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PREFERRED INFRASTRUCTURE REPORT

6.1 Overview

Three changes are proposed to the project described in EIS 1. These are:

- ❖ Consolidation of the two construction sites at Epping (Epping Services Facility and Epping Decline) into one site (Expanded Epping Services Facility).
- ❖ The relocation of the light vehicle access and egress point to and from Cheltenham Services Facility.
- ❖ Realignment of Norwest Station outside of the Norwest Boulevard footprint.

These proposed changes are described and assessed in detail in Sections 6.2, 6.3 and 6.4 respectively.

6.2 Epping Construction Sites

6.2.1 Description of Changes

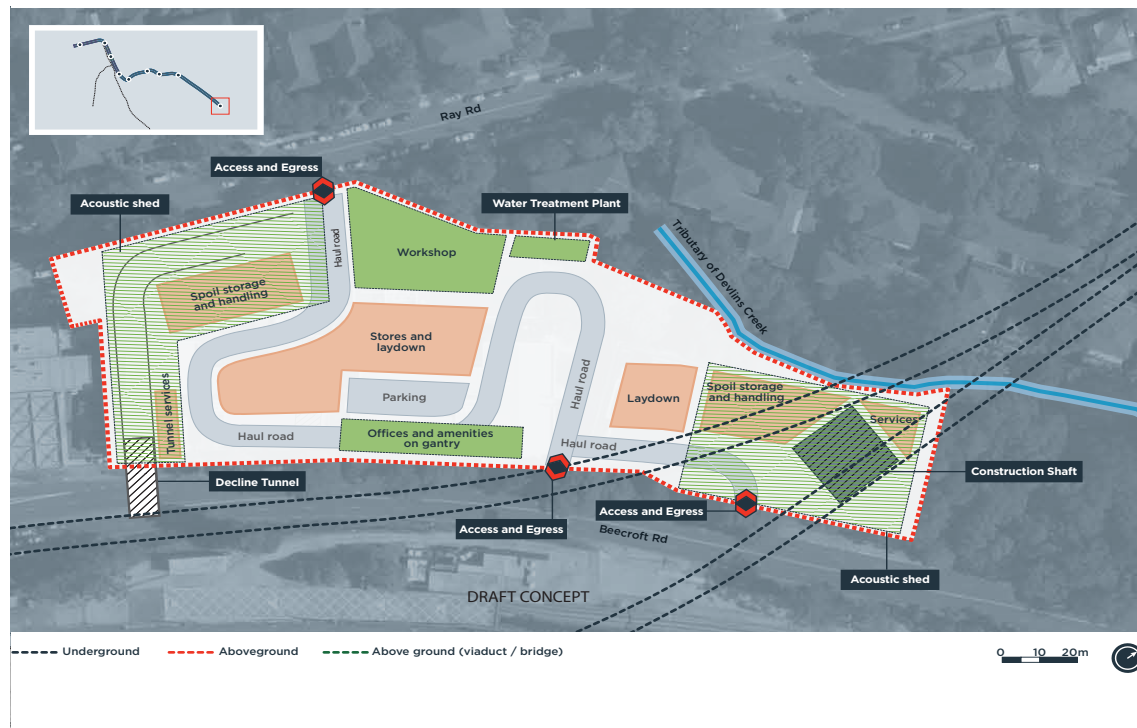
EIS 1 presented two construction sites within the Epping area, being Site 1 Epping Services Facility and Site 2 Epping Decline located on the western and eastern sides of Beecroft Road respectively. The proposed change to the project consolidates these two facilities into an expanded Site 1 and eliminates Site 2. This is shown on **Figure 6.1**.

The proposed change involves expanding Site 1 Epping Services Facility to the south-east to incorporate the full Epping Office Park site. This results in the need for three additional commercial buildings to be acquired. The expanded site would be around 12,000m² in area. This allows the

Figure 6.1 Location of Epping Services Facility and Epping Decline sites



Figure 6.2 Expanded Epping Services Facility construction site layout



6.2.2 Environmental overview of changes

In order to assess the changes to the Epping Services Facility as exhibited in EIS 1, an overview of the potential changes was conducted (**Table 6.2**). This assessment considers potential environmental aspects that may require further impact assessment in order to understand likely environmental impacts, and identify any relevant mitigation measures that may be required.

Table 6.2 Expanded Epping Services Facility environmental overview of changes

Aspect	Potential significant change in impacts?	Description
Statutory Planning	×	
Soils and Groundwater	×	There is no consequential change in the impacts presented in Chapter 8 of EIS 1 as there would be no significant change in the overall project tunnelling length and a revised assessment is not considered necessary.

Aspect	Potential significant change in impacts?	Description
Construction Traffic and Transport	✓	There is potential for changes in the impacts presented in Chapter 9 of EIS 1. These changes relate to: ▪ An increase in vehicle movements at the Expanded Epping Services Facility. ▪ A new vehicle access and egress point on Ray Road to and from the Expanded Epping Services Facility. ▪ Elimination of vehicle movements to the former Epping Decline site. Accordingly a revised assessment is included in Section 6.2.3.
Noise and Vibration – Construction	✓	There is potential for changes in the impacts presented in Chapter 10 of EIS 1. These changes relate to: ▪ An increase in construction activities at the Expanded Epping Services Facility. ▪ An increase in vehicle movements and access points at the Expanded Epping Services Facility, leading to a change to road traffic noise. ▪ Elimination of Epping Decline site as a noise source. Accordingly a revised assessment is included in Section 6.2.4.
European Heritage	✗	There is potential for changes in the impacts presented in Chapter 11 of EIS 1. This change relates to the elimination of the need for the clearing of heritage-listed bushland at the Epping Decline site. As this change is minor and would be beneficial, it was determined that a revised assessment is not required.
Indigenous Heritage	✗	There is no consequential change in the impacts presented in Chapter 12 of EIS 1 as it was determined that the potential for Aboriginal heritage in the NWRL impact zones at Epping is unlikely due to the already developed nature of the area. A revised assessment is not considered necessary.
Local Business Impacts	✓	There is potential for changes in the impacts presented in the Chapter 13 of EIS 1. These changes relate to: ▪ Acquisition of three additional commercial premises for the Expanded Epping Services Facility. Accordingly a revised assessment is included in Section 6.2.5.

Aspect	Potential significant change in impacts?	Description
Land Use and Community Facilities	✗	There is no consequential change in the impacts presented in Chapter 14 of EIS 1 as the additional land is not currently used for community facility purposes. Future land use of the site would be considered further in EIS 2. A revised assessment is not considered necessary.
Ecology	✗	There is no consequential change in the impacts presented in Chapter 15 of EIS 1. The expanded facility constitutes three additional commercial buildings. No additional clearing of vegetation would be required and a revised assessment is not considered necessary.
Visual Amenity	✓	There is potential for changes in the impacts presented in Chapter 16 of EIS 1. These changes relate to: ▪ A larger site and the addition of a second acoustic shed at the Expanded Epping Services Facility Site. ▪ Elimination of the construction site and acoustic shed at the former Epping Decline site. Accordingly a revised assessment is included in Section 6.2.6.
Climate Change and Greenhouse Gas Emissions	✗	There is no consequential change in the impacts presented in Chapter 17 of EIS 1. The proposed change eliminates one site and expands another with the same construction activities occurring in total. There would be potential for a minor decrease in greenhouse gas emissions due to the consolidation of office facilities from two locations to one location and the reduced length of the decline tunnel. A revised assessment is not considered necessary.
Surface Water and Hydrology	✗	There is no consequential change in the impacts presented in Chapter 18 of EIS 1 as general site activities are unchanged. A revised assessment is not considered necessary.
Other Issues (Waste Management and Air Quality)	✗	There is no consequential change in the impacts presented in Chapter 19 of EIS 1. The proposed change eliminates one site and extends another with the same overall construction activities occurring in total. There would be potential for a minor decrease in waste generation resulting from the consolidation of office facilities from two locations to one location and the reduced length of the decline tunnel. There would also be a reduction in the number of receivers sensitive to air quality impacts. A revised assessment is not considered necessary.

Aspect	Potential significant change in impacts?	Description
Cumulative Impacts	✓	There is potential for changes in the impacts presented in the Chapter 20 of EIS 1. These changes relate to: ▪ The elimination of the conflict between the use of the Epping Decline site concurrently with the Northern Sydney Freight Corridor project Accordingly a revised assessment is included in Section 6.2.7.

An assessment of changes for those environmental aspects determined to have a consequential change in impact is provided below.

6.2.3 Construction traffic and transport

A summary of the potential impacts associated with construction traffic and transport from EIS 1, the revised impacts and the potential change in impacts is provided in **Table 6.3**.

Table 6.3 Change in traffic and transport impacts at the Expanded Epping Service Facility

Element	EIS 1 impact	Revised impact	Change in impact
Level of service	Minor deterioration at the Carlingford Road / Beecroft Road intersection from D to E in the PM peak. No change to other intersections.	No change at any intersections.	Minor reduction in impacts
Buses	No potential for impacts.	No potential for impacts.	No change.
Pedestrians	Removal of pedestrian footpath along western side of Beecroft Road.	Removal of pedestrian footpath along western side of Beecroft Road. Provision of a signposted alternative pedestrian route via Ray Road and Kandy Avenue.	No change.
Cyclists	Potential impacts to existing cycle path passing underneath the Main North Rail Line and through the Epping Decline site.	No potential impacts.	Minor reduction in impacts.

Element	EIS 1 impact	Revised impact	Change in impact
Parking, taxis and kiss-and-ride	No potential impacts.	Potential loss of 2-3 car parking spaces on Ray Road to facilitate site access / egress point.	Minor increase in impacts.

The following sections provide a detailed assessment of the EIS 1 impacts and the revised impacts.

Summary of EIS 1 impacts

The potential construction traffic impacts identified in EIS 1 would arise primarily from the addition of heavy vehicles and light vehicles (cars and utes) onto surrounding roadways. These vehicle movements have the potential to increase traffic congestion and impact on intersection performance, as well as bus services, pedestrians and cyclists. Existing on and off street car parking may also be affected from construction works and / or construction worker vehicle parking.

EIS 1 described the anticipated access routes and vehicle numbers to the two Epping sites. These are repeated in **Table 6.4**.

Table 6.4 EIS 1 access routes and daily vehicle movements

Construction site	Proposed access route	Heavy vehicle movements	Light vehicle movements
Epping Services Facility	Beecroft Road (left in, left out)	80	34
Epping Decline	Beecroft Road (left in, left out)	80	34

Road network operation and intersection performance

EIS 1 undertook an analysis of the existing and anticipated intersection performance during construction for the major intersections surrounding the two sites at Epping (**Table 6.5**). This analysis showed that the existing intersection performance would remain largely unaffected by the addition of construction traffic.

Table 6.5 EIS 1 intersection performance

Intersection	Existing		During construction					
	LOS (AM)	DOS (AM)	LOS (PM)	DOS (PM)	LOS (AM)	DOS (AM)	LOS (PM)	DOS (PM)
Carlingford Road / Beecroft Road	E	1.00	D	1.00	E	1.00	E	1.00

Intersection	Existing		During construction					
	LOS (AM)	DOS (AM)	LOS (PM)	DOS (PM)	LOS (AM)	DOS (AM)	LOS (PM)	DOS (PM)
M2 Motorway off-ramp / Beecroft Road	A	0.55	A	0.70	A	0.56	A	0.71
M2 Motorway off-ramp / Beecroft Road	A	0.66	A	0.70	A	0.66	A	0.71

EIS 1 did not anticipate that there would be any traffic lane closures required on the surrounding network during the construction works. Some changes to the existing deceleration and acceleration lanes at the two sites would be required to assist in minimising impacts on passing traffic.

Buses

There are no scheduled route bus services that operate along this section of Beecroft Road and therefore the impact on bus operations envisaged in EIS 1 was minimal.

Pedestrians and cyclists

There is a footpath provided on the western side of the road with a formal concrete path from Carlingford Road to the EIS 1 Epping Services Facility site entrance. North of the Epping Services Facility site entrance it is a formed footpath only. Pedestrian volumes are relatively low.

There is no footpath provided on the eastern side of this section of Beecroft Road. There is a cycleway tunnel under the Main Northern Line that connects Cambridge Street with Beecroft Road which would need to be maintained throughout construction at the Epping Decline site. There are no marked cycle facilities on the remaining sections of Beecroft Road and cyclist volumes are also low.

Parking, taxis and kiss-and-ride

There is no on-street parking in this section of Beecroft Road and therefore the impact on parking would be minimal. The deceleration lane into the existing commercial development currently has a 'No Parking' restriction which enables taxis to pick up and set down passengers and a kiss-and-ride function. This restriction may need to be changed to 'No Stopping' for the duration of the works which would remove this opportunity. There would still be the opportunity for pick up and set down along the remainder of Beecroft Road.

Summary of revised impacts

The revised construction site access routes and vehicle numbers are shown on **Figure 6.3** and provided in **Table 6.6**.

