6. Environmental assessment

6.1 Noise and vibration

A noise and vibration assessment was undertaken by Renzo Tonin & Associates in June 2012 to assess the potential noise and vibration impacts during construction and operation of the proposal. A full copy of the report is provided in Appendix F and a summary is provided below.

6.1.1 Methodology

The noise and vibration assessment takes into consideration the RMS *Environmental Noise Management Manual* (RTA, 2001) and the following NSW Office of Environment and Heritage publications:

- *Road Noise Policy 2011*
- *Interim Construction Noise Guideline*
- *Assessing Vibration: A Technical Guideline*
- *NSW Industrial Noise Policy 2000.*

The study area for the noise and vibration assessment captured residents within the 50 dB(A) noise contour which included the first and second row of residential receivers along the eastern and western sides of Alfords Point Road. Beyond this distance the predicted operational noise levels would be below 50 dB(A).

Sensitive noise receivers and noise catchment areas (areas with a similar acoustic environment) where identified for the proposal and background noise monitoring was undertaken. Background noise monitoring was conducted between 24 November and 5 December 2011. Originally three noise monitoring locations were selected as representative of the different groups of receivers along Alfords Point Road. A fourth location was monitored during June 2012 after noise monitoring data at location three seemed inconsistent with the other locations, and a fifth location was monitored during December 2012 to represent receivers surrounding the proposed heavy vehicle inspection bay. The five noise monitoring locations are shown in Figure 6-2, Figure 6-3 and Figure 6-4, and described below:

- Location 1 (2 Nallada Road) – Located towards the northern end of the proposal site on the western side of Alfords Point Road. Houses in this area are elevated approximately 15 metres above Alfords Point Road. Line of sight to the road is partially obstructed due to the road being within a cutting
- Location 2 (26 Lemongum Place) – Located towards the southern end of the proposal site on the western side of Alfords Point Road. Houses in this area are behind the existing noise wall that runs along Alfords Point Road from Brushwood Drive to Jarrah Close
- Location 3 (76 Sylvan Ridge Drive) – Located on the eastern side of Alfords Point Road. Receivers in the area have similar elevation to the road and have relatively unobstructed views of Alfords Point Road
- Location 4 (88 Sylvan Ridge Drive) – Located on the eastern side of Alfords Point Road. Receivers in the area have similar elevation to the road and have relatively unobstructed views of Alfords Point Road
- Location 5 (7 Lee Place) – Located on the eastern side of Alfords Point Road near the proposed heavy vehicle inspection bay. The inspection bay is located within a deep cutting underneath the Old

Illawarra Road overpass which provides noise shielding to residences on the eastern side of Alfords Point Road.

A summary of the background noise monitoring results are provided in Table 6-2. Noise modelling for the proposal was verified by comparing measured traffic background noise levels with modelled traffic noise levels for existing road conditions (refer Table 6-17).

6.1.2 Existing environment

The proposal is located between the residential areas of Alfords Point and Illawong where residential properties are predominantly exposed to existing road traffic noise from Alfords Point Road and Brushwood Drive. A total of 158 residential receivers are located within the noise and vibration assessment study area and therefore have the potential to be impacted by construction and operation noise and vibration. An existing 3.2 metre high noise wall is located on the western boundary of the road corridor from the Brushwood Drive on ramp to a distance about 600 metres north (refer Figure 6-1). A gap in the noise wall at the end of Eucalyptus Street allows access to the bus stop on the Brushwood Drive on ramp.

Figure 6-1 Location of existing noise barrier

The closest residential receivers to the proposal are residences between Stringy Bark Place and Brushwood Drive on the western side of Alfords Point Road (between 10 and 80 metres from the proposal) and between Maxwell Close and Brushwood Drive on the eastern side of Alfords Point Road (between 10 and 80 metres from the proposal). The closest non-residential sensitive receivers to the proposal are shown in Figure 1-1 and include:

- Alfords Point Pre School - located at 2 Hickory Close
- Alfords Point Primary School - Located at 2C Brushwood Drive, Alfords Point
- Sir Thomas Mitchell Aged Care Facility – adjacent to the Illawong/Alfords Point off ramp.

To assess the potential noise impacts of the proposal, residential areas adjoining the proposal site were divided into Noise Catchment Areas (NCAs). NCAs are areas that are likely to have similar noise exposures due to factors such as topography, road design (cuttings, embankments and intersections), setbacks and types of residences. A description of the NCAs is provided in Table 6-1 and their locations are shown in Figure 6-2 and Figure 6-3.

Table 6-1 Noise catchment areas

NCA	Number of residential receivers	NCA description
1	24	Stringybark Place to Nallada Place on the western side of Alfords Point Road. NCA 1 is elevated from Alfords Point Road and has no existing noise wall. An Ausgrid easement separates NCA 1 and NCA 2.
2a	52	Tallowwood Close to Jarrah Close on the western side of Alfords Point Road. NCA 2a is similar in elevation to Alfords Point Road and has no existing noise wall.
2b	35	Watergum Place to Ribbon Gum Close on the western side of Alfords Point Road. NCA 2b is similar in elevation to Alfords Point Road and is behind an existing 2.7 to four metre high noise wall.
3	12	Shore Close to Sand Place on the eastern side of Alfords Point Road. NCA 3 is similar in elevation to Alfords Point Road. There is no existing noise wall.
4	35	Mariner Road to Maxwell Close on the eastern side of Alfords Point Road. NCA 4 varies in elevation compared to Alfords Point Road, with some areas similar in elevation and some areas lower in elevation. There is no existing noise wall.

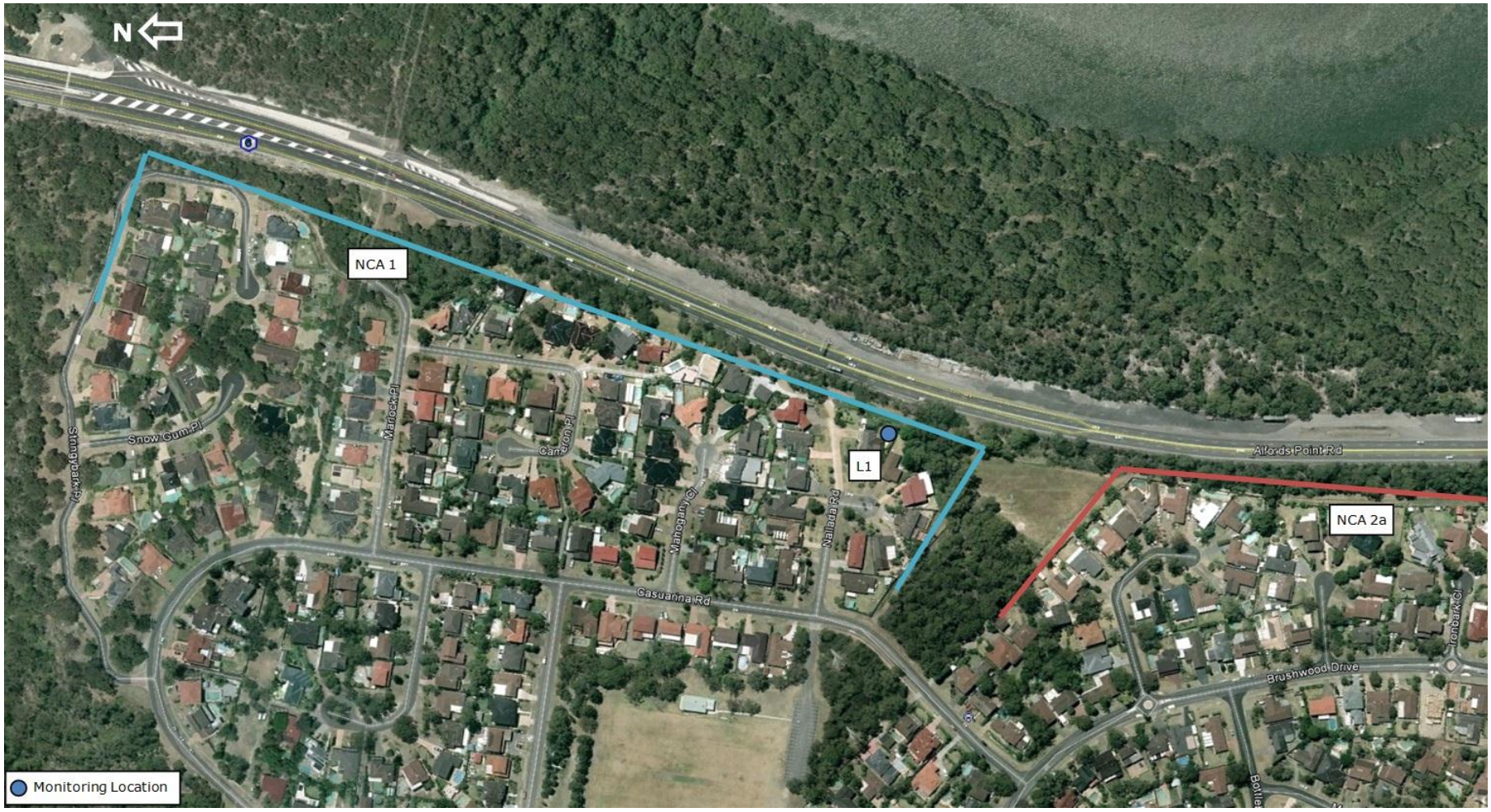


Figure 6-2 Noise catchment areas and monitoring locations (NCA 1 and 2a)

Figure 6-3 Noise catchment areas and monitoring locations (NCA 2b, 3 and 4)

The proposed heavy vehicle inspection bay would be located beneath the Old Illawarra Road overbridge. The nearest sensitive receivers to the Old Illawarra Road overbridge at about 60 metres from the proposal are shown in Figure 6-4 and include:

- R1 – residences in Gerald Road and Lee Place (east of the inspection bay)
- R2 – residence between Alfords Point Road and Old Illawarra Road (north of the inspection bay)
- R3 – residences in Travis Place (west of the inspection bay)
- R4 – residences in Bachli Place (north of the inspection bay, some still under construction).

Figure 6-4 Location of sensitive receivers nearest the heavy vehicle inspection bay

A summary of the background noise monitoring results is provided in Table 6-2.

Table 6-2 Background noise monitoring results dB(A)

Monitoring location	L_{Aeq} traffic noise level		L_{A90} background noise level		
	Day[1]	Night[2]	Day	Evening[3]	Night
Location 1	66	62	56	51	37
Location 2	59	56	50	47	48
Location 3	59	55	52	46	31
Location 4	62	58	57	52	35
Location 5			48	44	31

Notes: 1. Day-time is 7am to 6pm

2. Night-time is 10pm to 7am

3. Evening is 6pm to 10pm

6.1.3 Noise and vibration criteria

Construction noise criteria

The NSW Office of Environment and Heritage *Interim Construction Noise Guideline* (ICNG) (DECC, 2009) sets out noise management levels for construction projects in NSW. The construction noise management level is determined using the rating background level (RBL) for the relevant assessment period (ie during or outside recommended construction hours). Table 6-3 provides the ICNG noise management levels for noise affected and highly noise affected residences during recommended standard hours of construction (OEH, 2009).

Table 6-3 ICNG noise management levels

Time of day	Management level $L_{Aeq\ (15\ min)}$ [1]	How to apply
Standard hours: Monday to Friday 7am to 6pm and Saturday 8am to 1pm. No work on Sundays or public holidays	Noise affected RBL + 10 dB(A)	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.
	Highly noise affected 75 dB(A)	Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that noisy activities can occur.
Outside standard hours	Noise affected RBL + 5 dB(A)	A strong justification is typically required for works outside the recommended standard hours of construction. The proponent should apply all feasible and reasonable work practices to meet the noise affected level.

Note 1. Noise levels apply at the property boundary that is most exposed to construction noise. If the property boundary is more than 30 metres from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 metres of the residence.

Based on the rating background noise levels measured during noise monitoring, the construction noise management levels applicable to residences potentially affected by the proposal are summarised in Table 6-4.

Table 6-4 Construction noise management levels for residences

Time of Day	ICNG management level $L_{Aeq(15min)}$	Proposal management level $L_{Aeq(15min)}$, dB(A)				
		NCA 1	NCA 2a	NCA 2b	NCA 3	NCA 4
During recommended standard hours (day)	RBL + 10 dB(A)	66	60	60	57	57
Outside recommended standard hours (evening)	RBL + 5 dB(A)	56	52	52	51	51
Outside recommended standard hours (night)		42	53	53	36	36

Table 6-5 provides the ICNG noise management levels for non-residential sensitive receivers within the study area.

Table 6-5 Construction noise management level for non-residential sensitive receivers

Land use	Management level $L_{Aeq(15\ min)}$
Classrooms at school	Internal noise level = 45 dB(A)
Place of worship	Internal noise level = 45 dB(A)
Passive recreation areas	External noise level = 60 dB(A)

As a general rule, building structures would typically provide a minimum of 10 dB(A) reduction from external noise levels to internal noise levels. Therefore, the equivalent external management noise level for the internal areas of the schools is 55 dB(A). The outdoor play areas of the schools are classified as passive recreation areas with a management level of 60 dB(A) in accordance with Table 6-5.

Construction vibration criteria

Human comfort

The OEH *Assessing Vibration: a technical guideline 2006* provides criteria for assessing construction vibration disturbance to humans within buildings. Vibration sources during construction can be continuous, impulsive or intermittent. The preferred and maximum values for continuous and impulsive vibration, as defined in *Assessing Vibration; a technical guideline 2006,* are provided in Table 6-6.

Table 6-6 Preferred and maximum vibration criteria for human discomfort (m/s^2)

Location	Assessment period[1]	Preferred values		Maximum values	
		z-axis	x- & y-axis	z-axis	x- & y-axis
Continuous vibration					
Residences[2]	Day	0.010	0.0071	0.020	0.014
	Night	0.007	0.005	0.014	0.010
Offices, schools, educational institutions & places of worship	Day or night	0.020	0.014	0.040	0.028
Impulsive vibration					
Residences[2]	Day	0.30	0.21	0.60	0.42
	Night	0.10	0.071	0.20	0.14
Offices, schools, educational institutions & places of worship	Day or night	0.64	0.46	1.28	0.92

Note: 1. Daytime is 7am to 6pm and night-time is 10pm to 7am

2. The criteria for residences also applies to aged care facilities

Intermittent vibration is assessed using vibration dose values. The vibration dose values can be calculated using the acceleration of the vibrating source in each axis and the total period during which the vibration may occur. The preferred and maximum vibration dose values as per the *Assessing Vibration; a technical guideline 2006* are provided in Table 6-7.

Table 6-7 Intermittent construction vibration criteria for human discomfort

Location	Daytime values[1]		Night-time values[1]	
	Preferred	**Maximum**	**Preferred**	**Maximum**
Residences[2]	0.20	0.40	0.13	0.26
Offices, schools, educational institutions & places of worship	0.40	0.80	0.40	0.80

Notes: 1. Daytime is 7am to 6pm and night-time is 10pm to 7am

2. The criteria for residences also applies to aged care facilities

Structural damage

There is currently no Australian Standard for the assessment of building damage caused by construction vibration. However, the British Standard 7385: Part 2 *Evaluation and measurement of vibration in buildings* can be used as a guide to assess the likelihood of building damage from ground vibration. The German Standard DIN 4150 - Part 3 - *Structural vibration in buildings - Effects on structures* also provides recommended maximum levels of vibration to reduce the likelihood of building damage caused by vibration. This standard recommends maximum limits over a range of frequencies measured at the foundation of the uppermost floor. The minimum 'safe limit' of vibration at low frequencies for residential dwellings is five millimetres per second. Table 6-8 summarises the German Standard DIN 4150 minimum safe levels of vibration at different frequencies for residential dwellings.

Table 6-8 Vibration criteria for structural damage

Type of structure	Vibration velocity at foundation (mm/s)			Vibration velocity uppermost storey (mm/s)
	>10Hz	**10Hz-50Hz**	**50Hz-100Hz**	**All frequencies**
Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15

Operational noise criteria

Road traffic noise

The *NSW Road Noise Policy* (Department of Environment Climate Change and Water (DECCW, 2011)) provides traffic noise assessment criteria for particular types of roads and land uses. Under the *Road Noise Policy*, Alfords Point Road is considered an arterial road and the proposal is considered a road redevelopment. The *Road Noise Policy* criteria for residential receivers affected by noise from the redevelopment of an arterial road are provided in Table 6-9. For the purpose of this assessment an acute

noise impact is considered greater than $L_{Aeq,15hr}$ 65 db(A) during day-time hours and greater than $L_{Aeq,9hr}$ 60 db(A) during night-time hours.

Table 6-9 *Road Noise Policy* road traffic noise assessment criteria for residential receivers

Road category	Type of project/land use	Assessment criteria, dB(A)	
		Day (7am-10pm) $L_{Aeq,15\ hour}$	Night (10pm-7am) $L_{Aeq,9\ hour}$
Freeway/ arterial/ sub-arterial roads	Existing residences affected by noise from redevelopment of existing freeway / arterial/sub-arterial road	60 (external) [1]	55 (external)[1]

Note 1. The external criteria for residential receivers also applies to aged care facilities

The *Road Noise Policy* also sets guidelines for the assessment of road traffic noise on non-residential sensitive land uses such as schools, hospitals, places of worship and recreation areas. Based on the identified sensitive land uses within the study area, the applicable road traffic noise criteria for the proposal are provided in Table 6-10.

Table 6-10 *Road Noise Policy* noise criteria for non-residential sensitive land uses

Type of development	Assessment criteria dB(A)	
	Day (7am - 10pm)	Night (10pm - 7am)
School classrooms	$L_{Aeq(1\ hour)}$, 40[1] (when in use)	-
Open space (passive use)[3]	$L_{Aeq(15\ hour)}$ 55[2] (when in use)	-
Open space (active use)	$L_{Aeq(15\ hour)}$ 60[2] (when in use)	-

Notes 1. Internal noise criteria

2. External noise criteria

3. Passive open spaces applicable to school playgrounds

For a conservative assessment, a minimum of 10 dB(A) reduction from external noise levels to internal noise levels has been adopted. Therefore, the equivalent external noise criteria for school classrooms is $L_{Aeq(1\ hour)}$ 50 dB(A).

Relative noise increase

Under the *Road Noise Policy*, the traffic noise impact from the proposal also needs to consider the 'relative increase criteria'. The relative noise increase is the increase in total traffic noise level at a location due to the proposal (ie the relative increase is the noise contribution from the project above the existing background noise level). The relative increase criterion applicable to the proposal, as set out in the *Road Noise Policy,* is provided in Table 6-11.

Table 6-11 Relative increase noise criteria

Type of development	Total traffic noise level increase dB(A)
Redevelopment of existing road	Existing traffic $L_{Aeq(period)}$ +12 dB (external)

Sleep disturbance noise criteria

The *Road Noise Policy* does not specify a night-time L_{max} noise limit or noise goal. Night-time maximum noise levels are usually associated with sleep disturbance and subsequent health effects. According to the policy however, the likely maximum or peak noise levels are to be broadly assessed and reported for the night-time period, which is considered between 10pm and 7am.

Heavy vehicle inspection bay

There are no specific criteria for addressing noise from heavy vehicle inspection bays. For the purpose of this assessment, the potential noise impacts of the heavy vehicle inspection bay have been assessed against the NSW *Industrial Noise Policy* (INP) (Environment Protection Authority 2000). The assessment procedure under the *Industrial Noise Policy* has two components:

- Controlling intrusive noise impacts in the short term for residences
- Maintaining noise level amenity for residences and other land uses.

To assess the intrusiveness impact of the inspection bay in accordance with the *Industrial Noise Policy* the intrusiveness criterion is five dB(A) above the measured background level. Therefore, the applicable criteria for the proposal is 53 dB(A) during the day, 49 dB(A) during the evening and 36 dB(A) during the night. Assessment of the inspection bay against the amenity criteria is not suitable as noise events from the inspection bay would be short-duration and occur infrequently.

The use of the heavy vehicle inspection bay during the night-time hours (between 10 pm and 7 am) may result in sleep disturbance impacts. To assess the potential for sleep disturbance during the night time period the INP outlines a maximum noise level criteria of background + 15 dB(A). Therefore, the applicable criteria for the proposal would be 46 dB(A). An upper limit criteria of 65 dB(A) also applies which is an internal limit where noise levels are likely to cause awakening reactions.

6.1.4 Potential impacts

Construction

Construction noise

Typical plant and equipment that is likely to be used during construction of the proposal is summarised in Section 3.4.4. Table 6-12 lists the sound power levels associated with the plant and equipment likely to be used during construction.

Table 6-12 Typical construction equipment sound power levels

Plant description	L_{Aeq} sound power levels dB(A)	Plant description	L_{Aeq} sound power levels dB(A)
Rock breaker	117	Tracked excavator	107
Concrete saw	115	Grader	107
Rock screening unit (recycling)	114	Concrete truck	106
Drilling rig	111	Dump trucks	105
Mobile crane	110	Rollers	104
Rock crusher (recycling)	110	Truck (>20 tonne)	103

Plant description	L_{Aeq} sound power levels dB(A)	Plant description	L_{Aeq} sound power levels dB(A)
Compactor	110	Concrete pump	102
Front end loader	110	Backhoe	101
Pavement laying machine	109	Power generator	100

Table 6-13 provides the predicted construction noise levels that would be experienced at receivers during each phase of construction. Noise levels were calculated taking into consideration attenuation due to distance and shielding from surrounding buildings and structures.

For the assessment of construction noise, representative locations from the first and second row of residential receivers have been considered for each NCA. For demolition of concrete pavement, it is assumed that rock breaking and concrete sawing would not occur concurrently and as such have been listed as separate activities.

Table 6-13 Predicted construction noise levels, dB(A)

Activity	NCA1		NCA2		NCA3		NCA4		NCA5	
	Row 1	Row 2	Row 1	Row 2	Row 1	Row 2	Row 1	Row 2	Row 1	Row 2
External criteria Day	*66*	*66*	*60*	*60*	*60*	*60*	*59*	*59*	*59*	*59*
Evening	*56*	*56*	*52*	*52*	*52*	*52*	*52*	*52*	*52*	*52*
Night	*42*	*42*	*53*	*53*	*53*	*53*	*39*	*39*	*39*	*39*
Clearing	66	52	66	61	66	61	65	58	66	59
Utility adjustments	62	48	62	57	62	57	61	54	62	55
Concrete pavement demolition	67	53	67	61	67	62	66	58	67	60
Concrete pavement demolition (hydraulic hammers)	68	54	67	62	68	62	67	59	67	61
Bulk earthwork (hydraulic hammers)	69	55	69	63	69	64	68	60	69	62
Sub grade ripping and compaction	65	51	65	60	65	60	64	57	65	58
Material processing and screening	67	52	66	61	67	61	65	58	66	60
Drainage	65	51	65	59	65	60	64	57	65	58

Activity	NCA1		NCA2		NCA3		NCA4		NCA5	
	Row 1	Row 2	Row 1	Row 2	Row 1	Row 2	Row 1	Row 2	Row 1	Row 2
Pavement and concrete barrier construction	65	51	65	59	65	60	64	56	65	58
Street lighting installation	60	46	59	54	60	54	59	51	59	53
Signposting and line marking	61	46	60	55	61	55	59	52	60	54

Based on the predicted construction noise levels presented in Table 6-13 and the daytime construction noise management levels are generally exceeded for first row receivers. These exceedances vary depending on the construction activity and may reach as high as 10 dB(A) above noise management levels during concrete pavement demolition and bulk earthworks. Second row receivers are generally either not in exceedance or only slightly exceeded, by up to four dB(A).

Outside the recommended standard construction hours, noise management levels are generally exceeded at the external façade for both first and second row receivers. These exceedances are predicted up to 17 dB(A) for evening works, and up to 29 dB(A) for night works.

A feasible and reasonable approach to noise management would be required to minimise the impacts from construction noise as much as possible. Construction noise management measures are discussed in Section 6.1.5.

Construction site compounds

Two construction site compounds would operate during construction of the proposal as discussed in Section 3.5.1. The main compound would be between Alfords Point Road and the Illawong/Alfords Point off ramp. The secondary compound would be located south of the proposal between Old Illawarra Road and Alfords Point Road, near Rosewall Drive. The proposed hours of operation for the compounds would be the standard hours of operation outlined in Section 3.4.3. Activities associated with operation of the compounds that are likely to generate noise would include:

- Light and heavy vehicles movements
- Delivery and laydown of plant, equipment and material
- Maintenance of plant and equipment
- Mechanical plant associated with the site amenities.

The noise levels that would be experienced at sensitive receivers nearest the construction site compounds have been modelled and the results provided in Table 6-14. The construction noise goals that apply are based on background noise levels measured for the proposal in similar residential areas.

Table 6-14 Predicted noise levels from site compounds

Compound	Receiver	Distance to compound (m)	Day noise goal RBL+10 dB(A)	Predicted L_{Aeq} noise level dB(A)	Exceedance dB(A)
Main compound	5 Shore Road	60	60	61	1
	14 Ribbon Gum Close	45	60	61	1
Secondary compound	57 Jervis Drive	100	60	54	-
	1 Goolagong Place	65	60	59	-

Receivers nearest the main construction site compound are shielded by existing noise walls, boundary fences, and the Illawong/Alfords Point off ramp. The receivers to the east of the secondary construction site compound are shielded in part from the compound by the natural ground topography.

The exceedances shown in Table 6-14 are generally less than the exceedances predicted for the L_{Aeq} night-time assessment in Table 6-13. Noise mitigation and management measures would be implemented to minimise these noise criteria exceedances during operation of the construction site compounds (refer Section 6.1.5).

Construction vibration

Activities such as rock hammering, vibratory rolling excavating and compacting have the potential to cause human discomfort as well as structural damage to buildings. The relationship between vibration and the probability of causing human annoyance or damage to structures is influenced by the magnitude of the vibration source, ground conditions between the source and receiver, and the design of the structure in terms dimensions, materials, type and quality of construction and footing conditions. The intensity, duration, frequency content and number of occurrences of vibration, are all important aspects in both the annoyances caused and the strains induced in structures. Vibration generated by construction activities has been estimated at various distances and expected vibration impacts are shown in Table 6-15.

Table 6-15 Vibration generated from construction activities

Distance	Structural damage	Human disturbance
Less than 5 metres	Medium risk of structural damage as a result of vibratory rollers, compactors	High risk of adverse comment as a result of excavator, rock hammer, bulldozer, rollers and compactors
5 to 20 metres	Low risk of structural damage	Medium risk of adverse comment as a result of excavator, rock hammer, bulldozer, rollers and compactors
20 to 30 metres	Low risk of structural damage	Low risk of adverse comment

Distance	Structural damage	Human disturbance
30 to 60 metres	Very low risk of structural damage	Very Low risk of adverse comment
>60 metres	Very low risk of structural damage	Very Low risk of adverse comment

The nearest sensitive receivers to the proposal are located within Lemongum Place and Ribbon Gum Close in NCA 2b, and are generally 10 to 20 metres from the Brushwood Drive on ramp and bus bay. Due to the nature of works being carried out in this location such as pavement widening, the risk of structural damage is considered low. However, there is medium risk of human discomfort at these receivers as a result of vibration generated by excavator, rock hammer, bulldozer, rollers and compactors as the occupants may feel some vibration.

Recommendations for reducing potential vibration impacts, including minimum working distances for construction plant are provided in Table 6-16.

Table 6-16 Recommended buffer distances to avoid human discomfort during construction

Construction equipment	Minimum work distance (metres)	
	Structural damage	Human discomfort
Vibratory roller (1-18 tonne)	5-25	15-100
Dozer	2	10
Compactor	15	100
Excavator (less than 30 tonne)	10	15
Graders (less than 20 tonne)	2	10
Loaders	-	5
Small hydraulic hammer (5-12 tonne excavator)	2	7
Large hydraulic hammer (18-34 tonne excavator)	22	73
Jack hammer (hand held)	1	Avoid contact with structure
Truck movements	-	10

The buffer distances in Table 6-16 are for day-time hours between 7am and 10pm. Vibration producing activities such as rock hammering and compacting would not be undertaken out of hours. These buffer distances are unlikely to be breached during the majority of construction activities for the proposal and therefore structural damage is unlikely for all residences. Where any vibration producing construction plant are likely to breach these buffer distances, specific buffer distances would be determined once

vibration emission levels are measured from each plant item prior to the commencement of construction on site.

The majority of footings for residential buildings are greater than 40 metres from the proposal and therefore outside the minimum recommended buffer distances. The footings of residential receivers in NCA 2b are generally 10 to 20 metres from the Brushwood Drive on ramp and bus bay works. The nearest residences are those in Lemongum Place near the merge point off Brushwood Drive on ramp and Alfords Point Road northbound. If rock breaking is required in this area for pavement drainage excavation, the human comfort vibration limits would likely be exceeded for adjacent residences in Lemongum Place, including the Sir Thomas Mitchell Aged Care Facility. Accordingly, the mitigation measures outlined in Section 6.1.5 would be implemented.

Operation

Operational noise modelling

Road traffic noise predictions for the proposal were undertaken using the United Kingdom Department of Environment *Calculation of Road Traffic Noise 1988* (CoRTN). This method has been adapted to Australian conditions and extensively tested by the Australian Road Research Board. As a result, it is recognised and accepted by the Environment Protection Authority. Noise modelling for the proposal was verified by comparing measured traffic background noise levels with modelled traffic noise levels for existing road conditions. Table 6-17 provides the results of the noise modelling verification.

Table 6-17 Noise model verification, dB(A)

Location	$L_{Aeq,15hr}$ daytime noise level			$L_{Aeq,9hr}$ nigh time noise level		
	Measured	**Modelled**	**Variation**	**Measured**	**Modelled**	**Variation**
2 Nallada Road (NCA 1)	65.2	68.3	-3.3	60.9	61.1	-0.2
26 Lemongum Place (NCA 2a and 2b)	58.9	60.6	-1.7	55.3	53.6	1.6
76 Sylvan Ridge Drive (NCA 4)	59.5	61.8	-2.3	55.5	56.5	-1.0
88 Sylvan Ridge Drive (NCA 4)	62.3	65.4	-3.1	58.0	60.0	-2.1

The verification process indicated that noise modelling results are generally within acceptable tolerances and mostly conservatively high.

Operational noise modelling for the proposal was undertaken for the following scenarios:

- Opening year - noise levels are the levels produced by the 2016 traffic volumes for both ‘with the proposal’ and ‘without the proposal’ options
- Design year - noise levels are the predicted noise levels for 2026 for both ‘with the proposal’ and ‘without the proposal’ options.

Operational noise impacts

The $L_{Aeq,15hr}$ day and $L_{Aeq,9hr}$ night noise contours for the 2026 'with proposal' and 'without proposal' scenarios are presented in Appendix F. The noise contours assume no noise mitigation measures have been incorporated into the road development (other than existing noise barriers and boundary fences). A summary of the operational noise modelling results are provided in Table 10 of Appendix F and include:

- Existing noise levels at many properties already exceed the *Road Noise Policy* criteria of 60 dB(A) $L_{Aeq,15h}$ for day-time hours and/or 55 dB(A) $L_{Aeq,9h}$ for night-time hours
- The increase in noise levels between the design year 'without the proposal' and 'with the proposal' options is not more than two dB(A) at any residence and therefore the impact of the proposal is considered minimal
- Across the entire proposal, existing and design year noise levels were found to be 'acute' at 27 residential receivers during the day and 49 during the night, particularly at the upper level of double storey residences (refer Appendix D of Appendix F). Acute noise is considered greater than $L_{Aeq,15hr}$ 65 dB(A) during day-time hours and greater than $L_{Aeq,9hr}$ 60 dB(A) during night-time hours
- Although the road is being widened to the east, noise levels are predicted to reduce slightly at some properties in Sylvan Ridge Drive as a result of the proposal. This is due to the addition of a type F concrete barrier along the southbound carriageway between the road and the shared path. Although this barrier is low in height, the residences are at a lower elevation than the road and modelling indicated that this would provide some noise mitigation
- Two properties along the eastern side of Alfords Point Road in NCA 4 (88 and 90 Sylvan Ridge Drive) are predicted to be exposed to acute noise impacts. The acute noise impact level is due to there being no rear boundary fence at 88 Sylvan Ridge Drive, and 90 Sylvan Ridge Drive being located close to Alfords Point Road. It is noted that many of the remaining receivers on the eastern side are close to the acute noise level (refer Appendix E of Appendix F).
- The RNP relative noise criteria are unlikely to be exceeded as no sensitive receiver are likely to increase more than 12db(A) over the existing noise levels
- The primary school and pre-school within NCA2b are set well back from Alfords Point Road. While noise predictions indicate that noise levels would exceed the 50 dB(A) external criteria, this is an existing impact and noise levels would remain virtually unchanged as a result of the proposal
- The Sir Thomas Mitchell Aged Care facility is not anticipated to experience an increase in noise impacts as a result of the proposal during the day or night-time period. The *Road Noise Policy* criteria would not be exceeded (refer Table 10 of Appendix F).

