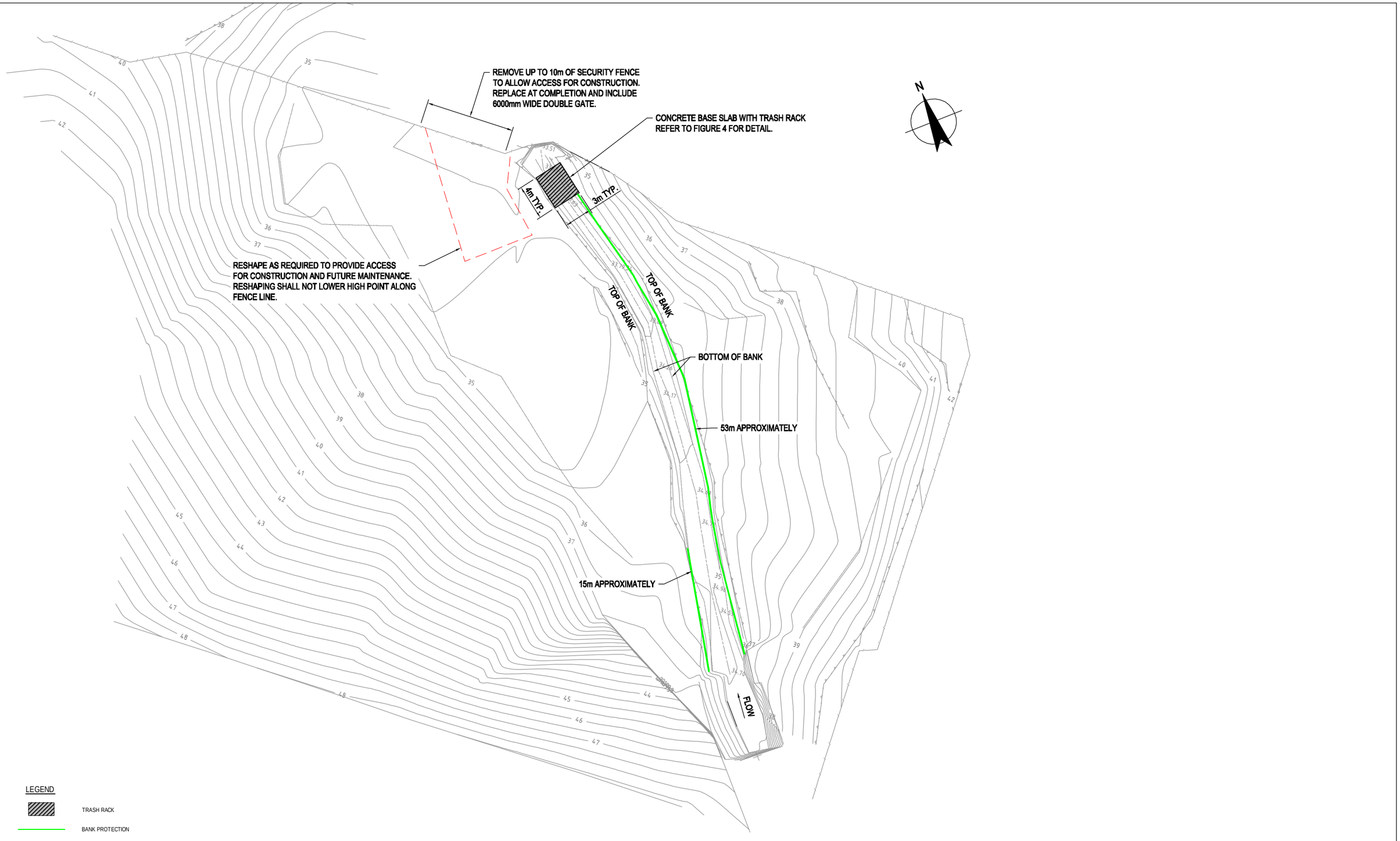

PRELIMINARY

No	Revision	Note: * indicates signatures on original issue of drawing or last revision of drawing	Drawn	Job Manager	Project Director	Date
A	PRELIMINARY ISSUE		CB		GL	26.02.16

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SCALE 1:200 AT ORIGINAL SIZE

GHD
Levels 2 & 3 GHD Tower, 24 Honeysuckle Drive
Newcastle NSW 2300 Australia
T 61 2 4979 9999 F 61 2 4979 9988
E nltmail@ghd.com.au W www.ghd.com.au

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Drafting Check		Design Check	
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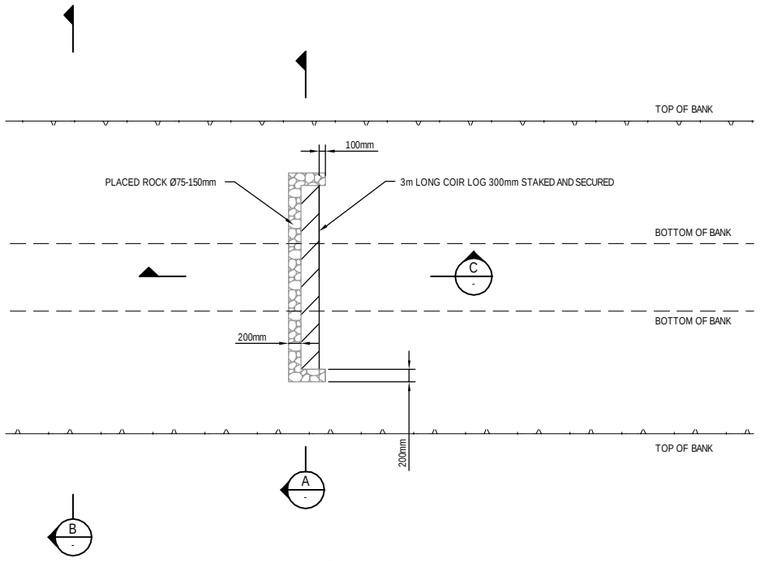
Client LANDCARE AUSTRALIA
Project M2 BIOILINK WATER QUALITY IMPROVEMENT WORK
Title GENERAL ARRANGEMENT PLAN SHEET 3 OF 3

Original Size A1 **Drawing No: 22-18213-C003** **Rev: A**

Plot Date: 26 February 2016 - 3:26 PM Plotted by: Colin Bode Cad File No: G:\22\18213\CADD\Drawings\22-18213-C003.dwg



PLAN

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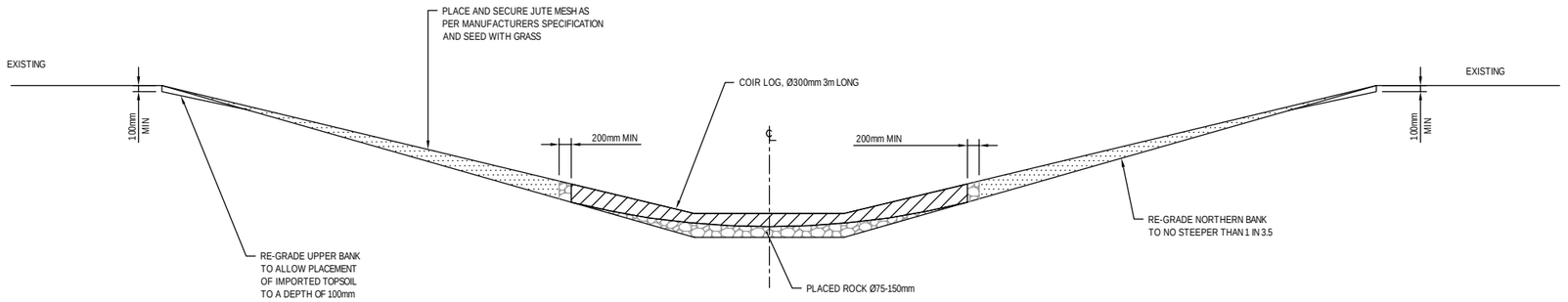

A SECTION

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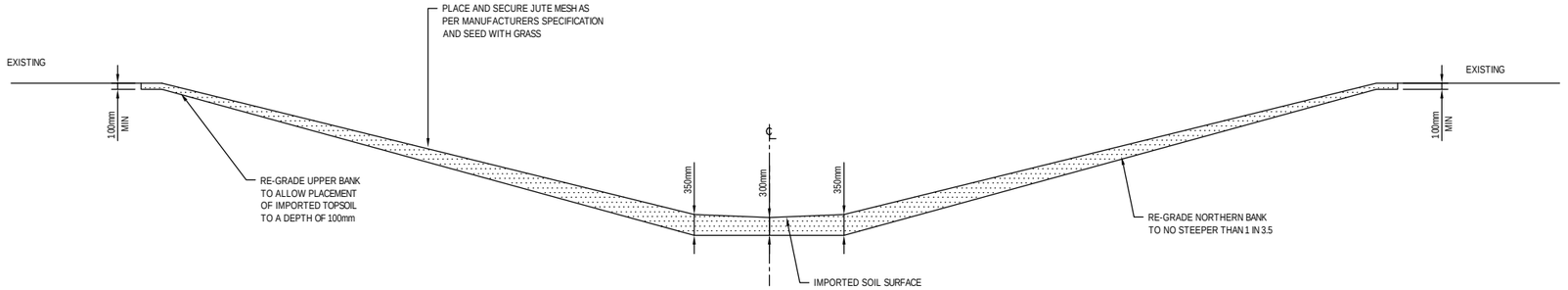
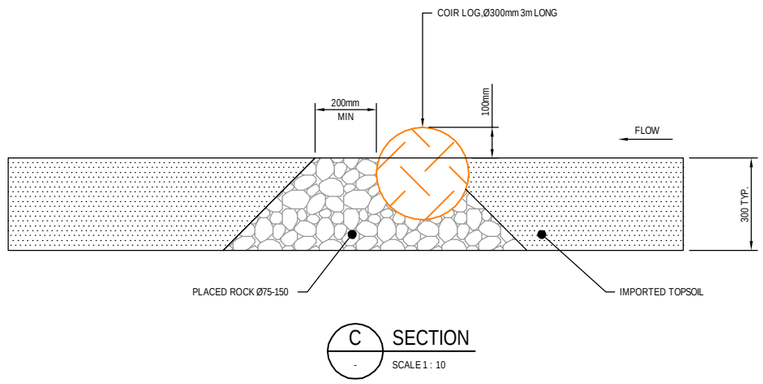
THROUGH COIR LOG BERM



B SECTION

SCALE 1 : 50

THROUGH IMPORTED SOIL



C SECTION

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PRELIMINARY

No	Revision	Note: * indicates signatures on original issue of drawing or last revision of drawing	Drawn	Job Manager	Project Director	Date
A	PRELIMINARY ISSUE		CB	GL	GL	26.02.16

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SCALE 1:10 AT ORIGINAL SIZE

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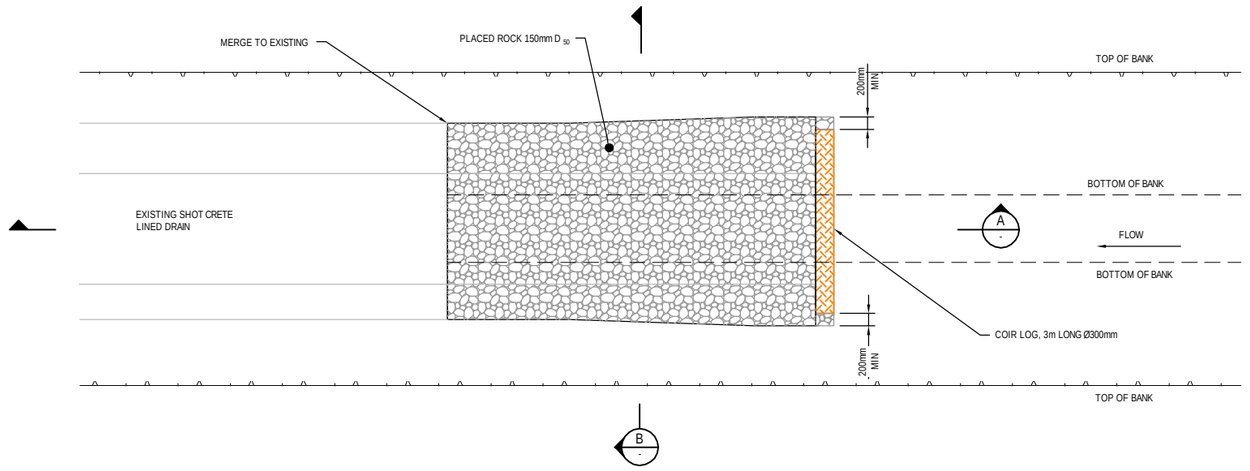
SCALE 1:50 AT ORIGINAL SIZE

GHD

Levels 2 & 3 GHD Tower, 24 Honeysuckle Drive
Newcastle NSW 2300 Australia
T 61 2 4979 9999 F 61 2 4979 9988
E nltmail@ghd.com.au W www.ghd.com.au

Drawn I. HAY	Designer C. DAVIES	Client	LANDCARE AUSTRALIA
Drafting Check	Design Check	Project	M2 BIOILINK WATER QUALITY IMPROVEMENT WORK
Approved (Project Director)		Title	DETAILS - SHEET 1 OF 2
Date			
Scale AS SHOWN	This Drawing must not be used for Construction unless signed as Approved	Original Size A1	Drawing No: 22-18213-C010 Rev: A

Plot Date: 26 February 2016 - 3:26 PM Plotted by: Colin Bode Cad File No: G:\22\18213\CADD\Drawings\22-18213-C010.dwg



PLAN

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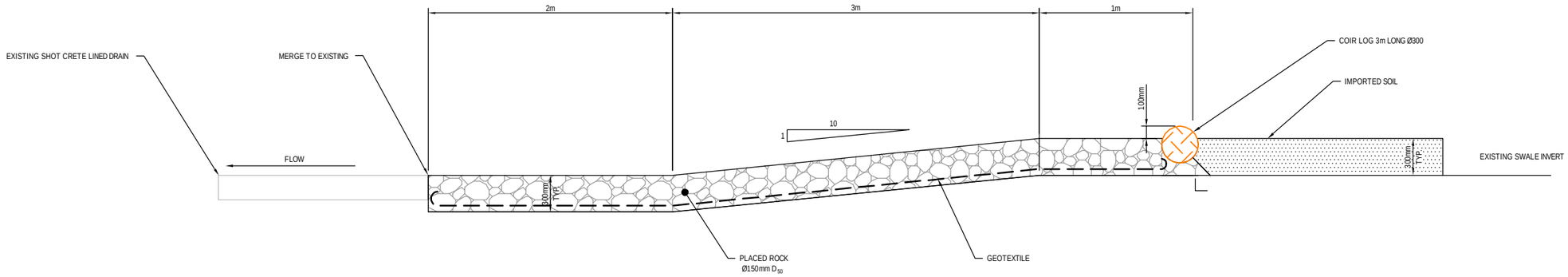

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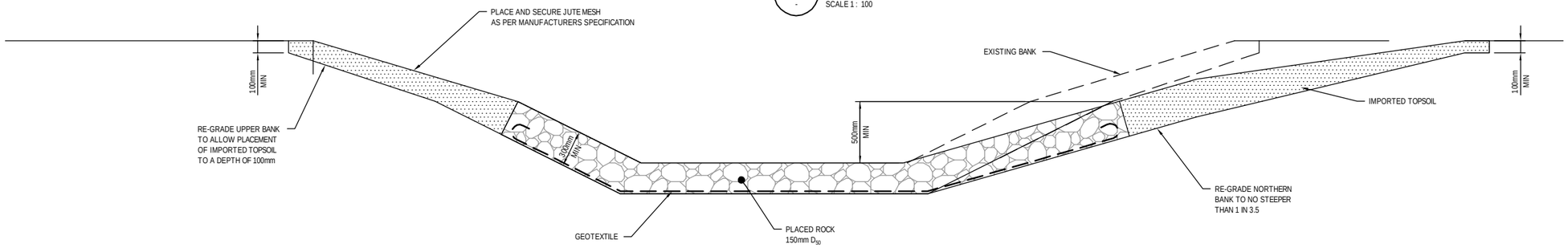

B SECTION

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PRELIMINARY

No	Revision	Drawn	Job Manager	Project Director	Date
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0 0.5 1.0 1.5 2.0 2.5m
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Levels 2 & 3 GHD Tower, 24 Honeysuckle Drive
Newcastle NSW 2300 Australia
T 61 2 4979 9999 F 61 2 4979 9988
E nltmail@ghd.com.au W www.ghd.com.au

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Drafting Check		Design Check	
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Client **LANDCARE AUSTRALIA**
Project **M2 BIOILINK WATER QUALITY IMPROVEMENT WORK**
Title **DETAILS - SHEET 2 OF 2**

Original Size **A1**
Drawing No: 22-18213-C011 **Rev: A**

Plot Date: 26 February 2016 - 3:25 PM Plotted by: Colin Bode Cad File No: G:\22\18213\CADD\Drawings\22-18213-C011.dwg

1. Water quality works materials specifications

The following provides the material specifications for construction of the proposed water quality improvement works at the M2 Biolink site.