Figure 6.3 Expanded Epping Services Facility heavy vehicle routes

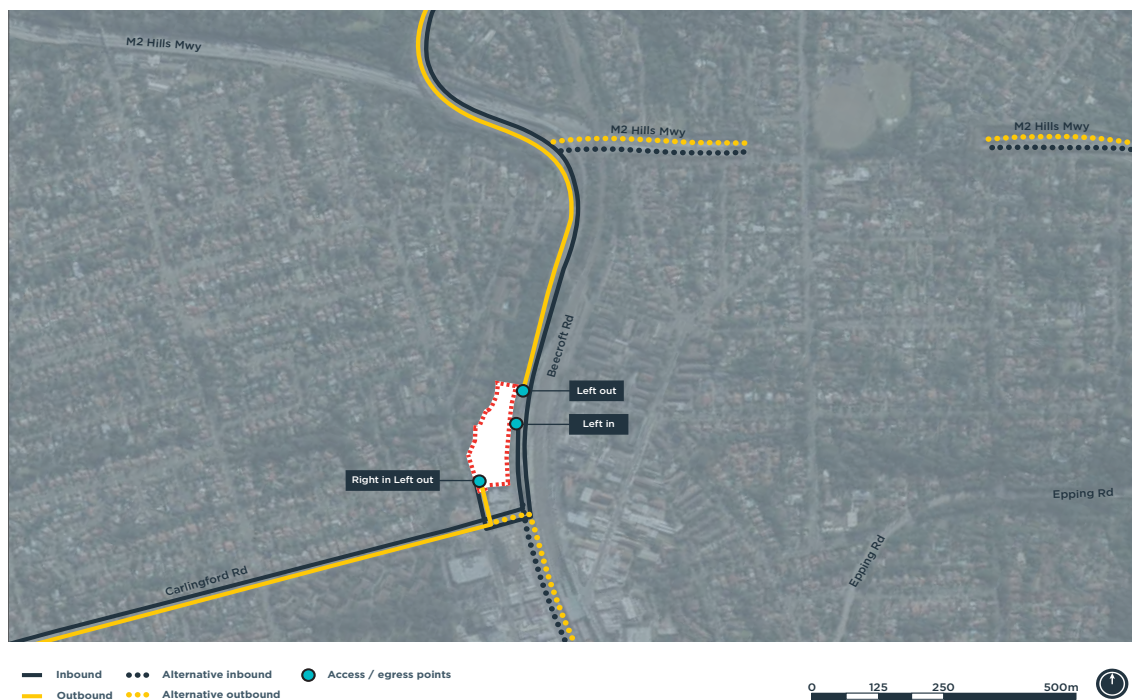


Table 6.6 Revised access route and daily vehicle movements

Construction site	Proposed access route	Heavy vehicle movements	Light vehicle movements
Expanded Epping Services Facility	Beecroft Road (left in, left out)	160	70
	Ray Road (right in, left out)		

Road network operation and intersection performance

A revised analysis was undertaken of the existing and anticipated performance of major intersections surrounding the expanded site (Table 6.7). This table shows that there would be minimal impact on the level of service of any of the surrounding intersection from the introduction of construction traffic.

Table 6.7 Revised intersection performance

Intersection	Existing		During construction					
	LOS (AM)	DOS (AM)	LOS (PM)	DOS (PM)	LOS (AM)	DOS (AM)	LOS (PM)	DOS (PM)
Carlingford Road / Beecroft Road	E	0.92	D	0.91	E	0.92	D	0.91
Carlingford Road / Ray Road / Rawson Street	E	0.85	F	1.04	E	0.86	F	1.08

In order to further reduce these potential impacts, truck movements on Ray Road would be restricted during the AM and PM peak periods. During these times, truck access and egress to and from the site would be via Beecroft Road only.

Buses

There are no scheduled route bus services that operate along the section of Beecroft Road north of Carlingford Road however, the M54 service operates along Carlingford Road and Beecroft Road to Epping Station and the route 546 and 549 services operate along Ray Road and Rawson Street for services to Epping, and Beecroft Road, Carlingford Road and Ray Road for services from Epping. There are no bus stops in the vicinity of the proposed site.

Pedestrians and cyclists

There is a footpath provided on the western side of Beecroft Road with a formal concrete path from Carlingford Road to the proposed Expanded Epping Services Facility site entrance. North of the site entrance it is a formed footpath only. Pedestrian volumes are relatively low. This pedestrian path would need to be closed during the construction phase and pedestrians redirected to Ray Road. This pathway ends at the proposed site entrance point with no formal pathway provided north of this point.

Traffic counts highlight that there is a significant pedestrian movement across Carlingford Road during the peak hour, on both the eastern and western pedestrian crossings.

There are no marked cycle facilities on the sections of Beecroft Road, Carlingford Road or Ray Road and cyclist volumes are also low.

Parking, taxis and kiss-and-ride

There is no on-street parking in the section of Beecroft Road past the site and the section of Carlingford Road on the approaches to Epping, therefore the impact on parking on these roads would be minimal.

There is a 'No Stopping' restriction in place on the eastern kerb line of Ray Road from the intersection with Carlingford Road to the proposed site access. Parking is permitted on the western side of Ray Road from just north of the Carlingford Road intersection. It is estimated that approximately 2-3 spaces may need to be removed at the site entrance to facilitate local traffic being able to pass any vehicles making the right turn into the site.

It is understood that there is commuter parking occurring in Ray Road at the present time for those commuters accessing Epping Station. The Expanded Epping Services Facility may have some impact for on-street parking should workers need to drive to the site however, parking would be provided within the construction site and workers would be encouraged to car pool or use public transport to limit this impact.

Conclusion

The consolidation of the two sites at Epping to a single Expanded Epping Services Facility site would result in some additional impacts to roads such as Ray Road, however it is expected that the traffic generated by the consolidated site would have minimal additional impact on the surrounding intersections during the peak periods. In order to further reduce these potential impacts, truck movements on Ray Road would be restricted during the AM and PM peak periods. During these times, truck access and egress to and from the site would be via Beecroft Road only.

The impact on parking would also be minimal and the redirection of pedestrians away from the Beecroft Road frontage of the site would be managed to provide a pedestrian route toward Kandy Avenue and the M2 Motorway overbridge from Carlingford Road and the Epping Town Centre (refer to mitigation measure T19).

6.2.4 Noise and vibration – construction

A summary of the potential impacts associated with construction noise and vibration from EIS 1, the revised impacts and the potential change in impacts is provided in **Table 6.8**.

Table 6.8 Change in noise and vibration impacts at the Expanded Epping Service Facility

Element	EIS 1 impact	Revised impact	Change in impact	Comments
Airborne Noise – Daytime	Potential exceedances of noise management levels of > 20 dB.	Potential exceedances of noise management levels of > 20 dB.	Reduction in impacts in some locations. Increase in impacts in some locations.	The change would eliminate and reduce potential impacts at receivers close to the former Epping Decline site. The change would increase or result in new impacts to receivers close to the Expanded Epping Services Facility Site.
Airborne Noise – Evening	Potential exceedances of noise management levels of > 20 dB.	Not applicable.	Potential reduction in impacts.	

Element	EIS 1 impact	Revised impact	Change in impact	Comments
Airborne Noise – Night-time	Compliance with noise management levels.	Potential exceedances of noise management levels of ≤ 10 dB.	Potential increase in impacts.	A site management and / or physical mitigation solution would be implemented to ensure noise levels from onsite heavy vehicle movements during the night-time period comply with the sleep disturbance Noise Management Level.
Onsite night-time trucks	Low risk of sleep disturbance.	Very low risk of sleep disturbance.	Minor reduction in impacts.	
Traffic noise	Complies with 2 dB allowance. Exceedance of external sleep disturbance NML of up to 11 dB.	Complies with 2 dB allowance. Exceedance of external sleep disturbance NML of up to 11 dB.	No change.	
Ground-borne noise	Not anticipated to be appreciable at nearest receiver.	Not anticipated to be appreciable at nearest receiver.	No change.	
Ground-borne vibration	May be perceptible at nearest receiver. Anticipated to be below the cosmetic damage screening criteria of 7.5 mm/s.	May be perceptible at nearest receiver. Anticipated to be below the cosmetic damage screening criteria of 7.5 mm/s.	No change.	

The following sections provide a detailed assessment of the EIS 1 impacts and the revised impacts.

Summary of EIS 1 impacts

EIS 1 envisaged noise and vibration impacts from the two sites would include:

- ❖ Airborne construction noise from surface activities.
- ❖ Road traffic noise from heavy vehicle movements, including night-time spoil removal activities.
- ❖ Ground-borne construction noise from underground excavation and mining of the decline tunnel.
- ❖ Ground-borne vibration from underground excavation and mining of the decline tunnel.

Airborne construction noise

The location of sensitive receivers and noise catchment areas surrounding the two EIS 1 Epping sites is shown on **Figure 6.4**. A summary of the predicted noise level exceedances from EIS 1 is provided in **Table 6.9**.

Figure 6.4 EIS 1 noise sensitive receivers and catchment areas – Epping sites

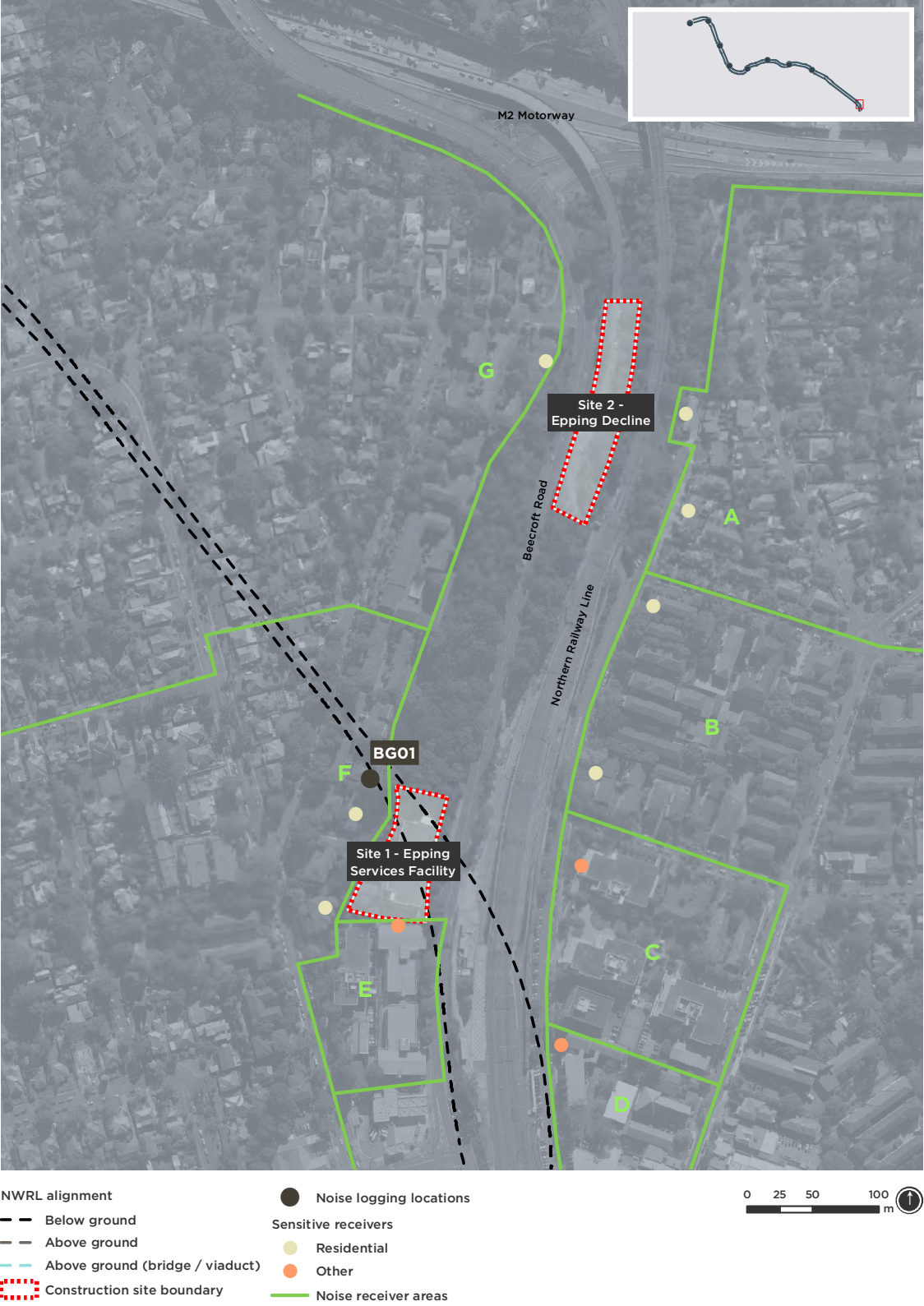


Table 6.9 EIS 1 predicted noise level exceedances at Epping Services Facility and Epping Decline

Receiver Area		Noise Modelling Scenario									
		Epping services facility - earthworks and site establishment (daytime)	Epping services facility - excavation of vertical shaft (daytime)	Epping services facility - roadheader support operations and spoil removal with acoustic shed (night-time)	Epping services facility - shaft concreting (daytime)	Epping services facility - shaft concreting (evening)	Epping decline - earthworks and site establishment (daytime)	Epping decline - excavation of decline shaft (daytime)	Epping decline - roadheader support operations and spoil removal with acoustic shed (night-time)	Epping decline - shaft concreting (daytime)	Epping decline - shaft concreting (evening)
A	Residences between Cambridge and Derby Street										
B	Residences Cambridge Street										
C	Commercial Cambridge Street			N/A		N/A			N/A		N/A
D	School			N/A		N/A			N/A		N/A
E	Commercial adjacent			N/A		N/A			N/A		N/A
F	Residences Edensor Street South										
G	Residences Edensor Street North										
		Compliance	≤ 10 dB exceedance			10 dB to ≤ 20 dB exceedance			> 20 dB exceedance or LAeq(15minute) > 70 dBA		

During the standard daytime construction period, noise levels were predicted in EIS 1 to be highest during the site establishment and excavation phases (including rock breakers). For these construction phases:

- ❖ NML exceedances of up to 31 dB were predicted at the nearest residential receivers in Area F during Epping Services Facility works.
- ❖ NML exceedances of up to 20 dB and 22 dB were predicted at the nearest residential receivers in Area A and G during Epping Decline site works.