Noise mitigation would be considered in accordance with RMS *Environmental Noise Management Manual 2001* where design year noise levels are acute, that is greater than $L_{Aeq,15hr}$ 65 dB(A) or $L_{Aeq,9hr}$ 60 dB(A), or where noise levels exceed the *Road Noise Policy 2011* criteria and have increased substantially (by more than two dB(A)) as a result of the proposal. Properties where further noise mitigation would be considered are listed in Table 9 of Appendix F. In addition to the properties listed in this table, RMS would include receivers on the eastern side of the proposal (from Maxwell Close to Brushwood Drive) in the investigation of feasible and reasonable noise mitigation measures due to the high number of receivers close to acute levels. This would include consideration whether a noise barrier is suitable for this length.

Maximum noise levels

Operation of the proposal may result in sleep disturbance and subsequent health impacts on residences. The *NSW Road Noise Policy 2011* does not specify a night time L_{max} noise limit or noise goal. The policy

does however require the likely maximum or peak noise levels to be broadly assessed and reported for the night time period, which is considered 10pm to 7am.

Unattended noise monitoring was undertaken at three locations along Alfords Point Road Point Road to establish the existing L_{max} traffic noise levels. The results of the monitoring are provided in Table 6-18. Maximum noise levels at night have been predicted using existing L_{max} noise level data and taking into consideration the existing noise walls and proposed road design.

Table 6-18 Maximum L_{max} night-time levels at monitoring locations, dB(A)

Monitoring location	Current L_{max} range	Predicted L_{max} range	$L_{max} - L_{eq}$ range
Location 1 (2 Nallada Road)	67 - 85	67 – 85	15 - 26
Location 2 (26 Lemongum Place)	66 - 91	66 – 91	15 - 33
Location 3 (76 Sylvan Ridge Drive)	65 - 78	66 - 79	15 - 25

As the proposal requires only a small change to the road width, the distances from vehicles to residences and therefore L_{max} noise levels are not expected to change substantially as a result of the proposal. L_{max} noise levels may increase by around one dB(A) at residences within NCA 3 and NCA 4 due to the road widening to the east, however no substantial change is predicted in other catchments.

As L_{max} noise levels would remain similar to current levels, no increase in sleep disturbance is anticipated as a result of the proposal.

The number of maximum noise events occurring on any night would be proportional to the volume of trucks on the road, and is not expected to change as a result of the proposal.

Heavy vehicle inspection bay

The proposal includes moving the existing heavy vehicle inspection bay to a new location under the Old Illawarra Road overpass.

Typical noise levels from activities that would occur during operation of the heavy inspection bay are summarised in the Table 6-19. These sound power levels for various activities allow the assessment of noise impacts against the *Industrial Noise Policy*. L_{Amax} noise levels are also provided in Table 6-19 to assess the potential for sleep disturbance.

Table 6-19 Typical sound power levels for activities at the heavy vehicle inspection bay

Activity	Sound power level, dB(A)	
	L_{eq}	L_{max} / L_1
Truck entering inspection bay	102	-
Truck exiting inspection bay	108	-
Truck idling and refrigeration condenser units on	96	-
Truck reverse signal	-	107

Activity	Sound power level, dB(A)	
	L_{eq}	L_{max} / L_1
Truck air brake release	-	116

Noise impacts from typical activities at the inspection bay were determined by modelling the noise sources, receiver locations and topographical features of the surrounding area. A typical truck inspection takes approximately five minutes, and generally only one truck is inspected at a time. Allowing time for changeover between the conclusion of one inspection and the beginning of the next, the worst case scenario for any 15 minute period was assumed as follows:

- Two trucks entering the inspection bay
- Two trucks idling continuously with mounted refrigeration equipment on and in use
- Two trucks exiting the inspection bay.

Based on the above worst case scenario, the predicted operational noise levels at the nearest affected receivers during the day and night-time periods are presented Table 6-20. The inspection bay is located within a deep cutting underneath the Old Illawarra Road overpass and the cutting itself provides noise shielding to residences, particularly on the eastern side of Alfords Point Road.

Table 6-20 Predicted L_{Aeq} noise levels at the heavy vehicle inspection bay

Receiver	*Industrial Noise Policy* criteria dB(A)			Predicted noise level $L_{aeq,\ 15min}$, dB(A)
	Day	Evening	Night	
R1 Gerald Road	53	49	36	36
R2 Old Illawarra Road				40
R3 Travis Place				39
R4 Bachli Place				42

Noise levels from operation of the heavy vehicle inspection bay are predicted to be within the *Industrial Noise Policy* day and evening criteria. The inspection bay is proposed to operate between 6 am and 6 pm, which falls during the night period under the *Industrial Noise Policy*. This shoulder period has background noise levels similar to daytime levels due to high levels of traffic during the morning peak. Therefore, noise emissions from the inspection bay between 6 am and 7 am would be within the *Industrial Noise Policy* criteria.

During the night, noise levels from operation of the heavy vehicle inspection bay are predicted to exceed the *Industrial Noise Policy* criteria. However, the night noise goal of 36 dB(A) outlined in Table 6-20 is conservative as it is determined from the low background noise levels measured in the middle of the night between about 1 am and 4 am. Therefore, while the criteria would be exceeded, the exceedance is only likely during the 1 am to 4 am period.

The operational hours of the inspection bay are proposed to be generally 6 am to 6 pm Monday to Saturday. This noise assessment shows that operation during these proposed hours would not exceed

the *Industrial Noise Policy* criteria. While there may also be inspections outside these hours, provided they are not during the quietest part of the night (between 1 am and 4 am), then the *Industrial Noise Policy* criteria would not be exceeded. Operation of the heavy vehicle inspection bay after 6 pm and before 6 am (and particularly during between 1 am and 4 am) would require strong justification (ie an emergency or safety situation) and compliance with RMS *Environmental Noise Management Manual Practice Note 7* would be required.

Sleep disturbance

The use of the heavy vehicle inspection bay during the night-time hours (between 10 pm and 7 am) may result in sleep disturbance impacts. For the assessment of sleep disturbance during the night time period, the following worst case scenario was assumed:

- One truck releasing air brakes on site
- One truck reversing with beeping alarm on site.

Based on the above worst case scenario, the predicted maximum noise levels at the receiver locations are provided in Table 6-21:

Table 6-21 Predicted heavy vehicle inspection bay maximum noise levels

Receiver	Criteria, dB(A)	Predicted L_{max}, dB(A)
R1 Gerald Road	31+15 = 46 (screening test) 65 (upper limit)	59
R2 Old Illawarra Road		60
R3 Travis Place		57
R4 Bachli Place		62

Maximum noise levels from the operation of the inspection bay are predicted to exceed the 'background + 15' criteria during the night-time period. However, the predicted noise levels are below the upper limit of 65 dB(A), which relates to an equivalent internal limit where noise levels are likely to cause awakening reactions.

Relocation of bus stop

The existing bus stop located near 14 Eucalyptus Street would be relocated 80 metres south from its current location. In terms of L_{Aeq}, the noise from a bus stopping or accelerating away from the new bus stop would be similar to a heavy vehicle passby on Alfords Point Road or Brushwood Drive on ramp. Furthermore, moving the noise wall opening seven metres to the south may affect noise levels experienced at receivers on Eucalyptus Street and Ribbon Gum Close. The houses nearest to the new bus stop location are already identified as having acute noise impacts from Alfords Point Road. During detailed design of the proposal, feasible and reasonable noise mitigation measures would be investigated for these dwellings as per the requirements of RMS *Environmental Noise Management Manual 2001 Practice Note 4*.

Operational noise mitigation options

Although the proposal is not expected to increase noise levels by more than two dB(A), 27 residences within the study area are already exposed to 'acute' noise levels during day-time hours and 49 during night-time. Therefore, an assessment of feasible and reasonable noise mitigation measures for these

residences is required. Final noise mitigation treatments would be determined during detailed design to allow for all design changes to be considered in the noise assessment. Nonetheless, the following recommendations provide in-principle noise control solutions to reduce noise impacts to residential receivers. In accordance with section 3.4.1 of the *Road Noise Policy,* feasible and reasonable mitigation measures have been considered in the following order of priority:

- Road design and traffic management
- Quieter pavement surfaces
- In-corridor noise barriers/mounds
- At-property treatments or localised barriers/mounds.

Road design and traffic management

During concept design development all feasible and reasonable traffic management and road design opportunities to reduce road traffic noise have been considered.

Quieter pavements

The RMS *Environmental Noise Management Manual* provides guidance on appropriate treatment of dwellings affected by traffic noise. Quiet road pavement surfaces such as stone mastic asphalt and open graded asphaltic concrete could be laid along the proposal length. At speeds of greater than 80 km/h, this treatment can provide a two to four dB(A) noise reduction at the source compared to standard pavements, although noise reductions are less for speeds less than 80 km/h. The posted speed limit for the proposal would be 80 km/h. There are also no intersections that would provide complications for maintenance. With this in mind, using a quieter pavement would be considered in the detail design.

Noise barriers

An existing noise wall is located on the western side of Alfords Point Road between Brushwood Drive and Jarrah Close. This noise wall is typically between 2.7 metres and four metres in height. The location of the existing noise wall to the west of Alfords Point Road is shown in Figure 3 of Appendix F.

The proposed new location of the noise wall opening at the end of Eucalyptus Street which provides access to the bus stop would be designed to have sufficient overlap to achieve noise reduction as per the RMS *Noise Wall Design Guideline* (RTA, 2006).

Noise barriers are most feasible where residences are closely grouped and where they are visually acceptable as outlined in the RMS *Environmental Noise Management Manual Practice Note 4*. Where driveway access is required it is preferred not to use noise barriers as the overall noise reduction provided by the barrier is compromised by the need to install an access gate.

A preliminary feasible and reasonable assessment of noise barriers as a noise mitigation option for acutely affected residences concluded the following:

- Dwellings within NCA 1 are at a higher elevation than the road and sit above a rock cutting. It is not likely to be feasible to construct a noise barrier at this location due to the topography. A noise barrier at the top of the cutting would also have visual impacts by blocking views
- In NCA 2a noise barriers may be feasible as residences back onto Alfords Point Road and there are no driveways or other obstructions. In NCA 2b there is already an existing noise barrier. Portions of this barrier may need to be relocated or adjusted as a result of works at the Brushwood Drive on ramp.
- Noise barriers are not reasonable for NCA 3 or 4 as there are only two residences in NCA 4 that have acute noise levels and there are none in NCA 3. However, as a high percentage of receivers

within noise catchments NCA 4 were identified as experiencing close to acute noise levels, RMS will consider noise barriers at this location. This would be determined during detailed design once a more detailed feasible and reasonable assessment is undertaken.

-

To assist with the ongoing consideration of noise barriers in NCA2a, a preliminary noise barrier analysis was conducted in accordance with RMS procedures to determine the 'target' and 'assessed' barriers, where;

- 'Target barrier' is the barrier that meets the *Road Noise Policy* noise goals
- 'Assessed barrier' is the barrier that provides the greatest marginal noise reduction benefit and the greatest benefit per unit area of barrier. This is the most cost-effective barrier.

Table 12 of Appendix F shows the noise barrier performance when the noise barrier is located on the roadside, approximately two metres from Alfords Point Road to allow space for landscaping. The barrier would be most effective when located on the roadside rather than at the residential property boundary as receiver levels are below the road level at the northern end of NCA 2a. The noise barrier analysis was conducted at the most affected receiver within the NCA and assessed the night-time scenario as this would be the worst case scenario. The results show that:

- The target barrier height is five metres
- The assessed barrier height is four metres.

Should a five metre noise barrier be installed along NCA 2a, no dwellings would require at-property treatment. However, should a four metre noise barrier be installed, then the balance of the dwellings remaining which are found to exceed the project noise goals should be considered for at-property noise mitigations.

If required, a detailed barrier analysis would be undertaken at the detailed design stage of the proposal to determine the optimum barrier height and at-property treatments considered where the existing barrier does not achieve the noise goals.

During the detailed design phase stage of the proposal, further investigation of all feasible and reasonable noise mitigation options would be undertaken in accordance with the Road Noise Policy for the receivers requiring noise mitigation measures. This would be done in consultation with the respective landowners to reduce traffic noise levels to within the applicable noise goals.

At-property treatment

At-property treatment would only be considered for dwellings where other noise mitigation measures are either exhausted or are not feasible or cost effective.

6.1.5 Safeguards and management measures

A construction noise and vibration management plan would be prepared and implemented to manage and mitigate adverse noise and vibration disturbance, taking into consideration the *Interim Construction Noise Guideline* (DECC, 2009) and the RMS *Environmental Noise Management Manual 2001*.

Environmental safeguards	Responsibility	Timing
An assessment of feasible and reasonable noise mitigation measures for operation of the proposal would be undertaken in accordance with the RMS *Environmental Noise Management Manual Practice Note 4*. This would include NCAs 1, 2a, 2b, 3 and 4.	RMS	Pre-construction (detailed design)

Environmental safeguards	Responsibility	Timing
A construction noise and vibration management plan would prepared and include, but not be limited to, the following: • Identification of potentially affected properties • A risk assessment to determine the potential for discrete work activities to affect receivers • A map indicating the locations considered likely to be impacted • Mitigation measures to reduce excessive noise during construction activities • A construction staging program incorporating a program of noise monitoring at sensitive receivers • A process for assessing the performance of the implemented mitigation measures • A process for resolving issues and conflicts • Consideration of the layout of construction compounds so that primary noise sources are at a maximum distance from residences, with solid structures (sheds, containers, etc) placed between residences and noise sources (and as close to the noise sources as is practical) • Compressors, generators, pumps and any other fixed plant located as far away from residences as possible and behind site structures • Where practical, equipment would be selected to minimise noise emissions. Equipment would be fitted with appropriate silencers and be in good working order. Machines found to produce excessive noise compared to normal industry expectations would be removed from the site or stood down until repairs or modifications can be made • Responsible working practices including: – Avoid the use of outdoor radios during the night-time period – Avoid shouting and slamming doors – Where practical, machines would be operated at low speed or power and switched off when not being used rather than left idling for prolonged periods – Minimise reversing – Avoid dropping materials from height and avoid metal to metal contact on material.	Construction contractor	Pre-construction

Environmental safeguards	Responsibility	Timing
Building condition surveys would be undertaken for any building, structure or utilities located within 20 metres of construction works. Where construction works are located within 10 metres of buildings, compliance vibration monitoring would be undertaken.	Construction contractor	Pre-construction
Works would be carried out during standard working hours (ie 7am–6pm Monday to Friday, 8am–1pm Saturdays). Any work that is performed outside normal work hours or on a Sunday or public holiday is to minimise noise impacts in accordance with RMS's *Environmental Noise Management Manual Practice Note 7 – Roadworks Outside of Normal Working Hours (RTA 2001)* and the *Interim Construction Noise Guidelines* (DECC 2009). This would include notifying the local community of any works planned to be undertaken outside standard construction hours.	Construction contractor	Pre-construction
The local community that could be affected by the proposed works would be contacted and informed of the proposed work, location, duration of work, and hours involved. The contact would be made a minimum five days prior to commencement of works.	Construction contractor and RMS	Pre-construction and construction
The Contractor would review their noise and vibration management plan in response to complaints and amended where practical throughout the construction phase. This would include consideration of respite periods	Construction contractor	Construction
Vibration producing activities such as rock hammering and compacting would not be undertaken during night works	Construction contractor	Pre-construction
During work hours, a community liaison phone number and site contact would be provided so that complaints can be received and responded to.	Construction contractor	Construction
Vibration testing would be undertaken on high risk plant to determine site specific buffer distances.	Construction contractor	Construction
Where vibration is found to exceed project criteria, management measures would be implemented to control vibration. In terms of human comfort criteria, measures would include modifications of construction methods and respite periods. For potential structural damage impacts, modification of construction methods would be necessary.	Construction contractor	Construction
If deemed necessary, attended compliance noise and vibration monitoring would be undertaken upon receipt of a complaint. Monitoring would be reported as soon as possible. In the case that exceedances are detected, the situation would be reviewed in order to identify means to minimise the impacts to residences.	Construction contractor	Construction
A noise monitoring program would be undertaken within 12 months of opening once traffic flows have stabilised in order to verify the predicted noise levels.	RMS	Post Construction

6.2 Biodiversity

A biodiversity assessment was prepared by GHD in August 2012 to assess the potential ecological impacts of the proposal. A copy of the assessment is provided in Appendix E and a summary is provided below.

6.2.1 Methodology

A desktop assessment was undertaken to identify threatened flora and fauna species, populations and ecological communities listed under the TSC Act and FM Act, as well as matters of national environmental significance (MNES) listed under the EPBC Act that may be affected by the proposal. Database records for the study area and locality (ie within a 10 kilometre radius of the study area) were reviewed and include:

- NSW Office of Environment and Heritage (OEH) Wildlife Atlas database for records of threatened species listed under the TSC Act (data supplied by OEH on 29 February 2012)
- Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) Protected Matters Online Search Tool for MNES listed under the EPBC Act and predicted to occur in the locality (database queried on 27 February 2012)
- Department of Primary Industries (DPI) Threatened Species Records Viewer (database queried 27 February 2012) for threatened species listed under the FM Act and recorded within the Sydney Metropolitan catchment
- Broad-scale vegetation mapping of south east NSW to identify threatened ecological communities mapped as occurring within the locality of the site (Tozer et al 2010).

Field surveys were conducted by ecologists between 27 and 29 February 2012. Survey techniques and effort were conducted with reference to the OEH *Threatened Species Survey Guidelines for Developments and Activities 2004* (DEC 2004). The field survey effort is shown in Figure 2 of Appendix E and included:

- Terrestrial flora survey including quadrat sampling surveys, on site vegetation mapping and targeted threatened flora surveys
- Terrestrial fauna survey including a fauna habitat assessment to identify potential shelter, basking, roosting, nesting and/or foraging sites, an assessment of hollow-bearing trees, diurnal bird surveys, nocturnal amphibian surveys, stationary Anabat recordings, spotlighting and opportunistic observations.

The habitat resources identified during the field survey were compared with the known habitat requirements of threatened and migratory biota identified in database searches. This was used to determine the likelihood of each threatened ecological community, endangered population and threatened or migratory species occurring within, or adjacent to, the proposal site.

6.2.2 Existing environment

Flora

Flora species

A total of 152 species of flora from 51 families were recorded during field surveys, comprising 101 native and 51 exotic species. The Poaceae (grasses, 27 species), Proteaceae (15 species, all native) and Asteraceae (daisies, 12 species, all exotic) were the most diverse families recorded. A full list of the

species recorded is presented in Appendix A of Appendix E. Species recorded are discussed below in relation to the vegetation communities occurring within the study area.

No threatened flora species were recorded during the field surveys. Desktop searches identified 31 threatened flora species listed under the TSC Act as previously recorded in the locality. Eleven of these 31 species were considered to have no potential to be present within the proposal site or be affected by the proposal as they are associated with specific habitat types that are not present in the study area. The other 20 threatened flora species previously recorded within the proposal site can be discounted as having potential to occur based on known distributions and/or the field survey effort undertaken (more detail relating to the assessment of likelihood of occurrence is provided in Appendix B of Appendix E).

The database searches identified 25 threatened flora species listed under the EPBC Act as potentially occurring in the study area. No threatened flora species listed under the EPBC Act were recorded within the study area. No threatened species are considered to have a potential to be present within the proposal site.

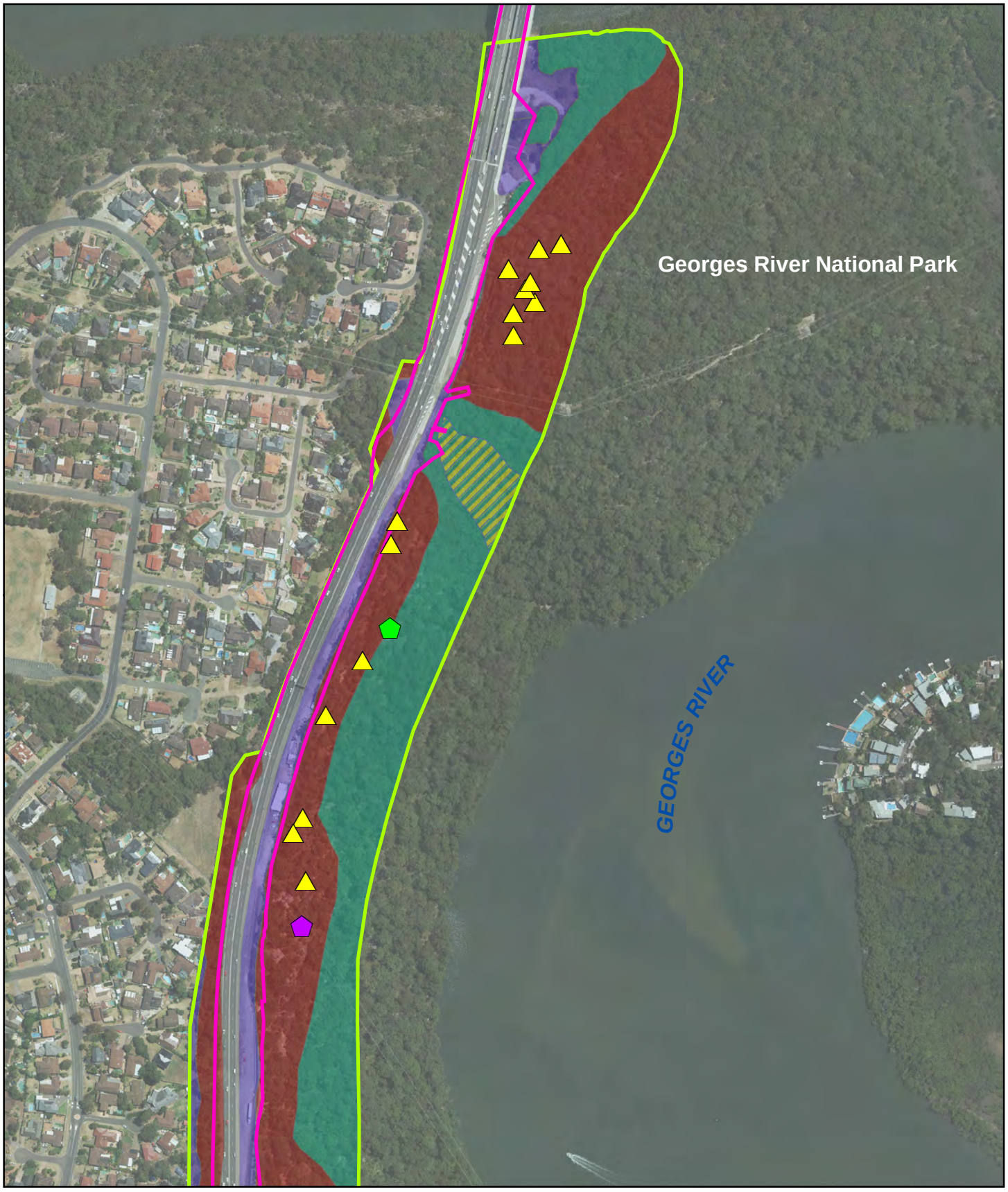
Vegetation communities

The majority of vegetation within the proposal site is exotic weed species. However, there is a thin strip of remnant native vegetation along the eastern edge, which is consistent with adjacent native vegetation that extends beyond the study area and into the Georges River National Park. Native vegetation within the proposal site contains moderate weed infestation due to disturbance and edge effects from construction of Alfords Point Road and associated road shoulders/shared path. Vegetation communities within the study area are shown in Figure 6-5 and described in Table 6-22 according to NSW Vegetation Types Database (DECCW, 2012).

One endangered ecological community listed under the TSC Act, Southern Sydney Sheltered Forest, occurs within the study area but does not occur within the proposal site. This community occurs along a gully that runs east from Alfords Point Road towards the Georges River (refer Figure 6-5). The Southern Sydney Sheltered Forest coincides with the Hinterland Sandstone Gully Forest vegetation community (ie is very similar and includes many of the same species), however only a portion of the Hinterland Sandstone Gully Forest vegetation community within the study area qualifies as Southern Sydney Sheltered Forest. Southern Sydney Sheltered Forest is likely to occur elsewhere in the locality surrounding the study area and this was directly observed and mapped during the field survey.

Database searches identified five threatened ecological communities listed under the EPBC Act as potentially occurring in the study area however none were observed in the study area during field surveys.

The closest mangrove area to the proposal is located along the shores of the Georges River, more than 100 metres from the proposal site.



LEGEND

- Yellow-bellied Sheathtail Bat (Saccolaimus flaviventris)
- Large-eared Pied bat (Chalinolobus dwyeri)
- Hollow-bearing Tree
- Proposal site
- Study Area
- Coastal Sandstone Ridgetop Woodland
- Exotic Shrubland
- Hinterland Sandstone Gully Forest
- Planted Natives
- Southern Sydney Sheltered Forest EEC

Note: Grey-headed Flying-fox (Pteropus poliocephalus) observed flying over at mulitiple locations

1:5,000 (at A4)

0 25 50 100 150 200

Metres

Geographic Coordinate System

Horizontal Datum: Geocentric Datum of Australia 1994

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Alfords Point Road REF

Job Number 21-21268

Revision E

Date 12 Feb 2013

Vegetation Communities, Threatened Biota and Habitat Features

Figure 6.5(a)

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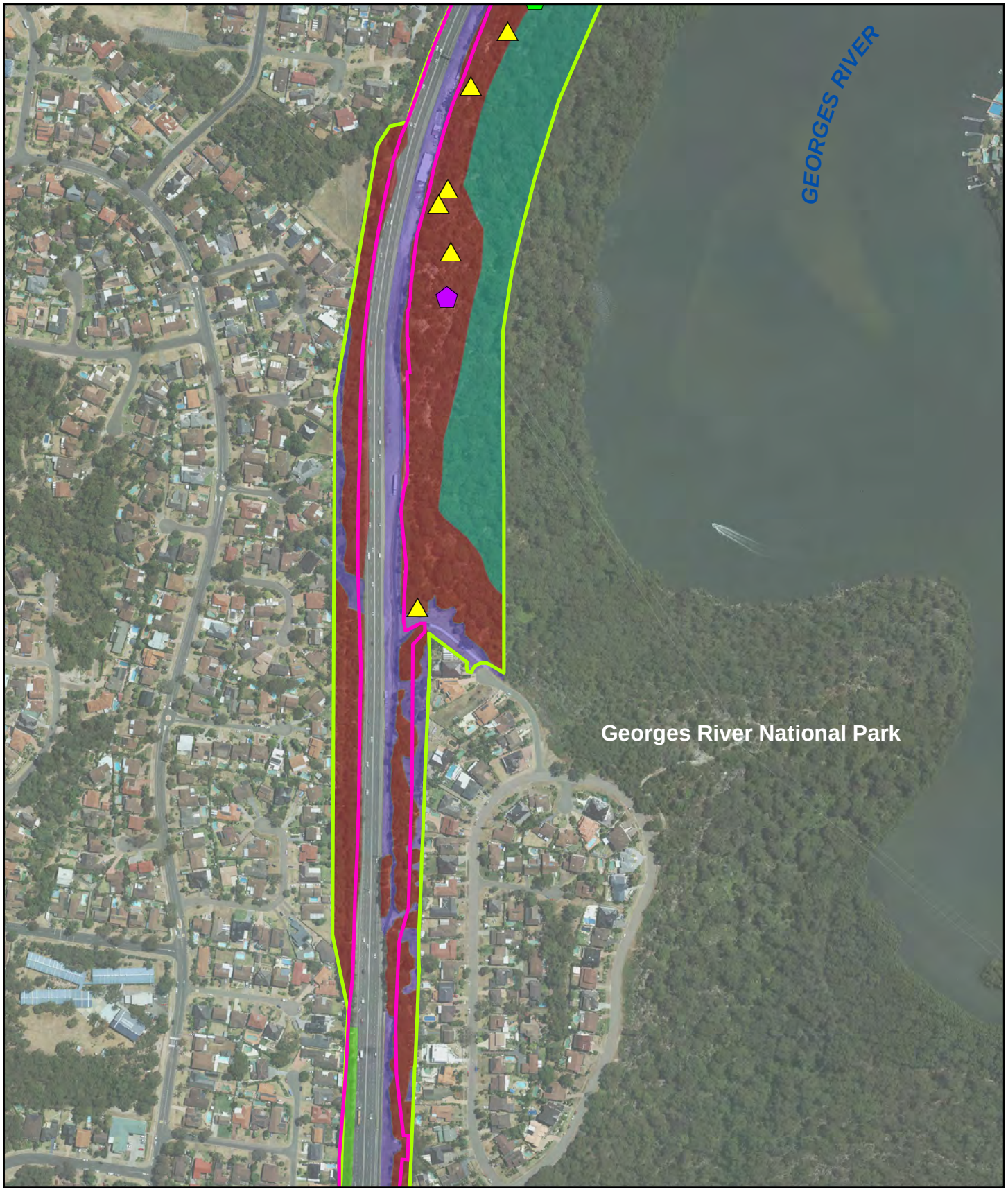

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Vegetation Communities, Threatened Biota and Habitat Features

Figure 6.5(b)

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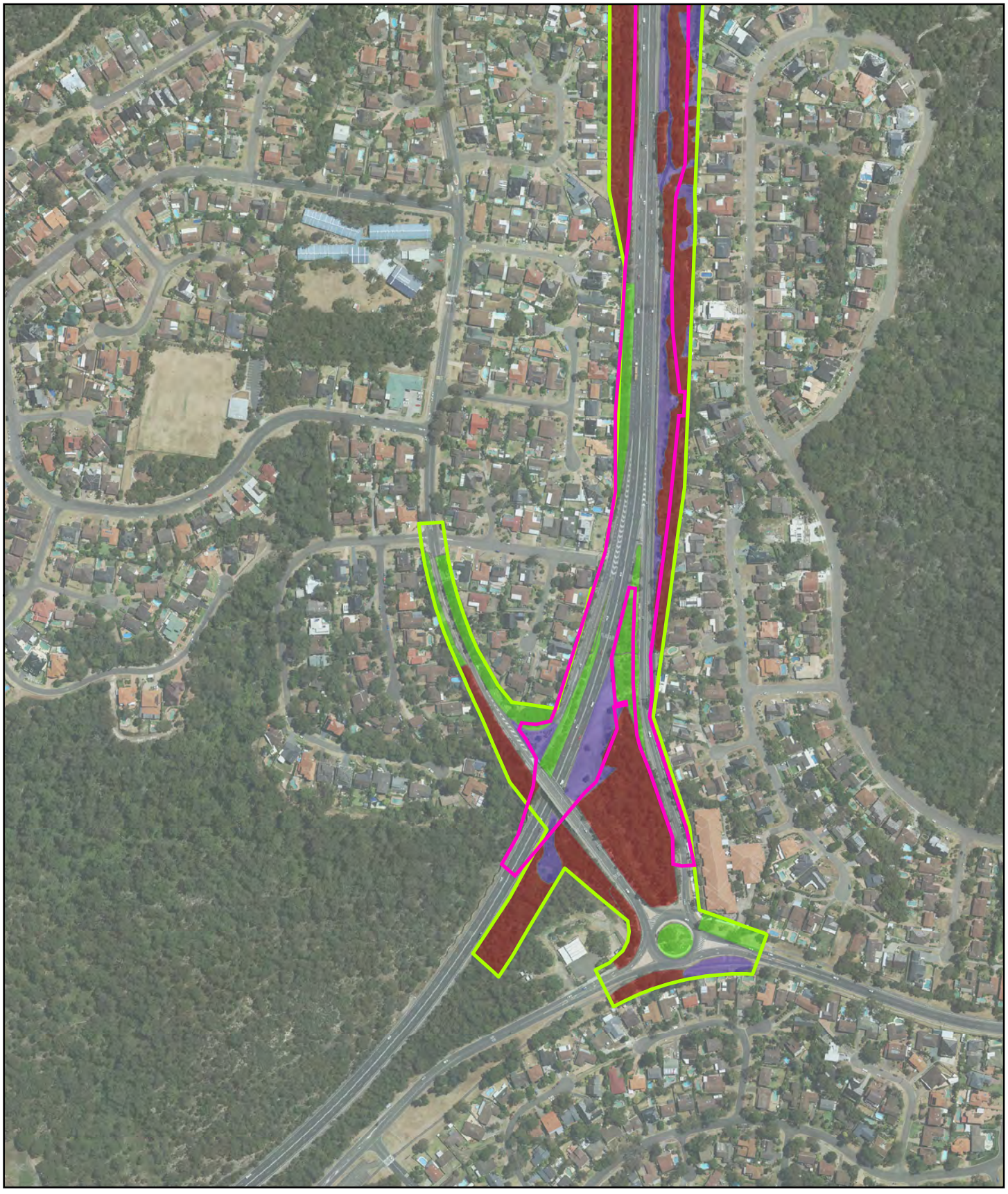