1.1 Earthworks

1.1.1 Excavation

The Contractor shall fill or excavate to the levels, slopes and dimensions shown on the drawings.

Material to be excavated shall be excavated by hand, machine or ripping, without the use of jackhammers and / or blasting.

Batter slopes shall be obtained by cut and fill of the existing material on site, where possible. Channel bed and banks shall be shaped to allow rock placement to merge with natural surfaces and the downstream creek invert.

All excavation shall be carried out in accordance with the contractor's Environmental Management Plan, in such a way as to minimise mobilisation of erosion products or silt. Where possible flow diversions shall be utilised to ensure excavation occurs in dry conditions. The contractor must ensure excavations are stable and adequately secure the ground surrounding the excavation against movement

1.1.2 Inspection

All earthworks shall be subject to inspection and approval by the Principal. Relevant landowners and authorities may be present at site inspections. The geotextile fabric (as outlined in section 1.3) shall not be placed until the formation has been formed, compacted and trimmed by the Contractor and approved by the Principal.

1.1.3 Maintenance

Wherever the excavated surface has been displaced by traffic, or has softened or has otherwise deteriorated under the action of ponded water, or has been broken up by drainage channels or by any other cause, the Contractor shall make good the formation by excavating and removing the soil in such places down to a solid foundation and filling with approved material, properly compacted up to the specified level or as directed by the Principal. The Contractor shall not be entitled to any extra payment for making such good.

1.1.4 Stockpiles

In general, stockpiles are to be managed in accordance with the Managing Urban Stormwater: Soils and Construction, 4th ed. (Landcom, 2004). Stockpiles are to be located outside of the watercourse and drainage lines and in areas least susceptible to wind erosion and provide adequate drainage and erosion protection. The contractor shall install temporary silt fences around all subsoil and topsoil stockpiles. Stockpiles shall not exceed 2 metres in height. The contractor shall cover with mulch, anchored fabrics or seeding with rye corn, any stockpiles that it anticipates will remain bare for more than 28 days.

1.1.5 Surplus excavated material

Promptly remove and dispose of excavated material that is not required for reuse. Surplus material is the property of the controlling authority or owner of the excavation sites. Do not dispose of the surplus material without the prior written consent of the site owner, owner's agent, lessee or controlling authority.

1.1.6 Drainage and dewatering

Keep all excavations free of water. Provide, maintain and operate intercepting works to prevent surface water from entering the excavations; and all equipment necessary for dewatering the excavations and keeping the Works free from water.

If foundation soils are disturbed or loosened by the upward seepage of water or an uncontrolled flow of water, the affected areas shall be excavated and replaced with approved granular fill and compacted at the Contractor's cost.

The Contractor shall dispose of water from the work in a suitable manner without damage to adjacent property and the environment. No water shall be drained into the work built or under construction without the prior approval of the Principal's Authorised Person.

Lowering of the water table by well points or other external dewatering methods may only be used if no damage is likely to be caused to adjacent structures and services.

1.2 Erosion and sediment control

1.2.1 General

The Contractor shall install all necessary erosion and sediment control measures, as per the site Soil and Water Management Plan, prior to commencement of works involving clearing and grubbing or other earthworks activities involving disturbance of existing ground surfaces. The Contractor shall take all necessary action to protect batters from erosion during the Contract.

1.2.2 Control measures

A sediment and erosion control plan for temporary control measures required by the Contractor's operations shall be submitted to the Principal for approval within 14 days of award of Contract.

All temporary erosion and sediment control works shall be removed by the Contractor before the end of the Contract maintenance period. All materials used for the temporary erosion and sediment control works shall be removed from the site or otherwise disposed of by the Contractor to the satisfaction of the Principal. The buried portion of silt fencing geofabric may be cut off 50 mm below ground level and left in place. The cost of construction and maintenance of temporary erosion and sediment control measures shall be borne by the Contractor. Maintenance of permanent control measures entrusted into the care and control of the Contractor by the Contract up until the Date of Practical Completion shall be the responsibility of and at the cost of the Contractor.

1.3 Geotextile fabric

The Contractor shall place geotextile fabric on the approved formation as shown on the design drawings, following the methodology outlined below.

The geotextile fabric shall be loosely laid onto the prepared formation with loose folds of cloth allowing for movement of the cloth. Fabric is to be placed from the downstream end with the upstream fabric lapped over the downstream fabric. The top of each section shall be buried (keyed) by creating an excavation not less than 150 mm in depth, backfilled with excavated spoils and compacted with the excavator bucket. Alternative methods may be approved by the Principal.

Joins in the geotextile fabric are to meet the requirements of RTA QA Specification R63 *Geotextiles, Separation and Filtration.* This includes minimum overlaps of 500 mm where large ground deformations are expected. Sewing may be permitted provided that the seam strength is equal to or greater than the specified grab strength. Flat, prayer, J, Double J or butterfly seams are permitted with a minimum number of two parallel rows of stitching required.

The amount of geotextile fabric left exposed at any one time shall be kept to a minimum.

During each stage of construction, the prepared slope shall be kept free of water prior to placement of the geotextile fabric and up until after rock and/or plantings have been placed. The contractor shall make good the formation by excavating and reshaping such places in the event slopes or trenches become affected by water prior to placement of the geotextile fabric. The Contractor shall not be entitled to any extra payment for making such good.

The geotextile fabric shall be BIDIM A49 or equivalent and shall exhibit properties of porosity, permeability, tensile strength and abrasion resistance suitable for the proposed use as part of an erosion control treatment. The geotextile fabric shall comply with Australian Standards *AS 3705 – 2003 Geotextiles- Identification, marking and general data* and any statement of properties shall use the terms described in *AS 3704 – 2005 Geosynthetics- Glossary of terms* and refer to the relevant test methods described in *AS 3706 – 1990 Geotextiles- Methods of Tests*, parts 1 to 13.

1.3.1 Damage to geotextile fabric

The Contractor shall carry out the construction of the rehabilitation treatments in such a manner as to avoid damage to the underlying geotextile fabric. The Contractor shall repair/replace any damaged geotextile fabric (as identified by the Principal).

1.4 Jute Mesh

Jute mesh is to meet the following requirements:

- Jute mesh shall be a uniform, open, plain weave cloth of undyed and unbleached single jute yarn. The yarn shall be of a loosely twisted construction and it shall not vary in thickness more than one-half its normal diameter.
- Jute mesh shall be placed within 48 hours after finish grading or topsoiling of an area is completed.
- The jute mesh shall be placed in a manner that will minimise disturbance of the underlying soil.
- The surface shall be smoothed and all gullies and potholes backfilled prior to applying jute mesh. All rocks or clods larger than two inches in size and all sticks and other foreign material that will prevent contact of the jute mesh with the surface shall be removed.
- Jute mesh shall be placed uniformly, in contact with the underlying soil, at the locations shown on the Drawings. The top edge of each strip shall be anchored by placing a tight

fold of mesh vertically in a 150 mm deep slot or trench in the soil and tamping and stapling in place.

- Jute mesh shall be held in place by wire staples driven vertically into the soil. The mesh shall be fastened at intervals not more than 1 m apart in three rows for each strip of mesh, with one row along each edge and one row alternately spaced in the middle. Edges of adjacent strips shall be overlapped by a 150 mm minimum with a row of staples at a maximum interval of 1 m in the overlapped area. Staples shall be U-shaped and shall be approximately 150 mm long and 25 mm wide.
- Bottom edges shall be lapped 300 mm minimum over the next lower strip, if applicable, or buried as specified for top edges.

Mulch may be used as an alternative to jute mesh following approval from the Principal.

1.5 Rock

Rock shall be placed in layers in an interlocking manner such that they are firmly held in position and not likely to roll down the slope or wash away under high flow conditions.

Rock shall also be selectively placed ensuring gaps between rocks are minimised and voids to sunlight are eliminated. The contractor shall key toe rocks to a minimum of two-thirds diameter into undisturbed material along the length of the rock works.

All rock shall be placed on the batter slope using a hydraulic excavator or grab crane or other similar equipment such that the rocks are firmly in place and minimal disturbance is caused to the filter cloth or underlying rocks and that all WHS requirements are adhered to.

1.5.1 Rock Quality

Individual rocks shall have the following physical properties:

- Rock shall be clean, hard and durable and free from fractures or soft or crumbling material.
- Rock shall be rough and angular (with exception of cut sandstone blocks);
- Rock shall have a minimum dry density of 2,100 kg/m^3;
- Rock shall have a minimum wet unconfined compressive strength of 15 MPa;

1.5.2 Handling

Rock shall be carefully placed by the bucket from a loader or excavator and not be dumped directly from a truck unless otherwise specified.

1.5.3 Rock structure construction

Any proposed alteration to the design of the rock works by the contractor shall be submitted to the Principal for approval. The contractor shall not place any rock until the Principal has approved the newly excavated profile.

Rock structures are to be constructed, to eliminate any significant voids between rocks and to create an interlocking mass of rock so that rocks do not become readily dislodged. The Principal may direct the keying in of the rock be extended so that the edge of the rock surface is flush with the existing bed levels or bank surfaces.

1.6 Concrete

Supply concrete manufactured in compliance with Section SP45 of the Water Services Specification (WS-Spec). WS-Spec is available from Standards Australia.

Supply concrete from plant(s) with third party certified Quality Systems for the manufacture and supply of concrete. Do not use any admixtures in the concrete.

Work shall comply with the Standards listed in Table 1-1.

Table 1-1 Quality system standards

Concrete generally	
AS1379:	Specification and supply of concrete.
AS3600:	Concrete Structures.
AS2758.1:	Aggregates and Rock for Engineering Purposes – Concrete Aggregates.
AS3972:	Portland and blended cement.
Sampling and testing	
AS1012:	Methods of testing concrete.
AS1141:	Methods for sampling and testing aggregates.
Formwork	
AS3610:	Formwork for concrete.

1.6.1 Reinforcement

Supply reinforcement which complies with AS 1302 Steel reinforcing bars for concrete, AS 1303 Steel reinforcing wire for concrete, and/or AS 1304 Welded wire reinforcing fabric for concrete.

1.6.2 Concrete

The following specifications relate to any concrete:

Standards

- Workmanship and materials to comply with AS3600, AS3610, AS1379, AS1478, AS3582, AS5100.5 and AS3972.

Consistency and finish

- Wet concrete to be uniform, homogeneous, cohesive and able to work readily into corners and around reinforcement completely filling formwork without segregation, excess free water on surface, loss of material or contamination.
- Concrete to have good dimensional stability and able to resist plastic settlement cracking, thermal cracking and shrinkage cracking.
- Finished concrete to be a durable, dense, homogeneous mass completely filling formwork, embedding reinforcement and tendons, and free of stone pockets, of uniform colour and texture, with low permeability and adequate but not excessive strength for grade.

Quality

- Quality of concrete elements are outlined in Table 1-2.

Table 1-2 Concrete quality

Structural element	Flowable concrete
Exposure Classification	B1
Strength Grade (MPa)	N20
Transfer Strength FCP (MPa)	-
Minimum Density (kg/m3):	2350
Max. Aggregate Size (mm):	20
Max./Peak In-situ Concrete Temperature (ºC)	65
Cement Type	General Blend (GB)
Supplementary Cementitious Material	Minimum 10% of cement content
Maximum Water/Cementitious ratio	0.45
Max. 56 Day Drying Shrinkage	800 X 10-6
Required Additives	Superplasticiser

Additives

- Supplementary cementitious materials include silica fume, fly ash, and ground granulated blast furnace slag.
- Slump to be as required for placement (e.g. pumping), compaction and finishing. Use superplasticisers and high range water reducers to AS1478 to achieve adequate workability.
- Maximum sulphate content of concrete to be less than 5% by mass of acid soluble SO_3 as a percentage of cementitious material.
- Use cementitious materials less than six months old. Use bagged cement in order of receipt.
- For general blended cement (GB) containing ordinary Portland cement plus at least 5% supplementary cementitious materials:
  - Silica fume to be less than 10%.
  - Flyash to be less than 25%.
  - Ground granulated blast furnace slag to be less than 40%.
- For double blended cement total supplementary cementitious material must be less than smaller of percentages given above for constituents included.
- For triple blended cement total supplementary cementitious material must be less than 40%.
- Supplementary cementitious materials specified in table above are in addition to materials incorporated in GB cement.
- Admixtures to comply with AS1478.
  - Admixtures must not reduce strength of concrete below specified value.

  - Use admixtures in accordance with manufacturer's recommendations.
  - Concrete additives shall not enhance corrosion of reinforcement, nor be detrimental to concrete or steel during expected life of structure.
  - Do not use chemical admixtures or other materials without Principal's written approval.
- Do not use calcium chloride. Maximum acid soluble chloride ion content of concrete to be less than 0.15% by mass of cementitious material.
- Do not use strongly ionized salts.