During subsequent construction activities, the noise modelling scenarios included the benefit of construction site noise barriers (hoardings) and site buildings which assist in reducing the potential noise impacts.

For night-time spoil management operations associated with the underground tunnelling, an acoustic shed was included in the modelling for the purpose of reducing airborne noise levels as far as practical. With the proposed acoustic sheds at the Epping Services Facility and Epping Decline sites:

- ❖ Noise levels were predicted to comply with the NMLs at all residential receivers.
- ❖ If trucks are used to remove spoil, then compliance was predicted at the services facility. For the Decline site, the predicted exceedance was up to 14 dB in Area G.

On-site night-time L_{Amax} truck noise

The L_{Amax} noise levels associated with individual truck movements were predicted to be 59 dBA at the nearest residential receivers in Edensor Street and 62 dBA at the nearest residential receivers in Cambridge Street / Beecroft Road. There were expected to be up to two truck movements per hour. In relation to the predicted L_{Amax} noise levels from onsite truck movements:

- ❖ At residences in Edensor Street and Cambridge Road, the maximum noise levels were predicted to exceed the sleep disturbance screening criterion by up to 12 dB and 15 dB respectively. This indicated that more detailed analysis was required.
- ❖ The maximum noise levels of 59 dBA (Edensor Street) and 62 dBA (Cambridge Road) complied with the sleep disturbance NML of 65 dBA (external). Maximum noise levels were therefore unlikely to cause awakening reactions.
- ❖ The maximum noise levels at both locations were at the lower range of the existing L_{Amax} noise levels.

On the basis of the above, it is concluded that the risk of sleep disturbance was low.

Construction traffic noise

Traffic noise levels were predicted for residential receivers located on the proposed access routes to the Epping Decline site and the Epping Services Facility. In this instance, the access to both sites was proposed to be via Carlingford and Beecroft Roads which are sub-arterial roads with significant daytime flows.

Given that night-time spoil removal was proposed, the night-time L_{Aeq} increase and sleep disturbance were also assessed.

The predicted night-time noise level increase (L_{Aeq}) associated with construction traffic complied with the 2 dB allowance, therefore sensitive receivers were not likely to notice an increase in the average road traffic noise levels during construction. There were expected to be up to two movements or events per hour during the night and, whilst there was an exceedance of the external sleep disturbance NML of 65 dBA (of up to 11 dB), the L_{Amax} levels would have been comparable with other heavy vehicles using the sub-arterial roads.

Ground-borne construction noise

Ground-borne construction noise impacts were not anticipated to be appreciable for the Epping Services Facility on the basis that the proposed demolition and excavation works would have been on the surface and undertaken during daytime periods when ambient noise levels are highest.

At the nearest residential and commercial buildings adjacent to the Epping Services Facility, ground-borne noise levels were anticipated to be audible during daytime rock breaker activities, however airborne noise levels associated with the rock breaker works were anticipated to be much higher than the ground-borne noise levels and therefore more prominent. The airborne noise levels associated with rock breaker activities during the daytime periods were included in the airborne noise modelling results.

Minimal impacts from ground-borne construction noise were anticipated in EIS 1 from mining of the Epping decline tunnel, given the offset distance from the decline to the nearest receivers.

Ground-borne construction vibration

During rock breaker activities at the Epping Services Facility, it was anticipated that ground-borne vibration levels may be perceptible at the nearest residential and commercial receivers. Potential impacts would have been mitigated by undertaking rock breaking works during daytime periods and observing respite periods.

At the nearest commercial building, attended vibration measurements would have been required at the commencement of potentially high vibration activities to ensure that vibration levels remained below the safe vibration levels associated with minor cosmetic building damage.

Ground-borne vibration levels from roadheaders mining the Epping decline tunnel were predicted to be much lower than the 7.5 mm/s screening level (relating to the threshold where minor cosmetic damage may occur). Human comfort vibration impacts from tunnelling works would have been managed in accordance with the Construction Noise and Vibration Strategy (CNVS).

Summary of revised impacts

A revised noise and vibration assessment has been undertaken and is presented below.

Airborne construction noise

The location of sensitive receivers and noise catchment areas surrounding the Expanded Epping Service Facility site is shown on **Figure 6.5**. The revised predicted noise level exceedances are provided in **Table 6.10**.

Figure 6.5 Revised noise sensitive receivers and catchment areas - Expanded Epping Services Facility

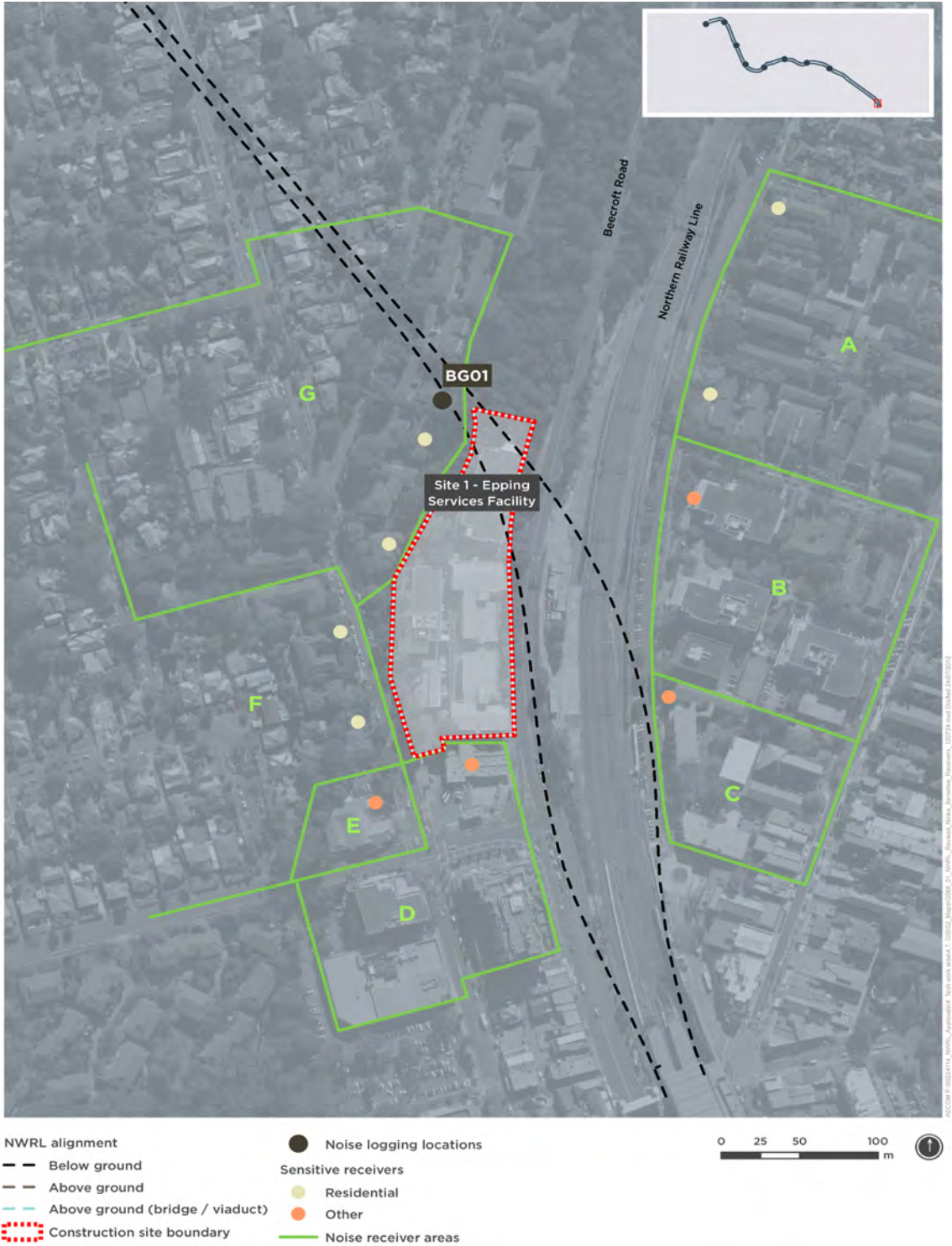


Table 6.10 Revised predicted noise level exceedances at the Expanded Epping Services Facility

Receiver Area		Noise Modelling Scenario				
		Epping services facility and decline - earthworks and site establishment (daytime)	Epping services facility and decline - excavation of vertical shaft (daytime)	Epping services facility and decline - shaft concreting (daytime)	Epping services facility and decline - roadheader support operations and spoil removal with acoustic shed (night-time) No on site trucks, trucks having direct access via Beecroft Road to the acoustic sheds	Epping services facility and decline - shotcreting operations with acoustic sheds (night-time) includes one concrete truck unloading at Beecroft Road Bay - no onsite trucks
A	Residences Cambridge Street					
B	Commercial Cambridge Street				N/A	N/A
C	School				N/A	N/A
D	Commercial adjacent				N/A	N/A
E	Church				N/A	N/A
F	Residences Ray Road					
G	Residences Edensor Street					

Compliance
 ≤ 10 dB exceedance
 10 dB to ≤ 20 dB exceedance
 > 20 dB exceedance or L_{Aeq}(15minute) > 70 dBA

The airborne construction noise predictions at the Expanded Epping Services Facility indicate:

- ❖ The predicted noise levels for daytime site establishment and excavation indicate high exceedances of the NMLs for daytime construction at the nearest residential receiver areas adjacent to the site. During site establishment and excavation, NMLs at the nearest receivers in Areas F and G would be exceeded by more than 20 dB. There would be minor exceedances at Areas C, D and E of less than 10 dB during site establishment and compliance at these areas during excavation. At Area A, there would be a minor exceedance during earthworks which would increase to a moderate exceedance during excavation.

For this scenario, the previous configuration (assessed in EIS 1) was predicted to result in similar magnitude exceedances at the nearest residential receivers. Overall, the sensitive receiver area potentially affected would be less for the Expanded Epping Services Facility site compared with the previous configuration presented in EIS 1.

- ❖ During daytime shaft concreting, the NMLs would be complied with at all receivers, except Areas F and G where there would be moderate exceedances. For evening concreting works, there would be a minor exceedance at Area A residences and moderate exceedances at Areas F and G. These impacts are similar to those predicted for the previous configuration assessed in EIS 1.
- ❖ For the night-time roadheader spoil management activities, acoustic sheds of double skin construction (high noise insulation) were included in the modelling at the Expanded Epping Services Facility to enable compliance with night-time NML at the residences adjacent to the site. It is noted there would be minor exceedances of 1 dB and 2 dB at Areas G and F respectively, and these can be addressed during the detailed design stage by minor improvements in the shed's sound insulation performance. The introduction of onsite trucks with direct access to the acoustic sheds from Beecroft Road is not anticipated to increase onsite night-time noise levels. The modelling for this scenario includes one truck in any 15 minute period accessing both the services facility and decline tunnel sheds. For the previous configuration (assessed in EIS 1) the predicted exceedance was up to 14 dB at the nearest residences as a result of trucks onsite. The modelling for this scenario included one truck in any 15 minute period accessing both the services facility and decline tunnel areas.
- ❖ For the night-time shotcreting activities, sheds of double skin construction (high noise insulation) were included in the modelling at the Expanded Epping Services Facility. Higher impacts when compared to the night-time roadheader spoil management activities are predicted with exceedances of 6 dB, 3 dB and 5 dB at Areas A, F and G respectively. The modelling for this scenario includes one concrete truck unloading at a purpose built bay on Beecroft Road in any 15 minute period, with up to 4 events expected during the night. This scenario was not included in the EIS 1 assessment.

Where receivers are “highly noise affected” (ie where the predicted noise level exceeds 75 dBA) or the NMLs would be exceeded by more than 20 dB, having considered all feasible and reasonable noise mitigation, the proponent may need to implement respite periods and liaise with the community as outlined in Table 6.1 of the Noise and Vibration Technical Paper for EIS 1. The TfNSW Construction Noise and Vibration Strategy (CNVS) would be implemented to manage the potential noise impacts. At Epping this is anticipated to occur during the daytime earthworks and excavation activities.

On-site night-time L_{Amax} truck noise

The L_{Amax} noise levels associated with individual truck movements onsite (which in this instance are directly into the acoustic sheds or at the Beecroft Road unloading bay) are predicted to be 48 dBA at the nearest eastern residential receivers in Cambridge Street. At the nearest western residential receivers in Ray Road / Edensor Street a level of 46 dBA is predicted. The predicted noise levels and the sleep disturbance screening criteria are presented in **Table 6.11**.

Table 6.11 Expanded Epping Services Facility predicted onsite truck noise

Location	RBL +15 dB screening criterion (dBA)	Sleep disturbance NML (dBA)	Existing L_{Amax} noise levels at night (dBA) ¹	Predicted on site truck noise L_{Amax} (dBA) ²
Residences on Ray Road	47	65	61 to 70	46
Residences on Cambridge Street	47	65	61 to 70	48

1. The existing maximum noise levels are based on the 25th percentile and the 75th percentile of the 15-minute L_{Amax} noise levels of the ambient survey.