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Vegetation Communities, Threatened Biota and Habitat Features

Figure 6.5(c)

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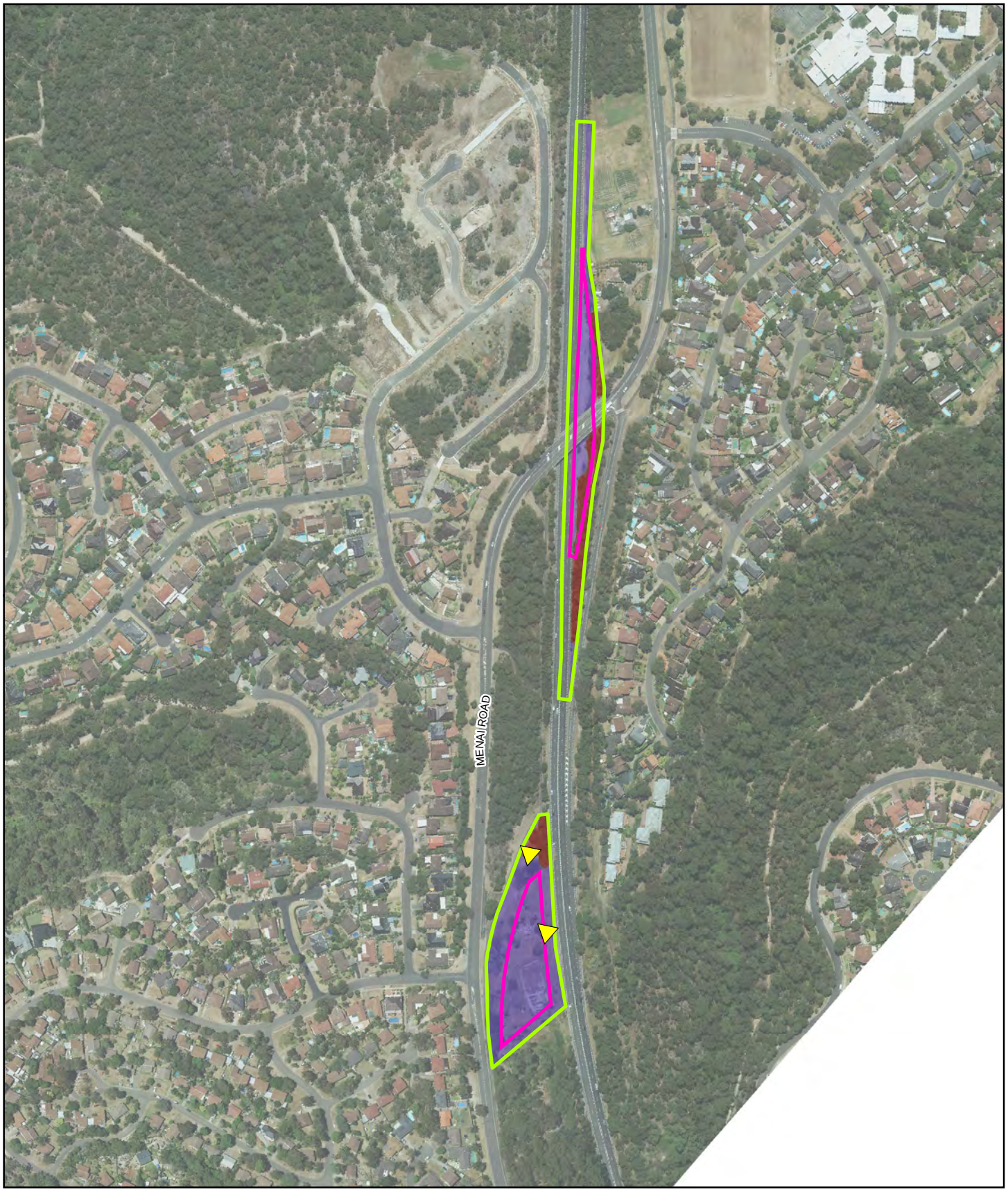

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Vegetation Communities, Threatened Biota and Habitat Features

Figure 6.5(d)

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Data Source: NSW Department of Lands: Cadastre - Jan 2011; Geoscience Australia: 250k Data - Jan 2011. Created by:SDWOODGER

Table 6-22 Summary of vegetation communities recorded within the study area

Vegetation community (Tozer, 2010)	NSW vegetation type (DECCW, 2012)	Status	Per cent cleared (DECCW, 2012)[1]
Coastal Sandstone Ridgetop Woodland	Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux, Sydney Basin	Native	25
Hinterland Sandstone Gully Forest[2]	Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest in sandstone gullies of western Sydney, Sydney Basin	EEC TSC Act	20
Exotic shrubland	n/a	Exotic	n/a
Planted native vegetation	n/a	Exotic	n/a

Note 1. Estimated percentage of pre-European vegetation extent that has been cleared within the Hawkesbury Nepean Catchment Management Authority region

2. A proportion of this vegetation community in the study area qualifies as EEC Southern Sydney Sheltered Forest and includes many of the species that make up the EEC.

A detailed description of each vegetation community is provided in Appendix E and a general summary of the dominant species present within each community is provided below.

Coastal Sandstone Ridgetop Woodland

This community has a woodland structure with a diverse sclerophyll shrub layer and a groundcover of sedges, grasses and herbs. Dominant canopy species include Smooth-barked Apple (*Angophora costata*), Sydney Peppermint (*Eucalyptus piperita*) and Red Bloodwood (*Corymbia gummifera*). In patches, there is a dense small tree layer of Black She Oak (*Allocasuarina litttoralis*), Lemon-scented Tea-tree (*Leptospermum polygalifolium*) or Old-man Banksia (*Banksia serrata*).

The shrub layer is dense and species rich and includes Pink Spider Flower (*Grevillea sericea*), Sunshine Wattle (*Acacia terminalis subsp. angustifolia*), Sweet Wattle (*Acacia suaveolens*), Hairpin Banksia (*Banksia spinulosa*), *Platysace linearifolia*, Large-leaf Bush pea (*Pultenaea daphnoides*) and Needlebush (*Hakea sericea*).

The groundcover is very dense, species rich and variable. Species include sedges such as *Lepidosperma laterale*, grasses such as Kangaroo Grass (*Themeda australis*), Wiry Panic (*Entolasia stricta*) and Blady Grass (*Imperata cylindrica*), along with other forbs such as *Lomandra multiflora*, Flax Lily (*Dianella caerulea var. producta*), *Lomandra oblique*, and herbs such as *Pomax umbellata* and Lesser Flannel Flower (*Actinotus minor*).

Hinterland Sandstone Gully Forest

This community has a forest structure with an open shrub and small tree layer, and a dense understorey of ferns, sedges and grasses. The canopy is dominated by Smooth-barked Apple (*Angophora costata*) and Sydney Peppermint (*Eucalyptus piperita*). On side slopes there is an open small tree layer of Old Man Banksia (*Banksia serrata*), Cheese Tree (*Glochidion ferdinandii*) and Christmas Bush (*Ceratopetalum gummiferum*). On lower slopes and gullies there is a dense small tree layer of Coachwood (*C. apetalum*) and Grey Myrtle (*Backhousia myrtifolia*).

There is an open, diverse and variable shrub layer of species such as Narrow-leaved Geebung (*Persoonia linearis*) and Spiny-leaf Podocarp (*Podocarpus spinulosa*).

There is diverse and variable understorey, including grasses such as Weeping Grass (*Microlaena stipoides*), Wiry Panic (*Entolasia stricta*) and Kangaroo Grass (*Themeda australis*), ferns such as Bracken (*Pteridium esculentum*), Common Maidenhair (*Adiantum aethiopicum*) and Rainbow Fern (*Calochlaena dubia*), and forbs such as Burrawang (*Macrozamia communis*) and Flax Lily (*Dianella caerulea var. producta*).

There are large numbers of scramblers and climbers such as Sweet Sarsparilla (*Smilax glyciphylla*), Wonga Wonga Vine (*Pandorea pandorana*) and Hairy Apple Berry (*Billardiera scandens*). There is also localised severe infestation of Crofton Weed (*Ageratina adenophora*) and African Love Grass (*Eragrostis curvula*).

Exotic shrubland

This community has a variable structure including areas of open and closed shrubland and tussock grassland. It is dominated by exotic species, including noxious and environmental weeds with occasional remnant or opportunistic native plants associated with the two native communities described above.

There are occasional, isolated sub-mature trees including Smooth-barked Apple (*Angophora costata*), Sydney Peppermint (*Eucalyptus piperita*) and Coastal Banksia (*Banksia integrifolia*).

The shrub layer, where present, is dominated by Lantana (*Lantana camara*) and Bitou Bush (*Chrysanthemoides monilifera subsp. Rotundata*). There is locally dense cover of tall forbs such as Fleabane (*Conyza bonariensis*) and Purpletop (*Verbena bonariensis*) and the tussock grass African Love Grass (*Eragrostis curvula*). Throughout, there is a very high cover of a diverse mix of exotic grasses, scramblers and herbs including noxious and environmental weeds. There are occasional native shrubs, herbs and grasses associated with the two native communities described above, though always at low cover abundances.

The mapped extent of this community also includes gravel tracks, hardstand areas and other infrastructure with occasional plants associated with cracks or shallow soil deposits. This community also occurs within the entire 6000 square metre construction site compound south of Old Illawarra Bridge.

Planted native vegetation

This community has a variable structure including areas of scrub and tussock grassland (Specht 1970). It is dominated by a small number of planted native species broadly associated with the two native communities described above along with occasional noxious and environmental weeds.

One patch consists of a linear strip of the small tree Black She-Oak (*Casuarina littoralis*). Another consists of densely planted Spiny-headed Mat-rush (*Lomandra longifolia*).

Groundwater dependant ecosystems

The proposal footprint is located within a high rainfall area (1017 millimetre average annual rainfall – BOM, 2012) and thus native vegetation would not rely solely on groundwater to achieve a forest or woodland structure. No wetland areas or springs are located within the proposal site nor is there any other evidence of the existence of a shallow water table. The proposal site sits on a ridge at an elevation greater than 100 metres above the Georges River. It is therefore likely that depths to groundwater are considerable and any terrestrial vegetation would rely primarily on surface water for sustenance.

Noxious and environmental weeds

The proposal site contains six species declared as noxious weeds in the Sutherland local government area (refer Table 6-23). There is a localised infestation of Lantana (*Lantana camara*) and Bitou Bush (*Chrysanthemoides monilifera* subspecies *rotundata*) to the north of the proposal site, which extends off site to the north in the vicinity of Alfords Point Bridge.

The noxious weeds listed in Table 6-23 are interspersed with severe infestations of environmental weeds throughout the study area. The exotic grasses Paspalum (*Paspalum dilatatum*), African Love Grass (*Eragrostis curvula*), Narrow-leafed Carpet Grass (*Axonopus fissifolius*) and Kikuyu Grass (*Pennisetum clandestinum*) are abundant in the road reserve adjoining Alfords Point Road. There is also localised severe infestation with Crofton Weed (*Ageratina adenophora*) in a gully which extends eastwards from the proposal site.

The distribution of noxious and environmental weeds in the study area is closely tied to disturbance, with road verges, drainage works and other recently cleared environments dominated by exotic plant species. Surface water and potentially nutrient flows from hard stand areas contribute to the observed weed infestation. Adjoining areas of native vegetation are relatively free of weeds as is typical of exposed positions on Hawkesbury Sandstone substrates. These environments are relatively dry and nutrient-poor reducing the susceptibility of native vegetation to weed infestation.

Table 6-23 Declared noxious weeds of the Sutherland local government area recorded during field survey

Scientific name	Common name	Control category	Legal requirements
Lantana camara	Lantana	4	The growth of the plant must be managed in a manner that reduces its numbers, spread and incidence, and continuously inhibits its reproduction.
Chrysanthemoides monilifera subspecies *rotundata*	Bitou bush	4	The growth of the plant must be managed in a manner that reduces its numbers, spread and incidence, and continuously inhibits its reproduction.
Ricinus communis	Castor oil plant	4	The growth of the plant must be managed in a manner that reduces its numbers spread and incidence, and continuously inhibits its reproduction.
Cestrum parqui	Green Cestrum	3	The plant must be fully and continuously suppressed and destroyed.
Ligustrum lucidum	Privet (Broad-leaf)	4	The growth of the plant must be managed in a manner that reduces its numbers spread and incidence, and continuously inhibits its flowering and reproduction.
Ligustrum sinense	Privet (Narrow-leaf/Chinese)	4	The growth of the plant must be managed in a manner that reduces its numbers spread and incidence, and continuously inhibits its flowering and reproduction.

Fauna

Fauna species

A total of 52 species of native fauna and one exotic bird species were recorded during the field surveys, comprising three frog species, 37 bird species, eight mammal species and four reptile species. One threatened species, the Grey–headed Flying-fox (*Pteropus poliocephalus*), vulnerable under both the TSC and EPBC Acts, was recorded flying over the study area during nocturnal surveys and would be expected to forage within the study area on an occasional basis. Two additional threatened species, the Large-eared Pied Bat (*Chalinolobus dwyerii*) and Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*), are potentially present based on probable Anabat call recordings. Both of these species are listed as Vulnerable under the EPBC Act and the Large-eared Pied Bat is listed as vulnerable under the TSC Act. There are no potential roost sites for either species in the proposal site. They may however occasionally use aerial foraging habitat through and above the proposal site. A detailed list of all species observed in the study area is provided in Appendix E.

Desktop searches identified 50 threatened fauna species listed under the TSC Act as being previously recorded or predicted to occur in the locality. No threatened biota listed under the FM Act has previously been recorded or are predicted to occur in the locality of the study area. The searches also identified 19 threatened fauna species listed under the EPBC Act as potentially occurring in the study area. These species would be expected to occur within habitats in the Georges River National Park however would be highly unlikely to use habitats within the proposal site given the highly modified nature of the area and the location next to a busy arterial road (further information relating to likelihood of occurrence is provided in Appendix B of Appendix E).

There are 88 previous records of the Koala within a 10 kilometre radius of the site since 1985 (OEH, 2011a). The majority of these records are from the Holsworthy Military Area to the west of the study area and the Georges River National Park to the east. The proposal site is isolated from these areas of known habitat by residential development, Alfords Point Road and associated steep cuttings and batters. The proposal site does not contain any Koala food tree species identified on Schedule 2 of State Environmental Planning Policy 44 or any primary, secondary or supplementary Koala food trees identified for this region in the Koala Recovery Plan (DECC 2008). Given the absence of known food trees and the landscape context, Koalas are unlikely to occur in the proposal site and the habitat present would not support a resident local population.

The proposal site is highly modified and contains no habitat resources of relevance to any other threatened fauna species. The site supports some juvenile and sub-mature eucalypts which would provide limited nectar and pollen for nectivorous species. Given the context of these trees at the base of a steep cutting, directly adjacent to a busy arterial road, they are unlikely to be utilised by any threatened fauna.

Migratory species

Database searches identified 14 migratory species listed under the EPBC Act as potentially occurring in the study area. This included three marine bird species, four wetland birds (two of which are also listed as marine species) and seven terrestrial bird species.

Two of these bird species, listed as migratory under the EPBC Act, were observed during field surveys. The White-bellied Sea-eagle (*Haliaeetus leucogaster*) was observed flying overhead and above the Georges River, and the Rufous Fantail (*Rhipidura rufifrons*) was observed foraging in native vegetation to the east of the study area.

The proposal site would have little value to any other migratory species as it comprises highly modified residential and cleared areas. Additionally, there is no suitable wetland habitat within the proposal site that would provide for adequate breeding, shelter or foraging habitat for wetland migratory species.

Fauna habitats

The proposal site is dominated by exotic shrubland and cleared areas (including about 3.37 hectares of exotic vegetation and 0.58 hectares of planted native vegetation). The proposal site includes about 2.71 hectares of native woodland and forest vegetation communities as shown on Figure 6-5. The Georges River is located to the north and east of the proposal site and there are no major drainage lines or wetland habitats within the proposal site. The Towra Point Wetland is located about 12 kilometres east (downstream) of the proposal.

A total of 17 habitat trees, including hollow-bearing trees, were recorded in the study area however only one is within the proposal site (refer Figure 6-3). The proposed construction site compound 400 metres south of the Old Illawarra Road overbridge contains a single mature, hollow-bearing Forest Red Gum (*Eucalyptus tereticornis*). Hollow-bearing trees within the study area, including the single hollow-bearing tree within the construction site compound, support a range of different sized hollows, from less than five centimetre diameter to over 20 centimetres. These hollows would provide roosting and potentially breeding habitat for arboreal mammals, bats and birds such as the Common Ringtail Possum (*Pseudocheirus peregrinus*), White-striped Freetail-bat (*Tadarida australis*) and Rainbow Lorikeet (*Trichoglossus haematodus*), all of which were observed at the site. These hollows would also provide potential habitat for threatened hollow-dependant fauna such as the Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*), Yellow-bellied Glider (*Petaurus australis*) and Eastern Freetail-bat (*Mormopterus norfolkensis*).

Three broad fauna habitat types were recorded within the study area and are described below.

Exotic shrubland and cleared areas

These areas occur along the verge of Alfords Point Road and the existing shared path, as well as around residential developments in the southern part of the study area. These areas would have historically supported native woodland vegetation but have been extensively modified by previous development and therefore provide limited habitat value for native fauna. Regrowth trees and shrubs would provide some foraging resources for native birds such as Thornbills (*Acanthiza* species) and Red-browed Finches Finch (*Neochmia temporalis*) which were observed in these areas during the survey. Several species of native reptiles were also observed foraging and basking in areas of exotic grassland. These areas contain no habitat features of relevance to threatened fauna. Several species of threatened birds and microbats would be considered likely to occur in adjacent habitats within the Georges River National Park but would be unlikely to occur within areas of exotic shrubland or cleared areas.

Native woodland and forest

Native woodland and forest in the broader study area adjacent to the proposal site within the Georges River National Park provides good quality habitat for fauna species. These habitats include extensive rock outcrops, plateaus and overhangs, abundant woody debris and leaf litter, patches of dense understorey shrubs, hollow-bearing trees and a range of fruiting and flowering trees and shrubs.

This vegetation provides good connectivity with native vegetation along the Georges River and Mill Creek and eventually with large protected areas and conservation reserves such as the Holsworthy Military Area and Heathcote National Park. Any potential noise and light disturbance from the adjacent road is readily attenuated as the land slopes steeply away from the top of the existing ridge down towards the Georges River. As a result this vegetation would be expected to support a large variety of native fauna, including a number of threatened species.

Eucalypts in the study area represent known or preferred feed trees for a number of fauna species, including threatened birds and the Grey-headed Flying-fox. Red Bloodwood is a keystone nectar feed tree and is a known feed tree for the threatened Grey-headed Flying-fox, Swift Parrot (Lathamus discolor) and Yellow-bellied Glider. None of the eucalypts recorded are winter-flowering species, however, winter-flowering banksias and acacias at the site would help provide year-round foraging resources for a range of native birds, bats and mammals. None of the tree species are Koala food trees listed under Schedule 2 of SEPP 44 as regional primary, secondary or supplementary food trees identified in the Koala Recovery Plan.

Drainage line and wetland habitats

There is a small, first order drainage line running through the study area 20 metres to the east of the proposal site and 300 metres south of Alfords Point Bridge (refer Figure 6-5). This drainage line has been substantially modified during construction and maintenance of the existing Alfords Point Road. Downstream to the east, this drainage line runs down a steep gully and is mostly confined to bedrock, with defined banks. The gully is in good condition with intact geomorphology, riparian vegetation and good water clarity. Moderate weed infestation and contamination was observed primarily due to coarse particulates (ie rubbish).

The remainder of the study area has little in the way of wetland habitats. These areas supported common species of frogs such as the Common Eastern Froglet (*Crinia signifera)* and Smooth Toadlet, (*Uperoleia laevigata)* and would also be likely to provide habitat for reptiles such as the Eastern Water Skink (*Eulamprus quoyiii)* and Red-bellied Black-snake (*Pseudechis porphyriacus*). Towra Point Wetland, a wetland of international significance (Ramsar site) is located about 12 kilometres east (downstream) of the proposal, outside of the study area.

Habitat connectivity

Vegetation in the Georges River National Park, directly adjacent to the proposal site, is mapped as a core east-west linkage in the *Sutherland Shire Council Greenweb* program (SSC 2012). This means it is considered to contain key habitat areas, key linkages and threatened species, or endangered ecological communities. To the east, native vegetation in the Georges River National Park is contiguous with native vegetation stretching along the Georges River, eventually connecting to vegetation bordering the Woronora River. To the west, it connects with extensive areas of native vegetation along Mill Creek, in to the Holsworthy Military Reserve and eventually into Heathcote National Park. This vegetation therefore provides an important movement corridor for native fauna, allowing them to move throughout the landscape.

The proposal site is located on the edge of the patch of habitat that contributes to this east west linkage and therefore does not provide an important linkage for flora and fauna. Alfords Point Road is a busy, dual carriageway and constitutes an existing 'hostile gap' separating patches of habitat. Fauna movement, pollination and seed fall of plants and other ecological processes would therefore likely occur around the proposal site (ie along the banks of the Georges River) instead of through the proposal site.

6.2.3 Potential impacts

Construction

Vegetation clearing

The majority of the proposal site is disturbed, cleared land containing exotic pasture species or environmental weeds. Construction of the proposal would result in the removal or modification of about 6.68 hectares of vegetation, including 3.37 hectares of exotic or planted vegetation and 2.71 hectares of

native vegetation communities as shown on Figure 6-5. The proposed clearing would allow the construction of the proposal including road widening and associated shoulders, batters, shared path, the relocated heavy vehicle inspection bay, construction compounds and stockpile site, on ramp and off ramp widening and bus stop relocation. The extent of vegetation clearing and habitat removal within the proposal site is summarised in Table 6-24.

Table 6-24 Impact of the proposal on vegetation communities

Vegetation community (Tozer, 2010)	TSC Act status	EPBC Act status	Area within proposal site (hectares)	Area within locality [1] (hectares)	Percentage in locality to be cleared
Coastal Sandstone Ridgetop Woodland	Not listed	Not listed	2.56	3923.97	0.07%
Hinterland Sandstone Gully Forest	EEC[2]	Not listed	0.14	3694.39	0.4%
Total native vegetation			**2.71**	**12,573.36[3]**	**0.02%**
Exotic shrubland	Not listed	Not listed	3.37	n/a	n/a
Planted native vegetation	Not listed	Not listed	0.58	n/a	n/a
Total all vegetation			**6.68**		

Notes: 1. Based on Tozer 2010 vegetation mapping

2. Only a proportion of this vegetation community in the study area comprises the EEC Southern Sydney Sheltered Forest.

3. Total of all native vegetation in the locality.

The clearing of 2.71 hectares of native vegetation would involve removal of a moderately diverse range of non-threatened native plants, including a small number of mature trees. The 2.71 hectares of native vegetation to be removed is around 0.02 per cent of the estimated area of native vegetation in the locality and extensive areas of these vegetation communities and species are present in the adjacent Georges River National Park. This minor reduction in the extent of native vegetation would not threaten the viability or persistence of any vegetation community in the locality or region. Furthermore, it is expected that flora populations would persist within adjoining areas of alternative habitat beyond the boundaries of the study area.

About 0.14 hectares of Hinterland Sandstone Gully Forest would be cleared, including 0.017 hectares that qualifies as the Southern Sydney Sheltered Forest endangered ecological community (refer Figure 6-5). This Southern Sydney Sheltered Forest endangered ecological community also extends beyond the proposal site along a gully that runs east from Alfords Point Road towards the Georges River (refer Figure 6-5). Therefore, the potential exists for indirect impacts arising from edge effects, sedimentation, noise and light. The assessment of significance concluded that the proposal is not likely to have a significant impact on the Southern Sydney Sheltered Forest (refer Table 6-26 and Appendix E).

Construction would require minor excavations and trenching for utilities which has the potential to damage tree roots and impact tree health beyond the boundaries of the proposal site. Construction of the fill batter on the eastern side of Alfords Point Road may also impact tree health beyond the boundaries of the proposal site by compacting soil around the base of trees. The biodiversity management plan outlined in Section 6.2.4 would include site specific measures developed by the construction contractor to avoid and minimise the risk of potential impacts to vegetation outside of the proposal site including accidental damage to vegetation from large construction plant.

Habitat removal

As discussed in Section 6.2.2, the vegetation proposed to be removed provides limited suitable habitat for native fauna species. Fauna habitat resources that would be removed include foraging and shelter resources for opportunistic native fauna including common and widespread birds (such as the Noisy Miner, Australian Magpie and Rainbow Lorikeet), opportunistic frogs (such as the Common Eastern Froglet and Striped Marsh Frog) and opportunistic reptiles (such as the Eastern Blue-tongue Lizard and Garden Sun-skink). The proposal site consists primarily of a narrow strip of exotic weeds and regrowth native vegetation adjoining a major road and does not comprise habitat resources for the majority of woodland and forest birds, forest owls, terrestrial or arboreal mammals, native frogs and reptiles.

The proposal would result in the removal of potential foraging habitat for one threatened species, the Grey-headed Flying-fox. Additionally, the proposal may also remove potential foraging habitat for two threatened microbats, the Yellow-bellied Sheathtail Bat and Large-eared Pied Bat, and two EPBC listed migratory species the White-bellied Sea-eagle and the Rufous Fantail. The removal of potential foraging habitat is a very small proportion of available foraging resources for local populations of the Grey-headed Flying Fox and other native fauna (0.09 per cent of the extent of suitable foraging habitat in the locality). The proposal site does not contain any known or potential roosting habitat for the Grey-headed Flying-fox (which favours tall, closed forest close to permanent water)or Large-eared Pied Bat (which requires caves). The single mature, hollow-bearing Forest Red Gum tree located in the proposed construction site compound 400 metres south of the Old Illawarra Road overbridge would not be removed and therefore potential roosting habitat for the Yellow-bellied Sheathtail Bat (which requires hollow-bearing trees) would not be impacted.

Given the high mobility of the Grey-headed Flying Fox and large areas of high quality foraging habitat in the locality, the assessment of significance test concluded that the proposal is not likely to have a significant impact on this species (refer Table 6-26 and Appendix E). Similarly, the outcome of the assessments of significance for the Large-eared Pied Bat and Yellow-bellied Freetail Bat concluded that the proposal is not likely to have a significant impact on either of these species (refer Table 6-26 and Appendix E).The biodiversity assessment concluded that the proposal site is unlikely to contain any important breeding, roosting or nesting habitat. Of the 17 hollow-bearing trees identified within the study area, none would be removed as part of the proposal. The adjacent study area within the Georges River National Park has substantial habitat with extensive rock landforms and abundant fallen woody debris and leaf litter providing habitat for native reptiles, small mammals and microbats. Within the proposal site this type of habitat represents only a small proportion of the available habitat within the locality.

Fauna mortality

As discussed in Section 6.2.2, the proposal site provides limited habitat resources for native fauna species and provides only foraging and shelter resources for opportunistic species. Construction of the proposal has the potential to result in injury or mortality of small opportunistic fauna which may seek shelter in the vegetation within the proposal site. The species most likely to be affected however are widespread and abundant and therefore any potential losses of individuals are highly unlikely to impact upon any ecologically significant proportion of local populations. More mobile fauna such as native birds, the Grey-headed Flying Fox, terrestrial and arboreal mammals are unlikely to be affected by construction activities.

The Koala species is generally at risk of injury or mortality due to vehicle collisions or tree felling operations. However, given the absence of known food trees and the landscape context, Koalas are unlikely to occur in the proposal site and the habitat present would not support a resident local population.

The proposal site is unlikely to provide a movement corridor for Koalas and widening Alfords Point Road due to the proposal is unlikely to result in an increase in Koala mortality due to vehicle collision. The proposal would increase the width of Alfords Point Road and may result in a minor increase in the volume of traffic. This would have a negligible effect on the risk of vehicle collisions with native fauna given the existing volume of traffic on Alfords Point Road and because the proposal disturbance footprint does not intersect any fauna movement corridors.

Aquatic habitats

The proposal would not directly affect any riparian and aquatic habitats. There is however the potential for aquatic habitats within the study area to be indirectly impacted including a small drainage line to the east of the proposal site. Potential impacts which may result in a decline to aquatic habitat value include:

- Alterations to riparian and floodplain geomorphology
- Alterations to catchment hydrology
- Reduced water quality through hydrocarbon contamination or through increased nutrient or sediment inputs.

The hydrology of the study area has been substantially modified through previous engineering works for Alfords Point Road and surrounding suburban development. The proposal would result in an increase in the proportion of hardstand surfaces in the study area and minor modifications to drainage patterns. The drainage line adjacent to the proposal site has been previously modified to accommodate stormwater discharge from beneath Alfords Point Road. Any additional structural works required for the proposal would be restricted to the disturbed portions of the drainage line and therefore would not adversely affect any aquatic habitats in the vicinity of the proposal site.

No mangroves or wetlands would be directly impacted by the proposal as the closest mangrove area is located along the shores of the Georges River, more than 100 metres from the proposal. Indirect impacts may occur through erosion and sedimentation as the wetlands are downstream of the proposal however these would be minimised through the implementation of erosion, sedimentation and water quality management measures as outlined in Section 6.4.3 and Appendix G.

Introduction/spread of weeds and edge effects

The proposal has the potential to result in a minor increase to weed infestation and other 'edge effects' associated with construction activities. The potential edge effects may include increased noise and light pollution, or erosion and sedimentation along the interface of intact vegetation and cleared areas.

Weed infestation may occur due to dispersal of weed propagules (seeds, stems and flowers) into areas of native vegetation via erosion (wind and water), physical transmittal (via workers shoes, clothing and vehicles) during construction. The proposal involves widening an existing road and would therefore not constitute a new impact. Weed invasion and edge effects are already present at the site, notably within the area containing Southern Sydney Sheltered Forest vegetation, beneath the Alfords Point Bridge and within cleared areas of the proposal site.

Substantial disturbance has previously occurred over the study area and weed invasion is already prevalent. Subsequently, the potential for an increase in edge effects and weed invasion would be limited by the presence of existing disturbance and further impacts are unlikely to be ecologically significant.

The areas deemed most vulnerable to edge effects are those downslope of the proposal site including:

- The northern end of the study area, including the area under Alfords Point Bridge leading down to the Georges River (this area is already extensively disturbed and dominated by noxious weeds)

- The vicinity of the drainage line downslope and to the east, including areas of Southern Sydney Sheltered Forest EEC vegetation
- The narrow strip of vegetation to the east of the southern half of the proposal site.

Given the existing disturbance to the proposal site and the current levels of weed infestation, only a minor increase in weed infestation and other edge effects are expected. The potential for weed prologues to be transported off site would be managed through implementation of the weed management plan outlined in Section 6.2.4.

Introduction of pests and pathogens

Construction activities have the potential to introduce or spread pathogens into the study area such as Phytophthora (*Phytophthora cinnamomi*), Myrtle Rust (*Uredo rangelii*) and Chytrid fungus (*Batrachochytrium dendrobatidis*) through vegetation disturbance and increased visitation. There is little available information about the distribution of these pathogens within the locality, and no evidence of these pathogens was observed during field surveys.

The potential for impacts associated with these pathogens is low, given the disturbed nature and high visitation rates to the proposal site and lack of intact native vegetation.