Handling and placement

- Do not add water to concrete after truck has left batching plant.
- Mix concrete to ensure uniform distribution of constituents.
- Remove free water, dust and debris, stains etc. from forms, excavations etc. before placing concrete.
- In hot conditions dampen formwork and/or sub-grade before placing concrete.
- Elapsed time between wetting of mix and discharge of concrete at site must be as short as possible, and comply with times outlined in Table 1-3.

Table 1-3 Concrete discharge times

Concrete temperate at time of discharge (˚C)	Maximum elapsed time (hours)
10 – 24	2.00
24 – 27	1.50
27 - 30	1.00
30 - 32	0.75
>32	No discharge

- Use placement methods that will minimise plastic settlement and shrinkage cracking.
  - Limit vertical free fall by use of chutes etc.
  - Keep chutes vertical, full and immersed in concrete.
  - Place concrete in layers and blend succeeding layers by compaction.
  - Maintain concrete edge in a plastic state.
  - Properly compact concrete using mechanical vibrators (and hand methods if required) to remove air bubbles and give maximum compaction without segregation of concrete.
  - Take care to avoid contact between vibrators and partially hardened concrete, formwork or reinforcement.
  - Do not use vibrators to move concrete along forms.
- In cold weather maintain temperature of freshly mixed concrete within limits shown below.
  - "Outdoor" air temperature is air temperature at time of mixing, or predicted or likely air temperature during next 48 hours.

- Before and while placing concrete maintain temperature of formwork and reinforcement at > 5°C.
- Do not use calcium chloride, salts, chemicals or other material in mix to lower the freezing point of concrete.
- Do not allow frozen materials to enter mixer.
- Do not use high alumina cement.

- Keep forms, materials, equipment in contact with concrete free of frost and ice.
  - Heat concrete materials (other than cement) to minimum temperature necessary to ensure temperature of placed concrete is within limits specified.
  - Maximum water temperature: 60°C when placed in mixer.
- In hot weather prevent premature stiffening of fresh concrete, reduce water absorption and evaporation losses.
- Mix, transport, place and compact concrete as quickly as possible. During placement temperature of concrete must not exceed temperatures outlined in Table 1-4 and
- Table 1-5.

Table 1-4 Concrete/environment temperatures

Outdoor Air Temperature	Temperature of Concrete	
	Minimum	Maximum
>5 C	10 C	32 C
<5 C	18 C	32 C

Table 1-5 Concrete placement temperatures

Concrete Element	Temperature Limit
Unreinforced Concrete in Sections- 1m each dimension	27 C
Concrete f'c ≥ 40 MPa in Sections ≥ 500 mm Thickness	27 C
Concrete in Footings, beams, columns, walls and slabs f'c ≥ 32 MPa	32 C
Elsewhere	32 C

- Do not mix concrete when surrounding outdoor shade temperature ≥ 32°C.
  - Maintain temperature of formwork and reinforcement at ≤ 32°C before and during placing.
  - Maintain specified temperature of placed concrete by:
    - Cool concrete using liquid nitrogen injection before placing, or
    - Cover container in which concrete is transported to forms, or
    - Spray coarse aggregate using cold water, or
    - Use chilled mixing water.
- Protect fresh concrete from premature drying - particularly in hot, windy or dry (low humidity) conditions, excessively hot or cold temperatures, rain, etc.

  - Provide wind breaks.
  - Maintain concrete at a reasonably constant temperature with minimum moisture loss for curing period.
- For concrete with water: cement ratio less than 0.5, in hot, windy or dry (low humidity) conditions spray exposed surfaces of fresh concrete with fog spray application of aliphatic alcohol retardant immediately after placement to reduce risk of plastic shrinkage cracking. In severe climatic conditions consider revibrating concrete before it reaches initial set.

Curing

- Commence curing of concrete to AS3600 as soon as possible after placing and finishing or stripping, and within one hour.
  - Ensure exposed surfaces are not stained.
  - Acceptable methods of curing include:
    - Retention of formwork.
    - Ponding or continuous sprinkling with water (moist curing).
    - An impermeable membrane (use white or light coloured plastic in hot conditions). Seal around edges.
    - An absorptive cover kept continuously wet and covered by impermeable membrane.
    - Steam curing.
    - An approved curing compound. Provide:
      - Efficiency index.
      - Certified test results for water retention to AS3799 appendix B.
      - Evidence that an acceptable final surface colour will be obtained.
      - Evidence of compatibility with concrete and applied finishes (if any).
      - Methods of obtaining required adhesion for toppings, render etc.
      - Uniform continuous flexible coating without visible breaks or pinholes, which remains unbroken for at least the curing period after application.
- Do not use wax-based or chlorinated rubber-based curing compounds on surfaces forming substrates to applied finishes, concrete toppings and cement based render.
- Cure continuously until number of days during which air temperature is above 10°C totals:
  - 3 days for exposures classification A1 and A2
  - 7 days for exposure classification B1, B2 and C.
- Prevent rapid drying out at end of curing period.

Records

- Keep on site a log book recording each placement of concrete including date, climatic conditions, portion of work, specified grade and source of concrete, delivery docket data, methods of placement and compaction, project assessment carried out, slump measurements, volume and other notable matters.

1.7 Cast in items

All anchor bolts and fastenings cast in concrete shall be Stainless Steel Grade 316 to AS 2837 unless otherwise shown on the Drawings.

1.8 Steelwork

Use Grade 250 steel in accordance with AS/NZS 3678, and AS/NZS 3679. Fabricate in accordance with AS 4100. Round all cut edges to 2 mm radius.

Except where otherwise noted on the Drawings, hot dip galvanise all steelwork in accordance with AS 1650. Do not weld galvanised components after galvanising.

Prior to galvanising, clean the steelwork surface of all dirt, weld spatter, grease, slag, oil, paint or other deleterious matter and chemically descale in accordance with AS 1627 Part 5, or abrasive blast clean in accordance with AS 1627 Part 4 to Class 3 standard.

The zinc coating shall consist of a uniform layer of commercially pure zinc free from abrasion, cracks, blisters, chemical spots or other imperfections and shall adhere firmly to the surface of the steel. The thickness of zinc coating shall not be less than 100 microns at any point.

Any surface damage to the galvanising shall be shot or grit blasted clean and given two coats of Amercoat No 62 primer. Apply the second coat after the first coat is touch dry and within twenty-four hours of application of the first coat.

Where site welding of galvanised steelwork has been approved, the resulting weldment is to be chipped and cleaned to bare metal and painted with Galment zinc enriched paint.

Appendix G

ISEPP Consultation Communications

The Hills Motorway Limited: ABN 28 062 329 828
Registered Address: Level 3 505 Little Collins Street, Melbourne, Vic, 3000.
1 Tollaust Lane (off Culloden Rd) North Ryde

Hills Motorway Management Limited: ABN 89 064 687 645
Locked Bag 2215, North Ryde BC, NSW, 1670
T: 1800 196 266 **E:** hillsm2@transurban.com **W:** hillsm2.com.au

10 June 2016
Ref: CR-M2-O0377

Daniel Noaeen
Delivery and Operations NSW / VIC
Transurban
Level 9, 1 Chifley Square
Sydney NSW 2000
Australia

Harry Muker
Ryde City Council
Locked Bag 2069
North Ryde NSW 1670

Dear Harry,

Notification regarding proposed M2 Macquarie Park Motorscapes Project

The Hills M2 Motorway would like to formally notify the Ryde City Council of the proposal known as the M2 Macquarie Park Motorscapes Project in accordance with the State Environmental Planning Policy (Infrastructure) 2007 (the ISEPP). On behalf of Roads and Maritime, Transurban is responsible for the work pursuant to their lease of the site.

The proposal includes the following activities:

- Preparation of project safety, traffic and environmental documentation.
- Creation of site access from the M2 Motorway and an alternative foot and temporary construction equipment access point from Leisure Close across Dunholm Reserve.
- Construction of a box culvert to allow construction vehicles to cross the existing swale drain that runs parallel to the M2 Motorway boundary.
- Establishment of internal traffic haulage routes, environmental controls, laydown areas and site compound facilities.
- Control of noxious weed species including removal and disposal off-site (or mulching and burial on site).
- Revetment work to Shrimptons Creek and Industrial Creek.
- Installation of gross pollutant traps at Shrimptons Creek and Industrial Creek.
- Rehabilitation of the existing swale drain that adjoins the M2 Motorway boundary.
- Modification work to the existing water quality basin.
- Importing of clean topsoil associated with the revegetation and VENM for soil re-profiling, access tracks, etc.
- Revegetation of the site with native species as per a Landcare Vegetation Management Plan.
- Earthworks associated with an art installation.
- Replacement of road signage and road barriers.
- Demobilisation.
- Ongoing weed management measures including long term maintenance and monitoring activities.

A Review of Environmental Factors (REF) is currently being prepared in accordance with Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

In regard to clause 13 of the ISEPP, the proposal would impact on Ryde City Council infrastructure where site access is required from Leisure Close via Dunholm Reserve. Access would be required for around 53 days for both pedestrian and construction equipment. It is proposed to install temporary track mats in Dunholm Reserve for the construction period to minimise impact to the environment. The temporary removal of the existing pedestrian gates and replacement with vehicle access gates at Leisure Close to Dunholm Reserve is also proposed. The site, including pedestrian gates, would be restored to current or better condition as part of the project demobilisation process.

The proposal would have a minor temporary impact on street parking in Leisure Close. A maximum of three cars driven by construction workers would require the use of exsiting street parking for around 53 days, associated with the site access arrangement described above. It is not anticipated that this activity would strain the capacity of the road system in the local area.

In regard to clause 15 of the ISEPP, the Ryde Local Environmental Plan 2014 Flooding Map does not indicate that the proposal site is located on flood-liable land. Modelling has shown some sections of the site around Industrial and Shrimptons Creeks are flood-liable. The impact of the proposal has been assessed and it is not anticipated that the flood patterns in and around the site would change by more than a minor extent.

The current proposed commencement date of the proposal is June 2016, with completion by December 2017. The proposed works are expected to be undertaken during normal working hours outside peak periods, and it may be necessary to undertake work outside standard hours.

As part of the proposal, stakeholder and community consultation would occur as required.

To ensure all potential issues are addressed, it would be appreciated if you could provide any comments regarding this proposal to the undersigned within 24 days from the date of this letter. Any response from Council within that period will be considered by Transurban in its environmental assessment (REF) of this proposal.

Should you require further information, please do not hesitate to contact Daniel Noaeen on 0405231143.

Yours sincerely,

Domenico De Conti

Asset Manager Hills M2

The Hills Motorway Limited: ABN 28 062 329 828
Registered Address: Level 3 505 Little Collins Street, Melbourne, Vic, 3000.
1 Tollaust Lane (off Culloden Rd) North Ryde

Hills Motorway Management Limited: ABN 89 064 687 645
Locked Bag 2215, North Ryde BC, NSW, 1670
T: 1800 196 266 **E:** hillsm2@transurban.com **W:** hillsm2.com.au

28 April 2016 ~~2015~~
Ref: CR-M2-O0375

Daniel Noaeen
Delivery and Operations NSW / VIC
Transurban
Level 9, 1 Chifley Square
Sydney NSW 2000
Australia

Matt Springall
Senior Field Officer (Bush Regeneration)
Lane Cove National Park
PO Box 3009, West Lindfield NSW 2070

Dear Matt,

ISEPP Notification regarding proposed M2 Macquarie Park Motorscapes Project

Following on from our previous discussions, The Hills Motorway Limited (**THML**) would like to formally notify the National Parks and Wildlife Service (**NPWS**) of the proposal known as the M2 Macquarie Park Motorscapes Project.

Under clause 16 of the State Environmental Planning Policy (Infrastructure) 2007, THML are required to notify the NPWS of proposed work that would be undertaken adjacent to Lane Cove National Park, which is land reserved under the under the *National Parks and Wildlife Act 1974*.

The proposal includes the following activities:

- Preparation of project safety, traffic and environmental documentation.
- Creation of site access from the M2 Motorway and an alternative foot access point from Leisture Close.
- Construction of a culvert to allow construction vehicles to cross the existing swale drain that runs parallel to the M2 Motorway.
- Establishment of internal traffic haulage routes, environmental controls, laydown areas and site compound facilities.
- Control of noxious weed species including removal and disposal off-site (or mulching and burial on site).
- Revetment work to Shrimptons Creek and Industrial Creek.
- Installation of gross pollutant traps at Shrimptons Creek and Industrial Creek.
- Rehabilitation of the existing swale drain that adjoins the M2 Motorway boundary.
- Importing clean topsoil associated with the revegetation and VENM for soil re-profiling, access tracks, etc.
- Revegetation of the site with native species as per a Landcare Australia Vegetation Management Plan.
- Associated earthworks.
- Replacement of road signage and road barriers.
- Demobilisation.
- Ongoing weed management measures including long term maintenance and monitoring activities.

The current proposed commencement date of the proposal would be June 2016, to be completed by December 2017. The proposal is expected to be undertaken during normal working hours outside peak periods, and it may be necessary to undertake work outside standard hours.

As part of the proposal, stakeholder and community consultation would also occur as required.

To ensure all potential issues are addressed, it would be appreciated if you could provide any comments regarding this proposal to the undersigned within 21 days from the date of this letter. Any response from NPWS within that period will be considered by THML in its environmental assessment (Review of Environmental Factors) of this proposal.

Should you require further information, please do not hesitate to contact Daniel Noaeen on 0405 231 143.

Yours sincerely,

PP

Domenico De Conti
Asset Manager Hills M2

Office of Environment & Heritage
NSW National Parks & Wildlife Service

Guidelines for developments adjoining land managed by the Office of Environment and Heritage

Published by:

Office of Environment and Heritage
59–61 Goulburn Street
Sydney
PO Box A290
Sydney South 1232

Phone: 131555 (NSW only – publication and information requests)
(02) 9995 5000 (switchboard)
1300 361 967 (national parks information requests)
Fax: (02) 9995 5999
TTY/voice: 133 677
Speak & listen: 1300 555 727
Email: info@environment.nsw.gov.au
Website: www.environment.nsw.gov.au

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Contents

1 Introduction

These guidelines have been prepared for use by councils and other planning authorities when they assess development applications that may impact on land and water bodies managed by the Office of Environment and Heritage (OEH).

The National Parks and Wildlife Service (NPWS) is part of OEH. NPWS is directly or jointly responsible for managing a wide range of lands acquired, reserved or dedicated under the *National Parks and Wildlife Act 1974* (NPW Act). These include:

- national parks
- historic sites
- nature reserves
- Aboriginal areas
- karst conservation areas
- regional parks
- state conservation areas.

Approximately 30% of these lands are also declared wilderness areas under the *Wilderness Act 1987*. Some of these parks are in World Heritage areas or on the National Heritage Register or State Heritage Register.

These areas of land are referred to as the conservation reserve system or protected areas. In this document, OEH land or land managed by OEH is used as an abbreviated reference to the full spectrum of reserves, including terrestrial and aquatic areas.