2. Predicted L_{Amax} noise levels assume shielding by 3 m perimeter hoarding located west of the unloading bay

There are expected to be up to 2 truck movements per hour. In relation to the predicted L_{Amax} noise levels from onsite truck movements:

- ❖ At residences in Ray Road the maximum noise levels are predicted to meet the sleep disturbance screening criterion, and at Cambridge Street marginally exceed by 1 dB. This indicates that more detailed analysis is required at Cambridge Street.
- ❖ The maximum noise levels of 46 dBA (Ray Road) to 48 dBA (Cambridge Street) are below sleep disturbance NML of 65 dBA (external). Maximum noise levels are therefore not expected to cause awakening reactions.
- ❖ The maximum noise levels of 46 dBA to 48 dBA are significantly less than the existing L_{Amax} noise levels (61 dBA to 70 dBA).

On the basis of the above, it is concluded that the risk of sleep disturbance due to night-time onsite truck movements is very low for residences on Cambridge Street and Ray Road.

Construction traffic noise

Traffic noise levels have been predicted for residential receivers located on the proposed access routes to the Expanded Epping Services Facility. In this instance, the access to the site would be via Carlingford and Beecroft Roads which are sub-arterial roads as well as via Ray Road which is a local road. Carlingford Road, Beecroft Road and Ray Road have daytime flows significantly higher than the traffic generated by the site resulting in traffic noise level increases of less than 0.1 dB.

Given that night-time spoil removal is proposed, the night-time L_{Aeq} increase and sleep disturbance have also been assessed in **Table 6.12**. It should be noted that night-time access and egress to and from the site is proposed to and from Beecroft Road only.

Table 6.12 Expanded Epping Services Facility construction traffic on public roads

Site Access	Access Road	Predicted road traffic noise increase (dB)	RBL +15 dB screening criterion (dBA)	External L_{Amax} NML (dBA)	Predicted L_{Amax} noise level (dBA)
Beecroft Road	Carlingford Road	0.1	47	65	76
Beecroft Road	Beecroft Road	0.1	47	65	72

Table 6.12 indicates that the predicted noise level increase (L_{Aeq}) associated with construction traffic complies with the 2 dB allowance, therefore sensitive receivers are not likely to notice an increase in the average road traffic noise levels during construction. There are expected to be up to 2 movements or events per hour during the night and whilst there is an exceedance of the sleep disturbance screening criterion (of up to 29 dB) and external sleep disturbance NML of 65 dBA (of up to 11 dB), the L_{Amax} levels would be comparable with other heavy vehicles using the sub-arterial and local roads.

Overall, the impacts of construction traffic on public roads would be similar to those predicted for the previous configuration assessed in EIS 1.

Ground-borne construction noise

Ground-borne construction noise impacts are not anticipated to be appreciable for the Expanded Epping Services Facility on the basis that the proposed demolition and excavation works would be on the surface and undertaken during daytime periods when ambient noise levels are highest.

At the nearest residential and commercial buildings adjacent to the Expanded Epping Services Facility, ground-borne noise levels are likely to be audible during daytime rock breaker activities, however airborne noise levels associated with the rock breaker works are likely to be much higher than the ground-borne noise levels and therefore more prominent. The airborne noise levels associated with rock breaker activities during the daytime periods are included in the airborne noise modelling results.

Minimal impacts from ground-borne construction noise are anticipated from mining of the Epping decline tunnel, given the offset distance from the decline to the nearest receivers.

Ground-borne construction vibration

During rock breaker activities at the Expanded Epping Services Facility, vibration levels may be perceptible at the nearest residential and commercial receivers. Potential impacts would be mitigated by undertaking rock breaking works during daytime periods and observing respite periods.

At the nearest residential / commercial buildings, attended vibration measurements would be required at the commencement of potentially high vibration activities to ensure that vibration levels remain below the safe vibration levels associated with minor cosmetic building damage.

Ground-borne vibration levels from roadheaders mining the Epping decline tunnel are predicted to be much lower than the 7.5 mm/s screening level (relating to the threshold where minor cosmetic damage may occur). Human comfort vibration impacts from tunnelling works would be managed in accordance with the CNVS.

Conclusion

A summary of the revised noise and vibration impacts compared to that of EIS 1 is provided below:

- ❖ Removal of the EIS 1 Epping Decline site would significantly reduce the impact of construction noise at the receivers that are adjacent to this site. These include the residences on Cambridge Street north of Surrey Street and those on the north end of Edensor Street. These residences are located typically 50m from the former Epping Decline site and 250m from the Expanded Epping Services Facility. Construction activities would therefore move from being as close at 50m to being more than 250m from these receivers.
- ❖ Residences, commercial receivers and the school located on the eastern side of the Expanded Epping Services Facility are predicted to experience either no change or a minor increase in construction noise as result of combining the sites. For residences in Area B and commercial receivers in Area C, no significant change in noise levels is expected. At the Our Lady Help of Christians' Primary School there is an increase in predicted noise levels of 3 dB during earthworks and 6 dB during excavation, as a result of the closer proximity of the expanded site.
- ❖ The nearest commercial receiver south of the expanded site would experience an appreciable increase in construction noise, primarily because the existing adjacent building was previously shielding noise emissions and is now proposed to be demolished to allow expansion of the site area.
- ❖ Residences on Ray Road in Area F would experience an increase in noise level as a direct result of the expanded site being located across Ray Road from these residences.
- ❖ Residences on Ray Road and Edensor Street in Area G would experience a minor increase in predicted noise level of up to 3 dB. The NML exceedances increase from up to 31 dB to up to 34 dB as result of combining the sites.
- ❖ Spoil handling and removal activities as well as shotcreting result in decreased impacts at Area F and Area G as a result of restricting night-time access from Beecroft Road into the acoustic sheds, and the use of a concrete unloading bay at Beecroft Road.

Overall, the noise impacts of the revised site and activities at Epping would not result in increased noise and vibration impacts on sensitive receivers above the predictions presented in EIS 1. While some residences in areas F and G would experience higher noise levels during some scenarios, this is balanced by the significant reduction in noise impacts on receivers adjacent to the former Epping Decline site. Furthermore, restrictions on night-time access, including the implementation of a site management and / or physical mitigation solution to ensure noise levels from onsite heavy vehicle movements during the night-time period comply with the sleep disturbance Noise Management Level (refer to mitigation measure NV18), would result in reduced night-time impacts on receivers in Area F and G.

6.2.5 Local business impacts

A summary of the potential impacts to local businesses from EIS 1, the revised impacts and the potential change in impacts is provided in **Table 6.13**.

Table 6.13 Change in local business impacts at the Expanded Epping Service Facility

Element	EIS 1 impact	Revised impact	Change in impact
Number of businesses impacted	109	164	Increase in potential adverse and beneficial impacts.
Commercial property acquisition	1 property with 9 tenants.	4 properties with 18 tenants in total.	Increase in impacts.
Negative impacts	Potential negative impacts associated with accessibility, visibility and operating amenity.	Potential negative impacts associated with accessibility, visibility and operating amenity.	Increase in impacts associated with additional businesses being impacted.
Positive impacts	Potential positive impacts associated with workforce utilising local businesses in proximity to the construction site.	Potential positive impacts associated with workforce utilising local businesses in proximity to the construction site.	Potential for increase in beneficial impacts associated with larger workforce closer to Epping Town Centre.

The following sections provide a detailed assessment of the EIS 1 impacts and the revised impacts.

Summary of EIS 1 impacts

The major civil construction works are situated adjacent to the established town centre of Epping which provides a mix of smaller scale retail, cafes, restaurants, health services and community facilities.

Business survey

A sample count of local businesses in the vicinity of Beecroft Road at Epping was undertaken. The survey identified that the following businesses may be impacted by the major civil construction works:

- ❖ Retail (19).
- ❖ Accommodation, cafes and restaurants (41).
- ❖ Transport and storage (2).
- ❖ Finance and insurance (4).
- ❖ Property and businesses services (10).
- ❖ Health and community services (13).
- ❖ Personal and other services (20).

The low rise commercial businesses that lie directly to the north and south of the Epping Services Facility site were not included in the business survey.

Negative impacts due to construction related works

The negative impacts described and assessed in EIS 1 which may arise due to construction works around Epping include:

- ❖ Poorer accessibility to businesses during the construction works may occur as a result of heavy vehicle movements into and out of the sites along Beecroft Road. However, the Construction Traffic assessment in EIS 1 indicated that additional truck movements in the vicinity of Epping would be acceptable.
- ❖ Visibility to the businesses located in the town centre was not anticipated to be affected during construction as the sites were located some distance away from these businesses.
- ❖ Businesses may experience a reduction in operating amenity during construction works. In particular, outdoor cafes, food outlets and eateries stand to be most affected due to noise and air impacts. It is noted these businesses would already experience reduced amenity from traffic on Beecroft Road. The Construction Noise and Vibration assessment in EIS 1 indicated that noise impacts would be within acceptable levels and the Air Quality assessment identified effective mitigation measures for controlling dust.
- ❖ Low rise commercial buildings lie directly south and east of the Epping Services site. It was anticipated that, during construction, these businesses may experience a reduction in the quality of the operating amenity as a result of potential noise and vibration disturbances.

Positive impacts due to construction related stimulus

The positive impacts described and assessed in EIS 1 which may arise due to construction works around Epping include:

- ❖ Retail, accommodation, cafes, restaurants and the health and community services sector were expected to benefit from increased expenditure within the area due to increased patronage from construction workers.
- ❖ Cafes, restaurants and eateries, which account for the highest number of businesses in this locality, were identified as the businesses which would stand to benefit the most during construction. The increase in trade may have subsequently led to increased employment and incomes for businesses and employees.
- ❖ It was anticipated that the 7/11 service station at the corner of Beecroft and Carlingford Roads may encounter increased demand for convenience goods.

Summary of revised impacts

A revised assessment of local business impacts has been undertaken and is presented below.

Business survey

A revised count of local businesses in the vicinity of the Expanded Epping Services Facility was undertaken. The survey identified that the following businesses may be impacted by the major civil construction works:

- ❖ Agriculture, forestry and fishing (1).
- ❖ Mining (1).

- ❖ Retail trade (21).
- ❖ Accommodation, cafes and restaurants (43).
- ❖ Communication services (2).
- ❖ Finance and insurance (9).
- ❖ Property and business services (33).
- ❖ Education (1).
- ❖ Health and community services (25).
- ❖ Cultural and recreational services (4).
- ❖ Personal and other services (22).
- ❖ Transport and storage (2).

An additional 55 businesses were identified along Ray Road and Rawson Street. These businesses primarily consisted of Property and Business Services (42%), and Health and Community Services (12%). Taken together, a total of 164 businesses were identified around the Expanded Epping Services Facility.

The locality of the additional local businesses relative to the Expanded Epping Services Facility is illustrated in **Figure 6.6**. A direct impact to the consolidation of the Epping sites is the need to acquire additional property to allow accommodation of the increased site capacity. Specifically, an additional three properties would be acquired, inclusive of:

- ❖ 242 Beecroft Road – Commercial office block (9 tenants).
- ❖ 244 Beecroft Road (empty).
- ❖ 4 Ray Road – Commercial office block (9 tenants).

These three properties are supplementary to the initial acquisition of 240 Beecroft Road – Commercial office block (9 tenants). It is possible some of the commercial businesses located within these premises may relocate and / or establish similar businesses in the locality.

Figure 6.6 Additional local businesses impacted



Negative impacts due to construction related works

The Expanded Epping Services Facility would introduce additional impacts to local businesses within the locality. Specifically the removal of the Epping Decline site and resulting merger into the Epping Services site would concentrate the major civil works into one locality.

As a result of these revised works, increased heavy vehicle movements at the Carlingford Road / Ray Road / Rawson Street intersection is expected. It is estimated that at peak operation, the expanded site would generate approximately 160 truck trips per day, with a total of approximately 16 heavy vehicle movements in and out of the site each hour. In addition, there would be approximately 70 daily light vehicle movements to / from the site.

Based on consolidated works and expected disruptions described above, the key negative impacts on local businesses would be focussed on Rawson Street and Epping / Beecroft Road businesses as follows.

Rawson Street businesses

The accessibility to the 8% of businesses along Rawson Street that rely on traffic related activity to generate trade would be adversely affected due to the Expanded Epping Services Facility. These businesses include Accommodation, Cafes and Restaurants (ie Epping RSL, Terrace Bar & Grill) and Retail Trade (ie Coles). While not solely dependent on passing traffic for commerce, these businesses may experience a reduction in demand for their goods and services from poorer accessibility caused by increased vehicular movements at the Carlingford Road / Ray Road / Rawson Street intersection. Businesses may also experience reduced operating amenity due to noise and vibration. It is unlikely that visibility would be affected, however, due to the distance of the businesses from the works.

The remaining 92% of businesses along Rawson Street are considered non-traffic related and comprise of Property and Business Services (eg Northern Times Newspaper, APMP Pty Ltd, KeyCorp Pty Ltd and accountancy firms), Finance and Insurance (eg Retire Investment / Finance Solutions, Combined Insurance and Berry Actuarial Planning), and Health and Community Services (ie Physiotherapists, Neuropaths and Epping Family Wellness Centre). These businesses would continue to provide goods and services to patrons irrespective of the accessibility concerns given their customer base are not wholly traffic dependent and reliant.