Operation

Habitat fragmentation

Vegetation in the Georges River National Park, directly adjacent to the proposal site, is recognised as an important habitat corridor (refer Section 6.2.2). The proposal site is located on the edge of this patch of habitat and does not comprise an important connecting linkage. The majority of the proposal site is hardstand or low, exotic vegetation that would have very little value as fauna movement habitat. The entire edge of the proposal site that adjoins native vegetation is at the bottom of a steep cutting and/or is already fenced. Fauna movement, pollination and seed fall of plants and other ecological processes would occur around rather than through the proposal site.

The proposal involves construction of structures that may obstruct movement of fauna attempting to cross Alfords Point Road. In addition to the road, potential obstructions include concrete barriers, cycle path and the existing noise wall. Alfords Point Road is a busy, dual carriageway at least four lanes wide and would comprise a 'hostile gap' separating patches of habitat as defined in the BioBanking assessment methodology (DECC, 2008). All of the above listed barriers would be parallel to existing, equivalent barriers, including large rock cuttings, and would not significantly increase the degree to which fauna movement is disrupted.

In this context, the proposal would not have a significant effect on fauna movement or habitat connectivity.

Noise, light and vibration

The proposal site comprises a busy arterial road (Alfords Point Road) with high traffic volumes, particularly during peak hours. Habitats adjacent to the proposal site therefore already experience high levels of noise, light and vibration disturbance. In approximately half of the study area these effects are attenuated by the presence of noise mitigation structures or the existing road cutting and steeply sloping landform. The proposal is likely to have a minor impact on fauna given the current disturbances experienced at the proposal site and the presence of existing barriers.

Cumulative impacts

The proposal is an upgrade to an existing road and the majority of the proposal site falls within land which is extensively modified by existing, approved developments. Impacts on native flora and fauna are substantially less than would be associated with an undisturbed greenfield site. Nonetheless, the proposal has the potential to result in cumulative impacts and exacerbate the negative effects associated with Alfords Point Road and other development in the study area. Potential cumulative impacts arising from the proposal include:

- An increase in the degree of vegetation clearing in the study area and associated loss of habitat
- An increase in the magnitude of edge effects on remnant native vegetation
- Ongoing risk of vehicle collisions with fauna.

Mitigation measures are proposed to ameliorate each of these potential cumulative impacts and are outlined in Section 6.2.4.

The proposal would be located entirely within the existing Alfords Point Road corridor and would comprise a relatively minor increase in the degree of habitat fragmentation or indirect effects. Alfords Point Road already comprises a 'hostile gap' separating patches of habitat as defined in the BioBanking assessment methodology (DECC, 2008). The proposal is unlikely to result in a significant cumulative increase in impacts and is unlikely to cross any critical threshold for impacts that would have a significant adverse effect on local populations of any native biota.

Key threatening processes

A key threatening process is defined in the TSC Act as an action, activity or proposal that:

- Adversely affects two or more threatened species, populations or ecological communities
- May cause species, populations or ecological communities that are not currently threatened to become threatened.

There are several key threatening processes listed under the relevant legislation. Those potentially relevant to the proposal are discussed in Table 6-25. Mitigation measures to limit the impacts of these key threatening processes are provided in Section 6.2.4.

Table 6-25 Key threatening processes relevant to the proposal

Key threatening process	Status	Comment
Clearing native vegetation	TSC Act, EPBC Act	Clearing of native vegetation has occurred historically within and around the study area. The proposal would result in the clearing of 2.71 hectares of native vegetation, including 0.017 hectares of vegetation which constitutes an EEC, from within the proposal site. The vegetation to be removed is in moderate to low condition due to weed infestation and other edge effects. The clearing of this vegetation is not likely to significantly affect any threatened biota. A biodiversity management plan would be developed and implemented to limit impacts on native vegetation.

Key threatening process	Status	Comment
Clearing of hollow-bearing trees	TSC Act	A total of 17 hollow-bearing trees were recorded within the study area, however only one was recorded in the proposal site. This hollow-bearing tree is located within the construction site compound however impact would be avoided through the layout of the compound. The proposal would not increase the operation of this key threatening process.
Removal of dead wood and dead trees	TSC Act	There are good quantities of dead wood and dead trees scattered throughout the study area that would provide habitat resources for native fauna. There is no woody debris of any note within the proposal site. The proposal would not increase the operation of this key threatening process.
Invasion of plant communities by perennial exotic grasses	TSC Act	The entire proposal site features moderate to severe infestation with perennial exotic grasses. Adjoining areas of native vegetation also feature localised moderate infestation. There is the potential for perennial exotic grasses to further invade native vegetation through disturbance during construction of the proposal and a shift of the disturbance corridor east into intact native vegetation. A biodiversity management plan would be prepared and include measures to limit the spread of weeds during construction. These mitigation measures are likely to limit the operation of this key threatening process.
Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands	TSC Act, FM Act	The hydrology of the study area is already substantially modified by engineering works for Alfords Point Road and surrounding suburban development. The proposal is unlikely to increase the operation of this key threatening process.
Infection of native plants by *Phytophthora cinnamomi*	TSC Act, EPBC Act	Construction activities have the potential to introduce the root-rot fungus *Phytophthora cinnamomi* into the study area, which could lead to dieback of vegetation. The biodiversity management plan would include measures to limit infection of native vegetation. The proposal is unlikely to increase the operation of this key threatening process.
Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae	TSC Act	Construction activities have the potential to introduce Myrtle Rust to the study area. The biodiversity management plan would include measures to limit the introduction and spread of Exotic Rust Fungi. The proposal is unlikely to increase the operation of this key threatening process.

Key threatening process	Status	Comment
Infection of frogs by amphibian chytrid causing the disease chytridiomycosis	TSC Act, EPBC Act	Construction activities have the potential to introduce amphibian chytrid to the study area which could lead to death of local frogs. A fauna management plan would be developed and include measures to limit the impacts of Chytrid on fauna and their habitat. The proposal is unlikely to increase the operation of this key threatening process. During field surveys, the only frogs heard or seen where the Common Eastern Froglets (*Crinia signifera*), Brown-striped Frog (*Limnodynastes peronii*), and Smooth Toadlets (*Uperoleia laevigata*).

Impacts on listed threatened biota

The desktop assessment, field surveys and habitat assessments have been used to identify threatened biota that may be affected by the proposal, through either direct or indirect impacts. If any threatened biota listed under the TSC Act is potentially affected by the proposal then an assessment of significance (seven-part tests) under section 5A of the EP&A Act must be prepared in accordance with the DECC (2007) *Threatened species assessment guidelines - the assessment of significance.*

If threatened biota listed under the EPBC Act is potentially affected by a proposed activity then the significance of impacts must be assessed through the *Matters of National Environmental Significance – Assessment of significance guidelines* (DEWHA, 2009).

The DECC (2007) *Threatened species assessment guidelines - the assessment of significance* and DEWHA 2009) *Matters of National Environmental Significance – Assessment of significance guidelines* require proponents to compile a list of threatened biota which may be affected by the proposal and which require an assessment of significance. Threatened biota do not have to be considered as part of the assessment of significance if adequate surveys or studies have been carried out that clearly show that the species:

- Does not occur in the study area
- Will not use on-site habitats, even on occasion
- Will not be influenced by off-site impacts of the proposal.

A list of threatened biota potentially affected by the proposal is provided in Appendix C of Appendix E, including the nature of any previous records in the locality and an assessment of the likelihood of occurrence in the study area. Based on the targeted surveys and habitat assessments undertaken, the majority of the threatened biota presented in Appendix C of Appendix E do not occur in the study area. Further, given the existing disturbance associated with Alfords Point Road and poor quality of habitat resources in the proposal site, the majority of threatened biota would not use on site habitats, even on occasion. Given the limited scale and magnitude of impacts arising from the proposal and impact mitigation and environmental management measures described in Section 6.2.4, no additional threatened biota outside of the study area are likely to be affected by offsite impacts of the proposal. However, as a conservative approach, threatened fauna that may occasionally utilise habitat resources adjacent to the proposal site, within the Georges River National Park, observed during field surveys, have been considered as potentially affected.

Based on the above, the following are considered affected threatened biota for the proposal and require specific assessments of significance of impacts:

- Southern Sydney Sheltered Forest, listed as an EEC on the TSC Act. The proposal would remove 0.017 hectares of this vegetation type
- Grey-headed Flying Fox, listed as a vulnerable species on the TSC Act and the EPBC Act and which was observed flying over the study area. The Grey-headed Flying Fox may forage in the proposal site on occasion
- The Large-eared Pied Bat, listed as a vulnerable species on the TSC Act and the EPBC Act and which was tentatively recorded within the study area and may forage in the proposal site on occasion
- The Yellow-bellied Freetail Bat, listed as vulnerable on the TSC Act and which was tentatively recorded within the study area and may forage in the proposal site on occasion
- Gang-gang Cockatoo and Glossy Black-cockatoo which are listed as vulnerable on the TSC Act may utilise habitats in the study area on an occasional basis
- Masked Owl and Powerful Owl which are listed as vulnerable on the TSC Act may utilise habitats in the study area on an occasional basis
- Greater Broad-nosed Bat and East coast Freetail Bat which are listed as vulnerable on the TSC Act may utilise habitats in the study area on an occasional basis
- Eastern Bentwing Bat which is listed as vulnerable on the TSC Act may utilise habitats in the study area on an occasional basis
- Koala, listed as a vulnerable on the TSC Act and the EPBC Act. Considered unlikely to occur in the proposal site given the absence of food trees and the physical isolation of the site from areas of known habitat. A precautionary approach has been taken and an assessment of significance undertaken, given the known population in the wider locality.

The results of the assessments of significance for potentially affected threatened biota listed under the TSC Act and EPBC Act are summarised in Table 6-26. The full assessments of significance for affected threatened biota listed under the TSC Act and EPBC Act are provided in Appendix E.

Table 6-26 Summary of TSC Act assessments of significance

Common name	TSC Act	Summary of assessment of significance
Threatened ecological communities		
Southern Sydney Sheltered Forest	EEC	This ecological community occurs along a gully that runs east from Alfords Point Road towards the Georges River (refer Figure 6-5). It occurs within the proposal site and potential exists for indirect impacts arising from edge effects, sedimentation, noise and light. The ecological community coincides with the Hinterland Sandstone Gully Forest vegetation community; however only the area mapped on Figure 6-5 qualifies as the EEC based on geomorphic position and soil type. Southern Sydney Sheltered Forest would occur elsewhere in the locality however given the scale and magnitude of impacts arising from the proposal indirect impacts on any other patches of the EEC are unlikely. The assessment of significance test concluded that the proposal is not likely to have a significant impact on the Southern Sydney Sheltered forest.

Common name	TSC Act	Summary of assessment of significance
Threatened fauna		
Grey-headed Flying Fox	V	The Grey-headed Flying-fox, which is listed as vulnerable under both the TSC and EPBC Acts, was recorded overflying the study area during nocturnal surveys and would be expected to forage within the study area on an occasional basis. The proposal would remove a small quantity of foraging resources for this species however this is not considered to be key foraging habitat. Given the high mobility of this species and large areas of high quality foraging habitat in the locality, the outcome of the assessment of significance test has concluded that the proposal is not likely to have a significant impact on the Grey-headed Flying Fox.
Large-eared Pied Bat	V	The Large-eared Pied Bat, listed as a Vulnerable species on the TSC Act and the EPBC Act, was tentatively recorded within the study area based on 'probable' Anabat call identification. This species is cave roosting. There are no suitable breeding or diurnal roost sites within the proposal site though there are potentially suitable sites in sandstone cliffs and overhangs within the study area. The Large-eared Pied Bat may forage in the proposal site on occasion. The outcome of the assessment of significance test has concluded that the proposal is not likely to have a significant impact on the Large-eared Pied Bat.
Yellow-bellied Freetail Bat	V	The Yellow-bellied Freetail Bat, listed as a Vulnerable species on the TSC Act which, was tentatively recorded within the study area and may forage in the proposal site on occasion. The outcome of the assessment of significance test has concluded that the proposal is not likely to have a significant impact on the Yellow-bellied Freetail Bat.
Koala	V	Given the absence of known food trees and the landscape context, Koalas are unlikely to occur in the proposal site and the habitat present would not support a resident local population. The outcome of the assessment of significance test has concluded that the proposal is not likely to have a significant impact on the Koala.
Gang-gang Cockatoo and Glossy Black-cockatoo	V	There are no hollow-bearing trees that could provide roost sites within the proposal site. These species are highly unlikely to depend on the resources that would be removed by the proposal. The proposal would not cause any barrier to movement between roost sites and potential foraging habitat. The outcome of the assessment of significance test has concluded that the proposal is not likely to have a significant impact on the Gang-gang Cockatoo or Glossy Black-cockatoo.

Common name	TSC Act	Summary of assessment of significance
Masked Owl and Powerful Owl	V	The proposal site makes up only a small proportion of the home range of individuals within the local populations (if present). There are no hollow-bearing trees that could provide roost sites within the proposal site. These species may forage within the study area on occasion however the species is highly unlikely to depend on the resources that would be removed by the proposal. The proposal would not cause any barrier to movement between roost sites and potential foraging habitat. Given the large area of protected habitat present in the locality, and the large home range of these species, the proposal is unlikely to impact the lifecycle of the species. The outcome of the assessment of significance test has concluded that the proposal is not likely to have a significant impact on the Masked Owl or Powerful Owl.
Greater Broad-nosed Bat and East coast Freetail Bat	V	The proposal would not remove any hollow-bearing trees and is highly unlikely to prevent these species from using roost trees in the broader study area through indirect effects. These species may forage within the study area on occasion however are highly unlikely to depend on the resources that would be removed by the proposal. The proposal is therefore unlikely to adversely affect the lifecycle of these species. The outcome of the assessment of significance test has concluded that the proposal is not likely to have a significant impact on the Greater Broad-nosed Bat or East coast Freetail Bat.
Eastern bentwing Bat	V	A local population of the Eastern Bentwing Bat may forage throughout the proposal site, including over open areas on occasion however the species is highly unlikely to depend on the resources that would be removed by the proposal. The proposal is therefore unlikely to adversely affect the lifecycle of the species. The outcome of the assessment of significance test has concluded that the proposal is not likely to have a significant impact on the Eastern bentwing Bat.

The results for the assessments of significance with threatened species listed under the EPBC Act are provided in Table 6-27. The full assessments of significance for affected threatened biota listed under the EPBC Act are provided in Appendix E of Appendix E.

Table 6-27 Summary of EPBC Act assessments of significance

Common name	EPBC Act	Summary of assessment of significance
Grey-headed Flying Fox	V	The proposal would remove a small quantity of foraging resources for the species. Based on the DEWHA (2009) significant impact criteria for vulnerable species consideration of the above criteria, the proposal is not likely to have a significant impact on the Grey-headed Flying-fox.
Koala	V	The Koala is considered unlikely to occur in the proposal site given the absence of food trees and the physical isolation of the site from areas of known Kola habitat. Based on the DEWHA (2009) significant impact criteria for vulnerable species consideration of the above criteria, the proposal is not likely to have a significant impact on the Koala.

Common name	EPBC Act	Summary of assessment of significance
Large-eared Pied Bat	V	There are no suitable breeding or diurnal roost sites within the proposal site though there are potentially suitable sites in sandstone cliffs and overhangs within the broader study area. Based on the DEWHA (2009) significant impact criteria for vulnerable species consideration of the above criteria, the proposal is not likely to have a significant impact on the Grey-headed Flying-fox.

Two migratory bird species were observed during field surveys: the White-bellied Sea-eagle and the Rufous Fantail. Other seasonally migratory or nomadic species would also be likely to utilise habitats within the Georges River National Park on occasion. The EPBC Act requires an assessment of the significance of potential impacts of a proposal on migratory species with reference to the criteria specified in the *Matters of National Environmental Significance – Assessment of significance guidelines* (DEWHA 2009).

The proposal site would have little value for migratory species and does not comprise 'important habitat'. Impacts would be restricted to the proposal site and its immediate vicinity and so the proposal would not substantially modify any important habitat.

Only a small number of individuals of the White-bellied Sea-eagle, Rufous Fantail or any other migratory species would ever occupy habitat within or near the proposal site. The proposal site does not contain any habitat resources that are likely to be significant to any migratory species. The proposal would not significantly increase the degree of fragmentation or isolation of habitat in the locality. Therefore the proposal would not seriously disrupt the lifecycle of an ecological significant proportion of the population of any migratory species.

Based on the consideration of the criteria contained in the *Matters of National Environmental Significance –Assessment of significance guidelines* (DEWHA 2009), the proposal would not be likely to have a significant impact on any migratory species.

6.2.4 Safeguards and management measures

Environmental safeguards	Responsibility	Timing
A Biodiversity Management Plan (BMP) would be prepared and included within the CEMP. The BMP is to include (but not be limited to) the following: • A suitably qualified ecologist is to be engaged to visit the site prior to any clearing works to clearly demarcate vegetation protection areas (particularly hollow bearing trees and areas of EEC) and conduct a pre-clearing survey report • A site walk with the RMS Environmental Officer to confirm clearing boundaries prior to the commencement of work • A map which clearly shows vegetation clearing boundaries and no-go zones • A procedure for clearing potential habitat including hollow-bearing trees in accordance with RMS Specification G40. An experienced, licenced wildlife carer or ecologist would be present to supervise vegetation clearing and capture then relocate fauna if required. Fauna handling and vegetation removal would be in accordance with the RMS *Biodiversity Guidelines 2011* • Incorporation of management measures identified as a result of the pre-clearing survey report and nomination of actions to respond to the recommendations made. This should include details of measures to be implemented to protect clearing limits and no go areas • Content of toolbox talks and records of attendance • Compliance with RMS Biodiversity Guidelines (RTA, 2011). • Clearing of mature trees should be minimised where possible • Habitat features such as mature tree trunks and rock fragments within the proposal site should be salvaged and replaced within revegetation areas as far as is practicable. • Protocols to prevent introduction or spread of chytrid fungus should be implemented following OEH Hygiene protocol for the control of disease in frogs (DECCW, 2008c).	Construction contractor	Pre-construction

Environmental safeguards	Responsibility	Timing
Prepare Environmental Work Method Statements for specific work activities, which must include but not be limited to the following: • Description of the work activity including machinery • Outline of the sequence of tasks, including interfaces with other construction activities • Identification of potential environmental risks/impacts due to the work activity and risks/impacts associated with wet weather events • Evaluation of possible mitigation measures to reduce the environmental risk and selection of most practical cost-effective operational and monitoring measures to reduce environmental impact • A map indicating the locations of likely potential environmental impacts and sensitive locations • Identification of work areas and exclusion areas • A process for assessing the performance of the implemented environmental control measures.	Construction contractor	Pre-construction
A weed management plan (WMP) would be prepared and incorporated into the CEMP. The WMP would be in accordance with the requirements of RMS Specifications G36 and G40 and include (but not be limited to) the following: • Type and location of weeds of concern (including noxious weeds) within the proposal site • Sensitive receivers (such as native vegetation and waterways) within or adjacent to the proposal site • Measures to prevent the spread of weeds and fungi, including hygiene procedures for equipment, footwear and clothing • Proposed weed control methods and targeted areas • Weed disposal protocols.	Construction contractor	Pre-construction

6.3 Hydrology and drainage

A hydrology and hydraulic assessment of the proposal was prepared by GHD in August 2012. The purpose of the assessment was to determine the existing hydrology and drainage conditions within the proposal site and assess the potential impacts of construction and operation of the proposal on these conditions. The assessment delineated the existing catchment boundaries and estimated existing runoff characteristics using a simplified DRAINS model. The changes to the flow patterns including changes in the magnitude of flow were then determined to assess the impacts of the proposal. A copy of the full assessment is provided in Appendix G and summarised below.

6.3.1 Existing environment

The hydrological catchments associated with the existing Alfords Point Road alignment and the general flow directions of surface water are shown in Figure 6-6. In general, the existing road alignment drains directly into the Georges River National Park via several discharge points. However, an existing spill containment facility/gross pollutant trap at the southern abutment of Alfords Point Bridge discharges runoff towards the Georges River. The existing drainage infrastructure along Alfords Point Road is shown in Figure 3-7. The existing drainage patterns are summarised in Table 6-28.

Table 6-28 Existing drainage patterns within the study area

Metres south of Alfords Point Bridge	Existing drainage pattern
0 to 300	This section of road drains in a northerly direction via a spill containment system, discharging to the Georges River under Alfords Point Bridge.
300 to 800	This section of road drains in a northerly direction where it currently discharges towards the Georges River National Park to the east 300 metres south of Alfords Point Bridge. Minimal formal existing drainage infrastructure is present in this section of road.
800 to 1600	This section of road drains in a northerly direction where it currently discharges towards the Georges River National Park to the east about 800 metres south of Alfords Point Bridge. Minimal formal existing drainage infrastructure is present in this section of road.
1600 to 1775	A high point exists on Alfords Point Road at about 1775 metres south of Alfords Point Bridge. Runoff from the northbound carriageway sheets off to the existing drainage swale to the west of the road while runoff from the southbound carriageway is collected at the central median barrier and discharged to the east of the road.
Brushwood Drive on ramp	Runoff from the on ramp connects into the existing drainage network in Alfords Point Road which drains in a southerly direction.
Illawong/Alfords Point off ramp	Runoff from the off ramp connects into the existing drainage network in the triangle between Alfords Point Road and the Brushwood Drive off ramp.
Existing heavy vehicle inspection bay location	Runoff from the proposed truck inspection bay is conveyed to the south by an existing pipe network.

Existing culverts

Cross drainage for overland flow is provided through a 1050 millimetre diameter pipe about 300 metres south of Alfords Point Bridge and a 600 millimetre diameter pipe about 1620 metres south of Alfords Point (refer Figure 3-7). Both pipes discharge stormwater runoff in an easterly direction under the existing pavement which is collected primarily from two residential catchments on the western side of Alfords Point Road. The catchments for these culverts are shown in Figure 6-6 and the hydrology is provided in Table 6-29.

Figure 6-6a Catchments and main discharge points (northern section)

Figure 6-6b Catchments and main discharge points (mid section)

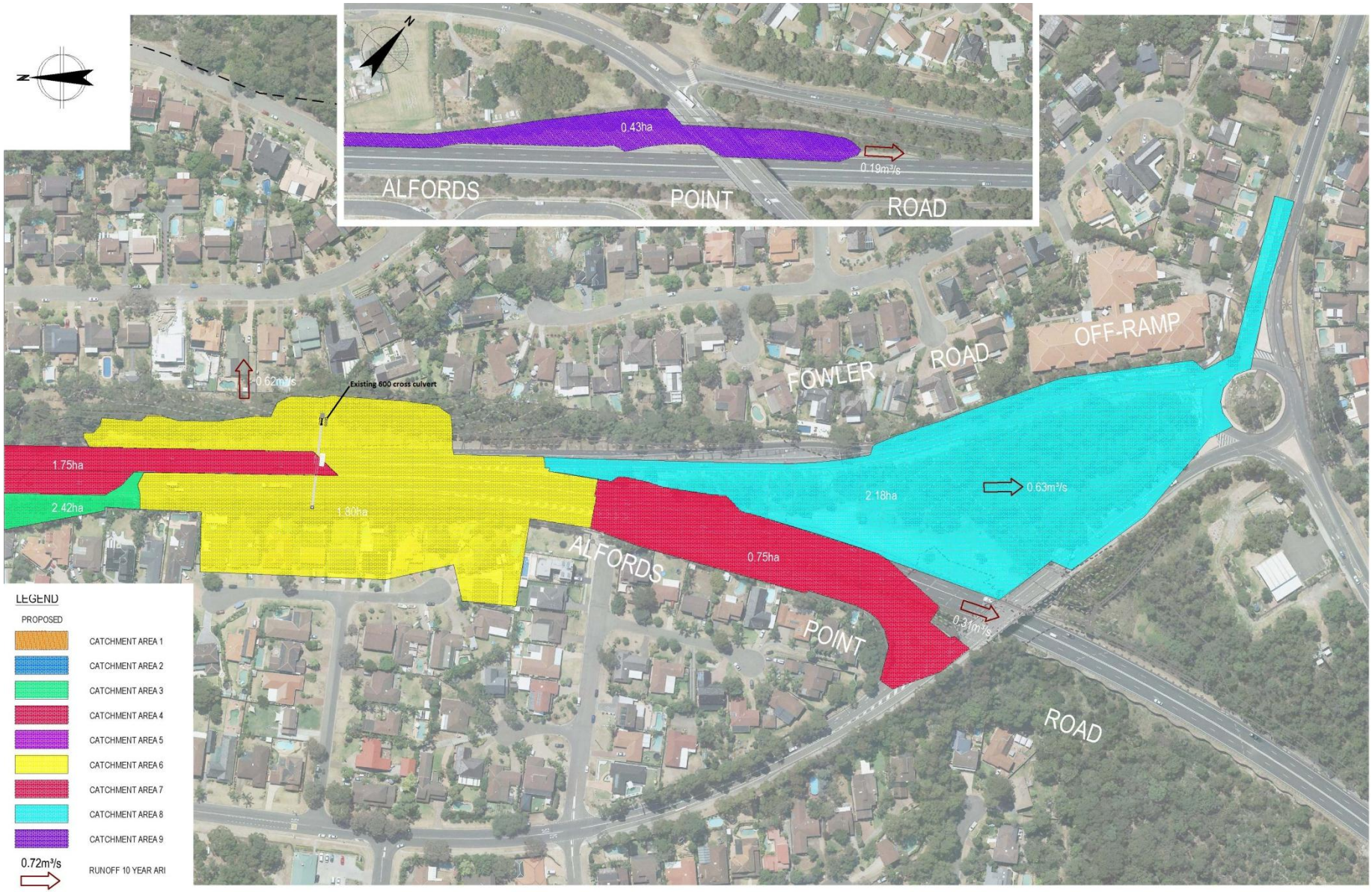


Figure 6-6c Catchments and main discharge points (southern section)

Table 6-29 Hydrology of culvert catchments

Culvert location (south of Alfords Point Bridge)	Catchment area (ha)	Pipe diameter (mm)	Maximum peak flow (m^3/s)		
			10yr ARI	20yr ARI	100yr ARI
310	8.17	1050	2.41	2.88	3.77
1620	1.13	600	0.42	0.49	0.62

Flooding

The 1 in 100 year flood level at the Georges River is 2.6 metres above Australian Height Datum (Lyall and Associates 2006). Alfords Point Road is located well above the 100 year flood level and would not be impacted by flooding or high tides in the Georges River.

The existing drainage outlets within the proposal site are not affected by a tail water condition (submergence of outlets) induced by flooding or high tides in the Georges River.

6.3.2 Potential impacts

Construction

During construction, local flow patterns may be affected due to disruptions to flow paths. This may result in scouring of drainage lines due to increased flow volumes or localised, minor flooding at low points in the topography. The construction compounds and stockpile site would not be located within the 1 in 100 year flood level and therefore potential inundation of stockpiles and materials/liquids storage areas is unlikely. Temporary sediment basins to manage stormwater are discussed in Section 6.4.2. The location and sizing of construction basins would be confirmed during detailed design.

Operation

The proposal would require alteration and upgrade of the existing road drainage and stormwater management system. This includes construction of a considerable number of additional pits and inlets to cater for the type F concrete barrier that would be constructed in the median of Alfords Point Road. The proposal would also require upgrading the existing pipes and drainage lines to realign with the new kerb and road surface level. A summary of key drainage features of the proposal, including those required at the heavy vehicle inspection bay is provided in Section 3.3.4 and Figure 3-7.

Catchment hydrology modelling undertaken for the proposal indicates the overall catchment area for Alfords Point Road would not substantially change as a result of the proposal (refer Table 6-30 and Appendix G). Hydrological modelling was also undertaken for the existing cross drainage culverts to assess their capacity to cater for any potential increase in surface water flow generated from the proposal. The results of the hydrological modelling for the existing culverts are provided in Table 6-30.

Table 6-30 Hydrological modelling of culverts

Culvert (metres south of Alfords Point Bridge	Catchment area		Flow rate (m^3/s) 1/100 year event		Max flow capacity of culvert (m^3/s)
	Existing	Proposed	Existing	Proposed	
310	8.17	8.05	3.77	3.87	7.1
1620	1.13	1.15	0.622	0.69	1.8

Table 6-30 indicates that there would be minimal difference in the flow rate experienced at both culverts during 1 in 100 year rainfall event between the existing and proposed conditions. Furthermore, the culverts would have sufficient capacity to cater for stormwater flow volumes during operation of the proposal without flooding occurring at culvert inlets. This indicates that, while the proposal involves pavement widening, it is not anticipated to substantially alter the volume or rate of stormwater runoff experienced at these culverts, Therefore, the volume and rate of stormwater discharged into surrounding sensitive environments such as the Georges River National Park is not anticipated to substantially increase as a result of the proposal. An operational detention (water quantity) basin is therefore not considered warranted. The need for an operational water quality basin is assessed separately in Section 6.4 As the flow rate of stormwater discharged at culvert outlets would be largely unchanged, scouring or changes to the geomorphology of drainage lines is unlikely to occur, including during high-intensity short-duration rainfall events.

6.3.3 Safeguards and management measures

Environmental safeguards	Responsibility	Timing
A contingency plan would be prepared in preparation for a potential flood event during construction and would outline evacuation procedures.	Construction contractor	Pre-construction

6.4 Soils and water quality

6.4.1 Existing environment

Soils and geology

The Soils Landscapes of Sydney 1:100,000 Sheet (Chapman and Murphy 1989) indicates the proposal is located on the Lucas Heights and Hawkesbury soil landscapes. This landscape is characterised by gently undulating crests and ridges on plateau surfaces of the Mittagong formation. Table 6-31 describes the location and characteristics of the soil landscape groups within the proposal site.

Table 6-31 Soil characteristics within the proposal site

	Hawkesbury soil landscape	Lucas heights soil landscape
Location	North and south of the Georges River in areas of steep slopes	Covering the majority of the proposal site and the study area. Generally in areas of low to moderate slopes
Geology	Hawkesbury Sandstone	Mittagong Formation
Dominant soil type	Loose, coarse quartz sand (generally topsoil) Earthy, yellowish-brown sandy clay loam (subsoil) Pale, strongly pedal light clay (subsoil)	Loose, yellowish-brown sandy loam (topsoil) Bleached, stony, hard setting sandy clay loam (subsoil) Earthy, yellowish-brown sandy clay loam (subsoil) Pedal, yellowish-brown clay (subsoil)

	Hawkesbury soil landscape	Lucas heights soil landscape
Erodibility	Low to moderate	Moderate to high
Erosion hazard	Non-concentrated flows: moderate to extreme Concentrated flows: extreme	Non-concentrated flows: slight to extreme Concentrated flows: high
Surface movement potential	Stable to slightly reactive	Generally slightly reactive to moderately reactive
Landscape limitations	Mass movement hazard, rock fall hazard, steep slopes, severe erosion hazard, rock outcrop, shallow soils	Localised surface movement potential

The Sydney 1:100,000 Geology Map (Department of Mineral Resources, 1983) indicates the geology of the proposal site is Hawkesbury Sandstone (a medium to coarse-grained quartz sandstone) with sandstone rock outcrops and plateaus.

A search of the Australian Soil Resource Information System on 30 March 2012 identified the proposal site as having a low to extremely low probability of containing acid sulfate soils. The Sutherland Shire council zoning map identified Class 1 and Class 2 acid sulfate soils present adjoining the Georges River however this is outside the proposal site.

The presence of saline soils is considered unlikely within the proposal site as it does not contain any low lying areas within close proximity to a watercourse.

Topography

The topography of the study area is defined by the Georges River which cuts through the landscape leaving distinguishable valley slopes and ridgelines. Alfords Point Road crosses the Georges River via Alfords Point Bridge and then rises up out of the valley to a distance about 1.7 kilometres to the south. This rise in elevation is from 27 metres Australian Height Datum (AHD) at the southern abutment of Alfords Point Bridge to about 98 metres AHD at a location just north of Brushwood Drive. At Brushwood Drive the topography plateaus into gently undulating landscape. As Alfords Point Road rises away from the Georges River, the road corridor is characterised by alternating deep cuts and steep slopes on either side of the alignment.

Contamination

Searches of the following contamination databases and lists were undertaken in February 2012 to ascertain the presence of known contamination within the proposal site:

- Contaminated Land Record (OEH, 2011)
- List of NSW contaminated sites notified to OEH (OEH, 2011a).