OEH recognises the benefits of working in partnership with planning authorities to ensure that developments adjoining parks and reserves are sympathetic to the values of those areas. The issues and approaches outlined in these guidelines are provided to assist planning authorities in their decision-making.

OEH also provides support services to the Botanic Gardens Trust. The Trust is responsible for management of the three botanic gardens in the greater Sydney area – Royal Botanic Gardens Sydney and Domain, Blue Mountains Botanic Garden (Mount Tomah) and Australian Botanic Garden (Mount Annan). These guidelines recognise the unique nature and management objectives applying to the botanic gardens and provide key contacts for consultation regarding the potential impacts of development proposals.

For developments in proximity to, or that may impact on marine parks or aquatic reserves, guidance and advice should be sought from the Department of Primary Industries[1].

1.1 Values of OEH land

Land managed by OEH includes unique, biologically diverse and culturally significant areas in NSW and Australia. It plays an important role in protecting native flora and fauna (including threatened species, migratory fauna and endangered ecological communities) and natural features (such as wetlands, estuaries and caves). It also provides protection for natural and cultural landscapes that support Aboriginal sites, cultural heritage values and non-indigenous heritage. Direct benefits of reserved land are provided to the community through opportunities for recreation, education and scientific research, and the services that land provides in the form of clean water, amenity and tourism.

[1] http://www.dpi.nsw.gov.au/fisheries

1.2 Applying the guidelines

The goal of these guidelines is to guide consent and planning authorities when assessing development applications that adjoin land managed by OEH. The aim of this advice is to avoid and minimise any direct or indirect adverse impacts on this land.

The guidelines will also be of assistance to planning authorities in the development of environmental planning instruments (such as local environmental plans) applying to land adjoining, or in the vicinity of, land managed by OEH.

Councils and other consent authorities need to consider the following issues when assessing proposals adjoining OEH land and, in particular, their impacts:

- erosion and sediment control
- stormwater runoff
- wastewater
- management implications relating to pests, weeds and edge effects
- fire and the location of asset protection zones
- boundary encroachments and access through OEH lands
- visual, odour, noise, vibration, air quality and amenity impacts
- threats to ecological connectivity and groundwater dependent ecosystems
- cultural heritage.

For each of these issues, the guidelines identify the key risks to OEH land and a recommended approach for consideration by planning authorities. The potential for cumulative impacts from developments along the boundaries of OEH land should be considered as part of case-by-case assessments.

There are also specific legislative requirements for development in the locality of wild rivers declared under the NPW Act. These requirements, which may include consultation with the Minister for the Environment, are discussed below.

While every effort has been made to ensure that these guidelines are as comprehensive as possible, it is acknowledged that they cannot foresee every possible circumstance or proposed development that may adjoin OEH land. Nevertheless, where unique or unusual circumstances arise, the main priority should still be to avoid and then minimise any direct or indirect adverse impacts on land managed by OEH.

2 Issues to be considered when assessing proposals adjoining OEH land

2.1 Erosion and sediment control

Aim

To prevent erosion and the movement of sediment onto OEH land, and ensure no detrimental change to hydrological regimes.

Risks to OEH land

Removal of vegetation and disturbance of groundcover from construction activities will expose the soil and increase the risk of erosion. Eroded sediments, including those from soil stockpiles, may be transported downstream or down slope and deposited on vegetation and in creeks, rivers, wetlands and other aquatic habitats.

Changes to the hydrology of streams outside the reserve system, including from activities on land that may not immediately adjoin reserves, can impact on land managed by OEH by:

- increasing the intensity and frequency of flows as a result of clearing vegetation
- increasing the area of impermeable surfaces.

These changes can result in damage (sometimes permanent) to downstream aquatic habitats by scouring the bed and banks of watercourses, altering water quality and smothering sensitive areas (such as seagrass beds). Coastal lakes, which may intermittently be closed, are particularly susceptible to increased sedimentation. OEH manages a number of coastal lakes such as those in Myall Lakes and Jervis Bay national parks.

Developments may also direct flows to a single discharge point thereby increasing erosion potential downstream. Some developments may interrupt natural flows.

Erosion can affect the landscape values assigned to a location by Aboriginal people and impact on any Aboriginal objects present through the removal and subsequent displacement of sediments. Changes to an Aboriginal site caused by erosion will affect the site's setting in the landscape which is important to Aboriginal people. The setting of a place is often as important as the objects the place may contain.

Furthermore, erosion can affect any Aboriginal objects, including stone objects, shells and rock art, that may be present. It can expose objects to increased weathering and other impacts, resulting in a greater chance of displacement from the original location. Sediment accumulation over Aboriginal objects can also result in further damage if the objects are in contact with acidic soils.

Many national parks also support significant historic heritage, including archaeological relics, convict-built roads, cemeteries, buildings and bridges, which is vulnerable to the impacts of erosion.

Recommended approach

Appropriate erosion and sedimentation control measures should be implemented prior to works commencing and maintained for the duration of construction and until soil is stabilised after construction. In some cases it will be necessary to prepare detailed sediment and erosion control plans (soil and water management plans) for the proposed development.

As general erosion and sediment control measures, OEH recommends that:

- clearance of native vegetation be kept to a minimum
- areas of vegetation be fenced off during construction
- areas of bare soil and stockpiles be managed to prevent erosion during the construction process
- disturbed areas are rehabilitated and appropriately stabilised as soon as possible following construction (this includes removal of control measures, such as sediment fences, when they are no longer required).

To prevent sediment moving from an adjacent property onto OEH land and to avoid and minimise erosion risks, OEH also recommends that appropriate controls should be applied in accordance with the following guidance documents:

- *Erosion and sediment control on unsealed roads* (OEH 2012)[2]
- *Managing Urban Stormwater – Soils and Construction, Volume I* (Landcom 2004)[3]
- *Managing Urban Stormwater – Soils and Construction, Volume II* (DECC 2008)[4]
- *A Resource Guide for Local Councils: Erosion and Sediment Control* (DEC 2006).[5]

2.2 Stormwater runoff

Aim

Nutrient levels are minimised, and stormwater flow regimes and patterns mimic natural levels before it reaches OEH land.

Risks to OEH land

The discharge of stormwater to OEH land poses a threat to the values of land and downstream environments by:

- dispersing litter and pest species (especially weeds)
- altering nutrient composition and pollutant levels, which can damage native vegetation and aquatic ecosystems, reduce water recreation safety and promote weed growth
- causing potential erosion and sedimentation in watercourses, particularly where new developments have led to an increased volume and concentration of flow
- impacting on Aboriginal sites, which are frequently located close to watercourses, and historic heritage.

These potential impacts, which are also cumulative, have a range of implications for the management of OEH land. They pose serious risks to the protection of park values and assets, and to catchment ecological health.

These risks are recognised in provisions in the National Parks and Wildlife Regulation 2009 which requires the consent of OEH to discharge stormwater into a park (for example, where a development proposes new infrastructure that alters stormwater flows and directs them into a park). In addition, State Environmental Planning Policy 71 – Coastal Protection provides that untreated stormwater may not be discharged into certain coastal lakes and other areas.

Information and support is available to deal with diffuse source pollution associated with stormwater, including a tool developed by OEH to estimated changes in pollutant loads resulting from land-use changes.[6]

[2] http://www.environment.nsw.gov.au/Stormwater/ESCtrlUnsealedRds.htm
[3] www.landcom.com.au/whats-new/publications-reports/the-blue-book.aspx
[4] www.environment.nsw.gov.au/stormwater/publications.htm
[5] www.environment.nsw.gov.au/stormwater/publications.htm
[6] www.environment.nsw.gov.au/water/dswpoll.htm

Recommended approach

- Development proposals for areas adjacent to OEH land should incorporate stormwater detention and water quality systems (with appropriately managed buffer areas) ***within*** the development site.
- Stormwater should be diverted to council stormwater systems or to infiltration and subsurface discharge systems ***within*** the development site.
- The discharge of stormwater to OEH land, where the quantity and quality of stormwater differs from natural levels, must be avoided.

Infrastructure associated with stormwater treatment must ***not*** be located on OEH land and any stormwater outlets should disperse the flow at pre-development levels. Landowners and development proponents are responsible for ensuring that all tanks, storage areas and associated infrastructure are appropriately sized and maintained to ensure that there is no unauthorised overflow onto OEH land.

OEH acknowledges that in some limited and exceptional cases it may not be possible to avoid the discharge of stormwater from development sites onto OEH land. In these cases OEH may be willing to grant an approval to allow the discharge of stormwater onto OEH land. Such an approval will only be granted where it can be clearly shown to be in the best overall interests of the environment (for example, by addressing existing impacts from unmanaged stormwater). The final decision rests solely with OEH.

Any person seeking approval to discharge stormwater onto OEH land should provide a written request to the relevant NPWS Regional Office containing detailed information on the proposal which should include:

- current stormwater flows (volume and quality) emanating from the adjoining property into OEH land, including existing undeveloped and developed areas
- current stormwater management arrangements (if any)
- identification of any existing impacts on the land as a result of stormwater from the property (including erosion, sedimentation, weeds and tree dieback)
- proposed changes to stormwater related to the development where the following stormwater management standards should be met:
  - for subdivisions, multi-unit dwellings, commercial and industrial development:
    - no increase in pre-development peak flows from rainfall events with a 1 in 5 year and 1 in 100 year recurrence interval
    - no increase in the natural annual average load of nutrients and sediments
    - no increase in the natural average annual runoff volume.
  - for single residential dwellings or small developments on highly constrained lots:
    - standard local council discharge requirements and best practice stormwater treatment to reduce nutrient and sediment loads and average annual runoff volumes to pre-development levels.
- likely impacts from those changes to OEH land
- clear explanation of the reasons why stormwater discharge is considered unavoidable
- an explanation of the overall environmental benefits to OEH land from the proposed stormwater management system.

In considering any requests to allow stormwater discharge, OEH may also require the proponent to submit an environmental impact assessment to meet relevant requirements of Part 5 of the *Environmental Planning and Assessment Act 1979*.

Councils and other planning authorities should ***not*** grant approvals that involve the discharge of stormwater to OEH land or include conditions requiring such an outcome from OEH.

Where new stormwater infrastructure may discharge into marine parks or aquatic reserves, planning authorities should consult with the Department of Primary Industries.

2.3 Wastewater

Aim

There are no adverse impacts on OEH land due to wastewater from adjacent development.

Risks to OEH land

Some new developments, particularly in remote or rural areas, do not have access to mains sewerage systems. In these cases other options for sewage disposal are required, including septic tanks and composting toilets. Some developments (such as horticultural or turf industries) may propose to undertake effluent irrigation or the discharge of other types of wastewater into the environment.

If wastewater disposal systems are not designed, installed, operated and maintained correctly they can pose significant risks to OEH land. These risks are similar to the risks from stormwater runoff, although the degree of risk is relatively greater given the nature of waste products involved and the potential impacts to ecosystem and human health.

Recommended approach

In considering proposals involving wastewater disposal, including sewage management, consent authorities should ensure that disposal systems will be designed and operated to the highest standards. This will require consideration of compliance measures that will be used to ensure ongoing satisfactory operation of the systems.

With the exception of facilities that are directly related to the provision of park visitor or management facilities, wastewater management infrastructure must ***not*** be located on OEH land. In addition (with the same exception), there must be no discharge of wastewater to OEH land, including nutrient or pathogen export from effluent disposal areas.

OEH recommends that planning authorities refer to the following information when considering proposals involving wastewater management:

- *Environment and Health Protection Guidelines: On-site Sewage Management for Single Households* (Department of Local Government 1998)
- *Environmental Guidelines: Use of effluent by irrigation*[7] (DEC 2004)
- water quality.[8]

2.4 Management implications relating to pests, weeds and edge effects

Aim

Adjoining development does not:

- lead to increased impacts from invasive species (weeds and pests), domestic pets and stock

[7] www.environment.nsw.gov.au/resources/water/effguide.pdf
[8] http://www.environment.nsw.gov.au/water/waterqual.htm

- facilitate unmanaged visitation, including informal tracks, resulting in negative impacts on cultural or natural heritage values
- lead to impacts associated with changes to the nature of the vegetation surrounding the reserve
- impede OEH access for management purposes, including inappropriate fencing.

Risks to OEH land

Development adjoining OEH land has the potential to significantly affect the operation or management of OEH land, resulting in damage to conservation values and cost implications for future management. Development may result in:

- increased informal and inappropriate access (such as by trail-bike riders)
- increase in invasive species and decline in biodiversity and ecosystem health (such as dieback)
- impacts on areas of particular environmental sensitivity, including Aboriginal and historic heritage sites, watercourses and threatened species habitat
- disturbance and predation by domestic pets or stock animals.

Clearing of vegetation (including aquatic vegetation) along or near the boundary of OEH land can lead to edge effects such as:

- increased drying of soils and consequent changes to vegetation at the land boundary
- decline in fauna species that are sensitive to changes in vegetation along newly created edges
- increased predation in the vicinity of the OEH land boundary associated with aggressive species in open situations (such as nest predation by ravens and currawongs).

OEH encourages and supports the sustainable management and development of adjoining land, particularly where it is sympathetic to the protection of conservation values in parks and reserves. The Conservation Partners Program[9] provides support for landowners interested in voluntarily protecting the conservation values of their land, and the Backyard Buddies[10] program provides advice on how to attract and maintain native animals and plants.

OEH also works with adjoining neighbours and other authorities to undertake strategic pest management programs. Regional Pest Management Strategies focus efforts on the highest priority pest species across OEH lands.[11]

Recommended approach

In assessing proposals, consent authorities should consider the types of impacts associated with development adjoining land managed by OEH. OEH considers that site layout and design should seek to avoid and then minimise and mitigate any adverse environmental impacts.

The management of companion animals, such as cats and dogs, and stock is a particular challenge for developments adjoining OEH land. OEH recommends that planning authorities investigate all available options for minimising the risks from domestic pets and stock that may arise from new development. This includes educational tools (such as signage),

[9] www.environment.nsw.gov.au/cpp/ConservationPartners.htm
[10] www.backyardbuddies.net.au/
[11] http://www.environment.nsw.gov.au/pestsweeds/regionPestManagement.htm

compliance (such as regular council patrols), physical controls (such as fencing), and other options (such as restrictive covenants where legally possible).

Adjoining developments should not compromise public and OEH staff access to OEH land. For proposals involving boundary fencing, OEH has established policies and procedures to guide the choice of suitable fencing and cost-sharing arrangements. Consent authorities should refer development proponents to the *Boundary Fencing Policy*.[12]

OEH also encourages consideration of an appropriate buffer, vegetated where possible, or set-back between any development and OEH land. Where managed effectively, a buffer may minimise the impact to the natural and cultural values of OEH land, and increase the resilience of the area to counter potential impacts of climate change. Given the differences between sites and development types, it is not possible to specify a standard buffer; each development will need to be assessed on its merits. Developments that are designed to be sympathetic to adjoining lands, and to integrate with the landscape, are likely to require less need for buffers or set-backs.