Like traffic related businesses on Rawson Street, non-traffic related businesses may also experience a reduction in their operating amenity caused by the traffic congestion and increased heavy vehicle movements occurring throughout working hours. This may potentially affect employee productivity, interactions with customers and general work place ambience. Visibility to these businesses would be unlikely to change as the businesses are predominantly located within low rise commercial buildings.

Additionally, the expanded civil works on Ray Road and the additional vehicle movements on Ray Road / Rawson Street may lead to a reduction in the availability of off-street parking for customers. However, it is expected that the impact would be minimised as customers seeking to access Rawson Street businesses would continue to use the large car parking facility located next to the Coles Supermarket.

Epping / Beecroft Road businesses

Heavy vehicles would utilise Epping / Beecroft Road to access civil related works on the expanded site leading to increased traffic congestion and interruptions for businesses within the Beecroft Road vicinity. Accessibility issues would likely ensue and potentially lead to disruptions to local businesses in this proximity. The high percentage of traffic related businesses (55%) along the Beecroft Road comprising Accommodation, Cafes and Restaurants (38%) and Retail (17%) may subsequently experience reductions in demand for goods and services as a result of poorer accessibility and increased traffic congestion.

The traffic dependent 7/11 service station situated on the Beecroft Road / Carlingford Road intersection is likely to experience reduced accessibility from daily heavy vehicle and light vehicle movements. That is, passing traffic may be inhibited from entering the service station. This, in effect, may potentially lead to a reduction in demand for goods and services during the major civil construction works.

The visibility of businesses to passing traders is, however, unlikely to be affected due to the distance of the expanded site from the Beecroft Road vicinity. Although the existing businesses along Beecroft Road would already experience poor operating amenity due to daily passing vehicles, the concentration of civil works and the additional heavy vehicle movements at the expanded site would

intensify the reduction in the quality of the operating amenity. Outdoor cafes and eateries relying on a serene environment would likely be the most affected from the noise, dust and air disturbances from the works.

Positive impacts due to construction related stimulus

Consolidation of the two construction sites would potentially introduce additional positive impacts to businesses within the precinct. Specifically, the concentration of major civil works to one site would require a larger construction workforce at the one locality. That is, the construction workforce at the former Decline site would now be reallocated to the Expanded Epping Services Facility site. Here, it is noted that the former Decline site was located at such a distance from local businesses that the major civil construction works would not have presented opportunities for increased demand of goods and services surrounding local businesses.

An increase in the construction workforce at the one locality would provide benefits to businesses along both Rawson Street and those situated within the Beecroft Road vicinity. Of the businesses within both localities, the predominant business type consisted of Retail (20%), Cafes and Restaurants (40%). It is envisaged that the retail businesses (ie Coles supermarket, numerous newsagency, convenience stores and mini supermarkets) would service the enlarged construction workforce requiring everyday necessities. The 7/11 service station situated at the corner of Beecroft and Carlingford Roads may also experience increased demand for their convenience goods due to its close proximity to the Expanded Epping Services Facility.

Additionally the cafes and restaurants (eg Terrace Bar and Grill, Epping RSL, Pizza parlour, bakeries and charcoal chicken outlets) would likely experience an increase in demand for their goods and services during the major civil construction works. In this regard, the incomes for these businesses and their employees may also increase to reflect the increased trade.

Health and community services, comprising 23% of businesses, in the town centre would also stand to benefit during the major civil construction works. An increase in patronage may be expected for these businesses (eg physiotherapists, medical centres, optometrists and dentists) as the construction workforce utilises these services.

Conclusion

The consolidation of the two construction sites is expected to increase the number of local businesses affected at this locality. The additional businesses affected are mainly located on Rawson Street, where an additional 55 businesses were identified.

The concentration of the major civil construction works at a single location, combined with heavy and light vehicle movements caused by the concentration of work at the expanded site, is expected to reduce the accessibility and the quality of the operating amenity of businesses during peak hours along Rawson Street and Beecroft Road.

However, as the bulk of businesses on Rawson Street comprise non-traffic related services (eg finance and accountancy services), these businesses are expected to be less affected by the major civil construction works given the customer base of these businesses are not directly related to traffic related and dependent services (ie customers seeking to use accountancy services are likely to continue the use of such services regardless of disruptions related to construction).

Comparatively the businesses along the Beecroft Road vicinity largely comprise accommodation, cafes and restaurants, and retail businesses. Although these businesses are expected to experience greater disruption from the Expanded Epping Services Facility, the potential negative impacts would be offset by an increase in construction workforce activity and consequent increase in demand for their goods and services.

6.2.6 Visual Amenity

A summary of the potential impacts associated with visual amenity from EIS 1, the revised impacts and the potential change in impacts is provided in **Table 6.14**.

Table 6.14 Change in visual impacts at the Expanded Epping Service Facility

Element / receiver	EIS 1 impact	Revised impact	Change in impact
Views from major routes	Minor adverse	Minor – moderate adverse	Increase in impacts
Views from public open space and community facilities	Not applicable	Moderate adverse	Increase in impacts
Views from residential areas	Negligible	Negligible – minor adverse	Increase in impacts
Views from commercial areas	Minor adverse	Moderate adverse	Increase in impacts
Views at night	Negligible	Negligible	No change

The following sections provide a detailed assessment of the EIS 1 impacts and the revised impacts.

Summary of EIS 1 impacts

EIS 1 described the potential visual impacts associated with the two construction sites at Epping. The impacts at the sites related to the following structures, equipment and activities:

- ❖ Acoustic sheds.
- ❖ Vegetation removal.
- ❖ Offices, storage and laydown areas.
- ❖ Workshops.
- ❖ Water treatment plant.
- ❖ Site hoarding.
- ❖ Cranes.
- ❖ Road transportation.
- ❖ Site lighting to enable 24 hour construction works.

A summary of the impacts from EIS 1 is provided in **Table 6.15**.

Table 6.15 Summary of EIS 1 visual impacts at Epping Services Facility and Epping Decline

Element / receiver	Epping Services Facility impact	Epping Decline impact
Views from major routes	Minor adverse	Minor adverse
Views from public open space and community facilities	NA	NA
Views from residential areas	Negligible	Negligible – minor adverse
Views from commercial areas	Minor adverse	Negligible
Views at night	Negligible	Negligible

Summary of revised impacts

As discussed in Section 6.2 the proposed change removes the Epping Decline site. As such, there would be no visual impacts associated with this site from the NWRL project.

A revised visual impact assessment has been undertaken for the Expanded Epping Services Facility and is presented below.

Visible components of the proposal

The following structures, equipment and construction activities are likely to be visible at the Expanded Epping Services Facility:

- ❖ Acoustic shed (maximum height of 15m from existing ground level), located in the northern corner of the site (between Beecroft Road and the tributary of Devlins Creek).
- ❖ Acoustic shed (maximum height of 15m from existing ground level), located in the southern corner of the site (between Beecroft Road and Ray Road).
- ❖ Vegetation removal adjacent to the tributary of Devlins Creek, Beecroft Road and Ray Road.
- ❖ Offices and facilities on a gantry over the haul road within the site (maximum height of 8m including 5m clearance underneath for trucks).
- ❖ Workshop (approximate height of 6m with canopy structure).
- ❖ Stores and laydown (approximate height of 3m).
- ❖ Water treatment plant (approximate height of 5 m and a footprint approximately 95m²), located on the western boundary, directly adjacent to the existing apartment block at 6 Ray Road.
- ❖ Hoarding approximately 3m high and enclosing the site.
- ❖ Mobile, crawler, gantry and tower cranes (up to 15-20m high).
- ❖ Road transportation via Beecroft, Carlingford Road and Ray Roads, with a possibility of 24 hour seven days a week vehicle movement.

The site would be sufficiently lit during evening hours to provide for worker safety and security of the site. This would include lighting from parking areas to offices, facilities, workshops, acoustic sheds, laydown areas and haul roads. The site would be lit to allow for 24 hour construction activity and would incorporate directional lighting, 'cut off' fittings to minimise light spill, glare and skyglow where possible.

The construction duration for this site is expected to be approximately four years. All of these elements are temporary and would be removed at the end of the construction process.

Views from major routes

There would be a noticeable change in the character of Beecroft Road where it runs along the eastern boundary of the site. Views would include the removal of existing buildings and vegetation on the site, the erection of two acoustic sheds, one a large rectangular shaped acoustic shed and the second an 'L-Shaped' acoustic shed running along the site boundary, site offices elevated on a gantry, two site access points along Beecroft Road and construction traffic movements into and out of the site. The commercial buildings adjacent to the worksite would be removed in their entirety, with the service station at the corner with Carlingford Road the remaining built development fronting Beecroft Road in this vicinity. This removal of commercial development would result in a much longer visible length of the worksite (in excess of 200 m) along Beecroft Road.

When approached from the south, the worksite would be visually prominent and comprise a large portion of the mid and foreground of views. When approached from the north, the retained bushland patch would partially screen the shed and site from views. Some additional traffic associated with the construction of the project would be visible along the road itself including large articulated trucks and the site entry. Overall, from this road there would be a **moderate adverse** visual impact due to a considerable reduction in visual amenity from a location of local sensitivity.

Train passengers using the Main North rail line would view the shed as a large structure sitting alongside commercial development on Beecroft Road. Rail passengers would view the worksite in the mid ground of the view, and be moving past the structure, reducing the duration of the impact. From the railway it is considered that there would be a minor adverse visual impact as there would be a noticeable change in the amenity of views on this journey, from a location of local visual sensitivity.

Views from public open space and community facilities

Due to local landform, and the type of land uses in the area, there are not expected to be any visual effects on views from local open space.

The Epping Baptist Church is located at the corner of Carlingford and Ray Roads. The Expanded Epping Services Facility would be in the foreground and middle ground of the view. Views would include the removal of commercial buildings and mature vegetation along Ray Road and the introduction of site boundary hoarding, the 'L-Shaped' acoustic shed stretching some 60m and sitting parallel with Ray Road, and with a site entry point on Ray Road in the distance of the view. Additional construction traffic would be visible using Ray Road and Carlingford Road from this location. From the Epping Baptist Church it is considered that there would be a **moderate adverse** visual impact as there would be a considerable change in the amenity of views of local visual sensitivity.

Views from residential areas

Residential properties on Edensor Street and Ray Road, located to the west of the construction site, include a mix of single dwelling and multi-unit residential properties. The landform rises from the tributary of Devlins Creek and bushland adjacent to the site, toward the corner of Kandy Avenue and Ray Road to the north east of the site.

The properties along Edensor Street and part way up Canberra Street are likely to experience views to the acoustic sheds and associated offices above intervening built form and vegetation which screen the lower portions of these structures. There is likely to be a **negligible** visual impact due to the noticeable change to the amenity of views of neighbourhood sensitivity.

The properties along Ray Road are located directly adjacent to the site and would experience views into and across the site. Currently views include the commercial development occupying most of this site, however, the existing commercial sits within a framework of mature trees which somewhat reduces its visual exposure. Views from these properties would see the removal of existing commercial development and mature vegetation, and the introduction of two large acoustic sheds, associated offices, workshops, parking and laydown areas, water treatment plant and haul roads. These elements would be visible with minimal screening and filtering due to their proximity to the site boundary and removal of vegetation as part of site clearance works. Overall, there is likely to be a **minor adverse** visual impact, due to the considerable visual change to the amenity of views of neighbourhood sensitivity. Before and after views of the site from Ray Road, indicative of residential property views, are shown in **Figure 6.7** and **Figure 6.8**. It is important to note that some residential properties located directly adjacent to the site and within close proximity to the site are likely to have greater exposure to this change in visual amenity.

Figure 6.7 View north along Ray Road, at the intersection with Edensor Street, before.



Figure 6.8 View north along Ray Road, at the intersection with Edensor Street, artist's impression



Residential apartments located on Carlingford Road spanning the corner with Beecroft Road and Rawson Street rise seven storeys from this elevated site. The site would be visible in the middle ground of panoramic views from residences in this building from a range of elevated perspectives. In these views the removal of existing commercial development and the mature framework of vegetation would be seen. Views would include the acoustic shed to the southern edge of the site, which is likely to block views to the centre of the worksite. These views are likely to include parts of the second acoustic shed, some haulage routes and parking, and site perimeter hoarding beyond the southern acoustic shed. From this location it is considered that there would be a **minor adverse** visual impact due to the considerable change to views of neighbourhood visual sensitivity.

Residential areas in the vicinity of Cambridge Street, approximately 100m to the east of the railway line, are located on land rising from the existing railway line eastward toward Oxford Street. Views from these properties are likely to include portions of the acoustic shed across the railway corridor, filtered and screened somewhat by adjacent vegetation located along the railway corridor. From these locations it is considered that there would be a **negligible** visual impact due to the noticeable change to views of neighbourhood visual sensitivity.

Views from commercial areas

The commercial properties on Beecroft Road would have been removed as a part of this proposal. However, the service station at the intersection with Carlingford Road would remain.