These searches found that neither the site nor any of the adjacent properties has received a notice of contamination or has been reported to OEH due to contamination.

Fill in the study area is generally located between 700 metres and 1500 metres south of Alfords Point Bridge on the western side of Alfords Point Road and between 1500 metres and 1750 metres south of

Alfords Point Bridge on the eastern side of Alfords Point Road. This fill was placed during construction of Alfords Point Road in the 1970s. Whilst the origin of the material is not known, it is likely the fill was sourced on site from the substantial blasting and excavation works undertaken to cut the road corridor into the sandstone slopes. It is likely that the requirement to import fill to the site would have been minimal and that any fill imported to the site would have been selected to achieve suitable construction qualities and therefore sourced from a single location.

Based on 1941 aerial photography and a historical review of development in the area, no other current or past activities are known within or adjacent to the proposal site that may have contributed to contamination of the environment. No evidence of illegal rubbish dumping was observed during a site investigation in February 2012 however it may occur from time to time along the Alfords Point Road corridor.

Water quality

The Georges River passes under Alfords Point Bridge at the northern extent of the proposal site and then runs southwards to the east of the proposal passing within 200 metres at its closest point. Mill Creek (a tributary of the Georges River) runs in a north-south direction to the west of the proposal site, passing within 450 metres at its closest point.

Within the study area, the Georges River and Mill Creek water quality is saline and affected by tidal flushing. Water quality within the Georges River is also affected by urbanisation of the catchment, particularly during periods of high rainfall when stormwater runoff reduces clarity. About 12 kilometres downstream of the proposal is Towra Point Wetland, a Ramsar site of international significance. The Georges River Wetlands also occur at several locations along the banks of the Georges River between Milperra and Como Bridge however no mangroves occur within the proposal site. The closest mangroves are located more than 100 metres from the proposal site along the banks of the Georges River.

Surface runoff from Alfords Point Road generally flows in a northward direction through piped drainage infrastructure on either side of the road before ultimately discharging at several locations towards the Georges River and the Georges River National Park. Discharge points are located on the eastern side of Alfords Point Road at the following locations:

- 300 metres south of Alfords Point Bridge
- 800 metres south of Alfords Point Bridge
- 1620 metres south of Alfords Point Bridge.

From Alfords Point Bridge to about 300 metres south, surface water from Alfords Point Road flows through an existing gross pollutant trap and spill containment system before discharging towards the Georges River under Alfords Point Bridge. This 25 kilolitre capacity system is located at the southern abutment of Alfords Point Bridge to provide operational water quality treatment for runoff intercepted on the southern approach to the bridge.

The quality of surface runoff from Alfords Point Road would be impacted by the build-up of contaminants on the road surface and median area including hydrocarbons, fuel additives, catalytic converter materials, metal from friction and corrosion of vehicle parts, lubricants, carbon, rubber and plastics.

Groundwater

The proposal site sits on a ridge at an elevation between 27 and 100 metres above the Georges River. It is therefore likely that depths to groundwater are considerable.

6.4.2 Potential impacts

Construction

Soils, topography and contamination

The proposal site is within the existing road corridor that was created during the 1970s through a series of cut and fills. Minor earthworks during construction are required to provide an adequate vertical alignment for the proposal. The cut and fill requirements of the proposal are shown in Figure 1-2 and discussed further in Section 3.4.5. These cut and fill requirements are not considered to be major alterations to the existing topography from a regional perspective and would only be noticeable in the direct vicinity of the proposal. Overall the proposal would not result in any substantial changes to local topography and the vertical alignment would match the existing nature of the terrain wherever possible.

The proposal would result in about 13,525 cubic metres of cut material and require about 1215 cubic metres of fill. The majority of cut material would be reused as fill on site however about 225 cubic metres would be unsuitable for reuse on site. Fill material imported from off site would be sourced from certified suppliers to avoid the potential for contaminated fill being used for the proposal.

There is potential for chemical and fuel spills or leaks to occur during construction, which may result in localised contamination of soils. The potential for these leaks and spills would be minimised through the implementation of safeguards and management measures outlined in Section 6.4.3.

Within the proposal site there are no registered sites on the EPA contaminated sites register and fill is likely to have been sourced from on site. Therefore, the potential to encounter contamination during construction is considered unlikely.

Water quality

Erosion and sedimentation

During construction, work activities have the potential to expose large areas of soil that may be eroded through wind and water leading to sedimentation of adjacent sensitive receiving environments including the Georges River National Park and the Georges River. In particular, short-duration, heavy rainfall events that occur from time to time within the study area have the greatest potential to erode exposed areas and cause sedimentation. Site establishment and preliminary works including vegetation removal, utility relocation and pavement demolition would destabilise the ground surface and expose large areas of soil.

Works within drainage lines such as construction of the carrier line on the eastern side of Alfords Point Road, works at culvert outlets 300 metres and 1620 metres south of Alfords Point Bridge, and replacement of the culvert underneath the footpath connection to Maxwell Close, have the potential to cause sedimentation of surface water as it flows through the site. The construction of the fill batter and excavation of the shared path on the eastern side of Alfords Point Road also represent high erosion potential activities as the terrain in this location is steeply sloping (high velocity of surface water on steep slopes has a high potential for scouring).

Other work elements that have the potential to expose soils and cause erosion and sedimentation of surrounding land and drainage lines include:

- Excavation works
- Stockpiling
- Landscaping.

If uncontrolled, erosion and sedimentation from the proposal could potentially have the following effects:

- Increased sediment load in the Georges River, Mill Creek and its tributaries resulting in increased turbidity affecting aquatic ecology
- Changes to drainage line hydrology due to sediment deposition.

The surface water catchments and main discharge points during construction are shown in Figure 6-6. The existing surface water catchments for the site would not be substantially altered during construction or operation of the proposal. Therefore, construction catchments and discharge points would be the same as operational catchments and discharge points.

Prior to the commencement of construction activities, erosion and sedimentation controls would be established to prevent sediment laden surface runoff entering the Georges River National Park and the Georges River. This would include works around drainage lines and on steep slopes.

Construction catchments that produce an annual soil loss in excess of 150 cubic metres are considered to require an erosion and sediment control management system in the form of a sediment basin. The provision of a sedimentation basin for construction catchments with less than 150 cubic metres annual soil loss may still be required depending on the local soil characteristics and sensitivity of the receiving environment.

None of the construction catchments for the proposal are anticipated to produce more than 150 cubic metres of annual soil loss however a temporary 135 cubic metre construction sediment basin is proposed to be constructed as part of the soil and water management strategy (refer Section 3.5.2). The sediment basin would be located on the eastern side of Alfords Point Road about 870 metres south of Alfords Point Bridge (refer Figure 3-7). A sediment basin at this location was investigated as the catchment discharge point is directly adjacent to the sensitive receiving environment of the Georges River National Park and there are currently no water quality/sediment control devices present. The sediment basin would be converted into a permanent water quality basin for operation of the proposal. During construction the basin would receive road surface run off from a catchment between 870 metres and 1600 metres south of Alfords Point Bridge (about 1.8 hectares).

Low lying areas of construction formations and excavations would collect stormwater and would need to be dewatered in accordance with the *RMS Technical Guideline for Dewatering*.

Site specific erosion and sedimentation control mitigation measures would be investigated during detailed design and would be included within an erosion and sedimentation control plan as part of the CEMP. All erosion and sedimentation control measures would be designed in accordance with the *Blue Book - Managing Urban Stormwater: Soils and Construction, Volume 1* (Landcom, 2004). Further investigation during detailed design would be undertaken to determine if and where construction basins would be required.

Pollutants

Construction of the proposal could impact water quality through the introduction of pollutants into surrounding watercourses. Watercourses that have the potential to be impacted include Georges River, Mill Creek and their associated tributaries. Activities adjacent drainage lines to these watercourses have the greatest potential to impact water quality. Pollutants may include accidental leakage or spillage of fuels, lubricating and hydraulic oils from construction equipment, and run-off from equipment and vehicle wash downs. Slurry generated from piling works and dampening of rock hammering would be contained and disposed of appropriately to avoid contamination of surface water on site. Waste from concrete works such as potential noise barrier slabs and culvert works would also be contained to avoid contamination of surface water.

The construction compound and stockpile sites (refer Figure 1-2) are located away from any major drainage lines. All liquids and fuels would be stored within bunded areas and dedicated plant and equipment wash down areas would be nominated.

Groundwater

No groundwater extraction is required for construction of the proposal and it is unlikely the groundwater table would be intercepted during excavation works.

Operation

Water quality

The increase in sealed road surface due to the widening of Alfords Point Road would reduce water infiltration and marginally increase the amount and velocity of stormwater run-off during operation. The risk of soil erosion would be minimal as all areas impacted during construction would be asphalted or rehabilitated and landscaped to prevent soil erosion from occurring. However, there is the potential for stormwater runoff to affect existing local water quality due to the generation of pollutants on Alfords Point Road. These pollutants may include:

- Suspended sediment from paved surfaces
- Heavy metals attached to particles washed off paved surfaces
- Oil, grease and other hydrocarbon products
- Litter
- Nutrients such as nitrogen and phosphorus from atmospheric deposition of particles.

The drainage design to manage road surface runoff during operation of the proposal is outlined in Section 3.3.4. In terms of water quality, a number of features of the drainage design would ensure stormwater leaving the road corridor and potentially discharging into adjacent sensitive receiving environments, such as the Georges River National Park, would be similar in quality to existing stormwater being discharged from Alfords Point Road. These features of the drainage design are described below.

The existing spill containment system and gross pollutant trap located near the southern abutment of Alfords Point Bridge on the eastern side of Alfords Point Road would be maintained as part of the proposal. Road surface runoff from Alfords Point Bridge to about 300 metres south would flow through this existing spill containment system before discharging towards the Georges River. During operation of the proposal the total contributing catchment for the spill containment system would be about 0.33 hectares. The spill containment system has a holding capacity of 25 kilolitres which would have more than sufficient capacity to deal with flows resulting from the proposal.

Road surface runoff between 300 metres and 850 metres south of Alfords Point Bridge would pass through a new swale drain before discharging into the existing gully that drains towards the Georges River National Park. This discharge point is about 300 metres south of Alfords Point Bridge. The swale drain would contain a series of pervious rock check dams to help distribute flows across the swale, avoid preferential flow paths and maximise contact with vegetation. The rock check dams would also assist in slowing the surface flow velocity, thereby providing an opportunity to capture some sediment upstream of the discharge point. The length of the swale and rock check dams would be determined during detailed design and would not encroach into the Georges River National Park.

Road surface runoff between 850 metres and 1600 metres south of Alfords Point Bridge is proposed to flow through a new water quality basin before discharging towards the Georges River National Park. It is proposed to convert the temporary construction sediment basin 870 metres south of Alfords Point Bridge

into a permanent water quality basin. The water quality basins would capture and treat stormwater runoff and accidental spills. The basin would assist in stormwater quality management by minimising the export of suspended solids and associated sediment bound contaminants including heavy metals, nutrients and organic compounds. The total contributing catchment to the water quality basin would be about 1.8 hectares and the volume of the water quality basin would be about 25 cubic metres. The water quality basin would serve a dual purpose of sediment and gross pollutant capture as well as spill control of insoluble pollutants. Control of insoluble pollutants would be achieved by using a water discharge pipe that releases captured water while retaining insoluble pollutants in the basin. The basin would be designed to retain a given volume of pollutant until the basin begins to overflow at which point a filter would prevent the loss of pollutants during high flow events.

Surface runoff from the heavy vehicle inspection bay would be collected by a gutter on the south eastern side and diverted to a low point at the southern edge. Runoff would then be discharge into an adjacent swale. The size of this swale would be confirmed during detailed design however it would be located wholly within the road corridor.

Additionally, existing vegetated swales at the following locations would be retained as part of the proposal to improve the water quality of road surface runoff:

- Western side of Alfords Point Road between 775 metres and 1500 metres south of Alfords Point Bridge
- Eastern side of Alfords Point Road between 1500 metres to 1800 metres south of Alfords Point Bridge.

Rock check dams, designed in accordance with standard drawing reference *MD.G38.A05.A*, would be used within these swales to help distribute flows across the swale.

The locations of operational water quality measures for the proposal are shown in Figure 3-7.

6.4.3 Safeguards and management measures

Environmental safeguards	Responsibility	Timing
Operation water quality measures would be further investigated during detailed design including consideration of bio filtration measures in consultation with the RMS Environmental Officer.	RMS	Pre-construction
The principal Erosion and Sedimentation Control Plan (ESCP) would be sent to RMS Senior Environment Officer (Sydney Region) for review and verification prior to the construction tender.	RMS	Pre-construction
The Construction Environmental Management Plan (CEMP) would include a contingency plan for any acid sulfate soils or contamination identified during the construction phase.	Construction contractor	Pre-construction

Environmental safeguards	Responsibility	Timing
A Soil and Water Management Plan (SWMP) would be prepared as part of the Construction Environmental Management Plan (CEMP) in accordance with the requirements of RMS contract specification G38 prior to the commencement of construction. The SWMP would also address the following: • The RMS Code of Practice for Water Management • The RMS Erosion and Sedimentation Procedure (RTA, 2008) • The *Blue Book - Managing Urban Stormwater: Soils and Construction, Volume 1 and 2* (Landcom, 2004) • RMS Technical Guidelines – *Temporary Stormwater Drainage for Road Construction* (RMS, 2011).	Construction contractor	Pre-construction
In addition to the G38 requirements, the SWMP would: • Address the requirements of the principal Erosion and Sedimentation Control Plan (ESCP) • Include an ESCP in accordance with the requirements of the Blue Book • Outline basin flocculation and dewatering procedures • Outline a procedure for the containment and management of spills or leaks • A summary of applicable legislation • A procedure for regular inspection, maintenance and cleaning of erosion and sediment controls • Outline regular monitoring of Bureau of Meteorology weather forecasts • Be reviewed by RMS's Environmental Officer, Sydney Region prior to the commencement of works.	Construction contractor	Pre-construction
A principal Erosion and Sedimentation Control Plan (ESCP) would be prepared during detailed design which is to include as a minimum: • Identification of catchment areas and the direction of on-site and off-site water flow • The likely run-off from each road sub-catchment • Separation of on-site and off-site water • The direction of run-off and drainage points during each stage of construction • The locations and sizing of sediment basins • The locations of other erosion and sediment control measures (eg rock check dams, swales and sediment fences) • A materials management plan. The ESCP is to be reviewed by a soil conservationist and would be updated to address the recommendations.	RMS / Designer	Pre-construction

Environmental safeguards	Responsibility	Timing
A separate ESCP is to be prepared which outlines controls to be implemented in preparation for a wet weather event.	Construction contractor	Pre-construction
Batters would be stabilised progressively using appropriate ground cover once construction completed.	Construction contractor	Construction
Disturbed surfaces would be compacted and stabilised in anticipation of rain events to reduce the potential for erosion.	Construction contractor	Construction
Topsoil would be stockpiled separately for possible reuse for the landscaping and rehabilitation works.	Construction contractor	Construction
All stockpiles would be designed, established, operated and decommissioned in accordance with RMS' *Stockpile Management Procedures* (RTA 2011a).	Construction contractor	Construction
Controls would be implemented at exit points to minimise the tracking of soil and particulates onto pavement surfaces.	Construction contractor	Construction
Any material transported onto pavement surfaces would be swept and removed at the end of each working day and prior to rainfall.	Construction contractor	Construction
An accredited soil conservationist would be engaged to regularly inspect works throughout the construction phase.	RMS	Construction
Low lying areas of construction formations and excavations would collect stormwater and would need to be dewatered in accordance with the *RMS Technical Guideline for Dewatering*.	Construction contractor	Construction
A monitoring program and checklist for the sediment basin would be prepared and implemented, including: • Monitoring procedures and frequency • Flocculation procedures • Dewatering procedures.	Construction contractor	Construction

6.5 Aboriginal cultural heritage

An Aboriginal archaeological survey report was prepared for the proposal by Kelleher Nightingale in April 2012. The full report is provided in Appendix H and the relevant findings are summarised below.

6.5.1 Methodology

A search of the OEH Aboriginal Heritage Information Management System (AHIMS) was conducted on 10 February 2012 to identify known Aboriginal sites or declared Aboriginal places within the study area. A number of other sources of information including heritage registers and lists were also searched for known Aboriginal heritage in the vicinity of the study area, including:

- Sutherland Shire Council Local Environment Plan 2006
- RMS Heritage Register
- Railcorp Heritage Register
- Sydney Water Heritage Register
- State Heritage Register and State Heritage Inventory

- Commonwealth Heritage List
- National Heritage List
- Register of the National Estate
- Australian Heritage Places Inventory
- Historic Heritage Information Management System.

An archaeological field survey of the proposal site was undertaken by Kelleher Nightingale on 27 March 2012. The archaeological field survey was arranged with Gandangara Local Aboriginal Land Council however, on the scheduled date Gandangara Local Aboriginal Land Council were unable to participate in the survey. Gandangara Local Aboriginal Land Council were provided with a draft copy of the archaeological survey report and invited to comment. No response has been received to date.

The purpose of the survey was to locate known Aboriginal sites identified in the database searches as well as identify any other previously unrecorded potential Aboriginal sites.

The field surveys were undertaken in accordance with the OEH *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* and the RMS *Procedure for Aboriginal Cultural Heritage Consultation and Investigation* (PACHCI).

6.5.2 Existing environment

Historical background

In terms of the topography, water systems, underlying geology and resources available, the study area would have been conducive to frequent habitation by Aboriginal people. The wide variety of plants and animals in the locality would have been used for food, tools, medicine and ceremonies. The Georges River would have provided food resources and a travelling corridor, and its creeks would have provided a source of fresh water. The Hawkesbury Sandstone geology has a strong relationship with occupational rock shelters and rock art, which are locational specific features (not spread uniformly on a large scale but rather dotted within the geology). Accordingly, shelter sites are the predominant recorded site type in the vicinity of the study area (refer Appendix H).

Recorded open sites are rare in the vicinity of the study area (refer Appendix H). Often steep terrain associated with ridge lines would preclude frequent or lengthy activities in the open that would result in large quantities of stone artefacts or shell material, as well as the low likelihood that archaeological deposits survive in steep, sandy contexts.

Search results

The AHIMS search identified 61 sites within the search area which covered a minimum one kilometre radius from the proposal site (refer Figure 2 of Appendix H). The Aboriginal sites identified in the AHIMS search are summarised in Table 6-32.

Table 6-32 Site types identified in AHIMS database search

Site type	Total
Potential archaeological deposit	21
Shelter with art	9
Artefact	15
Shelter with midden	8

Site type	Total
Grinding grooves	4
Shelter with art, shelter with midden	3
Shelter with art, shelter with deposit	1
Total	**61**

Results from the AHIMS search, as well as searches of other registers and lists, showed that no items of Aboriginal heritage have been registered within the proposal site, although one site (AHIMS 45-6-1645) is located about 40 metres from the western boundary of the proposal site. Three sites (AHIMS 45-6-1789, 45-6-2878, 45-6-1597) are located within 100 metres of the proposal site.

The archaeological field survey undertaken by Kelleher Nightingale located six sites within 100 metres of the proposal site (this includes identified AHIMS sites discussed above). These sites consisted of four shelter sites, a grinding groove site and an open artefact scatter. One Aboriginal site, Alfords Point Shelter (AP S1) was within 15 metres of the proposal site. AP S1 is a shelter identified on the western side of Alfords Point Road between Marlock Place and a heavily modified drainage line that flows east beneath Alfords Point Road. The deposit appeared uniformly level and stable, with potential for buried archaeological deposit.

Another site, Alfords Point Artefact Scatter (AP AS1) consisted of a scatter of two artefacts on a weathered sandstone exposure. This site was located just beyond the proposal site on the eastern side of Alfords Point Road adjacent to the existing heavy vehicle inspection bay, immediately east by a vertical 15 metre drop.

No Aboriginal objects, archaeological sites or items were identified in the proposed relocated heavy vehicle inspection bay.

6.5.3 Potential impacts

The proposal is located within the existing road reserve that was constructed in the 1970s for Alfords Point Road and Alfords Point Bridge. The natural landscape of this road corridor has been substantially modified due to cutting, levelling and filling of the landscape. For this reason the proposal would impact on an area which has previously been highly disturbed and exhibits no archaeological potential. No listed or registered Aboriginal sites are located within the proposal site and none were observed during field surveys for the proposal. Furthermore, due to the highly disturbed nature of the proposal site it is unlikely that unknown Aboriginal objects or sites would be uncovered during construction. The proposal is not anticipated have any impact on Aboriginal cultural heritage

Two sites have been identified within 15 metres of the proposal site. A shelter with potential archaeological deposit designated as AP S1 (41-6-0031) and an open artefact scatter designated as AP AS1 (41-6-0030). Construction activities such as piling and rock breaking within the vicinity of rock shelter AP S1 (41-6-0031) have the potential to cause impacts through vibration. Potential impacts to Aboriginal items or objects located adjacent to the proposal would be minimised through the implementation of mitigation measures outlined in Section 6.5.4.

6.5.4 Safeguards and management measures

Environmental safeguards	Responsibility	Timing
An Aboriginal Cultural Heritage Management plan would be prepared and included within the CEMP. The plan is required to address (but not be limited to) the following: • A sensitive areas map which clearly identifies exclusion zones • Fencing to control access to exclusion zones • An environmental risk assessment to determine potential risks for activities likely to affect significant heritage elements • Vibration management measures for works in the vicinity of APS1 • Specific mitigation measures to avoid risk of harm • A process to communicate risk and responsibilities through environmental awareness training and inductions • A stop works procedure in the event of actual or suspected potential harm to a heritage feature/place In the event of an unexpected find of an Aboriginal heritage item (or suspected item), work would cease in the affected area and RMS's Environmental Officer, Sydney Region and the RMS Senior Environmental Specialist (Aboriginal heritage), would be contacted for advice on how to proceed. The draft Unexpected Finds Procedure (RTA 2011) would be followed in the event a potential artefact is uncovered.	Construction contactor	Pre-construction

6.6 Non-Aboriginal heritage

A statement of non-Aboriginal heritage impact was prepared for the proposal by JCIS Consultants in July 2012. The report is provided in Appendix I and the relevant findings are summarised below.

6.6.1 Methodology

Historical land use patterns within the study area were researched to establish what heritage items may exist or have previously existed. The research utilised written and photographic resources such as cadastral information, historical title information and historical aerial imagery. The following heritage registers were also searched on 5 March 2012:

- Australian Heritage Database
- NSW Heritage Database
- Sutherland Shire LEP 2006
- Sutherland Shire LEP 2000 (repealed) – viewed to verify information obtained from the Sutherland Shire LEP 2006 and the NSW Heritage Database
- NSW section 170 Heritage and Conservation Registers
- National Trust Register.

A field survey of the study area was also undertaken by JCIS Consultants on 7 March 2012. The purpose of the field survey was to identify potential heritage items and potential archaeological remains. A total of 16 areas were inspected based on historical research and sites of possible settlement using 1955 aerial images.

6.6.2 Existing environment

Historical background

European occupation within the study area began in the early 1900s in an area of about four acres along the foreshore of the Georges River, upstream from the current Alfords Point Bridge. The 1906 Holsworthy Parish Plan indicates the land was leased for the quarrying of gravel and ballast. The quarrying land was expanded during the early 1900s, and from the 1920s the study area was subdivided into small farms. These farms included typical urban-rural fringe agricultural activities, such as small vegetable gardens, orchards and poultry farms. Alfords Point Road was constructed at this time and ran along the crest of the ridge. It is likely that any houses and farm buildings associated with early European activities would be located in close proximity to Alfords Point Road and therefore located on the top of the ridge line. Therefore, any potential relics or archaeological deposits associated with early European settlement of the area are expected to be located along the Georges River foreshore upstream of the Alfords Point Bridge or along the alignment of Alfords Point Road.

The post World War II period saw an intensification of urban fringe development in the study area, sparked by Sydney's population growth and improved transportation. By the 1960s Menai was identified as a major urban growth area and development began on residential precincts, including ridge crests at Alfords Point. This resulted in the decline of rural activity, eliminating almost all trace of the previous pattern of land settlement. To support growth and increased traffic pressures, Alfords Point Bridge and approaches were constructed in 1973 and included a generous cutting to allow for future carriageway widening. Alfords Point Road was later expanded in 1989 to include a tidal flow arrangement and an extension to four lanes between Brushwood Drive and Old Illawarra Road. During 2007 and 2008 Alfords Point Bridge was duplicated.

Database search results

No listed heritage items were located within the study area. The Georges River State Recreation Area is located adjacent to the study area and is listed on the Sutherland Shire LEP 2006. This area is a designated National Park (Georges River National Park) and is shown in Figure 1-2. The Royal National Park and Garrawarra State Conservation Area are over six kilometres to the south of the proposal site.

Field survey

The areas examined during the field surveys did not exhibit any potential for archaeological relics. The large excavation and cutting undertaken for construction of Alfords Point Road would have removed all heritage items and their archaeological remains. Furthermore, the extensive clearing and construction that occurred to accommodate housing and streets on both sides of Alfords Point Road during the 1980s and 1990s effectively removed any remains of rural settlement and previous land use that may have existed.

Two carvings of human heads on the western cutting immediately south of Alfords Point Bridge are not considered to be heritage items or archaeological relics. They do not meet any of the NSW Heritage significance criteria and do not have identified cultural heritage values. Therefore, these items are not considered further.

6.6.3 Potential impacts

The proposal is located within an area that was heavily disturbed during the 1970s construction works on Alfords Point Road and Alfords Point Bridge. Searches of heritage databases identified no known non-Aboriginal heritage items or sites located within the study area. Furthermore, the field survey indicated that no items or sites of potential heritage significance exist within the study area. The Georges River State Recreation Area (listed under the *Sutherland Shire Local Environmental Plan 2006*) is located adjacent to the proposal site however outside of the direct area of impact. The potential for indirect impacts such as impacts on biodiversity, water quality or visual impacts would be managed through the implementation of mitigation measures summarised in Section 7. The Royal National Park and Garrawarra State Conservation Area are over six kilometres to the south of the proposal site and therefore would not be impacted by the proposal.

Therefore, the proposal is not anticipated to impact on any non-Aboriginal heritage items or sites.

6.6.4 Safeguards and management measures

Environmental safeguards	Responsibility	Timing
In the event of an unexpected find of a non-Aboriginal heritage item (or suspected item) work would cease in the affected area and RMS unexpected finds procedure (RTA 2011) would be implemented.	Construction contractor	Construction

6.7 Traffic and access

A traffic impact assessment for the proposal was prepared by SMEC Australia in June 2012. A copy of this report is provided in Appendix J and summarised below. Potential cumulative traffic impacts that may arise from the additive effects of other external projects are considered in Section 6.16.

6.7.1 Existing environment

Existing road network

Alfords Point Road is a main arterial road that runs north-south through the proposal site with a posted speed limit of 80 km/h. It comprises a single four-lane carriageway with two lanes in each direction up to the southern abutment of Alfords Point Bridge. Alfords Point Bridge consists of two lanes in each direction. North of Alfords Point Bridge, Alfords Point Road is a six lane carriageway, with three lanes in each direction.

There is no parking provided along this section of Alfords Point Road. However, heavy vehicles are regularly observed parking in the heavy vehicle inspection bay on the southbound side of Alfords Point Road (about 900 metres south of Alfords Point Bridge).

An existing off-road shared path is located on the eastern side of Alfords Point Road. It connects Alfords Point Bridge with shared user paths along Old Illawarra Road, Fowler Road and Brushwood Drive. The path is primarily used for recreation and fitness purposes. Pedestrian and cyclist surveys undertaken by TTM Group in 2012 indicated that pedestrian and cyclist volumes along Alfords Point Road are negligible, with up to five movements combined per hour in both AM and PM peak periods (refer Appendix B of Appendix J). No pedestrian facilities are provided on the western side of Alfords Point Road.

Ausgrid has overhead power transmission lines and associated easements that cross Alfords Point Road at about 300 metres and 725 metres south of Alfords Point Bridge. Restricted vehicle access is provided

from the southbound lanes of Alfords Point Road to both of these easements. Restricted vehicle access, from the southbound lanes at the southern abutment of Alfords Point Bridge, is also provided to Alfords Point Bridge for maintenance activities. No access to the Georges River National Park is provided from Alfords Point Road.

A description of key roads within the local road network is provided in Section 2.2. Figure 6-7 shows the local road network within the proposal site and study area including the shared path.

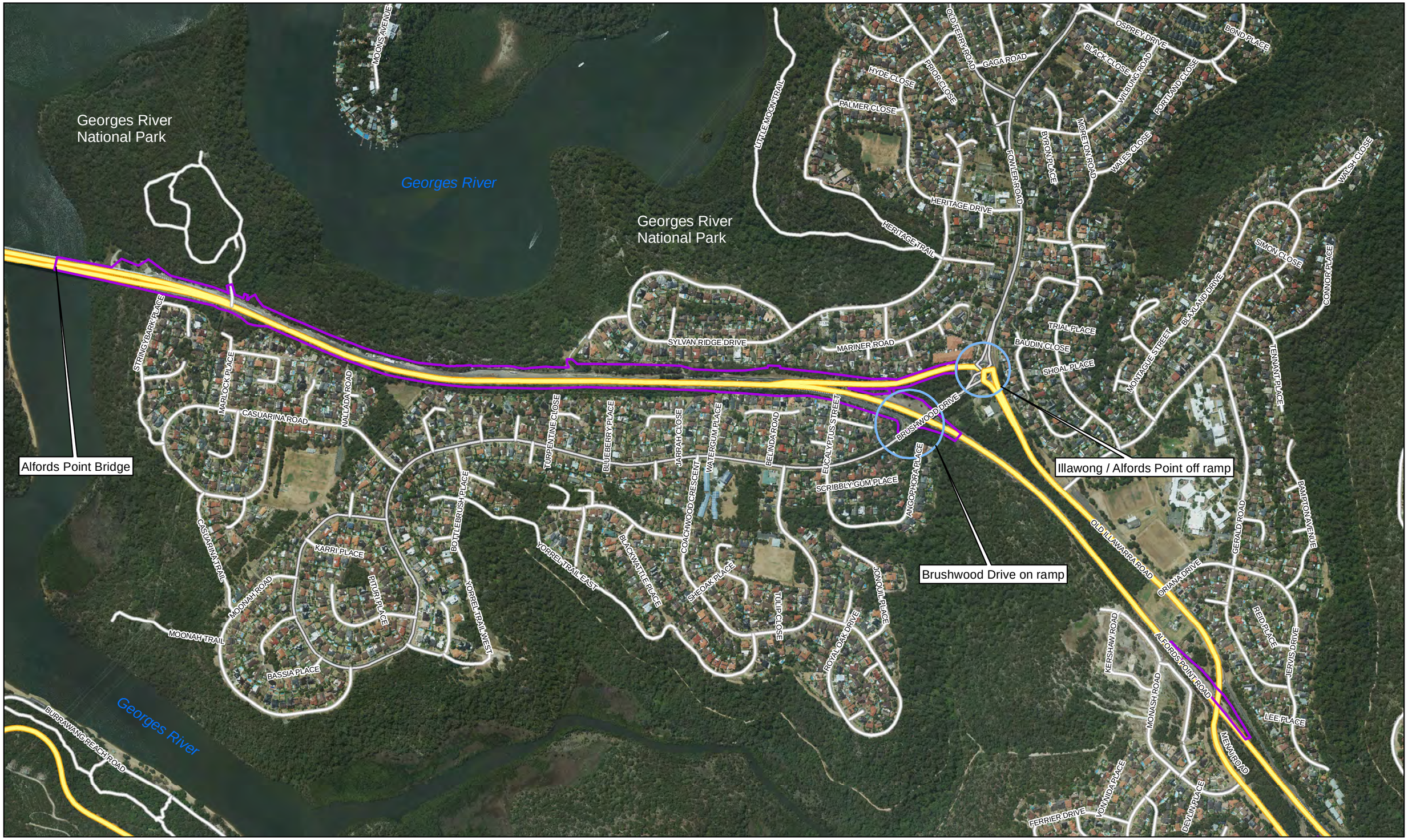
Existing traffic volumes and level of service

Road and intersection performance is assessed based on criteria defined in the RMS' *Guide to Traffic Generating Developments* (RTA, 2002). These criteria are 'average vehicle delay' and 'level of service' (refer Table 6-33). Average vehicle delay relates to the average waiting time of a vehicle at an intersection (seconds per vehicle). Level of service is a basic performance parameter used to describe the operation of an intersection. Levels of service range from A (indicating good intersection operation) to F (indicating over saturated conditions with long delays and queues). Level of service takes into account factors such as speed and travel time, freedom to manoeuvre, traffic interruptions, comfort and convenience, volume/capacity ratios, terrain types, proportion of heavy vehicles and road gradients (Austroads, 2009).