Where there is no buffer, consideration should be given to developing appropriate conditions or land management practices that minimise the potential edge effects from development. This might mean requiring the retention of areas of vegetation, siting a building back from an OEH boundary, or recommending a suitable boundary fence to contain domestic pets or stock animals. As noted above, OEH operates a number of programs that can assist and support landowners.

OEH acknowledges that in some situations clearing of vegetation on neighbouring land is required to manage risks associated with bushfire. OEH nevertheless recommends the retention of existing native vegetation where appropriate.

2.5 Fire and the location of asset protection zones

Aim

All asset protection measures are within the development area, and there is no expectation for OEH to change its fire management regime for the land it manages.

Risks to OEH land

OEH recognises fire as a natural and recurring factor which shapes the environment. However, it also acknowledges that altered fire regimes may pose a significant threat to life, property and other values including biodiversity, cultural heritage and tourism, and that the onset of climate change may exacerbate these risks. Fire management is one of the most important tasks in managing protected areas.

Recommended approach

For any proposals adjoining OEH land, consent authorities need to undertake an assessment of the fire risk in accordance with the bushfire guidelines.[13] The assessment should address appropriate fire management practices for the area. Councils should also ensure that the provisions of the *Rural Fires Act 1997* are implemented in the area proposed for development, and further consultation with the NSW Rural Fire Service may be required.

[12] www.environment.nsw.gov.au/policies/BoundaryFencing.htm
[13] *Planning for Bushfire Protection,* NSW Rural Fire Service 2006

While the bushfire guidelines note that asset protection zones can be located beyond property boundaries in certain 'exceptional circumstances', they also acknowledge that easements for bushfire protection should not be considered where the adjoining land is used for a public purpose where vegetation management is not likely or cannot be legally granted, for example in a national park. This means that asset protection zones should be provided in the development site and not extend into OEH land or rely on actions being undertaken by OEH. Appropriately designed fire protection zones and fire-fighting access tracks should be located on the land where development is proposed.

Fencing to be erected between the boundary of the property and OEH land should be of non-combustible material and designed for the intended purpose (for example, stock exclusion). Factors such as disruption to wildlife movements and impacts on fire suppression activities (including the ability of fire-fighting personnel to safely evacuate an area) should always be taken into account. Further information is provided in OEH's *Boundary Fencing Policy*.[14]

Councils and other planning authorities should not grant approvals that involve the undertaking of bush fire hazard reduction works within OEH land, including the establishment of asset protection zones, or include conditions requiring such an outcome.

2.6 Boundary encroachments and access through OEH land

Aim

No pre-construction, construction or post-construction activity occurs on land managed by OEH. Any access that does occur must be legally authorised and comply with park management objectives.

Risks to OEH land

Unauthorised access to OEH land can have direct physical impacts on the conservation values of parks, such as those due to the removal of vegetation, erosion and soil disturbance. If such access continues or other encroachments occur (such as the construction of buildings, car-parks or roads) this can have long-term implications affecting park planning, park management (for example fire protection) and public use and enjoyment.

Recommended approach

Consent authorities should ensure that where land involved in a proposal shares a common boundary with OEH land the boundary has been accurately surveyed to ensure there is no encroachment on OEH land as a result of the proposed development.

OEH land is ***not*** to be used:

- to access development sites
- to store materials, equipment, workers' vehicles or machinery
- for maintenance access after development.

Measures, such as temporary fencing of 'no-go' areas during construction or installation of permanent, wildlife-compatible fencing should be considered, and will require OEH approval if they are proposed to be located along the site boundary.

[14] www.environment.nsw.gov.au/policies/BoundaryFencing.htm

In addition, where ongoing access to the development site requires access through OEH land, the consent authority should ensure that there is a legal basis for such access prior to granting an approval. Consent authorities should specifically consider whether:

- access will be via an existing public access road
- access has been, or will be, granted by OEH including any conditions or limitations on such access (such as road widths) if there is no existing public access road
- there are any statutory limits on the use of the access roads in national parks that have been created by legislation related to Regional Forest Agreements.[15]

Councils and other planning authorities should not grant approvals that involve access through or across OEH land, or include conditions requiring such access, without clear written evidence of an agreement from OEH.

2.7 Visual, odour, noise, vibration, air quality and amenity impacts

Aim

There is no reduction of amenity on OEH land due to adjacent development.

Risks to OEH land

These impacts may particularly affect native fauna species (for example, noise, vibration and lighting may disrupt foraging and breeding habits). They may also adversely affect the use and public enjoyment of walking trails, camping and picnic areas.

Recommended approach

Planning authorities should take into account the visual (including lighting), noise, odour and air quality impacts of development adjacent to OEH land to ensure that it is sympathetic with natural and cultural heritage values, and does not impact upon amenity or public enjoyment of the land.

Planning authorities should consider whether it is appropriate to apply control measures, such as landscaping with local native plant species, implementing buffer areas, limiting hours of operation, and use of appropriate colours, building materials, lighting and height controls. Some types of developments, such as quarries and road works, can result in particularly significant impacts (for example noise and dust). Large-scale developments of this type are likely to need detailed site-specific management plans.

OEH land should not be considered as a buffer zone between a development and other surrounding uses (such as residential areas).

2.8 Threats to ecological connectivity and groundwater-dependent ecosystems

Aim

Native vegetation and other flora and fauna habitats that provide a linkage, buffer, home range or refuge role on land that is adjacent to reserves are maintained and enhanced, where possible.

Groundwater-dependent ecosystems in OEH land are protected.

[15] http://www.environment.nsw.gov.au/forestagreements/index.htm

Risks to OEH land

Naturally vegetated areas adjoining OEH land provide essential linkages for the maintenance of biodiversity and also minimise potential edge effects. These areas have a role in maintaining the viability of local populations and form an important component of home ranges of mobile species, as well as providing valuable wildlife refuge areas (including during periods of stress). Streams, rivers and other water bodies adjacent to OEH land may play similar roles.

Avoiding native vegetation clearing and fragmentation and retaining landscape connectivity will also assist in mitigating some of the impacts of climate change on biodiversity. Native vegetation in good condition and with a minimal edge to area ratio will be better able to resist weed invasion, wind damage, desiccation and other edge effects.

Development in areas of native vegetation or along water bodies that adjoin OEH land can result in fragmentation of habitat corridors and isolation from other areas of habitat in the locality. As noted in section 2.4, OEH runs a number of programs aimed at supporting and encouraging landowners to protect and manage the conservation values of their properties.

Recommended approach

OEH recommends that vegetation, waterways and water bodies adjoining OEH land that exhibit ecological connectivity should be retained, protected and, where necessary, rehabilitated. Consent authorities should consider the corridor values, or connective importance, of any vegetation (not only trees) and waterways or water bodies and possible impacts from the proposed development.

For proposals involving the extraction of groundwater, OEH recommends that consent authorities obtain and consider a comprehensive assessment of any potential impacts that may occur to groundwater-dependent ecosystems in adjoining OEH lands. This can include wetlands, vegetation, mound springs, river base flows, cave ecosystems, playa lakes and saline discharges, springs, mangroves, river pools, billabongs and hanging swamps. The groundwater dependence of ecosystems can range from complete reliance to a partial reliance on groundwater, such as might occur during droughts.

Ecological processes in groundwater-dependent ecosystems are threatened by the regular extraction of groundwater and changes in land use or management.

The protection of groundwater-dependent ecosystems is a key principle of the NSW State Groundwater Protection Policy.[16] Further information on groundwater, including groundwater vulnerability maps, is available from the NSW Office of Water.[17]

2.9 Cultural heritage

Aim

Aboriginal heritage values on OEH land, and areas and sites of heritage value that are World Heritage listed, on the National Heritage Register, or the State Heritage Register are protected.

[16] www.water.nsw.gov.au/ArticleDocuments/34/nsw_state_groundwater_quality_policy.pdf.aspx
[17] www.water.nsw.gov.au/Water-Management/Water-quality/Groundwater/Groundwater/default.aspx

Risks to OEH land

OEH land contains some of the most significant and intact areas of Aboriginal and historic cultural heritage values in NSW. This includes physical objects, items and places, as well as areas that are significant with respect to cultural traditions, customs, beliefs and history. It can include values that pre-date the arrival of settlers to Australia (for example, Aboriginal objects), as well as more contemporary associations (such as cemeteries).

Cultural heritage values can, and often do, extend across the landscape, spanning multiple land tenures and properties. Ensuring that these values endure and are able to be interpreted and appreciated by future generations requires protective action across boundaries.

As noted in the Introduction, there are a number of OEH lands that are either World Heritage listed (such as Blue Mountains National Park) or on the National Heritage List (Ku-ring-gai Chase National Park). The *Environment Protection and Biodiversity Conservation Act 1999* requires that approval be obtained from the Australian Government before any action that could have a significant impact on the world heritage or national heritage values of a listed place. Such impacts are not limited to those from adjoining properties, and could occur due to developments some distance away.

There are also many OEH lands (or areas, items or features in parks) that are listed on the State Heritage Register and protected under the NSW *Heritage Act 1977*.

Recommended approach

Consent and planning authorities should ensure that they give adequate consideration to potential impacts of adjoining development on the cultural heritage values of OEH land. In particular, this includes:

- Aboriginal heritage values on OEH land which can, but do not always, include areas listed on the State Heritage Register or gazetted as an Aboriginal Place (for example impacts on Aboriginal objects resulting from erosion, sediment and stormwater from adjoining developments)
- historic heritage values, especially any areas or specific places listed on the State Heritage Register
- World Heritage or National Heritage values.

3 Special requirements for botanic gardens and wild rivers

3.1 Botanic gardens

The Royal Botanic Gardens Sydney and Domain, Blue Mountains Botanic Garden (Mount Tomah) and Australian Botanic Garden (Mount Annan) were established and are managed under the *Royal Botanic Gardens and Domain Trust Act 1980*. The Botanic Gardens Trust is the authority responsible for management of the three botanic gardens. OEH provides support services to the Trust.

The principal objectives of the Trust, as specified in the Act, are to:

- maintain and improve Trust land, the National Herbarium and the collections of living and preserved plant life owned by the Trust
- increase and disseminate knowledge with respect to the plant life of Australia, and of NSW in particular
- encourage the use and enjoyment by the public of Trust lands by promoting and increasing the educational, historical, cultural and recreational value of those lands
- give particular emphasis to encouraging and advancing the study of systematic botany and to plant conservation.

The Trust is interested in working with proponents and planning authorities at an early stage to provide advice on developments adjoining any of the botanic gardens that may affect achieving the above objectives. Information and contacts for each botanic garden are available as follows.

Botanic garden	Information and contacts
Royal Botanic Gardens and Domain Sydney	http://www.rbgsyd.nsw.gov.au/welcome/royal_botanic_garden
Blue Mountains Botanic Garden (Mount Tomah)	http://www.rbgsyd.nsw.gov.au/welcome/blue_mountains_botanic_garden
Australian Botanic Garden (Mount Annan)	http://www.rbgsyd.nsw.gov.au/welcome/australian_botanic_garden

3.2 Wild rivers

Wild rivers are declared under s.61 of the NPW Act. The purpose of declaration is to identify, protect and conserve any water course of natural origin and exhibiting substantially natural flow. Wild rivers are managed to restore or maintain natural processes, and to identify, conserve and protect Aboriginal objects and places associated with wild rivers.

Under s.61A of the NPW Act, a statutory authority ***cannot*** carry out development in relation to a wild river unless it has consulted with, and considered any advice given by, the Minister

for the Environment in relation to the development. This requirement could potentially apply to upstream developments that may affect a wild river.

Wild rivers can only been declared over areas in OEH land. Wild rivers currently declared are:

- Upper Brogo River (Wadbilliga National Park)
- Forbes River (Werrikimbe National Park)
- Upper Hastings River (Werrikimbe National Park)
- Kowmung River (Kanangra-Boyd and Blue Mountains national parks)
- Washpool Creek (Washpool National Park)
- Colo River (Blue Mountains National Park)
- Grose River (Blue Mountains and Wollemi national parks).

Further information

National parks and wild rivers

General information on national parks: Environment Line on 1300 361 967

Spatial data for OEH land (requires GIS software):
http://mapdata.environment.nsw.gov.au/DDWA/

NPWS regional offices: www.environment.nsw.gov.au/NPWS/NPWSRegions.htm

Wild rivers: www.environment.nsw.gov.au/parktypes/WildRivers.htm

Botanic gardens

www.rbgsyd.nsw.gov.au

Heritage

Protection of Aboriginal heritage:
www.environment.nsw.gov.au/conservation/aboriginalculture.htm#what

OEH lands that are heritage listed

- State Heritage Register: www.heritage.nsw.gov.au/07_subnav_04b.htm
- World Heritage and National Heritage Register: www.environment.gov.au/heritage/index.html.

Office of Environment & Heritage
NSW National Parks & Wildlife Service

doc16/225729

Mr Domenico De Conti
Delivery and Operations NSW / VIC
Transurban
Level 9, 1 Chifley Square
Sydney NSW 2000

Attn: Daniel Noaeen

Your Ref: CR-M2-00375

Dear Domenico,

Re: ISEPP Notification regarding proposed M2 Macquarie Park Motorscapes Project

Thank you for the notification of works proposed by Transurban and The Hills Motorway Limited (THML) along the M2 at Macquarie Park. In response to the request for comment regarding the proposed work the following recommendations are provided;

- That continued consultation throughout the project be made with National Parks and Wildlife Service (NPWS), Valleys Area.
- That Transurban and THML apply the guidelines for development adjacent to OEH Estate. A copy of these have been included for your perusal.
- Upon completion of environmental assessments, as well as any technical drawings or designs for the proposed works, be forwarded through to NPWS for comment prior to the commencement of works.

We look forward to continuing to work with TransUrban on this project. Should you have any further queries please contact Ranger, Nicola Booth on 8448 0407, email Nicola.Booth@environment.nsw.gov.au. Alternatively contact with the NPWS Valleys Area office can be made on 8448 0400.

Yours sincerely,

Michele Cooper
Area Manager
Valleys Area

9/5/16.

Contact officer: Nicola Booth,
8448 0407

PO Box A290 Sydney South NSW 2000
Level 15, 59-61 Goulburn Street Sydney NSW 2000
Tel: (02) 9995 5000 Fax: (02) 9995 5399
ABN 30 841 387 271
www.nationalparks.nsw.gov.au

The Hills Motorway Limited: ABN 28 062 329 828
Registered Address: Level 3 505 Little Collins Street, Melbourne, Vic, 3000.
1 Tollaust Lane (off Culloden Rd) North Ryde

Hills Motorway Management Limited: ABN 89 064 687 645
Locked Bag 2215, North Ryde BC, NSW, 1670
T: 1800 196 266 **E:** hillsm2@transurban.com **W:** hillsm2.com.au

28 April 2016 ~~2015~~
Ref: CR-M2-O0376

Daniel Noaeen
Delivery and Operations NSW / VIC
Transurban
Level 9, 1 Chifley Square
Sydney NSW 2000
Australia

Harry Muker
Ryde City Council
Locked Bag 2069
North Ryde NSW 1670

Dear Harry,

Notification regarding proposed M2 Macquarie Park Motorscapes Project

The Hills M2 Motorway (**THML**) would like to formally notify the Ryde City Council of the proposal known as the M2 Macquarie Park Motorscapes Project.