The Epping town centre is located on a local ridge. From commercial premises in the vicinity of Carlingford Road, viewing toward Beecroft and Ray Roads, hoardings bordering the site, acoustic sheds and gantry with site offices are visible in the foreground and middle ground. The site works would be visually prominent as the scale and character of these structures would contrast with the surrounding grain of the residential and commercial built form. The introduction of the worksite would create a more built form dominated character to the view and reduce the visibility of bushland on Beecroft Road in views from this location. The visual impact of this change is expected to be **moderate adverse** as there would be a considerable change in the amenity of views from a location of local visual sensitivity.

Before and after views of the site from the corner of Beecroft and Carlingford Roads at Epping are shown in **Figure 6.9** and **Figure 6.10**.

Figure 6.9 View north along Beecroft Road, at the intersection with Carlingford Road, before.



Figure 6.10 View north along Beecroft Road, at the intersection with Carlingford Road, artist's impression



This artist's impression shows removal of site vegetation; site boundary hoarding; and acoustic shed visible in the background of this view.

Views at night

The visual setting of this area is considered to be **High district brightness area**, and generally includes lighting associated with Beecroft Road and commercial development on Beecroft Road, local roads, the railway line, and from the illuminated windows of adjacent residential areas. This setting includes considerable sky glow caused by this densely urbanised area. The lighting associated with the project would be located primarily along Beecroft Road and within the site, screened to the south by vegetation. Lighting on the site would be directed and use cut-off fittings therefore limiting any perceptible contribution to localised sky glow effects, as well as limiting any light trespass onto neighbouring properties. Although it is expected that the change in visual amenity at night would be noticeable, due to the existing setting of high district brightness, there would be an overall **negligible** visual impact to views at night.

Conclusion

Generally, the expansion of the Epping Services Facility would result in increased visual impacts from this site during the major civil construction phase of the project. However, it is noted that the all visual impacts associated with the Epping Decline described in EIS 1 have been removed.

6.2.7 Cumulative Impacts

A summary of the potential cumulative impacts from EIS 1, the revised impacts and the potential change in impacts is provided in **Table 6.16**.

Table 6.16 Change in cumulative impacts at the Expanded Epping Service Facility

EIS 1 impact	Revised impact	Change in impact
Noise and vibration impacts to receptors along Beecroft Road as a result of construction activities and related traffic.	Noise and vibration impacts to receptors along Beecroft Road as a result of construction related traffic.	Reduction in impact for construction activities. No change for construction related traffic.
Disruption to traffic along Beecroft Road as a result of construction related traffic.	Disruption to traffic along Beecroft Road as a result of construction related traffic.	Reduction in impact due to elimination of Epping Decline site, however potential cumulative impacts remain as both projects would use Beecroft Road.
Indirect heritage impacts to the stone causeway over Devlins Creek from the Epping Decline construction site (NWRL) and the viaduct North Sydney Freight Corridor (NSFC).	The NWRL has no potential for impacts to this heritage item.	Eliminated impact due to deletion of Epping Decline site.

EIS 1 impact	Revised impact	Change in impact
Impacts to bushland on the road reserve on Beecroft Road between Carlingford Road and Kandy Avenue.	Impacts to bushland on the road reserve on Beecroft Road between Carlingford Road and Kandy Avenue.	Reduction in impacts as the construction sites for the two projects are no longer immediately adjacent to each other.
Visual impacts along Beecroft Road as a result of Epping Service Facility and Epping Decline construction sites (NWRL) along with construction of a viaduct (NSFC).	Visual impacts along Beecroft Road as a result of Epping Service Facility construction site (NWRL) along with construction of a viaduct (NSFC).	Reduction in impacts as the construction sites for the two projects are no longer immediately adjacent to each other.
Water quality impacts on Devlins Creek. Devlins Creek runs along the western boundary of the Epping Services Facility and to the north of the Epping Decline construction sites (NWRL), as well as adjacent to the NSFC construction site.	Water quality impacts on Devlins Creek. Devlins Creek runs along the western boundary of the Epping Services Facility construction site (NWRL), as well as adjacent to the NSFC construction site.	Reduction in impacts due to the removal of the Epping Decline site.

The following sections provide a detailed assessment of the EIS 1 impacts and the revised impacts.

Summary of EIS 1 impacts

The potential for cumulative impacts along Beecroft between Epping Station and the M2 Motorway were identified with the Northern Sydney Freight Corridor (NSFC) project. Specifically, the potential cumulative impacts identified in EIS 1 were:

- ❖ Noise and vibration impacts to receptors along Beecroft Road as a result of construction activities and related traffic.
- ❖ Disruption to traffic along Beecroft Road as a result of construction related traffic.
- ❖ Indirect heritage impacts to the stone causeway over Devlins Creek. The NWRL EIS 1 does not identify direct impacts, however it raises the potential for indirect impacts due to construction related erosion and sedimentation. The preliminary environmental assessment of NSFC notes that works to construct a new bridge over the M2 Motorway would be located in close proximity to the existing causeway, although it does not identify potential impacts.
- ❖ Impacts to bushland on the road reserve on Beecroft Road between Carlingford Road and Kandy Avenue. The NWRL major civil construction works would impact the middle and western portion of the bushland. NSFC works would take place immediately to the east with potential to impact the remaining eastern portion of bushland in this area.
- ❖ Visual impacts along Beecroft Road as a result of construction hoarding and acoustics sheds at Epping Service Facility and Epping Decline construction sites along with construction of viaduct over the sectioning hut to the north of Epping Station and over Devlins Creek (immediately south of M2 Motorway).

- ❖ Water quality impacts on Devlins Creek. Devlins Creek runs along the western boundary of the Epping Services Facility construction site and to the north of the Epping Decline construction site. The Creek runs beneath the Main North Line just south of the M2 Motorway and therefore could potentially be impacted by the NSFC works.

Summary of revised impacts

The removal of the Epping Decline site and the expansion of the Epping Services Facility site would result in a change to these potential cumulative impacts. As the Epping Decline site was located immediately adjacent to a proposed construction site for the NSFC Project, these changes generally result in beneficial outcomes. Due to the close proximity of the Expanded Epping Services Facility and the proposed NSFC project construction site, it should be noted that some potential cumulative impacts would remain, including:

- ❖ Noise and vibration impacts to receptors along Beecroft Road as a result of construction related traffic.
- ❖ Disruption to traffic along Beecroft Road as a result of construction related traffic.
- ❖ Impacts to bushland on the road reserve on Beecroft Road between Carlingford Road and Kandy Avenue.
- ❖ Visual impacts along Beecroft Road as a result of construction hoarding and acoustics sheds at the Expanded Epping Service Facility construction site along with construction of a viaduct over the sectioning hut to the north of Epping Station and over Devlins Creek (immediately south of M2 Motorway).
- ❖ Water quality impacts on Devlins Creek. Devlins Creek runs along the western boundary of the Epping Services Facility construction site. The Creek runs beneath the Main North Line just south of the M2 Motorway and therefore could potentially be impacted by the NSFC works.

Conclusion

The removal of the Epping Decline site would result in the removal of some of potential cumulative impacts with the NSFC project, however a number of potential cumulative impacts would remain. It should be noted that the expanded Epping Services Facility does not result in any new cumulative impacts.

6.2.8 Summary and justification

The proposed consolidation of the two Epping construction sites into an Expanded Epping Services Facility site would result in a number of benefits including:

- ❖ Removal of the interface and potential cumulative impacts with the NSFC Project at the former Epping Decline.
- ❖ Shortening of the decline tunnel from around 300m to around 20m, with subsequent reductions in spoil volumes and heavy vehicle movements.
- ❖ Consolidation of the duplicated construction facilities to one site (such as offices, amenities and water treatment plants).

Whilst there would be a change in impacts from those presented in EIS 1, these are anticipated to be minor with the implementation of the revised mitigation measures identified within this report. In particular, the potential change in noise impacts would be managed by:

- ❖ The implementation of a site management and / or physical mitigation solution to ensure noise levels from onsite heavy vehicle movements during the night-time period comply with the sleep disturbance Noise Management Level. This may include restricting night-time heavy vehicle access from Beecroft Road directly into the acoustic sheds and the establishment of a dedicated unloading bay directly adjacent to Beecroft Road for night-time deliveries.
- ❖ The provision of acoustic sheds to reduce the impact of night-works.

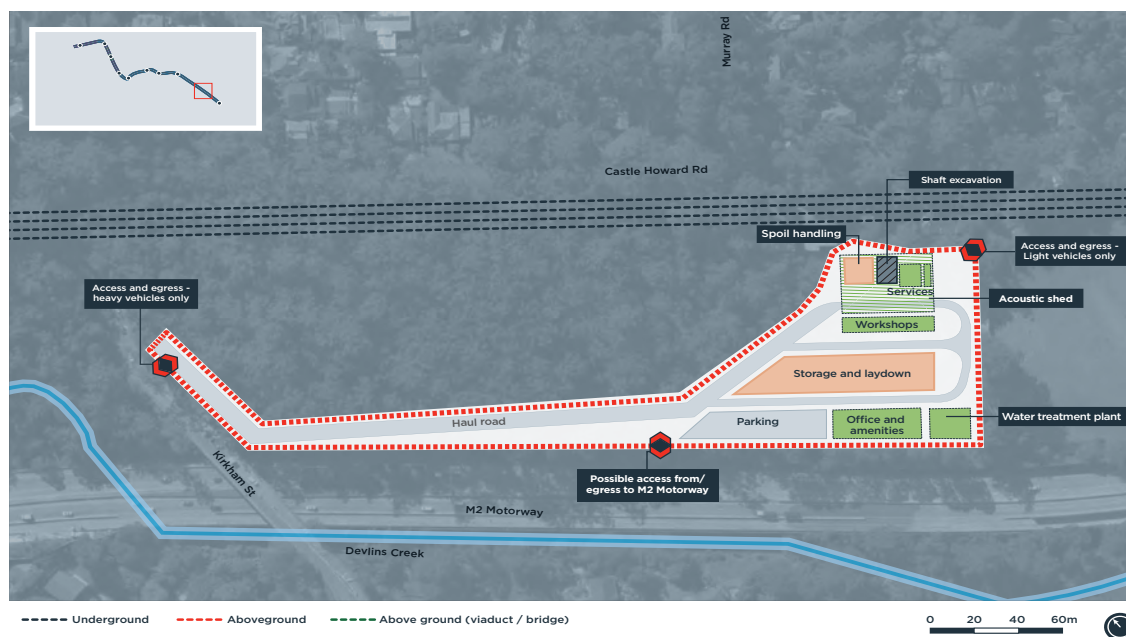
6.3 Cheltenham Services Facility light vehicle access and egress

6.3.1 Description of changes

EIS 1 proposed light vehicle access and egress to and from the Cheltenham Services Facility directly on and off Castle Howard Road at the location of the road reserve for Murray Road. The proposed change relocates this access and egress point to the existing access associated with Cheltenham Oval. This is shown on **Figure 6.11**.

This proposed change reduces the total area of the Cheltenham Services Facility construction site by 2,250m² to 9,750 m² and, therefore reduces the amount of vegetation clearing required to be undertaken. There would be no changes to the construction program described in EIS 1.

Figure 6.11 Cheltenham Services Facility light vehicle access and egress



6.3.2 Environmental overview of changes

In order to assess the changes to the light vehicle access and egress to and from the Cheltenham Services Facility as exhibited in EIS 1, an environmental overview of the potential changes was conducted (**Table 6.17**). This assessment considers potential environmental aspects that may require further impact assessment in order to understand likely environmental impacts, and identify any relevant mitigation measures that may be required.

Table 6.17 Cheltenham Services Facility light vehicle access environmental overview of changes

Aspect	Potential significant change in impacts?	Description
Statutory Planning	×	
Soils and Groundwater	×	There is no consequential change in the impacts presented in Chapter 8 of EIS 1 as there would be no change in overall project tunnelling length. A revised assessment is not considered necessary.
Construction Traffic and Transport	×	Whilst the proposed location of the light vehicle access and egress to the site has been relocated, light vehicles would continue to utilise Castle Howard Road. Additionally, there is no change to the anticipated light vehicle movements per day. As such, it is not anticipated that there would be changes in impacts associated with construction traffic and transport from those presented in the Chapter 9 of EIS 1. A revised assessment is not considered necessary.
Noise and Vibration – Construction	×	The proposed change would not result in changes to the proposed construction activities or construction site layout. As such there are not anticipated to be changes in the impacts presented in Chapter 10 of EIS 1. A revised assessment is not considered necessary.
European Heritage	×	There is potential for a change in the impacts presented in Chapter 11 of EIS 1. This change relates to the elimination of the need for the clearing of heritage-listed street trees on Castle Howard Road and a reduction in clearing within Beecroft Reserve. As this change is minor and would be beneficial, it was determined that further assessment is not required.
Indigenous Heritage	×	There is no consequential change in the impacts presented in Chapter 12 of EIS 1. NWRL PAD1 identified at Cheltenham Services Facility would still be partially impacted by the construction site. A revised assessment is not considered necessary.