Table 6-33 Level of service criteria for intersections and mid-blocks

Level of service	Intersections			Mid-block
	Average vehicle delay (sec/veh)	Traffic signals/roundabouts	Give way/stop signs	Two lanes (veh/h)
A	Less than 14	Good operation	Good	900
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and space capacity	1400
C	29 to 42	Satisfactory	Satisfactory, but accident study required	1800
D	43 to 56	Satisfactory but operating near capacity	Near capacity and accident study required	2200
E	57 to 70	At capacity and incidents will cause excessive delays; roundabouts required other control	At capacity and required other control	2800
F	> 70	Unsatisfactory and requires additional capacity	Unsatisfactory and requires other control	n/a

The existing traffic volumes and level of service of Alfords Point Road (about 500 metres north of Brushwood Drive) are summarised in Table 6-34. The traffic volumes are one hour, peak period counts and the level of service rating is based on the criteria outlined in Table 6-33. The proportion of daily traffic volume on Alfords Point Road that is heavy vehicles is 1.6 per cent for the northbound direction and 1.2 per cent for the south bound direction.



1:8,500 (at A3)

0 55 110 220 330 440

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56

N

LEGEND

- Key project intersections
- Proposal site
- Major Roads
- Secondary Roads
- Other Roads

Roads and Maritime Services
Alfords Point Road Upgrade

Job Number	21-21268
Revision	A
Date	12 Feb 2013

CLIENTS|PEOPLE|PERFORMANCE

Local road network and key intersections

Figure 6.7

G:\21\21268\GIS\Maps\MXD\21_21268_Z010_REF_LocalRoadNetworkKeyIntersections.mxd

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Data Source: NSW Department of Lands: Cadastre - Jan 2011; Geoscience Australia: 250k Data - Jan 2011. Created by: SDWOODGER

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Table 6-34 Existing performance of Alfords Point Road within the study area, 2011

Peak	Direction	Traffic volume	Level of service
AM	Northbound	4006	E
	Southbound	1438	B
PM	Northbound	1327	B
	Southbound	3803	E

Table 6-34 indicates that during AM peak hour periods the northbound lanes on Alfords Point Road are operating at capacity with a level of service of E. During the PM peak hour period the southbound direction of Alfords Point Road is also operating at capacity with a level of service E.

Existing intersection performance

Key intersections within the proposal site are shown in Figure 6-7. The intersections are described in Section 2.2 and include:

- Brushwood Drive on ramp
- Illawong/Alfords Point off ramp.

The current performances of the Illawong/Alfords Point off ramp and Brushwood Drive on ramp are provided in Table 6-35.

Table 6-35 Existing intersection performance 2011

Intersection	Peak	Level of service	Average delay (sec)	Average queue length (m)
Brushwood Drive on ramp	AM	F	110.8	97
	PM	A	0.9	0
Illawong/Alfords Point off ramp	AM	F	156.2	125
	PM	C	32.4	33

During the AM peak, both intersections operate at an unacceptable level of service F due to:

- Substantial delays and queue lengths at the Brushwood Drive northbound on ramp intersection for vehicles from the south-east Brushwood Drive approach
- Substantial delays for vehicles travelling from the Old Illawarra Road approach, due to an increased number of vehicles travelling from Fowler Road to Brushwood Drive.

During the PM peak, both intersections operate at a level of service of C or better which is an acceptable level. However, delays are experienced due to queue lengths (average length of 125 metres and maximum length of 650 metres) at the Illawong/Alfords Point off ramp. This also impacts southbound through traffic on Alfords Point Road and creates a safety hazard.

Crash history

A total of 62 crashes were recorded within the proposal site between 2006 and 2010. The majority of crashes (69.4 per cent) were rear-end collisions. Nine rear-end crashes occurred at the Brushwood Drive on ramp merge point. Five rear-end crashes occurred south of Alfords Point Bridge in the northbound direction and one in the southbound direction. The total crash rate during this five year period was 1.43 crashes per kilometre per year. The causality crash rate was 0.55 crashes per kilometre per year.

Buses

Veolia Transport operates bus services within the proposal site that service the surrounding suburbs of Illawong, Menai, Padstow, Sutherland, Miranda, Gymea and Cronulla. Bus services to Padstow railway station provide connection with the Sydney CBD train services during the peak periods. A summary of the existing bus routes and frequencies within the study area is provided in Table 6-36. A bus stop is located on the Brushwood Drive on ramp, adjacent to Eucalyptus Street (refer Figure 1-2). There are no bus stops located on Illawong/Alfords Point off ramp. The closest southbound bus stop to the proposal is located on Old Illawarra Road about 100 metres south of the roundabout. Bus stops within the study area generally do not have shelter or seating provisions.

Table 6-36 Existing bus routes and frequencies

Service descriptions	Frequency (minutes)			
	AM peak	PM peak	Off-peak	Sunday/public holiday
M92 - Parramatta to Sutherland, via Lidcombe, Bankstown, Padstow and Menai	10	10	15	20
962 - Cronulla to Bankstown, via Miranda, Gymea TAFE, Sutherland, Menai, Illawong and Padstow	15 to 20	15	30	60
963 - Menai to Alfords Point, via Illawong and limited services to Padstow Station	Infrequent service	30	15 to 45	No services

The proposal is within the Miranda to Bankstown strategic bus corridor, one of 43 Sydney metropolitan strategic bus corridors that provide a network of enhanced and more frequent bus services across Sydney.

Heavy vehicle inspection bay

There is a heavy vehicle inspection bay located on the southbound side of Alfords Point Road about 900 metres south of Alfords Point Bridge (refer Figure 1-2). During a site investigation in March 2012, heavy vehicle trailers were observed parked within the inspection bay.

6.7.2 Potential impacts

Construction

During construction, potential impacts to road users, pedestrians, cyclists and buses may occur as a result of:

- Construction vehicle movements to and from the site
- Changes to lane and intersection layout

- Partial or full lane closures
- Changes to pedestrian and cyclist access routes
- Changes to the bus stop on Brushwood Drive on ramp.

Road network

During construction, heavy vehicles would be required to access the site for equipment and material delivery and earthworks. Small vehicle movements would also be required for construction workers accessing the site during the morning and afternoon peak periods at the start and end of shifts. These movements have the potential to cause disruptions or delays to local traffic.

It is anticipated that about 15 heavy vehicles would access the site per day resulting in 30 heavy vehicle movements. About 20 to 30 smaller vehicles would also access the site per day resulting in 40 to 60 smaller vehicle movements. The majority of vehicles accessing the site would be via Alfords Point Road. These additional heavy and light vehicle movements would be negligible compared to the existing traffic volumes on Alfords Point Road and are likely to be dispersed within the current daily traffic volumes.

Access to the site compounds and stockpile site would be directly off the existing Alfords Point Road carriageway, Old Illawarra Road or from the Illawong/Alfords Point off ramp (refer Section 3.4.7). Access and egress to both construction site compounds would be under traffic control and may result in minor traffic delays as vehicles pull in and out of the site. Vehicles accessing and exiting the stockpile site underneath Old Illawarra Road overbridge may also cause minor disruptions as vehicles pull in and out.

Detailed construction staging for the proposal has been developed to minimise impacts to traffic, particularly during peak times (refer Section 6.7.3). Staging would allow construction of parts of the proposal while maintaining traffic flow on Alfords Point Road. Construction of the potential noise barrier on the western side of Alfords Point would require temporary closure of one northbound lane on Alfords Point Road. During peak periods, the speed limit would be reduced to 60 km/h however two lanes in each direction would operate. During off peak periods, traffic would be reduced to one lane in each direction and the speed limit reduced to 40km/h for high risk works to ensure safe separation of workers from passing vehicles. Construction and reconstruction of pavement on the Illawong/Alfords Point off ramp and Brushwood Drive on ramp would require closure of ramp lanes and would be undertaken outside of standard construction hours to minimise traffic impacts.

If overnight closure of the ramps is required, alternate routes would be provided. For closure of Brushwood Drive on ramp, vehicles wanting to travel north would have to head south along Old Illawarra Road for approximately 2.5 kilometres before entering the Alfords Point Road north bound lanes. For closure of the Illawong/Alford Point off ramp, vehicles travelling south that want to exit at the Illawong/Alford Point off ramp would have to continue travelling south for approximately 2.5 kilometres until the intersection with Old Illawarra Road before making a right turn onto Old Illawarra Road and being able to travel north again back towards Alford Point. Any required detours would be developed during detailed design and outlined within the CEMP.

Further measures detailed in Section 6.7.3 would be implemented to minimise the impacts on the road network from construction vehicles entering and exiting the site compounds and stockpile site.

Buses

During construction, the bus stop on Brushwood Drive on ramp would be closed. An interim bus stop would be provided and pedestrian access would be maintained to the interim bus stop at all times. The location of the interim bus stop would be determined during detailed design in consultation with the bus service provider. All existing bus services would be maintained during construction of the proposal and only minor delays are expected.

Pedestrians

As outlined in Section 3.4.1, the existing shared path between Alfords Point Bridge and Maxwell Close would be shifted east, and reduced in width at the commencement of construction works (Stage 1). Pedestrian and cyclist facilities within this location would be maintained and continue to remain accessible to pedestrian and cyclists during Stage 1 of construction. Sections of the shared path with a steep gradient would be separated to ensure pedestrian and cyclist safety. Stage 2 works would require the closure of the shared path between Maxwell Close and Fowler Road. The path would be diverted along Maxwell Close, Sylvan Ridge Drive and Heritage Drive. This would result in a minimal increase in travel times for pedestrians and cyclists.

Access

As Alfords Point Road is a controlled access road there are no residential access points and therefore no access impacts to the public are anticipated. There would be no impact to the existing Ausgrid easement (refer Section 3.6.1) or the gross pollutant trap as access would be maintained to these areas during construction.

Operation

Key intersections

VISSIM traffic modelling undertaken for the proposal assessed the potential operational impacts on key intersections. The scenarios modelled were as follows:

- 2016 without the proposal
- 2016 with the proposal
- 2026 without the proposal
- 2026 with the proposal.

Table 6-37 summarises the intersection modelling results for the year 2016 scenario with and without the proposal.

Table 6-37 Intersection performance, 2016 (with and without the proposal)

	Peak	**LoS**	**Average delay (sec)**	**Average queue length (m)**	**LoS**	**Average delay (sec)**	**Average queue length (m)**
		Without proposal			*With proposal*		
Brushwood Drive on ramp	AM	F	140.7	119	A	3.5	0
	PM	A	0.9	0	A	0.9	0
Illawong/ Alfords Point off ramp	AM	F	192.8	149	A	4.3	0
	PM	C	41.3	63	B	20.5	15

Table 6-38 summarises the intersection modelling results for the year 2026 scenario with and without the proposal.

Table 6-38 Intersection performance 2026 (with and without proposal)

	Peak	LoS	Average delay (sec)	Average queue length (m)	LoS	Average delay (sec)	Average queue length (m)
		Without proposal			*With proposal*		
Brushwood Drive on ramp	AM	F	201.5	181	A	4.0	0
	PM	A	1.0	0	A	1.0	0
Illawong/ Alfords Point off ramp	AM	F	248.4	170	A	4.6	1
	PM	D	46.3	97	B	27.7	27

Without the proposal, both intersections would operate at an unacceptable level of service F during the AM peak period for both 2016 and 2026. The Brushwood Drive on ramp would operate a level of service of A during the PM peak period for both 2016 and 2026. The Illawong/Alfords Point off ramp would operate at a satisfactory level of service of D or better during the PM peak period for both 2016 and 2026. However, substantial queue lengths would be experienced by vehicles on the off ramp which may impact southbound through traffic on Alfords Point Road.

With the proposal, a satisfactory level of service B or better would be experienced during the AM and PM periods at both intersections for the 2016 and 2026 scenarios.

Alfords Point Road

VISSIM traffic modelling was also undertaken for the proposal to assess the potential operational impacts on Alfords Point Road in year 2026. Table 6-39 provides the results of the 2026 traffic modelling for the both the with the proposal scenario and the without the proposal.

Table 6-39 Modelled network performance of Alfords Point Road, 2026

Performance parameter	Without proposal	With proposal	Without proposal	With proposal
	2026 AM peak		***2026 PM peak***	
Average vehicle speed (km/h)	27.6	64.3	48.5	58.1
Average vehicle delay (sec)	130.5	5.9	38.4	19.0

Table 6-39 indicates that in 2026 the proposal would increase the average speed of vehicles travelling along Alfords Point Road by 40km/h in the AM peak and 10km/h in the PM peak. The proposal would also substantially reduce the average vehicle delays in both the AM and PM peak periods. This reduction in congestion would improve safety for road users on Alfords Point Road and minimise the potential for rear-end collisions.

Relocation of the heavy vehicle inspection bay to underneath Old Illawarra Road would remove the need for heavy vehicles to merge at low speed with traffic on Alfords Point Road. This would have a positive

operational impact on Alfords Point Road by improving traffic flow on southbound lanes between Alfords Point Bridge and Illawong/Alfords Point Road off ramp. This would also have positive safety benefit.

Relocating the bus stop on Brushwood Drive on ramp to a location 80 metres south of its current location, and providing a bus bay and bus only lane would result in a positive impact on traffic flow in this location. Relocating the bus stop would increase sight distances for bus drivers, improving the efficiency at which buses can merge with other traffic when exiting the bus lane. The bus only lane at the entrance of Brushwood Drive on ramp would provide a dedicated lane for buses while they wait, to safely enter the bus stop, without blocking on ramp for though traffic. The bus bay would also improve through traffic on Brushwood Drive on ramp by allowing buses to pull further to one side when stopping at the bus stop.

Existing accesses to the Ausgrid easements would be maintained during operation of the proposal. The new central median that would be constructed from the southern abutment of Alfords Point Bridge to 1.8 kilometres south, would not impact through traffic on Alfords Point Road however would result in a safety benefit by reducing the potential for head on collisions. A u-turn facility would be provided in the central median for emergency vehicles at the southern abutment of Alfords Point Bridge.

Access gaps for fire and rescue services would be considered in the design of any noise barrier deemed necessary after the feasible and reasonable noise mitigation assessment.

6.7.3 Safeguards and management measures

Environmental safeguards	Responsibility	Timing
A traffic management plan (TMP) would be prepared prior to construction and included in the CEMP. The TMP would include measures to minimise construction vehicle impacts on the surrounding local road network, such as restrictions on vehicle delivery times and ensuring construction traffic is minimised during peak periods. The TMP would also ensure that pedestrian and cyclist access from Illawong and Alfords Point to Alfords Point Bridge is maintained at all times during construction. It would also ensure all property accesses, access to the Ausgrid easements and Alfords Point Bridge maintenance access would be maintained throughout construction.	Construction contractor	Pre-construction
Consultation with emergency service authorities would be undertaken during development of the detailed design including NSW Rural Fire Service and Fire Rescue.	RMS	Pre-construction
A detailed construction staging plan would be developed to maintain existing peak flow capacity. This would include staging of construction works on the Illawong/Alfords Point off ramp.	RMS	Pre-construction
Maintain pedestrian and cyclist access throughout construction.	Contractor	Pre-construction
Appropriate protection would be installed to separate pedestrians and cyclists from work areas.	Contractor	Construction

6.8 Landscape character and visual amenity

A landscape character, visual impact assessment and urban design report was prepared by RMS in October 2012. The report is provided in Appendix K and the relevant findings are summarised below.

6.8.1 Methodology

The landscape character and visual impact assessment report was prepared in accordance with the RMS *Environmental Impact Assessment Guidance Note – Guidelines for landscape character and visual impact assessment* (RMS 2008). The report defines several landscape character zones and assesses the potential landscape character and visual impacts of the proposal. The assessment is based upon the sensitivity of a view and the magnitude of the proposal in that view. Sensitivity and magnitude are combined to give a visual impact rating as follows:

- High: The visual impact on these receptors/viewers would require amelioration at the site planning stage to allow viewers to continue to enjoy the existing visual amenity
- Moderate: The visual impact on these receptors/viewers is at a localised scale and can be mitigated at detailed design phase or already has some existing screening or setback that minimises impact
- Low: The visual impact on these receptors/viewers is considered low and little or no amelioration is needed.

Proposal specific urban design principles have been developed as an integral part of the concept design (refer Section 3.4.8) and would be further refined during detailed design.

6.8.2 Existing environment

Alfords Point Road sits within an existing road corridor that is characterised by a number of deep cuttings and wide fill areas. Vegetation lines large parts of the corridor and an existing noise barrier is located on the western side between Brushwood Drive on ramp and the rear of Jarrah Close. In some locations, views of the adjacent Georges River National Park and the Georges River create a landscape experience for road users. Typical sections of the road corridor are shown in Figure 6-8 to Figure 6-11.

Figure 6-8 Road corridor at existing heavy vehicle inspection bay

Figure 6-9 Road corridor within typical cutting

Figure 6-10 Road corridor at proposed heavy vehicle inspection bay

Figure 6-11 Road corridor at bus stop on Brushwood Drive on ramp

Landscape character

Landscape character zones are areas with similar physical qualities that distinguish them from other character zones. Five landscape character zones are identified for the proposal as shown in Figure 6-12.

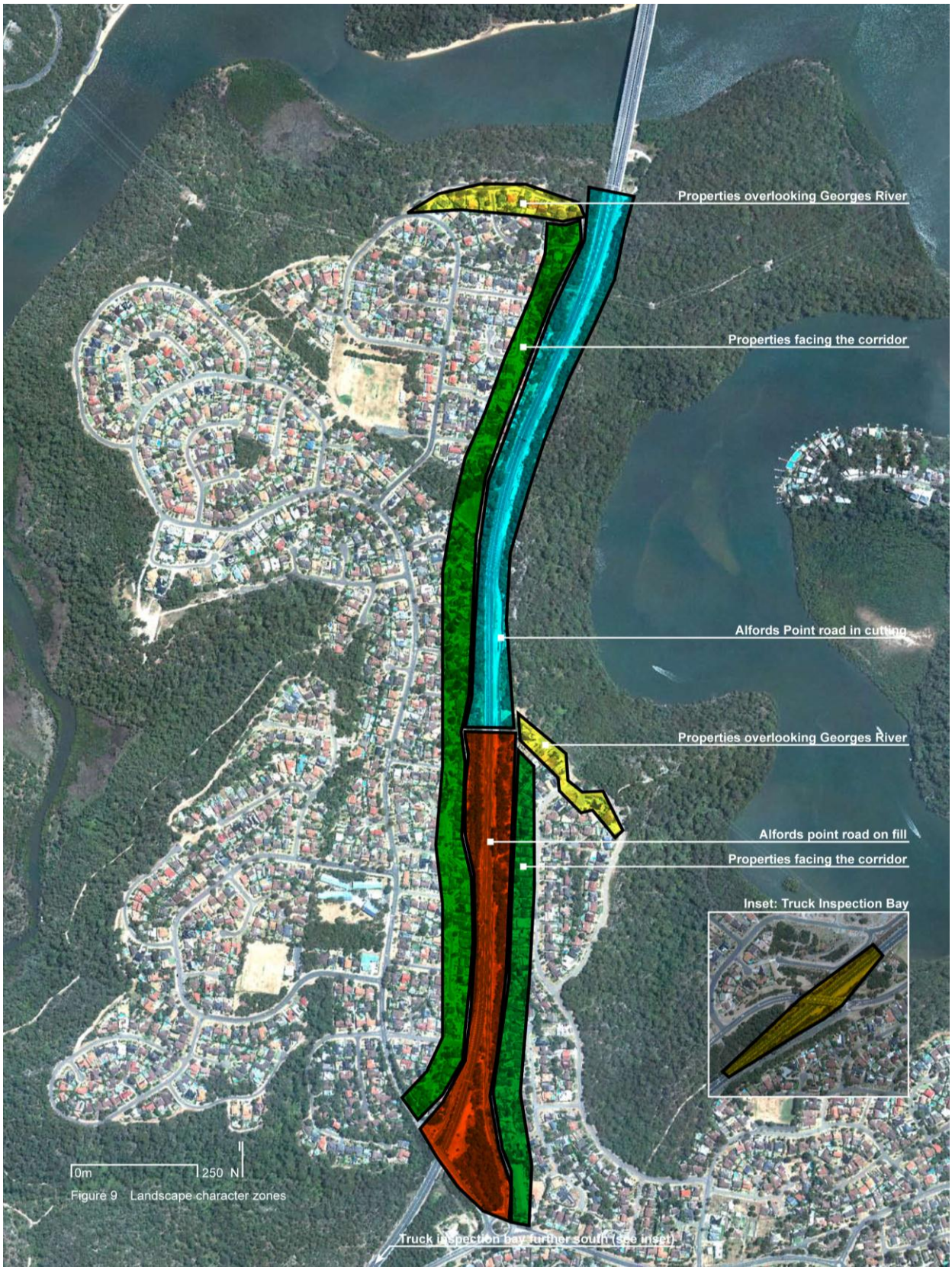

Figure 6-12 Landscape character zones

Landscape character zone 1 – Properties overlooking the Georges River

This character zone contains north-facing residential properties that overlook the Georges River. This landscape character zone has a strong connection to the Georges River and the Georges River National Park.

Landscape character zone 2 – Properties facing the road corridor

This landscape character zone contains the rows of residential properties in Illawong and Alfords Point that are adjacent to the road corridor. Whilst these properties face the corridor, they are separated from Alfords Point Road by vegetation along the corridor.

Landscape character zone 3 - Alfords Point Road on fill

This landscape character zone incorporates the portion of Alfords Point Road from Brushwood Drive overbridge to about 800 metres north and includes the Illawong/Alfords Point off ramp and Brushwood Drive on ramp. It is characterised by the existing paved surface and road side planting.

Landscape character zone 4 - *Alfords Point Road in cutting*

This landscape character zone is between the southern abutment of Alfords Point Bridge and about 800 metres north of Brushwood Drive overbridge. This character zone is within a substantial cutting, dominated by paved road surface and cutting walls.

Landscape character zone 5 – Proposed truck inspection bay

The landscape character zone of the proposed truck inspection bay is beneath the Old Illawarra Road overbridge. It is an area similar to landscape character zone 3 and 4 with continuity in the topography and road side vegetation. A sandstone cutting forms the boundary of the character zone which is similar to other cuttings on Alfords Point Road. Old Illawarra overbridge has a simple, robust design and regrowth vegetation partially screens the bridge components.

Visual catchment and viewpoints

The existing road corridor of Alfords Point Road limits the visual catchment to residential properties immediately adjacent to the corridor. The visual catchment of the study area and a representative sample of viewpoints within the visual catchment are shown in Figure 6-13. The viewpoints do not represent the entire number of properties likely to be visually impacted by the proposal, but rather give an indication of the typical range of views from properties within the study area. Twenty viewpoints from within the proposal's visual catchment have been identified and assessed. Viewpoints A01 to A13 and viewpoint R01 to R03 represent views from residential areas along Alfords Point Road adjacent to the proposed site. Viewpoints C01 and C02 represent views that have the potential to be impact by the shared path. Viewpoints T01 and T02 represent viewpoints that have the potential to be impacted by the heavy vehicle inspection bay.

Figure 6-13 Visual catchment and view points

6.8.3 Potential impacts

Construction

During construction, the positioning of plant and equipment along the alignment and the presence of construction compounds within the view of neighbouring properties and existing road users would result in minor, temporary visual impacts. Earthworks would also expose subsoil during the construction period that would be visible in the landscape. The use of lighting towers during night works may result in light spill impacting adjoining properties and residents.

Operation

Landscape character impacts

The potential impacts of the proposal on landscape character are summarised in Table 6-40 and discussed below. The assessments were undertaken on a worst case scenario basis and therefore included consideration of impacts from the potential noise barriers.

Table 6-40 Summary of landscape character impacts

Landscape character zone	Magnitude	Sensitivity	Overall rating
1 – Properties overlooking the Georges River	Negligible	High	Negligible
2 – Properties facing the road corridor	Moderate	Moderate	Moderate
3 - Alfords Point Road on fill	Moderate-low	Moderate-high	Moderate
4 - Alfords Point Road in cutting	Moderate-low	High	Moderate-high
5 – Heavy vehicle inspection bay	Low	Moderate	Moderate-low
Overall	Low	High	Moderate

Landscape character zone 1 – Properties overlooking the Georges River

This character zone contains north-facing residential properties which overlook the Georges River. Whilst highly sensitive to change due to the connection these properties have with the Georges Rive and adjacent areas of the Georges River National Park, the magnitude of the proposal in this character zone would be negligible due to the distance of this character zone to the proposal. Overall the landscape character impact rating would be negligible.

Landscape character zone 2 – Properties facing the road corridor

This character zone is formed from the rows of residential properties in Illawong and Alfords Point that are adjacent to the road corridor. Whilst having a moderate sensitivity to change, in that they already face the corridor, the magnitude of the proposal in this zone would be low due to the screening of the proposal by vegetation lining the corridor. Whilst some of the vegetation would be cleared, the separating effect of the vegetation would only be minimally reduced by the proposal. However, if a noise barrier was constructed between residences and the road corridor's eastern verge, a moderate level of impact would result due to the additional potential vegetation removal required for its construction. In particular, this additional vegetation removal would affect the character of those properties adjacent to the southbound off ramp.

Landscape character zone 3 - Alfords Point Road on fill

This character zone incorporates the portion of Alfords Point Road between Brushwood Drive and about 800 metres north, including Brushwood Drive on ramp and Illawong/Alfords Point off ramp. The current sensitivity of this landscape character for road users and adjacent properties is moderate-high due to the substantial amount of road pavement and road infrastructure. The magnitude of the proposal in this location would be moderate-low due to the widening of Illawong/Alfords Point Road off ramp, Brushwood Drive on ramp and construction of a potential noise barrier on the western and eastern sides of the road. If constructed, the noise barrier would be set back from the road by about two metres to allow the planting of screening vegetation to minimise its impact. There would still be a degree of residual impact though, as the planting in front of the noise barrier would not be the same height and proximity to the travel lanes as existing planting. Furthermore, vegetation on the Brushwood Drive on ramp in front of the existing noise barrier would be removed to provide access to the relocated bus stop. Considering the speed at which road users travel through this section of the road and the low sensitivity of this landscape character zone, the relationship between the noise barrier and the road, the level of impact the proposal would create in this landscape character is considered moderate.

Landscape character zone 4 - Alfords Point Road in cutting

Situated between the southern abutment of Alfords Point Bridge and about 800 metres north of Brushwood Drive, this landscape character zone has a high sensitivity to change due to substantial vegetation of both sides of the corridor and landscape experience it offers road users. The proposal would be of moderate-low magnitude in this location due the potential noise barrier on the western side of Alfords Point Road. The increase in paved surface and installation of concrete barriers would also have a minor contribution to the magnitude of the proposal. The level of overall impact would be moderate-high.

Landscape character zone 5 – Proposed heavy vehicle inspection bay

The location of the proposed heavy vehicle inspection bay would be underneath Old Illawarra Road overbridge and within an existing, wide cutting. This landscape character zone is highly modified and has a moderate sensitivity to change. The magnitude of the heavy vehicle inspection bay would be limited to the immediate area underneath Old Illawarra Road overbridge and would have a moderate-low level of impact, based on the limited change to topography required.

Visual impacts

The proposal is located within the existing Alfords Point Road corridor that was created in the 1970s. Cuttings already provide sufficient width to accommodate the proposal without substantial changes to the landscape. Due to the physical characteristics of the road corridor the visual catchment of the proposal is limited to the Alfords Point Road corridor itself and residential properties immediately adjacent to the corridor.

Table 6-41 summarises the visual impact of the proposal on the 20 existing viewpoints identified in Figure 6-13. Each viewpoint is given a visual impact rating based on the sensitivity of the view and the magnitude of change that would occur. Impacts on receptors vary depending on distance of the receptor from the proposal and whether views would be partially/completely screened. A detailed assessment of individual receptors is provided in Appendix K.

Table 6-41 Summary of visual impacts

Visual impact rating	Number of viewpoints affected
Negligible	2

Visual impact rating	Number of viewpoints affected
Low	0
Moderate/Low	1
Moderate	9
Moderate/High	5
High	3

Two viewpoints (R02 and A01) received a visual impact rating of negligible. Residential properties within these viewpoints are situated at a greater distance from the proposal, may have dense vegetation filtering views of the road or are elevated above the carriageway. These receptors are unlikely to have their visual amenity negatively affected by the proposal.

Nine viewpoints received a visual impact rating of moderate (A02, A03, A04, A05, A12, A13, R03, T01 and T02) due to their proximity to the proposal and distant views to the proposed noise barrier. Many of these viewpoints have their views of the proposal partially screened by vegetation or are have a different elevation to the road.

Five viewpoints, view A8, A9 A11, C01 and C02 in Figure 6-13, received a visual impact rating of moderate/high. This is due to the widened carriageway, median barrier, and potential noise barrier being located within their visual field.

Three viewpoints received an impact rating of high due to the location of the potential noise barrier or the removal of screening vegetation. These views are A06, A07, and A10 (refer Figure 6-13). The visual impacts to residential properties with these viewpoints would be minimised through the implementation of management measures and safeguards outlined in Section 6.8.4, including landscaping and tree planting. As discussed in Section 3.4.9, tree planting and other landscape treatments used to reduce the visual impact of the proposal would complement and reflect the works undertaken on the northern approach to Alfords Point Bridge and endemic plant communities existing beyond the corridor.

The features of the proposal that have the greatest potential to impact adjacent viewpoints include:

- Relocating the bus stop and footpath on Brushwood Drive on ramp would require vegetation removal resulting in a moderate impact to the outlook from the rear of properties on the western side of Alfords Point Road near the Brushwood Drive on ramp and the quality of the view for road users
- The potential noise barrier along the western and eastern side of Alfords Point Road would impact the adjacent residences given the distance between the residences and the road side edge. Some vegetation would require removal however as much as possible would be retained as a visual buffer
- Widening the Illawong/Alfords Point off ramp would require vegetation removal in this location resulting in the loss of existing visual buffer between residences on the eastern side of Alfords Point Road near the Illawong/Alfords Point off ramp and Alfords Point Road.

The variable message sign would have a negligible visual impact as it would replace an existing variable message sign. The new variable message sign would have similar dimensions to the existing variable message sign and would only be positioned about 500 metres south from its existing location. The heavy vehicle inspection bay would also have a limited visual impact. Adjacent sensitive residential receivers are located on top of a cutting and therefore at a different elevation to the inspection bay. Existing vegetation also partially screens their views of Alfords Point Road.

The potential noise barrier along the western edge of Alfords Point road is considered to have a low potential shadowing impact to adjacent residences given the large distance between the residences and the roadside edge (greater than 20 metres).

Overall, the proposal is considered to have a moderate level of visual impact on current viewpoints largely due to the potential noise barrier along the western side of Alfords Point Road.