The proposal would not impact on Ryde City Council infrastructure, however as part of THML's stakeholder consultation and good neighbour policy, we would like to inform you of the following activities as part of the proposal:

The proposal includes the following activities:

- Preparation of project safety, traffic and environmental documentation.
- Creation of site access from the M2 Motorway and an alternative foot access point from Leisture Close.
- Construction of a culvert to allow construction vehicles to cross the existing swale drain that runs parallel to the M2 Motorway.
- Establishment of internal traffic haulage routes, environmental controls, laydown areas and site compound facilities.
- Control of noxious weed species including removal and disposal off-site (or mulching and burial on site).
- Revetment work to Shrimptons Creek and Industrial Creek.
- Installation of gross pollutant traps at Shrimptons Creek and Industrial Creek.
- Rehabilitation of the existing swale drain that adjoins the M2 Motorway boundary.
- Importing clean topsoil associated with the revegetation and VENM for soil re-profiling, access tracks, etc.
- Revegetation of the site with native species as per a Landcare Australia Vegetation Management Plan.
- Associated earthworks.
- Replacement of road signage and road barriers.
- Demobilisation.
- Ongoing weed management measures including long term maintenance and monitoring activities.

The current proposed commencement date of the proposal would be June 2016, to be completed by December 2017. The proposal is expected to be undertaken during normal working hours outside peak periods, and it may be necessary to undertake work outside standard hours.

As part of the proposal, stakeholder and community consultation would also occur as required.

To ensure all potential issues are addressed, it would be appreciated if you could provide any comments regarding this proposal to the undersigned within 14 days from the date of this letter. Any response from Council within that period will be considered by THML in its environmental assessment (Review of Environmental Factors) of this proposal.

Should you require further information, please do not hesitate to contact Daniel Noaeen on 0405 231 143.

Yours sincerely,

pp

Domenico De Conti
Asset Manager Hills M2

Appendix H

Noise and Vibration Impact Assessment

M2 Macquarie Park Motorscapes Project

The Hills Motorway Limited

Noise and vibration assessment

D0 | v5

02 June2016

M2 Macquarie Park Motorscapes Project

Project No:	IA104600
Document Title:	Noise and vibration assessment
Document No.:	D0
Revision:	v5
Date:	02 June 2016
Client Name:	The Hills Motorway Limited (THML)
Project Manager:	Mary-Ellen Feeney
Author:	Luke Spencer
File Name:	J:\IE\Projects\04_Eastern\IA104600\25 Acoustics\Report\M2 Macquarie Park Motorscapes Project NVA D0v5.docx

Jacobs Australia Pty Limited

710 Hunter Street
Newcastle West NSW 2302 Australia
PO Box 2147 Dangar NSW 2309 Australia
T +61 2 4979 2600
F +61 2 4979 2666
www.jacobs.com

Document history and status

Revision	Date	Description	By	Review	Approved
D0v0	23/03/2016	Issued for internal review	L Spencer	B Ison	23/03/2016
D0v1	23/03/2016	Issued for client review	L Spencer		
D0v2	30/03/2016	Internal update to address PM edits	L Spencer		
D0v3	05/05/2016	Updated to address 2 May 2016 comments from THML	L Spencer		
D0v4	06/05/2016	Internal update	L Spencer		
D0v5	02/06/2016	Updated to include temporary vehicle access track via Leisure Close	L Spencer		

Contents

1. Introduction

The Hills Motorway Limited (THML) proposes to carry out site restoration, revegetation, water quality and visual improvements to a derelict area of about five hectares within the M2 Motorway (the motorway) corridor (the site).

The purpose of this report is to assess potential noise and vibration impacts associated with this proposal. This report is intended to support a *Review of Environmental Factors* being prepared to assess the overall environmental impacts associated with the proposal.

The primary objectives of this assessment were to:

- Identify nearby sensitive receivers in relation to the proposal.
- Characterise background noise conditions around the proposal site.
- Develop appropriate noise and vibration assessment criteria in accordance with relevant policy and guidelines.
- Quantitatively assess potential noise and vibration-related impacts.
- Recommend suitable management measures, as appropriate, to minimise impacts during construction.

In summary, this report provides information on the following:

- Details of the proposal (Section 2).
- The existing environment including ambient noise conditions (Section 3).
- Policy setting (Section 4).
- Applicable noise and vibration criteria (Section 5).
- Quantitative assessment of noise and vibration impacts including methodology and results (Section 6).
- Recommended noise and vibration safeguards and management measures to control potential impacts (Section 7).

2. Proposal description

The overall site improvement work, collectively known as the M2 Macquarie Park Motorscapes project (the proposal) is associated with an area situated on the northern side of the motorway at Macquarie Park, between the motorway boundary to the south and Lane Cove National Park to the north. THML currently lease the land of the subject site from the New South Wales Roads and Maritime Service (hereafter referred to as Roads and Maritime). As Roads and Maritime is the owner of the land they would be the project proponent and determining authority for the proposal's planning approvals.

The main features of the proposal include:

- Creation of site vehicular access from the M2 motorway and foot access from Leisure Close.
- Establishment of internal traffic haulage routes, environmental controls, laydown areas and site compound facilities.
- Control of noxious weed species including removal and disposal (or mulching and burial on site).
- Revetment work to the base of creek banks along stretches of Shrimptons Creek and Industrial Creek.
- Installation of gross pollutant traps at both creeks.
- Repair of the existing drainage swale next to the motorway.
- Earthworks associated with the revegetation of the site.
- Management of known areas of soil contamination.
- Earthworks and re-profiling associated with the art installation on the deck area of the site.
- Revegetation of the site with native vegetation species.
- Importation of up to 5,000 m^3 of Virgin Extracted Natural Material (VENM) and clean topsoil.
- Erection of the art installation.
- Removal of road signage.
- Ongoing pest and weed management including long term maintenance and monitoring activities.

The approximate location of the proposal is displayed below in Figure 2-1.

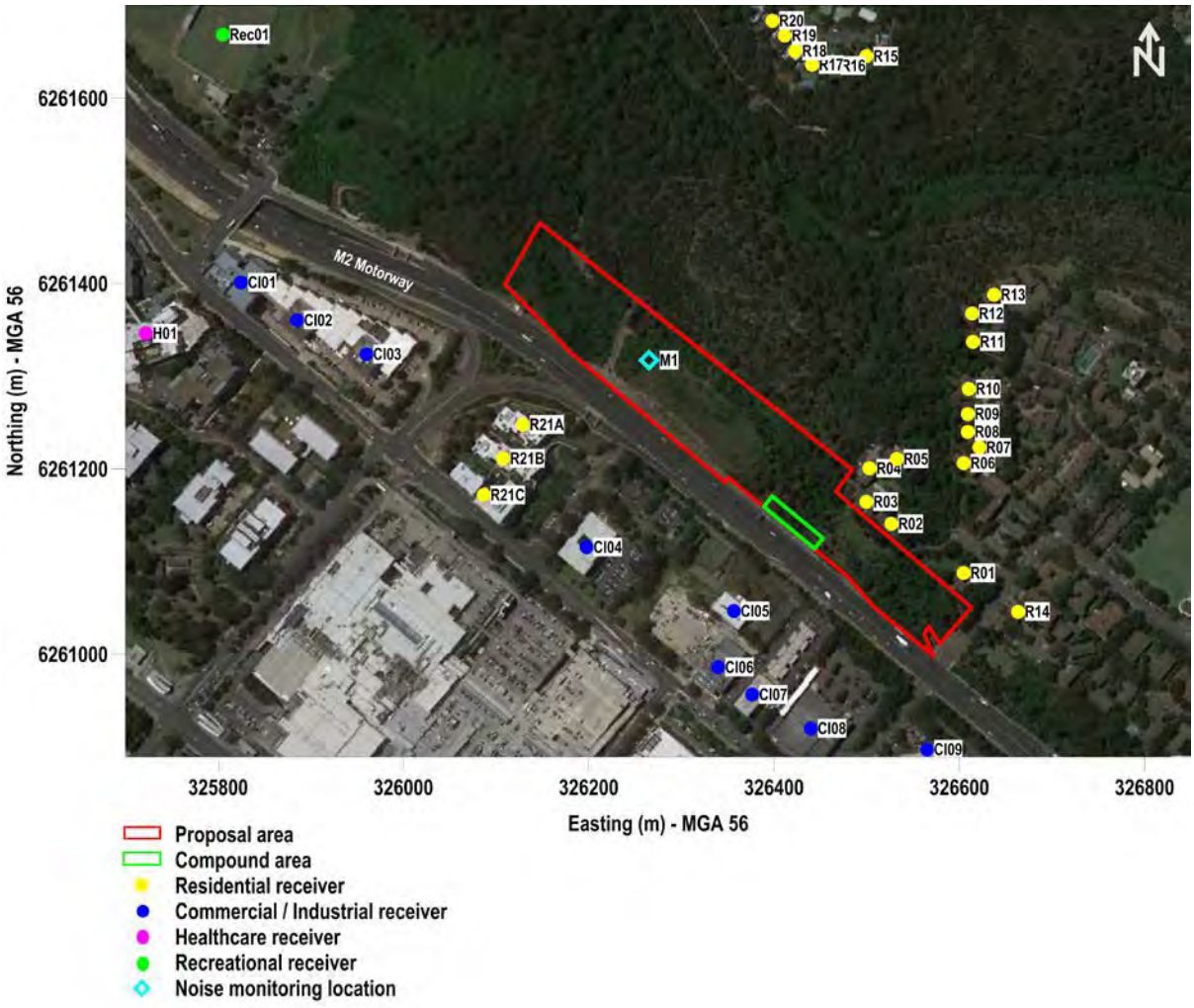

Figure 2-1 Proposal location and surrounding receivers (Imagery: Google Earth)

2.1 Construction methodology

The proposal would involve the following general sequencing of activities:

- Establishment of site access and temporary fencing, installation of erosion and sediment controls.
- Establishment of construction compound sites and access.
- Vegetation clearing and grubbing.
- Stripping, stockpiling and management of topsoil and unsuitable material.
- Earthwork preparation.
- Water quality improvement work.
- Landscaping and revegetation.
- Demobilisation work including installation of safety barriers, fencing, and signage relocation.
- Art installation.
- Removal of construction compound and site tidy up.
- Ongoing vegetation management and monitoring and maintenance work.

2.2 Construction hours and duration

The construction of the proposal is anticipated to start in May 2016 and continue for about an 18 month period. The majority of construction work would generally be carried out during standard working hours, as follows:

- Monday to Friday 7am to 6pm.
- Saturday 8am to 1pm.
- Sunday and Public Holidays, no work.

Out of hours work may be required to assist in reducing the duration of construction. It has been anticipated that out of hours work would be between 1.00pm to 5.00pm on Saturdays and at night, and would include materials transport and stockpiling activities and M2 Motorway signage relocation works.

2.3 Plant and equipment

An indicative list of plant and equipment that would typically be required has been provided below.

- Excavators (various- including attachments).
- Loaders.
- Bull dozers.
- Jack hammers.
- Mulchers.
- Cranage (e.g. frannas).
- Soil nail drilling rigs and other ground stabilisation plant and equipment.
- Articulated (and other) dump trucks.
- Pile augers (e.g. if deeper foundation required for art installation).
- Elevated work platforms.
- Compressors.
- Generators.
- Chainsaws.
- Welding equipment.
- Vibrator rollers.
- Water carts.
- Seeding equipment.
- Lighting towers.
- Road sweepers.
- Concrete/shotcrete equipment (epoxy/grouting for gross pollutant traps).
- Hand tools (powered and unpowered).
- Grouting pumps.
- Concrete agitator.
- Concrete vibrator.
- Grader.
- Roller.

2.4 Transport and handling of materials

Around 5,000 m^3 of topsoil material is conservatively estimated to be required for the proposal. This material would be sourced from other road work projects running concurrently in the vicinity of the M2 motorway. Haulage of this material to the site would result in around 330 truck and dog vehicular loads, or 330 two-way heavy vehicle movements. The work site would be accessed directly from the M2 Motorway.

During the peak earthworks activity it is anticipated that about six to eight trips per hour would occur with a round trip of about an hour (including loading and unloading) depending on the size of the fleet and the pressures of the construction program. This stage of construction would be likely to occur for a maximum of about 4 weeks.

2.5 Ancillary facility

A compound site would also be developed to support construction activities. The approximate location of the proposed compound site is displayed in Figure 2-1. Materials handling (i.e. loading and unloading of deliveries) and stockpiling activities are expected to take place at the compound site.

3. Surrounding environment

3.1 Noise sensitive receivers

A number of residential receivers are located from the north to east of the proposal along Leisure Close, Durham Close, Carlisle Close and Gloucester Avenue. The nearest residential receivers in relation to the proposal are displayed above in Figure 2-1. The Meriton Apartments are also located nearby off Talavera Road (displayed as receivers R21A, R21B and R21C in Figure 2-1).

A number of other non-residential receivers are also located close by, including commercial/industrial, health and recreational. These are also displayed in Figure 2-1.

3.2 Background noise levels

The quantitative noise assessment method in the *Interim Construction Noise Guideline* [ICNG], (DECC, 2009) (refer Section 5.1) requires an understanding of existing ambient and background noise levels around the proposal site.

Unattended background noise measurements were collected as part of the assessment, *M2 Park Development Acoustic constraints and options study,* (Jacobs, December 2014) in December 2014. Results from this monitoring are summarised below.

The term 'L_{A90}' is a statistical descriptor which refers to the noise level exceeded 90 per cent of the time during the monitoring period. It is commonly used to define the background noise level. 'L_{Aeq}' is the equivalent continuous sound level or energy-time average for the period of monitoring.

Table 3-1 Background noise levels, (Jacobs, December 2014)

Monitoring location ID	Day (7am to 6 pm)		Evening (6 pm to 10 pm)		Night (10 pm to 7am)	
	L_{Aeq} dB	L_{A90} dB	L_{Aeq} dB	L_{A90} dB	L_{Aeq} dB	L_{A90} dB
M1	61	55	56	49	57	40

This monitoring is considered to be indicative of ambient noise conditions at the nearest surrounding receivers, noting that it is generally equidistant from the M2 Motorway as the identified surrounding receivers, although it is noted that levels at residential receivers R15 to R20 along Gloucester Avenue may be lower, owing to the increase in setback distance from the M2 Motorway at this location.

3.3 Vibration sensitive receivers

All nearby residential premises and buildings used for other purposes are considered to be vibration-sensitive receivers. A review of the aboriginal and non-aboriginal heritage section of the REF identified the following heritage structures within the vicinity of the proposal which may be highly sensitive to vibration generated during construction:

- Shrimptons Creek indigenous rock shelter with rock art – approximately 50 metres to the north of the proposal.
- Macquarie University ruins – approximately 200 metres to the south west of the proposal.