Aspect	Potential significant change in impacts?	Description
Local Business Impacts	×	As the change relates to the relocation of the light vehicle access and egress to and from the site, there is no consequential change in the impacts presented in Chapter 13 of EIS 1. A revised assessment is not considered necessary.
Land Use and Community Facilities	×	The relocation of the light vehicle access and egress to and from the site would result in a reduction in vegetation clearing within an area zoned and actively used as public open space. However, the construction site in this location would still result in impacts to this open space. As such, there is no consequential change in the impacts presented in Chapter 14 of EIS 1. A revised assessment is not considered necessary.
Ecology	×	The relocation of the light vehicle access and egress to and from the site would result in a reduction in vegetation clearing of 0.225 ha of Coastal Shale-Sandstone Forest from the amount described in Chapter 15 of EIS 1. A revised table of impact to native vegetation outside of the North West Growth Centre is provided below. As this change is minor and would be beneficial, it was determined that further assessment is not required.
Visual Amenity	×	The relocation of the light vehicle access and egress to and from the site would result in a reduction in vegetation clearing along Castle Howard Road around the former light vehicle access and egress point. This may result in additional screening of the site for residences and road users to the north of the site from that presented in EIS 1. As this change is minor and would be beneficial, it was determined that further assessment is not required.
Climate Change and Greenhouse Gas Emissions	×	There is no consequential change in the impacts presented in Chapter 17 of EIS 1. The proposed change slightly relocates the light vehicle access and egress point and does not result in any changes to the construction site activities. A revised assessment is not considered necessary.
Surface Water and Hydrology	×	There is no consequential change in the impacts presented in Chapter 18 of EIS 1 as the general construction site activities are unchanged. A revised assessment is not considered necessary.

Aspect	Potential significant change in impacts?	Description
Other Issues (Waste Management and Air Quality)	✗	There is no consequential change in the impacts presented in Chapter 19 of EIS 1 as the general construction site activities are unchanged. A revised assessment is not considered necessary.
Cumulative Impacts	✗	There is no consequential change in the impacts presented in the Chapter 20 of EIS 1 as the general construction site activities are unchanged. A revised assessment is not considered necessary.

Table 15.7 of EIS 1 provided a summary of native vegetation impacted outside of the North West Growth Centre, including impacts on Coastal Shale-Sandstone Forest. As detailed above the proposed change to the light vehicle access and egress point to and from Cheltenham Services Facility Construction Site would result in a reduction in clearing of Coastal Shale-Sandstone Forest. The revised impacts to Coastal Shale-Sandstone Forest outside of the North West Growth Centre are shown in **Table 6.18**.

Table 6.18 Revised status, area and condition of Coastal Shale-Sandstone Forest impacted outside of the North West Growth Centre

Vegetation community	Condition	Cleared (ha)		Indirectly Impacted (ha)	
		EIS 1 impacts	Revised impacts	EIS 1 impacts	Revised impacts
Coastal Shale-Sandstone Forest	Status	Not listed		Not listed	
	Good	0.88	0.655	0.86	0.77
	Moderate	-	-	-	-
	Poor	0.45	0.45	0.30	0.30
	TOTAL	1.33	1.105	1.16	1.07

6.3.3 Summary and justification

The proposed relocation of the light vehicle access and egress point to and from the Cheltenham Services Facility would result in the following benefits:

- ❖ A reduction in direct impacts (ie clearing) to Coastal Shale-Sandstone Forest of 0.225 ha.
- ❖ A reduction in indirect impacts to Coastal Shale-Sandstone Forest of 0.09 ha.
- ❖ A reduction in impacts to the heritage listed street trees along Castle Howard Road.
- ❖ An increase in visual screening of the construction site from the retention of vegetation.
- ❖ A decrease in impacts to bush walking tracks through the bushland reserve.

There are not anticipated to be any additional adverse impacts associated with the proposed change.

6.4 Realignment of Norwest Station

6.4.1 Description of changes

EIS 1 proposed the Norwest Station box to be located directly underneath Norwest Boulevard. The proposed change realigns the station box to the south east to be adjacent to and outside of the footprint of Norwest Boulevard. The western extremity of the box would be located beneath Brookhollow Avenue near the point where it intersects with Norwest Boulevard. This is shown on **Figure 6.12**.

This proposed change reduces the interface of construction activities and Norwest Boulevard and, therefore reduces the potentially significant disruptions to Norwest Boulevard.

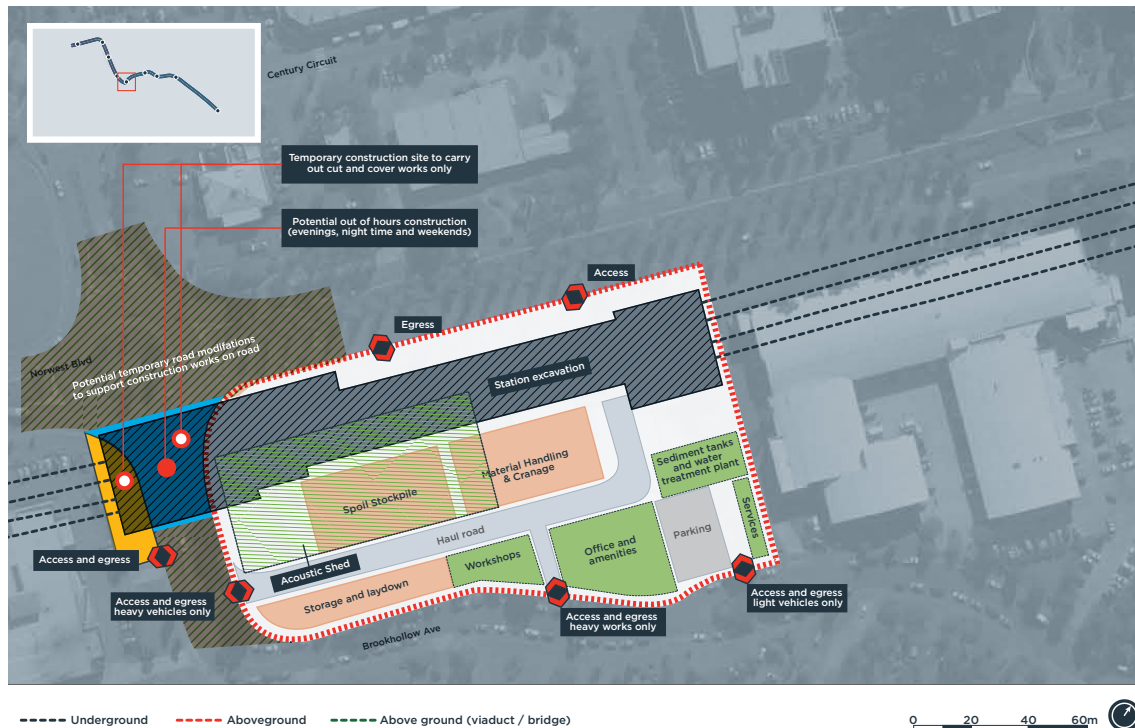
However, in order to complete the excavation of the entire station box, which is up to 210m long, an additional temporary area would be required during construction. This area is shown in **Figure 6.12** and comprises an area of landscaping within the boundary of 38 Brookhollow Avenue. Temporary occupation and diversion of Brookhollow Avenue would also be required at certain times to complete the cut and cover works across this road. Alternative access would be available via the other Brookhollow Avenue / Norwest Boulevard intersection located to the north. Brookhollow Avenue would be reinstated following construction.

The proposed change would also result in a revised construction program. Whilst the overall duration of works remains the same, the roof slab construction is simplified, and the construction duration reduced, by moving station box out of the Norwest Boulevard footprint. A revised construction program for Norwest Station is provided in **Table 6.19**.

Table 6.19 Norwest Station indicative program

Construction activities	Indicative construction timeframe											
	2013			2014			2015			2016		
Site establishment			•	•								
Shaft excavation				•	•	•	•	•	•			
Construction roof structure over Brookhollow Avenue						•	•					
TBM passing station								•	•			

Figure 6.12 Realigned Norwest Station construction site layout



6.4.2 Environmental overview of changes

In order to assess the changes to the Norwest Station box location as exhibited in EIS 1, an environmental overview of potential changes was conducted (**Table 6.20**). This assessment considers potential environmental aspects that may require further impact assessment in order to understand likely environmental impacts, and identify any relevant mitigation measures that may be required.

Table 6.20 Norwest Station realignment environmental overview of changes

Aspect	Potential significant change in impacts?	Description
Statutory Planning	✗	
Soils and Groundwater	✗	There is no consequential change in the impacts presented in Chapter 8 of EIS 1 as there would be no change in overall project tunnelling length. A revised assessment is not considered necessary.
Construction Traffic and Transport	✓	There is potential for changes in the impacts presented in Chapter 9 of EIS 1. These changes relate to: The realignment of the cut-and-cover excavation outside of Norwest Boulevard footprint. The proposed cut-and-cover station box excavation through Brookhollow Avenue. Accordingly a revised assessment is included in Section 6.4.3.
Noise and Vibration – Construction	✓	There is potential for changes in the impacts presented in Chapter 10 of EIS 1. These changes relate to: The change in the source of noise associated with the realignment of the station box excavation. Accordingly a revised assessment is included in Section 6.4.4.
European Heritage	✗	There is no consequential change in the impacts presented in Chapter 11 of EIS 1 as no European heritage items were identified in the vicinity of Norwest Station. A revised assessment is not considered necessary.
Indigenous Heritage	✗	There is no consequential change in the impacts presented in Chapter 12 of EIS 1 as no Indigenous heritage items were identified in the vicinity of Norwest Station. A revised assessment is not considered necessary.
Local Business Impacts	✗	The change relates to the slight relocation of the station box with the overall construction site remaining substantially the same. As such, there is no consequential change in the impacts presented in Chapter 13 of EIS 1. A revised assessment is not considered necessary.

Aspect	Potential significant change in impacts?	Description
Land Use and Community Facilities	✗	There is no consequential change in the impacts presented in Chapter 14 of EIS 1 as no there were no community facilities directly impacted by the Norwest Station construction site. A revised assessment is not considered necessary.
Ecology	✗	There is no consequential change in the impacts presented in Chapter 15 of EIS 1 as there is no native vegetation communities identified within the vicinity of Norwest Station. A revised assessment is not considered necessary.
Visual Amenity	✗	The change relates to the slight relocation of the station box with the overall construction site remaining substantially the same. As such, there is no consequential change in the impacts presented in Chapter 16 of EIS 1. A revised assessment is not considered necessary.
Climate Change and Greenhouse Gas Emissions	✗	There is no consequential change in the impacts presented in Chapter 17 of EIS 1. The proposed change slightly relocates the station box and does not result in any changes to the construction site activities. A revised assessment is not considered necessary.
Surface Water and Hydrology	✗	There is no consequential change in the impacts presented in Chapter 18 of EIS 1 as the general construction site activities are unchanged. A revised assessment is not considered necessary.
Other Issues (Waste Management and Air Quality)	✗	There is no consequential change in the impacts presented in Chapter 19 of EIS 1 as the general construction site activities are unchanged. A revised assessment is not considered necessary.
Cumulative Impacts	✗	There is no consequential change in the impacts presented in the Chapter 20 of EIS 1 as the general construction site activities are unchanged. A revised assessment is not considered necessary.

An assessment of changes for those environmental aspects determined to have a consequential change in impact is provided below.

6.4.3 Construction traffic and transport

A summary of the potential impacts associated with construction traffic and transport from EIS 1, the revised impacts and the potential change in impacts is provided in **Table 6.21**.

Table 6.21 Change in traffic and transport impacts at Norwest Station

Element	EIS 1 impact	Revised impact	Change in impact
Road diversions / closure	Norwest Boulevard required to be diverted a number of times to allow station box excavation. Potential short term closure to Norwest Boulevard.	Short term closure of Brookhollow Avenue for approximately 50m from the intersection with Norwest Boulevard and Century Circuit. Access to all properties on Brookhollow Avenue would be maintained via the Norwest Boulevard / Brookhollow Avenue (east) / Colombia Circuit intersection.	Reduction in impacts.
Level of service	No change at any intersections.	Potential minor deterioration from A to B at the Norwest Boulevard / Brookhollow Avenue (east) / Colombia Circuit intersection during some periods	Minor increase in impacts.
Buses	Relocation of one bus stop required.	No potential for impacts. The bus stop can be retained in its current location.	Reduction in impacts.
Pedestrians	Closure of footpath along Norwest Boulevard.	Closure of footpath along Brookhollow Avenue.	No change.
Cyclists	No potential impacts.	No potential impacts.	No change.
Parking, taxis and kiss-and-ride	Potential parking restriction on Brookhollow Avenue during construction.	Potential parking restriction on Brookhollow Avenue during construction.	No change.

The following sections provide a detailed assessment of the EIS 1 impacts and the revised impacts.

Summary of EIS 1 impacts

The potential construction traffic impacts identified in EIS 1 would arise primarily from the addition of heavy vehicles and light vehicles (cars and utes) onto surrounding roadways. These vehicle movements may increase traffic congestion and impact on intersection performance, as well as bus services, pedestrians and cyclists. Existing on and off street car parking may also be affected from construction works and / or construction worker vehicle parking.

EIS 1 provided anticipated access routes and vehicle numbers to the Norwest Station construction site. These are repeated in **Table 6.22**.

Table 6.22 EIS 1 access routes and daily vehicle movements

Construction site	Proposed access route	Heavy vehicle movements	Light vehicle movements
Norwest Station	Norwest Boulevard	90	36
	Brookhollow Avenue		

Road network operation and intersection performance

EIS 1 undertook an analysis of the existing and anticipated intersection performance during construction for the major intersections surrounding Norwest Station construction site (**Table 6.23**). This analysis showed there would be an increase in the Degree of Service (DOS) of 2% in the AM peak at the existing Norwest Boulevard / Windsor Road intersection with no change in the PM peak and no change to the AM / PM levels of service (LOS). For all other intersections, the existing performance would remain largely unaffected by the addition of construction traffic.