6.8.4 Safeguards and management measures

Environmental safeguards	Responsibility	Timing
Detailed design of the proposal, would incorporate the design principles outlined in the Landscape Character, Visual Impact Assessment and Urban Design Report where feasible, including: • Landscape and urban design principles in Section 3.3.6 and Appendix K • Treatment of verges, safety barriers and infrastructure elements would be simple and robust in detail, and considerate of the greater landscape experience • The design of safety barriers and lighting would be compatible with the design elements of Alfords Point Road northern approach and Alfords Point Bridge • The provision of seats with shade trees at steep sections of the shared path would be considered during detailed design	RMS/Designer	Pre-construction
The design of potential noise barriers would be undertaken during detailed design and would take into consideration the RMS Noise Wall Design Guidelines (RTA 2007). The following principles would be considered during the design of the potential noise barriers: • Two metre set back from Alfords Point Road to allow planting of vegetation to screen the roadside face of the noise barrier • The noise barrier would be consistent with the design of noise barriers on nearby roads • Materials, colours and textures would be selected to break up the dominant nature of the noise barrier • Transparent panels would be incorporated into sections of the noise barrier where it has potential to block solar access to adjacent residential properties • Consideration of landscape treatments on the residential face of the potential eastern barrier to reduce the incidence of graffiti.	RMS/Designer	Pre-construction
An urban design contractor from RMS panel would be engaged for the detailed design phase to ensure adequate consideration of urban design principles and objectives, and to ensure appropriate mitigation of identified impacts.	RMS/Designer	Pre-construction

Environmental safeguards	Responsibility	Timing
Where vegetation loss reduces the amount of screening between residences and the shared path and residents and the Illawong/Alfords Point off ramp, causing loss of amenity and privacy, the following would be considered: • Tree protection measures at the base of the fill embankment to maintain as much mature vegetation as possible • Early works to plant advanced stock adjacent to the proposed shared path at the top of the embankment • Early works to plant advanced stock between the base of the embankment and the road corridor boundary • Using fast growing species such as Acacia on the embankment.	RMS/Designer	Pre-construction
The footprint for construction works would be kept to a minimum to ensure existing stands of vegetation remain intact wherever possible and to screen adjoining sensitive receivers.	Construction contractor	Construction
Fencing with material attached (eg shade cloth) would be provided around the construction compounds and other areas to screen views of the construction compounds from adjoining properties.	Construction contractor	Construction
The work site would be left in a tidy manner at the end of each work day.	Construction contractor	Construction

6.9 Air quality

6.9.1 Existing environment

A search of the National Pollutant Inventory on 30 March 2012 identified 46 air pollutant substances from nine sources in the Sutherland Shire local government area (2010 to 2011 reporting period). The closest identified source of air pollutant was located over two kilometres south of the proposal.

Air quality within the study area would be typical of an arterial road within the Sydney region. Activities including the burning of fossil fuels, land clearing, industrial activities and the consumption of household energy would all be contributing factors impacting to air quality. However, the main source of emissions impacting air quality in the locality would be motor vehicles on the surrounding road network (OEH, 2003).

Air quality is highly dependent on the processes of wind, temperature inversions and rainfall. The climate of the study area is characterised by warm to hot summers and cool to mild winters. The relative close proximity of the study area to Botany Bay (less than five kilometres) would provide cooling sea breezes in the summer months.

6.9.2 Potential impacts

During construction the following activities may result in impacts to local air quality:

- Clearing of vegetation
- Stripping, stockpiling and managing topsoil

- Earthworks, excavation for road widening, construction of the road and shared path
- Road sub-grade preparation and road pavement works
- Transport and handling of soils and materials
- Use of construction vehicles
- Spray painting for line marking
- Rock hammering.

Potential air quality impacts during construction would predominantly be associated with the generation of dust. Dust settlement may impact upon adjacent properties causing soiling of surfaces. Substantial dust generation could result in health impacts to nearby receivers. Of particular concern is the Sir Thomas Mitchell Aged Care Facility adjacent to the Illawong/Alfords Point off ramp. Air quality impacts as a result of dust generation are considered to be minor and may occur at times throughout construction, however they would be minimised through the implementation of the safeguards and management measures outlined in Section 6.9.3.

The operation of machinery and other construction vehicles would result in the emission of exhaust fumes. The impact of these emissions would be temporary in nature (limited to the duration of construction) and only minor when compared to the exhaust fumes emitted from the existing traffic on Alfords Point Road. Implementation of the safeguards and management measures outlined in Section 6.9.3 would minimise these impacts.

During the application of asphalt and line marking, odours may be generated that impact adjacent residential areas or users of Alfords Point Road. These impacts would be limited to the duration of certain activities during construction and no long term odour impacts would result from the proposal.

Overall, potential air quality impacts during construction would be temporary in nature and minimised by the implementation of mitigation measures outlined in Section 6.9.3.

Operation

The proposal would increase the carrying capacity of Alfords Point Road to relieve existing congestion and accommodate forecast traffic growth associated with expected population growth in Sydney. This increase in traffic would impact on local air quality through vehicle emissions however the proposal would improve the operation of Alfords Point Road reducing local congestion and queuing times. This would therefore reduce the amount of idling vehicles with the locality and may potentially improve local air quality during peak periods.

The proposal includes relocating the existing bus stop on the Brushwood Drive on ramp which would continue to encourage the use of public transport. The proposal also incorporates a permanent shared path for pedestrians and cyclists which would provide a healthy, non-polluting means of transport for users of Alfords Point Road.

6.9.3 Safeguards and management measures

Environmental safeguards	Responsibility	Timing
An Air Quality Management plan would be prepared and included within the CEMP. The plan is required to address (but not be limited to) the following: • A procedure for monitoring dust on-site and weather conditions • Identification of dust generating activities and associated mitigation measures • Limits on the area that can be opened up or distributed at any one time • Compliance with RMS stockpile site management guideline (2011) • Progressive stabilisation plans.	Construction contractor	Pre-construction
Any rock hammering works required adjacent to Sir Thomas Mitchell Aged Care Facility would be dampened to reduce dust generation. At other locations dampening during rock hammering would be used as necessary to reduce dust generation or works would cease during windy conditions.	Construction contractor	Construction

6.10 Land use and property

6.10.1 Existing environment

Alfords Point Road is located in a predominantly low density residential area with the suburb of Alfords Point to the west and Illawong to the east. The following non-residential land uses are located in the study area:

- The Georges River National Park located directly east
- The Georges River located to the north and east
- Alfords Point Primary School located within the suburb of Alfords Point about 300 metres to the west
- Menai High School located within the suburb of Menai about 200 metres to the east
- Sir Thomas Mitchell Aged Care Facility, located directly adjacent to the Illawong/Alfords Point off ramp.

A new residential development is proposed for West Menai about two kilometres south, however this development has yet to be designated a state significant development by the Department of Planning and Infrastructure and therefore has not been considered further. No other future land use developments are known in the vicinity of the proposal.

Ausgrid has overhead power transmission lines and associated easements that cross Alfords Point Road at about 300 metres and 725 metres south of Alfords Point Bridge. Restricted vehicle access is provided from the southbound lanes of Alfords Point Road to both of these easements. Restricted vehicle access, from the southbound lanes at the southern abutment of Alfords Point Bridge, is also provided to Alfords Point Bridge for maintenance activities. No access to the Georges River National Park is provided from Alfords Point Road.

6.10.2 Potential impacts

The proposed locations for the construction site compounds, stockpile site, new bus bay, potential noise barrier and heavy vehicle inspection bay are all within the existing road corridor and no property acquisition is required. Therefore, the impacts to land use are considered negligible.

Ausgrid easement access and Alfords Point Bridge maintenance access would be maintained during construction and operation of the proposal.

6.10.3 Safeguards and management measures

Environmental safeguards	Responsibility	Timing
No specific safeguards or management measures are proposed.	N/A	N/A

6.11 Socio-economic

6.11.1 Existing environment

The population of Sutherland Shire local government area in 2011 was 210,863 (ABS, 2011). In 2011 the dominant age cohorts were the 35-39 and 40-44 aged groups, each with 7.2 per cent, followed by the 45-49 and 50-54 age groups each with 7.1 per cent (ABS, 2011). The 2011 median weekly household income level in Sutherland Shire was $1,674 compared to $1,237 for New South Wales (ABS, 2011).

Sutherland Shire's labour force in 2006 (2011 data not available) was 110,752 of which 69,274 were employed full-time (62.5 per cent) and 31,658 were employed part-time (28.6 per cent). Overall, 97.1 per cent of the labour force was employed and 2.9 per cent unemployed, compared with 94.7 per cent and 5.2 per cent respectively for the greater Sydney region.

No commercial premises are located within or immediately adjacent to the proposal site. Sir Thomas Mitchell Aged Care Facility is located adjacent to Illawong/Alfords Point off ramp. A Veolia bus stop is located on Brushwood Drive on ramp which is accessed from Eucalyptus Street. No access is provided to the Georges River National Park or the Georges River from Alfords Point Road.

Parking is prohibited along Alfords Point Road, however heavy vehicles currently use the heavy vehicle inspection bay as a rest area and often park trailers in this location. The closest formal truck stops to the proposal are located about 15 kilometres to the south at Lady Wakehurst Drive and Mount Ousley Road.

Residential properties are located along both sides of Alfords Point Road in the suburbs of Illawong and Alfords Point.

6.11.2 Potential impacts

Construction

Issues such as air quality, dust, traffic and access, land use, noise, vibration and visual amenity have the potential to impact the local community and road users during construction and operation of the proposal. These issues have been outlined and assessed in other sections of this report, as follows:

- Noise and vibration (refer Section 6.1)
- Visual impacts (refer Section 6.8)
- Traffic and access (refer Section 6.7)
- Air quality (refer Section 6.9)
- Land use and property (refer Section 6.10).

Traffic and access issues, as discussed in Section 6.7, have the potential to result in minor impacts to the community through traffic delays or potentially increased travel times during construction. Increased travel times would also be experienced by pedestrians and cyclists due alternate routes provided during closure of the shared path. This would include diverting pedestrians and cyclists onto Fowlers Road via Maxwell Close, Sylvan Ridge Drive and Heritage Drive during Stage 2 of construction (refer Section 3.4.2.

During works on the Brushwood Drive on ramp, the existing bus stop would be closed and an interim bus stop provided. Pedestrian access to the interim bus stop would be maintained at all times during construction. The location of the interim bus stop would be determined during detailed design in consultation with the bus service provider.

The public would be notified of the interim bus stop location, lane closures and pedestrian detours via variable message signs, regular construction updates, local newspaper articles and the RMS project website.

General amenity impacts may also be caused during construction of the proposal due to the following:

- Increases in noise due the operation of plant and equipment
- Potential dust disturbance due to vegetation removal, exposed soils or removal of existing infrastructure
- Increase in construction traffic due to the delivery of plant, materials and construction personnel
- Visual impacts due to construction works.

Removal of vegetation on the Illawong/Alfords off ramp to facilitate the additional lane and realignment of the shared path would result in potential noise and visual impacts being experienced at the Sir Thomas Mitchell Aged Care Facility. These potential noise and visual impacts are discussed further in Section 6.1 and Section 6.8 respectively.

The clearing of vegetation on the eastern side of Alfords Point Road about 800 metres south of Alfords Point Bridge would result in the loss of some privacy and visual amenity at adjacent residential dwellings. This vegetation along the road corridor boundary currently provides a visual buffer and its removal would result in a reduction of privacy at these residential dwellings. These visual impacts would be minimised where possible through the implementation of the safeguards and management measures outlined in Section 6.8 including early works to plant advanced screening vegetation. No private gardens or vegetation on private properties would be impacted by the proposal.

Currently, local residents are using the heavy inspection bay for parking heavy vehicles. Converting this area into a break down bay and restricting parking may result in local residents using other nearby areas for parking. There are a number of alternate locations where heavy vehicles may park including on the northbound side of Alfords Point Road adjacent to Marsden Road. RMS is undertaking on-going consultation with the trucking industry regarding the relocation of the heavy vehicle inspection bay.

The relocation of utilities discussed in Section 3.6.2 may result in minor, localised disruptions to the provision of utility services to some residents. Affected residents would be notified of the disruptions via letter in accordance with RMS utility relocation requirements.

Amenity in the broader Sutherland Shire area would not be impacted by the proposal as impacts would be localised and limited to areas immediately adjacent to the proposal.

Operation

The potential impacts of the proposal on traffic and access are discussed in Section 6.7. Overall the proposal would enhance road safety and travel times by providing an additional lane in each direction and improving the merge point congestion currently experienced at the Brushwood Drive on ramp,

Illawong/Alfords Point off ramp. The proposal would also improve the road safety issues associated with the current location of the heavy vehicle inspection bay.

If a noise barrier on the western side of Alfords Point Road is deemed feasible and reasonable as a noise mitigation option, its construction would result in minor visual impacts for motorists on Alfords Point Road however this would be minimised by landscape treatment on the roadside edge of the wall. The general amenity in the Sutherland Shire area is not considered likely to be negatively altered as result of the proposal.

The proposal would result in an upgrade to existing off-road pedestrian and cycle facilities along Alfords Point Road (details provided in Section 3.3.5). These improvements to pedestrian and cycle facilities would benefit the wider community as it would improve access along Alfords Point Road and provide a connection to existing pedestrian and cyclist facilities north of Alfords Point Bridge.

The location of the bus stop on the western side of Alfords Point Road would be adjusted and a bus only lane would be provided to improve safety for buses entering the on ramp.

Lockable gates and fencing have been incorporated into the proposal design to address potential community concerns regarding illegal dumping, rubbish and crime at the new heavy vehicle inspection bay.

6.11.3 Safeguards and management measures

Environmental safeguards	Responsibility	Timing
A complaint handling procedure and register would be included in the CEMP.	Construction contractor	Pre-construction
Local residents would be notified prior to works commencing and would be kept regularly informed of construction activities during the construction process.	Construction contractor	Pre-construction and Construction
During construction, road users, pedestrians and cyclists would be informed of changed conditions.	Construction contractor	Construction
Residents would be informed prior to any interruptions to utility services that may be experienced as a result of utilities relocation.	Construction contractor	Construction

6.12 Waste management

RMS is committed to ensuring the responsible management of unavoidable waste and promotes the reuse of such waste in accordance with the resource management hierarchy principles outlined in the *Waste Avoidance and Resource Recovery Act, 2000*. These resource management hierarchy principles, in order of priority are:

- Avoidance of unnecessary resource consumption
- Resource recovery (including reuse, reprocessing, recycling and energy recovery)
- Disposal.

By adopting the above principles, RMS aims to efficiently reduce resource use, reduce costs, and reduce environmental harm in accordance with the principles of ecologically sustainable development (refer Section 8.2).

6.12.1 Potential impacts

Waste streams likely to be generated during construction of the proposal include:

- Excess cut material of which 225 cubic metres is unsuitable for reuse
- Vegetation (6.68 hectares). Noxious weed material would collected and disposed of separately from native green waste
- Asphalt and concrete
- Roadside materials (fencing, guide posts, guard rails etc)
- Paper and office waste from the site compounds
- General waste from staff (lunch packaging, portable toilets etc)
- Chemicals and oils
- Waste water from wash down and bunded areas.

Construction activities that are anticipated to generate the largest quantities of waste are excavation and vegetation clearing. The potential to reuse these materials onsite would be investigated during detailed design to minimise the impacts of waste from the proposal. Reuse opportunities that would be investigated include mulching vegetation for sediment and erosion controls or use in rehabilitation, and onsite reuse of excavated material for fill or landscaping. Unsuitable fill material and excess cut material that cannot be used on site would be reused or disposed of in the following order of priority:

- Transfer to nearby RMS projects for immediate use
- Transfer to an approved RMS stockpile site for reuse on a future project only if a specific project has been identified prior to stockpiling. If a project cannot be identified the material would not be stockpiled
- Transfer to an RMS approved site for reuse on concurrent private/local government project only if a specific project is identified prior to stockpiling and all appropriate approvals are obtained. If a project cannot be identified the material would not be stockpiled
- Disposal at an accredited materials recycling or waste disposal facility
- As otherwise provided for by the relevant waste legislation.

6.12.2 Safeguards and management measures

Environmental safeguards	Responsibility	Timing
The following resource management hierarchy principles would be followed: • Avoid unnecessary resource consumption as a priority • Avoidance would be followed by resource recovery (including reuse of materials, reprocessing, and recycling and energy recovery) • Disposal would be undertaken as a last resort (in accordance with the *Waste Avoidance and Resource Recovery Act, 2001*).	Construction contractor	Construction

Environmental safeguards	Responsibility	Timing
A waste management plan would be prepared, which would include the following: • Identify all potential waste streams associated with the works • Identify opportunities to minimise the use of resources, and to reuse and recycle materials • Outline methods of disposal of waste that cannot be reused or recycled at appropriately licensed facilities.	Construction contractor	Pre-construction
Cleared weed free vegetation would be chipped and reused onsite as part of the proposed landscaping and to stabilise disturbed soils where possible. Weedy mulch would either be composted to ensure propagules and seeds are sterilised or would not be reused.	Construction contractor	Construction
Excess excavated material would be disposed of at an appropriate facility or reused appropriately for fill on the proposal site, or on other RMS projects, or as otherwise provided for by waste legislation.	Construction contractor	Construction
Garbage receptacles would be provided and recycling of materials encouraged. Rubbish would be transported to an appropriate waste disposal facility.	Construction contractor	Construction
All wastes would be managed in accordance with the *Protection of the Environment Operations Act 1997.*	Construction contractor	Construction
Portable toilets would be provided for construction workers and would be managed by the service provider to ensure the appropriate disposal of sewage.	Construction contractor	Construction
Site inductions would occur and be recorded by a Site Supervisor to ensure staff are aware of waste disposal protocols.	Construction contractor	Construction
A dedicated concrete washout facility would be provided during construction so that runoff from the washing of concrete machinery and equipment could be collected and disposed of at an appropriate waste facility.	Construction contractor	Construction
Excess soil requiring waste disposal would first be assessed against the waste classification guidelines *NSW DEC 2008 Part 1: Classifying Waste*. Soil samples would be taken from stockpiled material and analysed. Transportation would be undertaken by a licensed contractor capable of transporting the waste and waste would be disposed of to an appropriately licensed waste facility with supporting waste classification documentation.	Construction contractor	Construction

6.13 Demand on resources

6.13.1 Potential impacts

Construction of the proposal would require the use of a number of resources, including:

- Resources associated with the operation of construction machinery and motor vehicles (this includes the use of diesel and petrol)
- Material required for road surface and pavements (road base, paints, solvents, asphalt, spray seal, sand, concrete, aggregate etc)

- Fill required to meet design levels
- Materials required for road signage
- Construction water (for concrete mixing and dust suppression).

The initial estimated quantities of these materials that would be required for the proposal are provided in Table 3-4.

The materials required for construction of the proposal are not currently limited in availability however materials such as metal and fuel are non-renewable and would be used conservatively. Materials required for construction would be sourced from licensed facilities where possible. Excess spoil would be disposed of in accordance with safeguards and mitigation measures outlined in Section 6.12.2.

As discussed in Section 3.4.6, the amount of water required for construction is currently unknown. Water is likely to be sourced from the Sydney Water main system located in the vicinity of the proposal. Extraction of water from natural sources is not anticipated however any approvals under relevant legislation would be obtained if required. A small amount of water used on site would potentially be sourced from the construction sediment basin/sumps.

In addition, the management measures outlined in Section 6.13.2, measures identified in Section 6.12.2 to reuse waste onsite would assist in minimising the amount of resources required for construction.

6.13.2 Safeguards and management measures

Environmental safeguards	Responsibility	Timing
Procurement would endeavour to use materials and products with a recycled content where that material or product is cost and performance effective.	Construction contractor	Pre-construction and construction
Excavated material would be reused on-site for fill where feasible to reduce demand on resources.	Construction contractor	Construction
Any additional fill material required would be sourced from appropriately licensed facilities and/or other RMS projects.	Construction contractor and RMS	Construction

6.14 Hazards and risks

6.14.1 Existing environment

During the RMS risk management workshop of June 2012, existing hazards and risks in the vicinity of the proposal were identified. In general, they would be associated with operation of the existing road network and mainly include crashes due to vehicle congestion.

Alfords Point Road is also identified by the Rural Fire Service and Sutherland Shire Council as a vegetation buffer adjacent to Category 1 Bushfire Prone Land. Category 1 Bushfire Prone Land is the most hazardous vegetation category. Potential bushfire within the vicinity of the proposal is therefore also considered a risk. The closest fire station to the proposal is located at 202 Menai Road, Menai, about two kilometres south.

6.14.2 Potential impacts

Construction

Hazards and risks associated with construction include:

- Spills or leakage of contaminants such as fuels, chemicals and hazardous substances entering surface and groundwater, contaminating soils or posing a risk to human health
- Heavy rainfall events above the design capacity of controls resulting in discharge of sediment laden runoff into adjacent areas, resulting in pollution of waterways
- Biosecurity risks from the spread of disease, weeds or other pathogens through materials brought on site or by the movement of material around the site
- Changed traffic conditions leading to accidents
- Encountering utilities or contaminated material during excavation works
- Sparks and/or hot works causing bushfire particular during dry, hot periods
- Works next to the rock cuttings (ie rock hammering for drainage excavation) may cause rock material to fall posing a safety risk to construction workers and passing motorists
- Bushfire in adjacent vegetation resulting in a risk to construction workers.

An emergency response plane for hazards and risk during construction would be incorporated into the construction environmental management plan.

Operation

Operational hazards and risks relating to the proposal include:

- Fuel and oil spills from maintenance activities or vehicle crashes
- Vehicle accidents
- Fauna crossing Alfords Point Road resulting in vehicle crashes
- Uncontrolled pedestrian movements leading to accidents
- Potential noise barriers preventing fire and emergency service access.

Vehicle accidents are an inherent aspect of the operation of any road. During design of the proposal, RMS has applied the requirements of the RTA Road Design Guide to ensure that the road is designed to an appropriate safety standard. Similarly uncontrolled pedestrian access is a risk that RMS has endeavoured to control and the proposal includes a dedicated off-road shared path for safe pedestrian movement.

The biodiversity assessment did not consider fauna crossings or exclusion fencing to be warranted for this location given the current physical barriers (road and topography) that already restrict fauna movements (refer Section 6.2.3).

A spill containment basin would be provided about 860 metres south of Alfords Point Bridge to minimise the potential impacts to surface water quality from an oil or fuel spill (refer Section 3.3.4). Access gaps for fire and rescue services would be considered in the design of any noise barrier (refer Section 6.7.3).

6.14.3 Safeguards and management measures

Environmental safeguards	Responsibility	Timing
Emergency response plans would be incorporated into the construction environmental management plan. This would include a bushfire response plan.	Construction contractor	Pre-construction

6.15 Climate change and greenhouse gases

6.15.1 Overview

Climate change refers to the warming temperatures and altered climate conditions associated with the concentration of greenhouse gases in the atmosphere. These potential changes to future climatic conditions have the potential to impact existing and new road infrastructure.

In 2010 the NSW Government published climate change projections for NSW including the Sydney region. The study focused on projections to the year 2050 for rainfall, evaporation and maximum and minimum temperatures as these are the four climate variables considered to most directly affect biophysical systems across the state.

The projected climatic changes by 2050 for the Sydney region show that spring and summer rainfall is projected to increase, while winter rainfall is projected to decrease. Sea levels will rise, changing flood patterns and affecting the coast. And, maximum daily temperatures are predicted to increase particularly during winter and spring (DECCW, 2010). Table 6-42 shows the projected climate change in the Sydney catchment.

Table 6-42 Current and projected climate change in the Sydney catchment

Season	Minimum temperatures	Maximum temperatures	Precipitation	Evaporation
Spring	2-3°C warmer	2-3°C warmer	10-20% increase	10-20% increase
Summer	1.5-3°C warmer	1.5-2°C warmer	20-50% increase	10-20% increase
Autumn	1.5-3°C warmer	1.5-3°C warmer	No significant change	No clear pattern
Winter	1.5-3°C warmer	2-3°C warmer	10-20% decrease	No clear pattern

6.15.2 Potential climate change impacts on the proposal

Changes in rainfall patterns and severe weather events may influence the risk of erosion impacts on the proposal site and associated sediment loss, potentially impacting adjacent sensitive receiving environments such as the Georges River National Park. Severe weather events may also influence the construction schedule.

In the long-term, increases in temperature may affect the integrity of pavement and other construction elements, either directly or through evaporative changes and then changes to soil moisture content and soil instability which may eventually impact on foundations of structures, softening of pavements, and road rutting.

The proposal is not in a coastal location and would not be directly affected by sea level changes.

6.15.3 Potential impacts of the proposal on climate change

The effect of greenhouse emissions on the climate is believed to be the main instrument driving increased temperatures and other associated indicators of climate change (OEH, 2012).

Each gas that has been identified by the Intergovernmental Panel on Climate Change has been classified with a global warming potential, the units of which are ‘carbon dioxide equivalents’. This

represents the standardised effects of each gas in the atmosphere. Greenhouse gas emissions are also categorised according to the source of emission (World Business Council for Sustainable Development's Greenhouse Gas Protocol 2004). Scope one emissions are created directly by a person, for example fuel consumption. Scope two emissions are indirect emissions and include the generation of electricity. Scope three emissions are indirect emissions generated by the wider economy for example coal mining and export.

A greenhouse gas assessment was undertaken for construction and operation of the proposal by RMS in August 2012. The assessment identified the dominant sources of greenhouse gas emissions and the estimated volume of emissions that would be produced. A copy of the assessment is provided in Appendix L and the results are summarised below.

Construction

Construction of the proposal would result in greenhouse gas emissions being produced, including:

- Carbon dioxide may be generated from land clearing (decomposition of cleared vegetation)
- Carbon dioxide and nitrous oxide would be generated from liquid fuel use in plant and vehicles (diesel, petrol) during construction, disposal and transport of materials
- Methane may be generated from landfilling any carbon based waste, and possible fugitive emissions from the use of natural gas.

The estimated greenhouse gas emissions associated with construction of the proposal are summarised in Table 6-43.

Table 6-43 Summary of greenhouse gas emissions by construction activity

Construction activity	Scope 1 emissions	Scope 2 emissions	Scope 3 emissions	Total
Site offices / general areas	418	-	32	450
Demolition and earthworks	276	-	21	297
Pavements	1087	-	486	1574
Structures	8	-	1	9
Drainage	21	-	31	51
Road furniture	13	-	1161	1174
TOTAL	**1823**	**-**	**1732**	**3554**

Note: All emission values are in tonnes of carbon dioxide equivalent (t CO2-e)

The most substantial sources of greenhouse gas emissions during construction would be pavement and road surface works (45 per cent), and construction of road furniture (33 per cent), Of the 3554 tonnes of greenhouse gas emissions estimated during construction, about 55 per cent (1962 tonnes) would be the direct result of burning fuel to operate plant, equipment, trucks and vehicles.

Operation

During operation, the proposal may alleviate vehicle emissions through increased efficiency of the road network, reducing congestion and travel times. The proposal would also provide additional road capacity to cater for the expected population growth and increased vehicle numbers on Alfords Point road, alleviating potential future congestion.

A minimal amount of emissions would be generated during maintenance activities required for Alfords Point Road (which would be frequency and intensity dependant). The variable message board would generate a minimal amount of emissions during operation through the consumption of electricity.

6.15.4 Safeguards and management measures

Environmental safeguards	Responsibility	Timing
Detailed design would take into consideration the potential effect of climate change on the proposal, including drainage requirements.	RMS	Pre-construction
The use of alternative fuels and power sources for construction plant and equipment would be investigated and implemented, where appropriate.	Construction contractor	Pre-construction
The energy efficiency and related carbon emissions would be considered in the selection of vehicle and plant equipment.	Construction contractor	Pre-construction
Materials would be delivered as full loads and local suppliers would be used where possible.	Construction contractor	Construction
Construction equipment, plant and vehicles would be appropriately sized for the task.	Construction contractor	Construction
Equipment would be serviced frequently to ensure they are operating efficiently.	Construction contractor	Construction
Vehicles and machinery would not be left idling when not in use.	Construction contractor	Construction
Clearing of natural vegetation would be minimised where possible.	Construction contractor	Construction

6.16 Cumulative environmental impacts

6.16.1 Existing environment

Cumulative impacts have the potential to arise from the interaction of individual elements within the proposal and the additive effects of other external projects. RMS is required under Clause 228 (2) of the *Environmental Planning and Assessment Act 1979*, to take into account potential cumulative impacts as a result of the proposal.

6.16.2 Potential impacts

The proposal is part of a series of completed or planned upgrades for Alfords Point Road within the vicinity of Alfords Point Bridge. These upgrades include:

- Widening of Alfords Point Bridge (completed 2008)
- Widening of Alfords Point Road northern approach between Alfords Point Bridge and Clancy Street, Padstow Heights (completed 2011)
- Widening of Alfords Point Road southern approach between Alfords Point Bridge and Brushwood Drive, Alfords Point (the proposal).

As construction of Alfords Point Bridge and the northern approach to the bridge are both complete and in operation, no negative cumulative impacts are expected to arise during construction of the proposal.

The long-term effect of upgrading Alfords Point Bridge and the northern and southern approaches would have a positive cumulative impact on travel times, road safety and efficiency, facilitating the anticipated increase in traffic volumes as a result of future population growth.

A request has being lodged with the Department of Planning and Infrastructure to have a proposed multipurpose development in West Menai classified as a state significant project (also known as Heathcote Ridge development). This development would include 2400 residential dwellings, employment land for approximately 4700 jobs, new roads, bridges and community facilities.

Potential cumulative impacts may arise if construction of the West Menai development overlaps with construction of the proposal. Construction of the West Menai development would be staged over a 15 to 20 year timeframe and is unlikely to commence before construction of the proposal has been completed as this development has not been approved at the time of writing this REF and no land rezoning has occurred.

As a result of the West Menai development operation, it is estimated that traffic on Alfords Point Road would increase 36 per cent by 2031 (Hyder, 2011). However, as part of the development, significant road upgrades are proposed north, east and west of the development site in order to accommodate the transport needs of residents, workers and broader community (BBC Consulting Planners, 2011). Operation of the proposal would improve road congestion on Alfords Point Road and therefore would not contribute to any potential traffic impacts on the local road network that may arise from the West Menai development.

The West Menai development is outside the visual and noise catchment of the proposal (over 500 metres to the south west). Any sensitive receivers potentially affected by the proposal are therefore unlikely to be impacted by the West Menai development as well, making it unlikely for additive, cumulative noise and visual impacts to occur.

The proposal would require 6.68 hectares of vegetation clearing including 2.71 hectares of native vegetation (of which 0.017 hectares is classified as EEC). This would result in a loss of about 0.2 per cent of native vegetation within the general locality of the study area and therefore is unlikely to have a substantial additive cumulative impact when combined with any vegetation clearing required for the West Menai development.

No other major developments within the vicinity of the proposal are known. Other developments likely to occur within the locality would be small scale projects such as residential dwellings in adjacent residential areas, which are unlikely to have a noticeable cumulative impact.

The potential for adverse cumulative impacts would be addressed through the application of individual project specific environmental safeguards and management measures as summarised in Section 7.

6.16.3 Safeguards and management measures

Environmental safeguards	Responsibility	Timing
The CEMP would be revised to consider potential cumulative impacts from surrounding development activities as they become known.	Construction contractor	Pre-construction

6.17 Summary of beneficial effects

The beneficial effects of the proposal would include:

- Providing additional road capacity to accommodate the forecast traffic growth for the route
- Improving operational efficiency and travel times on Alfords Point Road

- Improving safety for heavy vehicles exiting the heavy vehicle inspection bay
- Traffic noise reductions for residents along the western side of Alfords Point Road, subject to an assessment of feasible and reasonable noise mitigation options
- Improving safety and congestion at the Illawong/Alfords Point off ramp and Brushwood Drive on ramp
- Improving safety for buses accessing the bus stop on Brushwood Drive on ramp and reducing conflict with other vehicles
- Providing a permanent shared path between Brushwood Drive and Alfords Point Road
- Improving pedestrian access to the bus stop on Brushwood Drive on ramp.

6.18 Summary of adverse effects

Adverse effects of the proposal would include:

- Construction phase traffic impacts, due to increased heavy vehicle movements on the existing road network
- Noise and vibration impacts to properties adjacent to the proposal site during construction
- Disruptions to traffic flow and access during construction
- Increased risk for spills and contamination during construction
- Increased risk of occurrence of erosion and sedimentation during construction
- Potential temporary decline in air quality during construction
- Increased risk of degradation of water quality and drainage lines during construction
- Increased potential of introduction of weed species during construction
- Removal of 6.68 hectares vegetation including 2.71 hectares of native vegetation (of which 0.017 hectares of vegetation constitutes an EEC)
- Visual impacts including loss of privacy from vegetation removal adjacent to properties at low elevation on the eastern side of Alfords Point Road.

7. Environmental management

7.1 Environmental management plans (or system)

A number of safeguards and management measures have been identified in order to minimise adverse environmental impacts, including social impacts, which could potentially arise as a result of the proposal. Should the proposal proceed, these management measures would be incorporated into the detailed design and applied during the construction and operation of the proposal.

A Project Environmental Management Plan (PEMP) and a Construction Environmental Management Plan (CEMP) would be prepared to describe safeguards and management measures identified. These plans would provide a framework for establishing how these measures would be implemented and who would be responsible for their implementation.