4. Policy setting

The following policies and guidelines have been considered as part of this assessment:

- *Interim Construction Noise Guideline* [ICNG], (DECC, 2009).
- *DRAFT Construction Noise and Vibration Guideline* [DCNVG], (Roads and Maritime, December 2015 (Draft)).
- *NSW Road Noise Policy* (RNP), (DECCW, 2011).
- *Assessing Vibration: a technical guideline*, (DECC, February 2006).
- *British Standard 6472-1: 2008 Guide to evaluation of human exposure to vibration in buildings Part 1: Vibration sources other than blasting* [BS 6472-1: 2008].
- *British Standard BS7385: 1990 Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from groundbourne vibration* [BS7385-2:1993].
- *Australian Standard AS2187.2 – 2006 Explosives – Storage and use Part 2: Use of explosives.*
- *DIN 4150-3 Structural vibration Part 3: Effects of vibration on structures* [DIN 4150-3:1999-02].
- *NSW Industrial Noise Policy,* (EPA, 2000).

Relevant criteria for the purpose of assessing this proposal from these policies and guidelines are discussed in Section 5.

5. Assessment criteria

5.1 Construction noise

In NSW, noise impacts arising from construction activities are managed in accordance with the ICNG. The guideline has been developed to assist with the management of noise impacts, rather than to present strict numeric noise criteria for construction activities.

The ICNG describes two methods for assessing noise impacts from construction activities; the quantitative method which is suited to noise intensive works and / or proposals running longer than three weeks; and a qualitative method which is suited for minor, short-term (i.e. duration less than three weeks) activities which would occur during standard hours of construction.

Owing to the expected duration of the proposal and the need for the proposal to be completed outside the standard hours of construction, a quantitative approach was considered for this assessment.

The ICNG recommends establishing noise management levels (NMLs) at receiver locations adjacent to the works, using information on the existing background noise level at these locations. Where the NML may be exceeded as a result of the proposed works and there is potential for adverse noise impacts to occur, appropriate management measures should be implemented.

Table 5-1 details the method for determining NMLs for residential receivers potentially affected by the proposal. Often works that may cause inconvenience within the community (e.g. traffic congestion) or safety concerns are done outside standard hours. NMLs during these periods are presented in the table for works 'Outside recommended standard hours'.

Table 5-1 Procedure for establishing construction NMLs at residential receivers (ICNG, DECC 2009)

Time of day	Management level $L_{Aeq\ (15\ min)}$	How to apply
Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	Noise affected (RBL + 10 dB)	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and the duration, as well as contact details.
	Highly noise affected (75 dB(A))	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences 2. If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected (RBL + 5 dB)	A strong justification would typically be required for works outside the recommended standard hours The proponent should apply all feasible and reasonable work practices to meet the noise affected level Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community For guidance on negotiating agreements see Section 7.2.2 of the ICNG (DECC, 2009).

Considering the background noise levels presented in Table 3-1 and the guidance from the ICNG above in Table 5-1, the following NMLs have been established to assess and manage noise impacts during construction.

Table 5-2 Construction NMLs for residential receivers

Day (7am to 6 pm)		Evening (6 pm to 10 pm)		Night (10 pm to 7am)	
L_{A90} dB	NML dB(A)	L_{A90} dB	NML dB(A)	L_{A90} dB	NML dB(A)
55	65	49	54	40	45

The ICNG also provides guidance for other types of receivers. Recommended management levels for relevant receiver types within the vicinity of the proposal and construction compound areas have been reproduced below.

Table 5-3 Noise management levels for non-residential land uses (ICNG, DECC 2009)

Land use	Management level $L_{Aeq\ 15\ minute}$ dB(A) (when in use)
Hospital wards and operating theatres	45 dB(A) internal noise level
Commercial premises	70 dB(A) external noise level
Industrial premises	75 dB(A) external noise level
Recreational area (active)	65 dB(A) external noise level

Noting that the ICNG criterion for hospitals is an internal level, a conservatively estimated transmission loss of 20 dB(A) has been applied (equivalent to a closed, single-glazed window as detailed in *Australia Standard AS2436-2010 Guide to noise and vibration control on construction, demolition and maintenance sites* [AS2436-2010]), which would result in an external criterion of 65 dB(A) at Macquarie University Hospital (receiver H01 as displayed in Figure 2-1).

5.1.1 Sleep disturbance

Noise impacts or events that can cause interruptions to sleeping patterns are considered separately to noise levels during works outside standard hours. The ICNG does not provide a specific method for assessment of potential sleep disturbance noise impacts; and guidance on the acceptability of these events is taken from the *NSW Road Noise Policy* (RNP), (DECCW, 2011).

The RNP provides two criteria:

- Sleep disturbance screening criterion – used to identify situations where there is the potential for sleep disturbance.
- Sleep disturbance awakening criterion – levels below which awakening is unlikely to occur.

The sleep disturbance screening criterion recommends that where the $L_{A1\ (1\ minute)}$ does not exceed the $L_{A90\ (15\ minute)}$ by 15 dB(A) or more, sleep disturbance impacts are likely to be maintained at an acceptable level. The $L_{A1,\ (1\ minute)}$ descriptor is meant to represent a maximum noise level when measured using a 'fast' time response.

The sleep disturbance awakening criterion is the threshold at which an awakening reaction is likely to occur. Research discussed in the RNP identified this threshold to be an internal bedroom noise level of around 50 to 55 dB(A).

Windows often allow the greatest amount of sound transmission from outside to inside across a building façade. Table B4 in AS2436-2010 provides indicative total A-weighted noise reduction levels across different types of windows.

Table 5-4 AS2436-2010 indicative outside to inside window transmission losses

Building type	Window type	Outside to inside reduction I total A-weighted sound pressure level dB
All	Open	10
Light frame	Single glazed (closed)	20
Masonry	Single glazed (closed)	25
	Double glazed (closed)	35

Where bedrooms are ventilated by an opened window, a sleep disturbance awakening criterion measured outside the bedroom window of 60 to 65 dB(A) less the conversion from $L_{AEq\ 15\ minute}$ to an $L_{A\ 1\ minute}$ (conservatively assumed to be 10 dB(A) would generally apply (i.e. 55 dB(A)).

5.2 Construction vibration

Section 7 of the DCNVG recommends safe working distances for achieving human comfort (*Assessing Vibration: a technical guideline*, (DECC, February 2006)) 2006) and cosmetic building damage (BS7385-2:1993) criteria for a range of different plant and equipment. These have been reproduced below.

Table 5-5 Recommended safe working distances for vibration-intensive plant and equipment, (DCNVG, Roads and Maritime 2015 (Draft))

Plant	Rating / description	Safe working distance (meters)	
		Cosmetic damage (BS7385-2: 1993)	Human response (DECC, 2006)
Vibratory Roller	<50 kN (typically 1-2 t) <100 kN (typically 2-4 t) <200 kN (typically 4-6 t) <300 kN (typically 7-13 t) >300 kN (typically 13-18 t) >300 kN (> 18 t)	5 metres 6 metres 12 metres 15 metres 20 metres 25 metres	15 m to 20 metres 20 metres 40 metres 100 metres 100 metres 100 metres
Small hydraulic hammer	300 kg – 5 to 12 t excavator	2 metres	7 metres
Medium hydraulic hammer	900 kg – 12 to 18t excavator	7 metres	23 metres
Large hydraulic hammer	1600 kg – 18 to 34 t excavator	22 metres	73 metres
Vibratory pile driver	Sheet piles	2 to 20 metres	20 metres
Pile boring	≤800 mm	2 metres	4 metres
Jackhammer	Hand held	1 metres	2 metres

Guidance for more sensitive structures is presented in the German Guideline, *DIN 4150-3 Structural vibration Part 3: Effects of vibration on structures* [DIN 4150-3:1999-02]. Vibration velocities not exceeding 3 mm/s at 1 to 10 Hz are recommended to avoid potential structural impacts for these types of structures. This criterion would apply at Shrimptons Creek indigenous rock shelter and the Macquarie University ruins.

5.3 Construction traffic

Application notes for the RNP state the following (http://www.epa.nsw.gov.au/noise/roadnoiseappnotes.htm):

> *'…for existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level as a result of the development should be limited to 2 dB above that of the noise level without the development. This limit applies wherever the noise level without the development is within 2 dB of, or exceeds, the relevant day or night noise assessment criterion.'*

This is also considered to apply to noise arising from construction activities. Hence a relative increase criterion of 2 dB(A) has been adopted for the assessment of construction traffic impacts.

5.4 Operational noise

Where a proposal has the potential to generate a new source of noise for residential receivers due to changes in road alignment or where a proposal would result in a change to the volume or mix of vehicles, an operational traffic noise assessment is undertaken in accordance with the RNP. Where the changes of an existing road alignment are only minor, a less detailed assessment of traffic noise impacts is required.

In accordance with the *Roads and Maritime Noise Criteria Guideline* (NCG), (Roads and Maritime, 2014), the minor works criteria of noise levels not increasing by 2 dB(A) relative to existing noise levels at the worst affected receiver apply. As such, the primary operational noise criteria considered for this assessment has been whether the proposal would result in a traffic noise increase of 2 dB(A) or more at any nearby receiver as a result of the permanent access point off the M2 Motorway.

6. Quantitative assessment

6.1 Construction noise

6.1.1 Noise sources

Overall sound power levels (SWLs) were predicted for each activity and phase of construction associated with the proposal. These SWLs were prepared with reference to the following standards for individual plant and equipment SWLs:

- *Australian Standard AS2436-2010: Guide to noise and vibration control on construction, demolition and maintenance sites* (AS 2436-2010).
- *British Standard 5228-1:2009 Code of practice for noise and vibration control on construction and open sites – Part 1: Noise* (BS 5228-1:2009).
- *Construction Noise Strategy 7TP-ST-157/2.0* (CNS), (TfNSW, April 2012).
- United Kingdom Department for Environment, Food and Rural Affairs (DEFRA) *Noise database for prediction of noise on construction and open sites.*

Penalties were applied to plant and equipment with the potential to generate particularly intrusive noise as described in the *NSW Industrial Noise Policy,* (EPA, 2000).

Table 6-1 Plant and equipment associated with each construction activity and estimated overall SWLs

ID	Activity	Plant / equipment	No.	Typical overall sound power level dB(A)
01	Establishment of site access and temporary fencing, installation of erosion and sediment controls	Franna Materials truck Hand tools	1 1 2	104
02	Establishment and demobilisation of construction compound	Franna Flatbed truck Light vehicle	1 1 2	102
03	Site compound operations	Franna Delivery truck Light vehicle Lighting tower Generator Compressor	1 1 2 2 1 1	104
04	Compound stockpiling activities	Excavator Dump truck Front end loader	1 1 1	112
05A	Vegetation clearing and grubbing - clearing	Bulldozer Excavator	1 1	112
05B	Vegetation clearing and grubbing - grubbing	Chainsaw Mulcher	1 1	109
06	Stripping, stockpiling and management of topsoil and unsuitable material	Bulldozer Excavator Dump truck	1 1 1	113

ID	Activity	Plant / equipment	No.	Typical overall sound power level dB(A)
07	Earthwork preparation	Vibratory roller	1	110
08A	Water quality improvement work – Shrimptons Creek scour protection	Hand tools Dump truck Excavator Materials truck	2 1 1 1	109
08B	Water quality improvement work – Shrimptons Creek gross pollutant trap installation	Shotcrete pump / Concrete agitator Hand tools	1 1	106
08C	Water quality improvement work – Industrial Creek scour protection	Hand tools Dump truck Excavator Materials truck	2 1 1 1	109
08D	Water quality improvement work – Industrial Creek trash rack installation	Shotcrete equipment / Concrete agitator Hand tools	1 1	106
08E	Water quality improvement work – M2 pavement swale drain rehabilitation	Excavator	1	105
08F	Water quality improvement work – Water quality basin channel modification	Shotcrete equipment Grout pump Hand tools	1 1 1	109
09	Landscaping and revegetation	Water cart Seeding machine	1 1	107
10A	Demobilisation works - installation of safety barriers and fencing	Hand tools Franna Materials truck Light vehicle	1 1 1 2	103
10B	Demobilisation works - M2 Motorway signage removal	Elevated work platform Hand tools Franna Materials truck Jackhammer (less than 50 per cent of the time) Light vehicle	1 1 1 1 1 2	109
11	Road sweeping of access routes	Road sweeper	1	106
12	Art installation	Soil nailing equipment Piling equipment Mobile Crane Flatbed truck Grout pump	1 1 1 1 1	116
13	Ongoing vegetation management and monitoring and maintenance work.	Water cart Light vehicle	1 1	107
14A	Development of paved access point off M2 Motorway for operational maintenance vehicles – Sub-base compaction and placement of road base	Excavator Grader Roller	1 1 1	112

ID	Activity	Plant / equipment	No.	Typical overall sound power level dB(A)
		Dump truck	1	
14B	Development of paved access point off M2 Motorway for operational maintenance vehicles – Pavement formation	Hand tools Concrete agitator inc. pump Concrete vibrator	1 1 1	108

Activities were positioned around the proposal site as described in the drawing *IA104600_GIS_REF_002_Proposed_r2v1_LR.*

It is noted that activities 04 (materials delivery and compound stockpiling activities) and 10B (M2 Motorway signage removal) are the only works proposed to be completed during night time hours.

6.1.2 Assessment approach

To evaluate potential impacts associated with each construction activity, computer-based modelling was completed using SoundPlan. Predictions were compared against NMLs developed in Section 5.1 to determine potential impacts. Table 6-2 lists the inputs which were considered as part of the model.

Table 6-2 Construction noise model

Model input	Details
Topography	Spot height data from the Jacobs, December 2014 assessment was used to generate a digital terrain model (DTM) for the study area.
Buildings	Buildings at all premises described in Section 3.1 were incorporated into the respective models. Building heights and extents were estimated using Google Maps.
Receivers	Set at a height of 1.5 meters for single-level residences, with receivers placed over multiple levels for multi-story dwellings. Positioned along the worst-affected façade in relation to the proposal.
Sources	As above in Table 6-1, generally set to a height of 2.5 metres.
Noise barrier	The existing 3.6 metre high noise wall along the northern side of the eastbound lane of the M2 Motorway was incorporated into the model.
Meteorology	Neutral conditions.

6.1.3 Predicted results

Construction activities during day time hours

Indicative noise levels were predicted for each stage of work described above in Table 6-1 at each of the receivers displayed in Figure 2-1. These levels are presented below in Table 6-3. For ease of interpretation, indicative noise levels exceeding the day time NMLs both for, and outside standard hours of construction have been highlighted in red and yellow respectively.