The plans would be prepared prior to construction of the proposal and must be reviewed and certified by a Roads and Maritime Services Environmental Officer, Sydney region, prior to the commencement of any on-site works. The CEMP would be a working document, subject to ongoing change and updated as necessary to respond to specific requirements. The CEMP and PEMP would be developed in accordance with the specifications set out in the RMS QA Specification G36 – Environmental Protection (Management System), RTA QA Specification G38 – Soil and Water Management (Soil and Water Plan) and the RTA QA Specification G40 – Clearing and Grubbing.

7.2 Summary of safeguards and management measures

Environmental safeguards outlined in this document would be incorporated into the detailed design phase of the proposal and during construction and operation of the proposal, should it proceed. These safeguards would minimise any potential adverse impacts arising from the proposed works. The safeguards and management measures are summarised in Table 7-1.

Table 7-1 Summary of site specific environmental safeguards

No.	Impact	Environmental safeguards	Responsibility	Timing
1	Noise and vibration	An assessment of feasible and reasonable noise mitigation measures for operation of the proposal would be undertaken in accordance with the RMS *Environmental Noise Management Manual Practice Note 4*.	RMS	Pre-construction
2	Noise and vibration	A construction noise and vibration management plan would prepared and include, but not be limited to, the following: • Identify potentially affected properties • A risk assessment to determine the potential for discrete work activities to affect receivers • A map indicating the locations considered likely to be impacted • Mitigation measures to reduce excessive noise during construction activities • A construction staging program incorporating a program of noise monitoring at sensitive receivers • A process for assessing the performance of mitigation measures • A process for resolving issues and conflicts • Consider construction compound layout so that primary noise sources are at a maximum distance from residences, with solid structures (sheds and containers) placed between residences and noise sources (and as close to the noise sources as is practical) • Locating compressors, generators, pumps and any other fixed plant as far from residences as possible and behind site structures • Where practical, equipment would be selected to minimise noise emissions. Equipment would be fitted with appropriate silencers and be in good working order. Machines found to produce excessive noise compared to normal industry expectations would be removed from the site or stood down until repairs or modifications can be made	Construction contractor	Pre-construction

No.	Impact	Environmental safeguards	Responsibility	Timing

		• Responsible working practices including:
		  ○ Avoid the use of outdoor radios during the night-time period
		  ○ Avoid shouting and slamming doors
		  ○ Where practical, machines would be operated at low a speed/power and switched off when not in use rather than left idling for prolonged periods
		  ○ Minimise reversing
		• Avoid dropping materials from height and avoid metal to metal contact on material.		

3	Noise and vibration	Building condition surveys would be undertaken for any building, structure or utilities located within 20 metres of construction works. Where construction works are located within 10 metres of buildings, compliance vibration monitoring would be undertaken.	Construction contractor	Pre-construction
4	Noise and vibration	Works would be carried out during standard working hours (ie 7am–6pm Monday to Friday, 8am–1pm Saturdays). Any work that is performed outside normal work hours or on a Sunday or public holiday is to minimise noise impacts in accordance with RMS's *Environmental Noise Management Manual Practice Note 7 – Roadworks Outside of Normal Working Hours (RTA 2001)* and the *Interim Construction Noise Guidelines* (DECC 2009). This would include notifying the local community of any works planned to be undertaken outside standard construction hours.	Construction contractor	Pre-construction
5	Noise and vibration	The local community that could be affected by the proposed works would be contacted and informed of the proposed work, location, duration of work, and hours involved. The contact would be made a minimum five days prior to commencement of works.	Construction contractor and RMS	Pre-construction and construction
6	Noise and vibration	The Contractor would review their noise and vibration management plan in response to complaints and amended where practical throughout the construction phase. This would include consideration of respite periods	Construction contractor	Construction
7	Noise and vibration	Vibration producing activities such as rock hammering and compacting would not be undertaken during night works	Construction contractor	Pre-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
8	Noise and vibration	During work hours, a community liaison phone number and site contact would be provided so that complaints can be received and responded to.	Construction contractor	Construction
9	Noise and vibration	Vibration testing would be undertaken on high risk plant to determine site specific buffer distances.	Construction contractor	Construction
10	Noise and vibration	Where vibration is found to exceed project criteria, management measures would be implemented to control vibration. In terms of human comfort criteria, measures would include modifications of construction methods and respite periods. For potential structural damage impacts, modification of construction methods would be necessary.	Construction contractor	Construction
11	Noise and vibration	If deemed necessary, attended compliance noise and vibration monitoring would be undertaken upon receipt of a complaint. Monitoring would be reported as soon as possible. In the case that exceedances are detected, the situation would be reviewed in order to identify means to minimise the impacts to residences.	Construction contractor	Construction
12	Noise and vibration	A noise monitoring program would be undertaken within 12 months of opening once traffic flows have stabilised in order to verify the predicted noise levels.	RMS	Post Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
13	Biodiversity	A Biodiversity Management Plan (BMP) is to be prepared and included within the CEMP. The BMP is to include (but not be limited to) the following: • A suitably qualified ecologist is to be engaged to visit the site prior to any clearing works to clearly demarcate vegetation protection areas (particularly hollow bearing trees and areas of EEC) and conduct a pre-clearing survey report • A site walk with the RMS Environmental Officer to confirm clearing boundaries prior to the commencement of work • A map which clearly shows vegetation clearing boundaries and no-go zones • A procedure for clearing potential habitat including hollow-bearing trees in accordance with RMS Specification G40. An experienced, licenced wildlife carer or ecologist would be present to supervise vegetation clearing and capture then relocate fauna if required. Fauna handling and vegetation removal would be in accordance with the RMS *Biodiversity Guidelines 2011* • Incorporation of management measures identified as a result of the pre-clearing survey report and nomination of actions to respond to the recommendations made. This should include details of measures to be implemented to protect clearing limits and no go areas	Construction contractor	Pre-construction
		• Content of toolbox talks and records of attendance • Compliance with RMS Biodiversity Guidelines (RTA, 2011). • Clearing of mature trees should be minimised where possible • Habitat features such as mature tree trunks and rock fragments within the proposal site should be salvaged and replaced within revegetation areas as far as is practicable. • Protocols to prevent introduction or spread of chytrid fungus should be implemented following OEH Hygiene protocol for the control of disease in frogs (DECCW, 2008c).		

No.	Impact	Environmental safeguards	Responsibility	Timing
14	Biodiversity	Prepare Environmental Work Method Statements for specific work activities, which must include but not be limited to the following: • Description of the work activity including machinery • Outline of the sequence of tasks, including interfaces with other construction activities • Identification of potential environmental risks/impacts due to the work activity and risks/impacts associated with wet weather events • Evaluation of possible mitigation measures to reduce the environmental risk and selection of most practical cost-effective operational and monitoring measures to reduce environmental impact • A map indicating the locations of likely potential environmental impacts and sensitive locations • Identification of work areas and exclusion areas • A process for assessing the performance of the implemented environmental control measures.	Construction contractor	Pre-construction
15	Biodiversity	A weed management plan (WMP) would be prepared and incorporated into the CEMP. The WMP would be in accordance with the requirements of RMS Specifications G36 and G40 and include (but not be limited to) the following: • Type and location of weeds of concern (including noxious weeds) within the proposal site • Sensitive receivers (such as native vegetation and waterways) within or adjacent to the proposal site • Measures to prevent the spread of weeds and fungi, including hygiene procedures for equipment, footwear and clothing • Proposed weed control methods and targeted areas • Weed disposal protocols.	Construction contractor	Pre-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
16	Hydrology and drainage	A contingency plan would be prepared in preparation for a potential flood event during construction and would outline evacuation procedures.	Construction contractor	Pre-construction
17	Soils and water quality	Operation water quality measures would be further investigated during detailed design including consideration of bio filtration measures in consultation with the RMS Environmental Officer.	RMS	Pre-construction
18	Soils and water quality	The principal Erosion and Sedimentation Control Plan (ESCP) would be sent to RMS Senior Environment Officer (Sydney Region) for review and verification prior to the construction tender.	RMS	Pre-construction
19	Soils and water quality	The Construction Environmental Management Plan (CEMP) would include a contingency plan for any acid sulfate soils or contamination identified during the construction phase.	Construction contractor	Pre-construction
20	Soils and water quality	A Soil and Water Management Plan (SWMP) would be prepared as part of the Construction Environmental Management Plan (CEMP) in accordance with the requirements of RMS contract specification G38 prior to the commencement of construction. The SWMP would also address the following: • The RMS Code of Practice for Water Management • The RMS Erosion and Sedimentation Procedure (RTA, 2008) • The *Blue Book - Managing Urban Stormwater: Soils and Construction, Volume 1 and 2* (Landcom, 2004) • RMS Technical Guidelines – *Temporary Stormwater Drainage for Road Construction* (RMS, 2011).	Construction contractor	Pre-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
21	Soils and water quality	In addition to the G38 requirements, the SWMP would: • Address the requirements of the principal Erosion and Sedimentation Control Plan (ESCP) • Include an ESCP in accordance with the requirements of the Blue Book • Outline basin flocculation and dewatering procedures • Outline a procedure for the containment and management of spills or leaks • A summary of applicable legislation • A procedure for regular inspection, maintenance and cleaning of erosion and sediment controls • Outline regular monitoring of Bureau of Meteorology weather forecasts • Be reviewed by RMS's Environmental Officer, Sydney Region prior to the commencement of works.	Construction contractor	Pre-construction
22	Soils and water quality	A principal Erosion and Sedimentation Control Plan (ESCP) would be prepared during detailed design which is to include as a minimum: • Identification of catchment areas and the direction of on-site and off-site water flow • The likely run-off from each road sub-catchment • Separation of on-site and off-site water • The direction of run-off and drainage points during each stage of construction • The locations and sizing of sediment basins • The locations of other erosion and sediment control measures (eg rock check dams, swales and sediment fences) • A materials management plan. The ESCP is to be reviewed by a soil conservationist and would be updated to address the recommendations.	RMS / Designer	Pre-construction
23	Soils and water quality	A separate ESCP is to be prepared which outlines controls to be implemented in preparation for a wet weather event.	Construction contractor	Pre-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
24	Soils and water quality	Batters would be stabilised progressively using appropriate ground cover once construction completed.	Construction contractor	Construction
25	Soils and water quality	Disturbed surfaces would be compacted and stabilised in anticipation of rain events to reduce the potential for erosion.	Construction contractor	Construction
26	Soils and water quality	Topsoil would be stockpiled separately for possible reuse for the landscaping and rehabilitation works.	Construction contractor	Construction
27	Soils and water quality	All stockpiles would be designed, established, operated and decommissioned in accordance with RMS' *Stockpile Management Procedures* (RTA 2011a).	Construction contractor	Construction
28	Soils and water quality	Controls would be implemented at exit points to minimise the tracking of soil and particulates onto pavement surfaces.	Construction contractor	Construction
29	Soils and water quality	Any material transported onto pavement surfaces would be swept and removed at the end of each working day and prior to rainfall.	Construction contractor	Construction
30	Soils and water quality	An accredited soil conservationist would be engaged to regularly inspect works throughout the construction phase.	RMS	Construction
31	Soils and water quality	Low lying areas of construction formations and excavations would collect stormwater and would need to be dewatered in accordance with the *RMS Technical Guideline for Dewatering*.	Construction contractor	Construction
32	Soils and water quality	A monitoring program and checklist for the sediment basin would be prepared and implemented, including: • Monitoring procedures and frequency • Flocculation procedures • Dewatering procedures.	Construction contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
33	Aboriginal cultural heritage	An Aboriginal Cultural Heritage Management plan would be prepared and included within the CEMP. The plan is required to address (but not be limited to) the following: • A sensitive areas map which clearly identifies exclusion zones • Fencing to control access to exclusion zones during construction • An environmental risk assessment to determine potential risks for discrete work elements or activities likely to affect significant heritage elements • Vibration management measures for works in the vicinity of APS1 • Specific mitigation measures to avoid risk of harm • A process to communicate risk and responsibilities through environmental awareness training and inductions • A stop works procedure in the event of actual or suspected potential harm to a heritage feature/place	Construction contactor	Pre-construction
34	Aboriginal cultural heritage	In the event of an unexpected find of an Aboriginal heritage item (or suspected item), work would cease in the affected area and RMS's Environmental Officer, Sydney Region and the RMS Senior Environmental Specialist (Aboriginal heritage), would be contacted for advice on how to proceed. The draft Unexpected Finds Procedure (RTA 2011) would be followed in the event a potential artefact is uncovered.		
35	Non-Aboriginal heritage	In the event of an unexpected find of a non-Aboriginal heritage item (or suspected item) work would cease in the affected area and RMS unexpected finds procedure (RTA 2011) would be implemented.	Construction contractor	Construction
36	Traffic and access	A traffic management plan (TMP) would be prepared prior to construction and included in the CEMP. The TMP would include measures to minimise construction vehicle impacts on the surrounding local road network, such as restrictions on vehicle delivery times and ensuring construction traffic is minimised during peak periods. The TMP would also ensure that pedestrian and cyclist access from Illawong and Alfords Point to Alfords Point Bridge is maintained at all times during construction. It would also ensure all property accesses, access to the Ausgrid easements and Alfords Point Bridge maintenance access would be maintained throughout construction.	Construction contractor	Pre-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
37	Traffic and access	Consultation with emergency service authorities would be undertaken during development of the detailed design including NSW Rural Fire Service and Fire Rescue.	RMS	Pre-construction
38	Traffic and access	A detailed construction staging plan would be developed to maintain existing peak flow capacity. This would include staging of construction works on the Illawong/Alfords Point off ramp.	RMS	Pre-construction
39	Traffic and access	Maintain pedestrian and cyclist access throughout construction.	Contractor	Pre-construction
40	Traffic and access	Appropriate protection would be installed to separate pedestrians and cyclists from work areas.	Contractor	Construction
41	Landscape character and visual amenity	Detailed design of the proposal would incorporate the design principles outlined in the Landscape Character, Visual Impact Assessment and Urban Design Report where feasible, including: • Landscape and urban design principles in Section 3.3.6 and Appendix K • Treatment of verges, safety barriers and infrastructure elements would be simple and robust in detail, and considerate of the greater landscape experience • The design of safety barriers and lighting would be compatible with the design elements of Alfords Point Road northern approach and Alfords Point Bridge • The provision of seats with shade trees at steep sections of the shared path would be considered during detailed design.	RMS/Designer	Pre-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
42	Landscape character and visual amenity	The design of potential noise barriers would be undertaken during detailed design and would take into consideration the RMS Noise Wall Design Guidelines (RTA 2007). The following principles would be considered during the design of the potential noise barriers: • Two metre set back from Alfords Point Road to allow planting of vegetation to screen the roadside face of the noise barrier • The noise barrier would be consistent with the design of noise barriers on nearby roads • Materials, colours and textures would be selected to break up the dominant nature of the noise barrier • Transparent panels would be incorporated into sections of the noise barrier where it has potential to block solar access to adjacent residential properties • Consideration of landscape treatments on the residential face of the potential eastern barrier to reduce the incidence of graffiti.	RMS/Designer	Pre-construction
43	Landscape character and visual amenity	An urban design contractor from RMS panel would be engaged for the detailed design phase to ensure adequate consideration of urban design principles and objectives, and to ensure appropriate mitigation of identified impacts.	RMS/Designer	Pre-construction
44	Landscape character and visual amenity	Where vegetation loss reduces the amount of screening between residences and the shared path and residents and the Illawong/Alfords Point off ramp, causing loss of amenity and privacy, the following would be considered: • Tree protection measures at the base of the fill embankment to maintain as much mature vegetation as possible • Early works to plant advanced stock adjacent to the proposed shared path at the top of the embankment • Early works to plant advanced stock between the base of the embankment and the road corridor boundary • Using fast growing species such as Acacia on the embankment.	RMS/Designer	Pre-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
45	Landscape character and visual amenity	The footprint for construction works would be kept to a minimum to ensure existing stands of vegetation remain intact wherever possible and to screen adjoining sensitive receivers.	Construction contractor	Construction
46	Landscape character and visual amenity	Fencing with material attached (eg shade cloth) would be provided around the construction compounds and other areas to screen views of the construction compounds from adjoining properties.	Construction contractor	Construction
47	Landscape character and visual amenity	The work site would be left in a tidy manner at the end of each work day.	Construction contractor	Construction
48	Air quality	An Air Quality Management plan would be prepared and included within the CEMP. The plan is required to address (but not be limited to) the following: • A procedure for monitoring dust on-site and weather conditions • Identification of dust generating activities and associated mitigation measures • Limits on the area that can be opened up or distributed at any one time • Compliance with RMS stockpile site management guideline (2011) • Progressive stabilisation plans.	Construction contractor	Pre-construction
49	Air quality	Any rock hammering works required adjacent to Sir Thomas Mitchell Aged Care Facility would be dampened to reduce dust generation. At other locations dampening during rock hammering would be used as necessary to reduce dust generation or works would cease during windy conditions.	Construction contractor	Construction
50	Land use and property	No specific safeguards or management measures are proposed.	N/A	N/A
51	Socio-economic	A complaint handling procedure and register would be included in the CEMP.	Construction contractor	Pre-construction
52	Socio-economic	Local residents would be notified prior to works commencing and would be kept regularly informed of construction activities during the construction process.	Construction contractor	Pre-construction and construction

No.	Impact	Environmental safeguards	Responsibility	Timing
53	Socio-economic	During construction, road users, pedestrians and cyclists would be informed of changed conditions.	Construction contractor	Construction
54	Socio-economic	Residents would be informed prior to any interruptions to utility services that may be experienced as a result of utilities relocation.	Construction contractor	Construction
55	Waste management	The following resource management hierarchy principles would be followed: • Avoid unnecessary resource consumption as a priority • Avoidance would be followed by resource recovery (including reuse of materials, reprocessing, and recycling and energy recovery) • Disposal would be undertaken as a last resort (in accordance with the *Waste Avoidance and Resource Recovery Act, 2001*).	Construction contractor	Construction
56	Waste management	A waste management plan would be prepared, which would include the following: • Identify all potential waste streams associated with the works • Identify opportunities to minimise the use of resources, and to reuse and recycle materials • Outline methods of disposal of waste that cannot be reused or recycled at appropriately licensed facilities.	Construction contractor	Pre-construction
57	Waste management	Cleared weed free vegetation would be chipped and reused onsite as part of the proposed landscaping and to stabilise disturbed soils where possible. Weedy mulch would either be composted to ensure propagules and seeds are sterilised or would not be reused.	Construction contractor	Construction
58	Waste management	Excess excavated material would be disposed of at an appropriate facility or reused appropriately for fill on the proposal site, or on other RMS projects, or as otherwise provided for by waste legislation.	Construction contractor	Construction
59	Waste management	Garbage receptacles would be provided and recycling of materials encouraged. Rubbish would be transported to an appropriate waste disposal facility.	Construction contractor	Construction
60	Waste management	All wastes would be managed in accordance with the *Protection of the Environment Operations Act 1997.*	Construction contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
561	Waste management	Portable toilets would be provided for construction workers and would be managed by the service provider to ensure the appropriate disposal of sewage.	Construction contractor	Construction
62	Waste management	Site inductions would occur and be recorded by a Site Supervisor to ensure staff are aware of waste disposal protocols.	Construction contractor	Construction
63	Waste management	A dedicated concrete washout facility would be provided during construction so that runoff from the washing of concrete machinery and equipment could be collected and disposed of at an appropriate waste facility.	Construction contractor	Construction
64	Waste management	Excess soil requiring waste disposal would first be assessed against the waste classification guidelines *NSW DEC 2008 Part 1: Classifying Waste*. Soil samples would be taken from stockpiled material and analysed. Transportation would be undertaken by a licensed contractor capable of transporting the waste and waste would be disposed of to an appropriately licensed waste facility with supporting waste classification documentation.	Construction contractor	Construction
65	Demand on resources	Procurement would endeavour to use materials and products with a recycled content where that material or product is cost and performance effective.	Construction contractor	Pre-construction and construction
66	Demand on resources	Excavated material would be reused on-site for fill where feasible to reduce demand on resources.	Construction contractor	Construction
67	Demand on resources	Any additional fill material required would be sourced from appropriately licensed facilities and/or other RMS projects.	Construction contractor/RMS	Construction
68	Hazards and risks	Emergency response plans would be incorporated into the construction environmental management plan. This would include a bushfire response plan.	Construction contractor	Pre-construction
69	Climate change and greenhouse gas	Detailed design would take into consideration the potential effect of climate change on the proposal, including drainage requirements.	RMS	Pre-construction
70	Climate change and greenhouse gas	The use of alternative fuels and power sources for construction plant and equipment would be investigated and implemented, where appropriate.	Construction contractor	Pre-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
71	Climate change and greenhouse gas	The energy efficiency and related carbon emissions would be considered in the selection of vehicle and plant equipment.	Construction contractor	Pre-construction
72	Climate change and greenhouse gas	Materials would be delivered as full loads and local suppliers would be used where possible.	Construction contractor	Construction
73	Climate change and greenhouse gas	Construction equipment, plant and vehicles would be appropriately sized for the task.	Construction contractor	Construction
74	Climate change and greenhouse gas	Equipment would be serviced frequently to ensure they are operating efficiently.	Construction contractor	Construction
75	Climate change and greenhouse gas	Vehicles and machinery would not be left idling when not in use.	Construction contractor	Construction
76	Climate change and greenhouse gas	Clearing of natural vegetation would be minimised where possible.	Construction contractor	Construction
77	Cumulative impacts	The CEMP would be revised to consider potential cumulative impacts from surrounding development activities as they become known.	Construction contractor	Pre-construction
78	Other - continued consultation	Detailed design would give consideration to the design requests from Veolia.	RMS	Pre-construction
79	Other - continued consultation	Detailed design would include an objective to incorporate operational access to the Ausgrid easement.	RMS	Pre-construction
80	Other - continued consultation	A Sydney Water servicing coordinator would be engaged prior to construction commencing to assess the impact of the proposal on Sydney Water assets	RMS	Pre-construction

7.3 Licensing and approvals

Table 7-2 list all relevant licenses, permits, notifications and/or approvals needed to construct/operate the proposal.

Table 7-2 Summary of licensing and approval required

Requirement	Timing
No additional licences or approvals are required for the proposal.	N/A

8. Conclusion

8.1 Justification

The proposal is considered to be consistent with a number of national, State and local strategies and plans, including:

- National Road Safety Strategy 2011-2020
- NSW 2021
- Transport for NSW - Long Term Transport Master Plan
- State Infrastructure Strategy 2012 to 2032
- NSW Bike Plan
- RMS Corporate Delivery Plan – 2012 to 2013
- Sutherland Shire Guide for Shaping the Shire to 2030.

The proposal is generally consistent with the above strategies and plans as it would address congestion issues on Alfords Point Road leading to improved efficiency, travel times and safety. The proposal is also consistent with the above strategies by complementing the recent upgrade of Alfords Point Bridge (2008) and the northern bridge approach (2011), which would contribute to an improved strategic bus and freight route between Miranda and Bankstown.

While there would be some environmental impacts as a consequence of the proposal, they have been avoided or minimised wherever possible through design and site-specific safeguards summarised in Section 7.

The beneficial effects listed in Section 6.17 are considered to outweigh the mostly temporary adverse impacts and risks associated with the proposal (refer Section 6.18).

8.2 Objects of the EP&A Act

The objects of the EP&A Act are discussed in Table 8-1

Table 8-1 Objects of the EP&A Act

Object	Comment
5(a)(i) To encourage the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment.	The proposal is needed to address current congestion a safety issues on Alfords Point Road. A number of mitigation measures would be implemented to minimise any environmental impacts associated with the proposal
5(a)(ii) To encourage the promotion and co-ordination of the orderly economic use and development of land.	The proposal would reduce congestion on Alfords Point Road improving travel times and catering for likely future traffic growth in the area. The proposal would also contribute to an improved arterial route for workers and freight between commercial and employment areas in Miranda and Bankstown.

Object	Comment
5(a)(iii) To encourage the protection, provision and co-ordination of communication and utility services.	Some utilities would require relocation or protection during construction. Utilities have been discussed further in Section 3.6.
5(a)(iv) To encourage the provision of land for public purposes.	The proposal involves works for the purpose of a road. It would also include a shared path on the western side of Alfords Point Road that would be used by the public.
5(a)(v) To encourage the provision and co-ordination of community services and facilities.	The proposal involves works for the purpose of a road and would not impact on any community services or facilities. During construction, potential noise impacts may be experienced at Sir Thomas Mitchell Aged Care Facility however these would be minimised through the implementation of safeguards and management measures outlined in Section 6.1.5. The proposal would benefit the community by providing an upgraded road, reducing current congestion and improving travel times.
5(a)(vi) To encourage the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats.	Construction of the proposal would require the clearing or permanent modification of regrowth native vegetation. These impacts on native vegetation, plants and threatened species, population and ecological communities are discussed in Section 6.2. The proposal would minimise where possible impacts on other vegetation and habitats located near the proposal.
5(a)(vii) To encourage ecologically sustainable development.	Ecologically sustainable development is considered in Sections 8.2.1 to 8.2.4.
5(a)(viii) To encourage the provision and maintenance of affordable housing.	Not relevant to the proposal.
5(b) To promote the sharing of the responsibility for environmental planning between different levels of government in the State.	Not relevant to the proposal.
5(c) To provide increased opportunity for public involvement and participation in environmental planning and assessment.	During development of the proposal, consultation with the community and relevant government agencies was undertaken. The REF will also be placed on public display providing further opportunities for comments. Details of this consultation can be found in Section 5.

8.3 Ecologically sustainable development

An objective of the EP&A Act is to encourage ecologically sustainable development. The principles of ecologically sustainable development have been considered throughout development of the proposal and are considered further below.

8.3.1 The precautionary principle

This principle states that *"if there are threats of serious or irreversible damage, lack of scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation".*

Evaluation and assessment of alternative options have aimed to reduce the risk of serious and irreversible impacts on the environment. Stakeholder consultation considered issues raised by stakeholders and a range of specialist studies were undertaken for key issues to provide accurate and impartial information to assist in the evaluation of options.

The detailed assessment of potential environmental impacts in the preparation of the concept design has sought to minimise impacts on the urban and natural amenity of the study area while maintaining engineering feasibility and safety for all road users. A number of safeguards have been proposed to minimise potential impacts. These safeguards would be implemented during construction and operation of the proposal. No safeguards have been postponed as a result of lack of scientific certainty.

A construction environment management plan would be prepared prior to commencing construction. This requirement would ensure that the proposed upgrade achieves a high-level of environmental performance. No mitigation measures or management mechanisms would be postponed as a result of a lack of information.

8.3.2 Intergenerational equity

The principle states, *"the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations".*

The proposal would cater for future population growth in the Sutherland Shire by improving the capacity and safety of Alfords Point Road. The proposal would benefit future generations by ensuring that the proposal does not give rise to long-term adverse impacts on the environment and potential impacts would be minimised by implementation of appropriate safeguards.

Should the proposal not proceed, the principle of intergenerational equity may be compromised, as future generations would inherit a lower level of service on the road transport network. Travel times and the number of accidents are likely to increase along this section of Alfords Point as the volume of traffic increases over time.

The proposal would benefit future generations by ensuring that road safety is improved, with this being a positive benefit for all road users.

8.3.3 Conservation of biological diversity and ecological integrity

This principle states that the *"diversity of genes, species, populations and communities, as well as the ecosystems and habitats to which they belong, must be maintained and improved to ensure their survival"*.

A thorough assessment of the existing local environment has been undertaken in order to identify and manage any potential impacts of the proposal on local biodiversity. Specific effort has been undertaken during design to minimise impacts on biodiversity.

About 6.68 hectares of vegetation including 2.71 hectares of native vegetation and associated habitat would require clearing for the proposal. This includes 2.56 hectares of Coastal Sandstone Ridgetop Woodland and 0.14 hectares of Hinterland Sandstone Gully Forest (a small portion (0.017 ha) of which is Southern Sydney Sheltered Forest listed as EEC under the TSC ACT). The proposed vegetation clearing would result in a total loss of 0.02 per cent of native vegetation within the general locality of the study area and therefore is not considered likely to threaten the viability or persistence of any vegetation community in the locality or region.

Three threatened fauna and one threatened ecological community have the potential to be impacted by the proposal. Assessments of significance for these species concluded that a significant impact as a result of the proposal is unlikely (refer Section 6.2).

The proposal is not considered to have a significant impact on biological diversity and ecological integrity. An ecological assessment and appropriate site-specific safeguards are provided in Section 6.2 and Appendix E.

8.3.4 Improved valuation, pricing and incentive mechanisms

This principle requires that "*costs to the environment should be factored into the economic costs of a project".*

The REF has examined the environmental consequences of the proposal and identified management measures and safeguards for areas which have the potential to experience adverse impacts. Requirements imposed in terms of implementation of these mitigation measures would result in an economic cost to the RMS. The implementation of management measures and safeguards would increase both the capital and operating costs of the proposal. This signifies that environmental resources have been given appropriate valuation.

The design for the proposal has been developed with an objective of minimising potential impacts on the surrounding environment. This indicates that the concept design for the proposal has been developed with an environmental objective in mind.

8.4 Conclusion

The proposed Alfords Point Road Upgrade at Alfords Point is subject to assessment under Part 5 of the EP&A Act. The REF has examined and taken into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposed activity. This has included consideration of conservation agreements and plans of management under the NPW Act, joint management and biobanking agreements under the TSC Act, wilderness areas, critical habitat, impacts on threatened species, populations and ecological communities and their habitats and other protected fauna and native plants.

A number of potential environmental impacts from the proposal have been avoided or reduced during the concept design development and options assessment. The proposal as described in the REF best meets the proposal objectives but would still result in some impacts on biodiversity, traffic, visual and noise. Mitigation measures as detailed in this REF would ameliorate or minimise these expected impacts. The proposal would also result in positive impacts through improved road safety, driving conditions and reduced travel times. On balance the proposal is considered justified.

The environmental impacts of the proposal are not likely to be significant and therefore it is not necessary for an environmental impact statement to be prepared and approval to be sought for the proposal from the Minister for Planning and Infrastructure under Part 5.1 of the EP&A Act. The proposal is unlikely to affect threatened species, populations or ecological communities or their habitats, within the meaning of the *Threatened Species Conservation Act 1995* or *Fisheries Management Act 1994* and therefore a Species Impact Statement is not required. The proposal is also unlikely to affect Commonwealth land or have an impact on any matters of national environmental significance and therefore a referral to DSEWPaC for a decision by the Commonwealth Minister for the Environment on whether assessment and approval is required under the EPBC Act, is not required.

9. Certification

This review of environmental factors provides a true and fair review of the proposal in relation to its potential effects on the environment. It addresses to the fullest extent possible all matters affecting or likely to affect the environment as a result of the proposal.

Mike Trebitsch

Environment Scientist

GHD Pty Ltd

Date: 21.2.13

I have examined this review of environmental factors and the certification by Mike Trebitsch from GHD Pty Ltd and accept the review of environmental factors on behalf of Roads and Maritime Services.

Deanne Forrest

Project Development Manager

Development Sydney | Project Development

Date: 20.2.13

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Terms and acronyms used in this REF

Acronym	Definition
CEMP	Construction Environmental Management Plan
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW). Provides the legislative framework for land use planning and development assessment in NSW
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth). Provides for the protection of the environment, especially matters of national environmental significance, and provides a national assessment and approvals process.
ESD	Ecologically sustainable development. Development which uses, conserves and enhances the resources of the community so that ecological processes on which life depends, are maintained and the total quality of life, now and in the future, can be increased
FM Act	*Fisheries Management Act 1994* (NSW)
Heritage Act	*Heritage Act 1977* (NSW)
ISEPP	State Environmental Planning Policy (Infrastructure) 2007
LALC	Local Aboriginal Land Council
LEP	Local Environmental Plan. A type of planning instrument made under Part 3 of the EP&A Act.
LoS	Level of Service. A qualitative measure describing operational conditions within a traffic stream and their perception by motorists and/or passengers.
MNES	Matters of national environmental significance under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999.*
Noxious Weeds Act	*Noxious Weeds Act 1993* (NSW)
NPW Act	*National Parks and Wildlife Act 1974* (NSW)
RTA QA Specifications	Specifications developed by the RTA for use with roadworks and bridgeworks contracts let by the RTA
SEPP	State Environmental Planning Policy. A type of planning instrument made under Part 3 of the EP&A Act.
SEPP 14	*State Environmental Planning Policy No.14 – Coastal Wetlands*
TSC Act	*Threatened Species Conservation Act 1995* (NSW)

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