These predictions indicate that NMLs are generally expected to be met with some exceptions. These exceptions are typically at the nearest residential receivers R01 to R05, with occasional exceedances also predicted at receivers R14 and R21. Levels exceeding the ICNG ‘highly affected’ criterion of 75 dB(A) were not predicted to occur during the proposal.

Table 6-3 Predicted noise levels by activity $L_{eq\ 15\ minute}$ dB(A) during works completed during standard hours of construction

Rec	NML Standard hours of construction	NML day time works (outside st. hours of construction)	Predicted noise level d(BA) for each construction activity																				
			1	2	3	4	5A	5B	6	7	8A	8B	8C	8D	8E	8F	9	10A	10B	11	12	13	14A	14B
R01	65	60	63	45	47	55	66	63	67	64	25	19	66	63	41	34	61	40	43	38	52	61	46	42
R02	65	60	69	52	54	62	69	66	70	67	31	20	60	58	45	25	64	41	47	41	56	64	50	46
R03	65	60	69	55	57	65	69	66	70	67	33	22	53	51	46	25	64	43	51	42	59	64	51	47
R04	65	60	69	49	51	59	66	63	67	64	32	22	31	29	46	46	61	43	49	42	60	61	51	47
R05	65	60	59	27	29	37	62	59	63	60	32	21	35	33	43	47	57	39	47	42	59	57	50	46
R06	65	60	46	42	44	52	52	49	53	50	31	20	36	28	39	44	47	35	36	39	55	47	40	36
R07	65	60	49	41	43	51	55	52	56	53	34	20	52	49	40	45	50	36	44	39	55	50	47	43
R08	65	60	48	43	45	53	55	52	56	53	34	21	49	46	41	45	50	38	44	39	55	50	47	43
R09	65	60	48	43	45	53	55	52	56	53	34	21	50	47	41	45	50	38	44	39	56	50	47	43
R10	65	60	48	34	36	44	54	51	55	52	35	22	48	44	41	45	49	38	44	39	56	49	47	43
R11	65	60	47	40	42	50	54	51	55	52	36	23	38	24	42	45	49	40	45	39	56	49	48	44
R12	65	60	44	37	39	47	52	49	53	50	38	28	35	23	40	45	47	38	43	39	54	47	46	42
R13	65	60	38	24	26	34	47	44	48	45	39	28	28	25	37	44	42	35	32	37	48	42	36	32
R14	65	60	59	41	43	51	61	58	61	58	24	17	57	47	36	37	55	36	40	36	48	55	43	39
R15	65	60	38	32	34	42	45	42	46	43	40	35	37	34	37	42	40	34	39	38	49	40	43	39
R16	65	60	38	32	34	42	46	43	47	44	41	35	34	27	38	43	41	35	40	38	50	41	43	39
R17	65	60	38	32	34	42	47	44	47	44	41	37	35	28	38	44	41	36	40	39	50	41	43	39
R18	65	60	39	32	34	42	47	44	47	44	42	38	35	29	38	44	41	36	40	39	50	41	43	39
R19	65	60	39	31	33	41	46	43	47	44	42	38	35	29	39	43	41	36	40	39	50	41	43	39
R20	65	60	39	31	33	41	46	43	48	45	42	38	34	30	39	43	42	36	40	39	50	42	43	39
R21A	65	60	47	36	38	46	50	47	55	52	29	25	34	23	48	46	49	47	51	49	58	49	55	51
R21B	65	60	52	37	39	47	54	51	59	56	32	29	29	23	53	49	53	53	53	56	64	53	57	53
R21C	65	60	56	37	39	47	55	52	61	58	47	32	30	25	55	50	55	55	53	58	65	55	58	54
CI01	70	60	41	29	31	39	44	41	48	45	33	21	21	17	38	41	42	39	40	40	48	42	43	39
CI02	70	60	43	30	32	40	46	43	50	47	36	23	24	22	39	42	44	41	41	41	50	44	45	41
CI03	70	60	47	32	34	42	48	45	54	51	38	25	25	23	42	45	48	44	43	45	52	48	47	43
CI04	70	60	47	40	42	50	51	48	55	52	37	25	30	25	49	47	49	47	54	50	60	49	57	53
CI05	70	60	47	46	48	56	56	53	57	54	36	20	39	30	48	44	51	52	57	43	58	51	53	49
CI06	70	60	49	40	42	50	53	50	57	54	37	20	31	27	50	44	51	51	57	44	60	51	53	49
CI07	70	60	43	43	45	53	55	52	56	53	32	19	39	37	43	42	50	48	51	42	54	50	50	46
CI08	70	60	45	44	46	54	55	52	56	53	33	17	45	38	41	41	50	50	49	39	52	50	47	43
CI09	70	60	44	39	41	49	51	48	53	50	32	17	46	39	40	38	47	45	44	39	50	47	47	43
H01	65	60	39	29	31	39	43	40	47	44	35	20	29	22	37	40	41	37	39	38	47	41	42	38
Rec01	65	60	36	27	29	37	43	40	44	41	38	22	29	26	34	38	38	34	37	36	45	38	40	36

Yellow highlighted values indicate levels exceeding NMLs for day time works outside standard hours of construction, Red highlighted values indicate levels above NMLs for day time works during standard hours of construction.

Construction activities during night time hours

Activities 04 (compound stockpiling activities) and 10B (M2 Motorway signage removal) are programmed to take place during night time hours. Predicted results at each receiver from these activities are summarised below in Table 6-4. Predictions exceeding the night time NML have been highlighted in yellow and levels above the night time NML and sleep disturbance criteria are shown in red. The sleep disturbance awakening criterion is expressed by the $L_{A1,\ (1\ minute)}$ descriptor, whereas the predictions are in the form of $L_{eq\ 15\ minute}$. Considering an estimation that the $L_{A1,\ (1\ minute)}$ is conservatively considered to be around 10 dB(A) higher than the predicted $L_{eq\ 15\ minute}$ values, where levels greater than 55 dB(A) have been predicted in Table 6-4, sleep disturbance impacts may occur.

Table 6-4 Predicted noise levels $L_{eq\ 15\ minute}$ dB(A) for night time activities 04 and 10B

Rec	Night time NMLs	Sleep disturbance awakening criterion	Predicted noise level d(BA) for each construction activity	
			4*	10B
R01	45	55	55	43
R02	45	55	62	47
R03	45	55	65	51
R04	45	55	59	49
R05	45	55	37	47
R06	45	55	52	36
R07	45	55	51	44
R08	45	55	53	44
R09	45	55	53	44
R10	45	55	44	44
R11	45	55	50	45
R12	45	55	47	43
R13	45	55	34	32
R14	45	55	51	40
R15	45	55	42	39
R16	45	55	42	40
R17	45	55	42	40
R18	45	55	42	40
R19	45	55	41	40
R20	45	55	41	40
R21A	45	55	46	51
R21B	45	55	47	53
R21C	45	55	47	53
CI01	70	-	39	40
CI02	70	-	40	41
CI03	70	-	42	43
CI04	70	-	50	54
CI05	70	-	56	57
CI06	70	-	50	57
CI07	70	-	53	51
CI08	70	-	54	49
CI09	70	-	49	44
H01	65	-	39	39
Rec01	65	-	37	37

Activity 04 considers the unloading and stockpiling of imported materials but not the movement of the delivery vehicles through the site. Considering a typical sound exposure level (SEL) for a delivery truck passby of around 92 dB(A) (from previous Jacobs measurements) and a frequency of around 4 passbys every 15 minutes; levels at the nearest receiver (R21A), an $L_{Aeq\ 15\ minute}$ result of around 26 dB(A) was predicted. Noting that these levels are more than 10 dB(A) below the unloading and stockpiling predictions (activity 04), no cumulative impacts are expected.

6.2 Construction vibration

Some vibration-intensive equipment is planned to be used during the proposal including jackhammers, pile boring equipment and vibratory rollers. Relevant recommended safe setback distances from the DCNVG for these plant and equipment have been reproduced below.

Table 6-5 Recommended safe working distances for vibration-intensive plant and equipment, (DCNVG, Roads and Maritime 2015 (Draft))

Plant	Rating / description	Safe working distance (meters)	
		Cosmetic damage (BS7385-2: 1993)	Human response (DECC, 2006)
Vibratory Roller	<50 kN (typically 1-2 t) <100 kN (typically 2-4 t) <200 kN (typically 4-6 t) <300 kN (typically 7-13 t) >300 kN (typically 13-18 t) >300 kN (> 18 t)	5 metres 6 metres 12 metres 15 metres 20 metres 25 metres	15 m to 20 metres 20 metres 40 metres 100 metres 100 metres 100 metres
Pile boring	≤800 mm	2 metres	4 metres
Jackhammer	Hand held	1 metres	2 metres

There is the potential for these safe setback distances to be encroached should earthwork preparation activities (activity 07) be required within around 40 metres of receivers R01, R02, R03, R04 and R05. Alternative ground preparation methods or monitoring and surveys may be required to limit or manage impacts during such works in these areas. Vibratory rolling activities are not expected to result in exceedances at receivers during works at any other areas of the proposal site.

Activities involving jackhammer and pile boring or soil nailing equipment are set a sufficient distance from receivers so as that vibration impacts arising from these plant and equipment are not expected.

Using prediction methods from the *FTA Guidance Manual for Transit Noise and Vibration Impact Assessment*, (US Federal Transit Administration, 2006) and BS 5228-1:2009, velocities from vibration-intensive equipment were calculated to be well below the 3 mm/s criterion at the two heritage structures (Shrimptons Creek indigenous rock shelter with rock art and Macquarie University ruins) identified within the vicinity of the proposal.

6.3 Construction traffic noise

Traffic volume data from the reports *M2 Park Development Acoustic constraints and options study,* (Jacobs, December 2014) and *M2 Motorway Remedial Work near Vimiera Road, Marsfield Review of Environmental Factors,* (EnviroPlan Pty Ltd, July 2013) indicates typical AM and PM traffic flows along the M2 Motorway of around 2000 vehicles in each direction (i.e. eastbound and westbound) with a heavy vehicle proportion of approximately 5 per cent. Considering the comparatively small volume of additional construction traffic expected to be generated by the proposal (approximately 16 heavy vehicle movements per hour), the change in resulting traffic noise levels are not expected to exceed the 2 dB(A) relative increase criterion.

Prior to the development of the permanent access off the M2 Motorway, an existing access track off Leisure Close would temporarily be used to bring plant and equipment onto the site for the vegetation clearance phase of construction. Once the plant and equipment has been received at the site the track would only be used by workers moving to and from the site. It is estimated less than ten vehicle movements would pass along this

track per day during the six to nine week period that it would be in-use. As such impacts associated with the use of this track are expected to be negligible.

6.4 Operational noise

The permanent access point which would be established off the M2 Motorway would only be used for maintenance vehicles during the operational phase of the proposal. The frequency of vehicles expected to use this access point is expected to be of the order of around 2 movements per month and as such are not expected to impact upon operational traffic noise conditions.

7. Safeguards and management measures

The following safeguards and management measures have been developed to specifically manage potential impacts which have been predicted as a result of the proposed works. These measures should be incorporated into a Construction Environmental Management Plan (CEMP) during construction.

Table 7-1 Recommended safeguards and management measure during construction

Impact	Environmental safeguards	Responsibility	Timing
CN01 – Noise impacts during day time construction activities	-Select low-noise plant and equipment. Ensure equipment mufflers operate in a proper and efficient manner. -Where possible, use quieter and less vibration emitting construction methods. -Only have necessary equipment on-site and turn off when not in use. -Ensure all plant and equipment is well maintained and where possible, fitted with silencing devices. -Implement training to induct staff on noise sensitivities associated with the proposal.	Contractor	During construction
CN02 – Noise impacts during night time construction activities	- Wherever possible, carry out works during Standard Working Hours. If this is not possible, try to complete any noisy work before 10pm. -Wherever possible make use of screening features (e.g. stockpiles) during materials transport, unloading and stockpiling activities. -Limit on-site speed limits to 20 kilometres per hour or less. -Arrange internal haulage routes in a manner which eliminates the need for reversing (i.e. limit reverse alarm noise). -Use wheel wash rather than rumble grid facilities to remove debris from vehicles at site access points. -Take care to avoid banging of truck tail gates during unloading activities. -Contact the potentially affected sensitive receivers by letter and inform them of the proposed works, location, type of work, days and dates of works and hours involved. The contact should be made at least 5 days prior to commencement of any works. - Conduct more detailed consultation with receivers R01 to R04 and R21 which may experience sleep disturbance impacts. -Implement measures commensurate with the extent of residual exceedance as described in Table C.1 of the DCNVG. This is likely to include validation monitoring, more targeted consultation and programmed respite periods during the 10 week materials importation period. -Avoid cumulative impacts associated with night time activities 04 and 10B by scheduling them for separate dates.	Contractor	During construction
CV01 – Cosmetic building and	Use alternative, non-vibratory equipment when	Contractor	During construction

Impact	Environmental safeguards	Responsibility	Timing
human health vibration impacts at receivers R01 to R05	conducting earthwork preparation activities within 50 metres of receiver R01 to R05. Or If vibratory rolling equipment is necessary within 50 metres of these premises, conduct detailed inspections including the preparation of a written and photographic report to document the structural condition prior to and after the completion of the activities. Complete monitoring vibration monitoring during the works to verify that cosmetic building and human comfort criterion are not being exceeded.		

8. Conclusion

A quantitative assessment was completed to determine potential construction noise and vibration impacts associated with a proposal to restore, revegetate and improve conditions at a site along the M2 Motorway known as the M2 Macquarie Park Motorscapes project.

Regarding construction noise, limited impacts were predicted during day time construction activities with levels exceeding the ICNG 'highly affected' criterion of 75 dB(A) were not predicted to occur at any nearby receiver during the proposal. Measures to manage and limit these low-level impacts predicted were recommended with consideration to guidance presented in the ICNG, *Environmental Noise Management Manual* (ENMM), (RTA, 2001) and DCNVG.

Levels during night time activities were predicted to exceed NMLs at several locations, with sleep disturbance impacts expected at a small number of receivers (R01 to R04 and R21) during the different stages of activities proposed at night. Safeguards including work practices and consultation, as well as additional measures commensurate with residual impacts as prescribed in Table C.1 of the DCNVG were recommended to control impacts associated with these activities.

Owing to comparatively high levels of existing traffic along the M2 Motorway, noise arising from construction traffic movements were not anticipated to result in changes in levels of more than 2 dB(A) at surrounding receivers. The low number of traffic movements along the access track off Leisure Close during the vegetation clearance phase of the project were also expected to result in negligible impacts.

Vibration levels expected to be generated during construction were evaluated against the safe setback distances recommended in the DCNVG. This assessment identified that vibrations generated during construction were not expected to be an issue, with the exception of earthwork preparation activities within 50 metres of receiver R01 to R05. Options to mitigate impacts whilst conducting earthwork preparation works within this area were recommended including alternative work methods or dilapidation surveys and monitoring.

The permanent access point to be established for maintenance vehicles off the M2 Motorway is not expected to result in any changes to operational traffic noise at surrounding receivers.