Table 6.23 EIS 1 intersection performance

Intersection	Existing		During construction					
	LOS (AM)	DOS (AM)	LOS (PM)	DOS (PM)	LOS (AM)	DOS (AM)	LOS (PM)	DOS (PM)
Norwest Boulevard / Windsor Road	C	0.90	D	0.92	C	0.92	D	0.92
Norwest Boulevard / Brookhollow Avenue (east) / Colombia Circuit	A	0.77	B	1.04	A	0.77	B	1.04
Norwest Boulevard / Brookhollow Avenue (west) / Century Circuit	A	0.60	A	0.57	A	0.61	A	0.57

EIS 1 envisaged that the existing lane numbers would be maintained on Norwest Boulevard during the construction phase, however this would require the construction of a temporary road pavement and various traffic switches in order to undertake the cut-and-cover station box excavation beneath Norwest Boulevard.

Buses

The Norwest Station worksite would have had an impact on the westbound bus stop in Norwest Boulevard east of Century Circuit. This stop is currently an indented bus bay which would have needed to be removed to accommodate temporary roadway for diversion of the westbound lanes around the station worksite. This bus bay may have needed to be closed for the duration of the traffic diversion.

The nearest stops to this location are at the intersection with Brookhollow Avenue (east) or between Brookhollow Avenue and Reston Grange to the west of the site. The eastbound bus bay and stop can be retained during the works. No other bus stops would be affected by the station works.

Pedestrians and cyclists

At various stages of construction it is likely that one of the footpaths on either side of Norwest Boulevard would have been closed, with the southern footpath being closed for the duration of the works. A pedestrian underpass under Norwest Boulevard is provided to the east of the site. Barricades would have needed to be erected as part of the site works to direct pedestrians to use this underpass to access the northern pathway. A pedestrian path along the northern side of Norwest Boulevard would be maintained for the duration of the works.

RMS is reviewing future operational needs for Norwest Boulevard. As part of the construction works traffic signals may have been required to safely operate the intersection and facilitate pedestrians crossing Norwest Boulevard to access the shopping centre from the western end of Brookhollow Avenue.

Parking, taxis and kiss-and-ride

Brookhollow Avenue carriageway is generally 11m wide and it may have been necessary to restrict kerbside parking along Brookhollow Avenue during the station site works. There would be no loss of on-street parking as a result of construction activities on Norwest Boulevard as parking is not permitted at the present time. The only off-street parking that would have been lost would be within the commercial land uses to be acquired on the southern side of Norwest Boulevard.

Taxi and kiss-and-ride users generally use Century Circuit adjacent to the retail precinct. Access to this area would remain unaffected during construction.

Summary of revised impacts

There would be no change to the daily vehicle movements which were detailed in EIS 1 and provided above. An additional short term access point would be required off Brookhollow Avenue to the site required on the western side of Brookhollow Avenue, resulting in three access and egress points to and from Brookhollow Avenue. Access and egress on and off Norwest Boulevard would be retained, however this would be utilised outside of peak periods only.

The site works would involve some top down excavation (prior to the fixing of a roof slab after which excavation can occur from beneath the roof slab), during which time the section of Brookhollow Avenue east of Norwest Boulevard would be closed to traffic. These closures would occur intermittently and only outside peak periods.

It is anticipated that the roundabout at the intersection of Brookhollow Avenue and Norwest Boulevard would be retained during construction. In this event there would be the need for physical alterations to the roundabout central island, westbound through lane approaches and eastbound through lane approaches. This is due to the excavation between the ground surface to the box slab which would encroach into the two westbound through lanes within the roundabout requiring intersection modifications.

Alternatively, it would be possible to remove the roundabout and signalise the intersection which would facilitate safe pedestrian access across Norwest Boulevard and improve sight distance and geometry along Norwest Boulevard. The final decision on arrangements for this intersection would be made in consultation with Roads and Maritime Services.

Road network operation and intersection performance

As the vehicle access routes and the vehicle numbers remains unchanged from EIS 1 there is not anticipated to changes to the predicted level of service or degree of service detailed in EIS 1.

During times when the Brookhollow Avenue leg of the Norwest Boulevard / Brookhollow Avenue (west) / Century Circuit intersection would be closed, access into Brookhollow Avenue would be maintained through the Norwest Boulevard / Brookhollow Avenue (east) / Colombia Circuit intersection. This intersection may experience a slight deterioration in level of service from A to B during peak periods.

It should be noted that the intersection of Norwest Boulevard / Century Circuit / Brookhollow Avenue would remain fully operational during these times for all other movements. There may be some minor localised queuing back into Brookhollow Avenue during after hours periods when the intersection at Norwest Boulevard / Century Circuit is restricted or closed to traffic. The extent of this queuing and delay would be minimal as traffic volumes along Brookhollow Avenue during these times would be low. It is understood that there are businesses in Brookhollow Avenue which operates 24 hours a day. When the Norwest Boulevard / Brookhollow Avenue intersection is closed opposite Century Circuit, access to and from Norwest Boulevard would still be possible via the Norwest Boulevard / Brookhollow Avenue / Columbia Circuit intersection.

Buses

During construction, access to and from the westbound bus stop in Norwest Boulevard east of Century Circuit would be maintained. This bus stop is currently an indented bus bay which would continue to accommodate arriving and departing buses 24 hours a day. The provision for buses to pull up safely at this location adjacent to the NWRL construction site would be investigated as part of the Construction Traffic Management and Control Plans for the site.

The eastbound bus bay and stop would be retained during the works.

Pedestrians and cyclists

Access to the indented westbound bus stop in Norwest Boulevard would be maintained during construction to and from the east, however, the southern footpath along the frontage to the construction site would be closed. The northern footpath along Norwest Boulevard would remain open at all times. An existing pedestrian underpass under Norwest Boulevard is provided to the east of the site. Barricades may need to be erected as part of the site works to direct pedestrians to use this underpass to access the northern footpath.

The western and southern footpath along the Brookhollow frontage of the construction site would be closed throughout the duration of construction. Pedestrian access would be possible via the footpath on the other side of Brookhollow Avenue with the exception of that section of the western footpath between the intersection with Norwest Boulevard and a point around 50m back along Brookhollow Avenue which would be closed for a period of time during station box excavation works.

Parking, taxi and kiss-and-ride

The Brookhollow Avenue carriageway is generally 11m wide and it may be necessary to restrict kerbside parking along Brookhollow Avenue during the station site works. This kerbside restriction is likely to extend along the Brookhollow Avenue frontage to the construction site. There would be no loss of on-street parking as a result of construction activities on Norwest Boulevard as parking is not permitted along Norwest Boulevard, which is an arterial road under the care and control of RMS. The only off-street parking that would be lost would be within the commercial land uses to be acquired between Norwest Boulevard and Brookhollow Avenue.

Taxi and kiss-and-ride users generally use Century Circuit adjacent to the retail precinct. Access to this area would remain unaffected during construction.

Conclusion

The proposed change to the station box location would result in a reduction in direct impacts (diversion and potential closure) to Norwest Boulevard associated with the elimination of excavation works directly beneath the roadway. There change would also result in the need to temporarily close a short section of Brookhollow Avenue.

6.4.4 Noise and vibration – construction

A summary of the potential impacts associated with construction noise and vibration from EIS 1, the revised impacts and the potential change in impacts is provided in **Table 6.24**.

Table 6.24 Change in noise and vibration impacts at Norwest Station

Element	EIS 1 impact	Revised impact	Change in impact	Comments
Airborne Noise – Daytime	Potential exceedances of noise management levels of > 20 dB.	Potential exceedances of noise management levels of > 20 dB.	Reduction in impacts in some locations. Increase in impacts in some locations.	The change would reduce potential impacts at receivers located to the north of the site. The change would increase impacts at receiver located to the south of the site.
Airborne Noise – Evening	Compliance with noise management levels.	Compliance with noise management levels.	No change.	
Airborne Noise – Night-time	Compliance with noise management levels.	Compliance with noise management levels.	No change.	
Onsite night-time trucks	Low risk of sleep disturbance.	Low risk of sleep disturbance.	No change.	

Element	EIS 1 impact	Revised impact	Change in impact	Comments
Traffic noise	Complies with 2 dB allowance. Exceedance of external sleep disturbance NML of up to 11 dB.	Complies with 2 dB allowance. Exceedance of external sleep disturbance NML of up to 11 dB.	No change.	
Ground-borne noise	Not anticipated to be appreciable at nearest receiver.	Not anticipated to be appreciable at nearest receiver.	No change.	
Ground-borne vibration	May be perceptible at nearest receiver.	May be perceptible at nearest receiver.	No change.	

The following sections provide a detailed assessment of the EIS 1 impacts and the revised impacts.

Summary of EIS 1 impacts

EIS 1 envisaged noise and vibration impacts from the Norwest Station construction site would include:

- ❖ Airborne construction noise from surface activities.
- ❖ Road traffic noise from heavy vehicle movements, including night-time spoil removal activities.
- ❖ Ground-borne construction noise from underground excavation.
- ❖ Ground-borne vibration from underground excavation.
- ❖ Airborne construction noise

The location of sensitive receivers and noise catchment areas surrounding the Norwest Station construction site is shown on **Figure 6.13**. A summary of the predicted noise level exceedances from EIS 1 is provided in **Table 6.25**.

Figure 6.13 Noise sensitive receivers and catchment areas - Norwest Station construction site (showing EIS 1 construction boundary)



Table 6.25 EIS 1 predicted noise level exceedances at Norwest Station construction site

Receiver Area		Noise Modelling Scenario				
		Earthworks and site establishment (daytime)	Excavation of the station box (daytime)	Roadheader operation and spoil removal with acoustic shed (night-time)	Station box construction (daytime)	Station box construction (evening)
A	Commercial adjoining south			N/A		N/A
B	Residences to the south					
C	Hillsong Church			N/A		
D	Commercial adjoining north			N/A		N/A
		 Compliance	 ≤ 10 dB exceedance	 10 dB to ≤ 20 dB exceedance	 > 20 dB exceedance or $L_{Aeq}(15\text{minute}) > 70\text{ dBA}$	

The predicted noise levels within EIS 1 for demolition and excavation at the Norwest Station site indicate high exceedances of the NMLs for the daytime period at the commercial receivers. These exceedances are 10 dB to 20 dB during earthworks / demolition and more than 20 dB during excavation. Minor exceedances of less than 10 dB were predicted at the residences and compliance was predicted at the Hillsong Church for these activities. During station box construction no exceedances of the NMLs were predicted.

For the potential night time excavation works with rock breakers, an acoustic shed of standard construction was included in the modelling to enable compliance with the NMLs.

Onsite night-time L_{Amax} truck noise

The L_{Amax} noise levels associated with individual truck movements were predicted in EIS 1 to be 58 dBA at the nearest residential receivers on Jacqui Circuit to the south of the site. Note that noise from vehicles would be unshielded at the site access, hence the predicted noise level does not consider any attenuation from the nominal 3 m high perimeter site hoarding.

There were expected to be up to four truck movements per hour. In relation to the predicted L_{Amax} noise levels from onsite truck movements:

- ❖ At residences in Jacqui Circuit the maximum noise levels were predicted to exceed the sleep disturbance screening criterion by up to 5 dB. This indicated that more detailed analysis was required.
- ❖ The maximum noise levels of 58 dBA (Jacqui Circuit) complied with the sleep disturbance NML of 65 dBA (external). Maximum noise levels were therefore unlikely to cause awakening reactions.
- ❖ The maximum noise level of 58 dBA (Jacqui Circuit) was at the mid range of the existing L_{Amax} noise levels (53 dBA to 68 dBA).

On the basis of the above, it was concluded that the risk of sleep disturbance was low.

Construction traffic noise

Traffic noise levels were predicted for residential receivers located on the proposed access routes to the Norwest Station construction site. In this instance, the access to the site would have been via Norwest Boulevard and Windsor Road which are sub-arterial roads with significant daytime flows.

Given night-time spoil removal is proposed, the night-time L_{Aeq} increase and sleep disturbance were assessed. The predicted noise level increase (L_{Aeq}) associated with construction traffic complied with the 2 dB allowance, therefore sensitive receivers were not likely to notice an increase in the average road traffic noise levels during construction.

There were expected to be up to four movements or events per hour during the night and, whilst there was an exceedance of the external sleep disturbance NML of 65 dBA (of up to 11 dB), the L_{Amax} levels would have been similar to those of other heavy vehicles already using Windsor Road and Norwest Boulevard.

Ground-borne construction noise

At the nearest commercial buildings, ground-borne noise levels were likely to be audible during daytime rock breaker activities, however airborne noise levels associated with the rock breaker works were likely to be much higher than the ground-borne noise levels and therefore more prominent. The airborne noise levels associated with rock breaker activities were included in the airborne noise modelling results.

The Hillsong HUB building, which contains a sound recording studio, is located approximately 170m from the proposed excavation works. Ground-borne noise emissions were not anticipated to be audible within the recording studio during the station excavation works.

Ground-borne vibration

During rock breaker activities, ground-borne vibration levels may have been perceptible at the nearest commercial receivers.

At the nearest commercial building, attended vibration measurements would have been required at the commencement of high vibration activities to ensure that vibration levels remain below the safe vibration levels associated with minor cosmetic building damage.

Summary of revised impacts

A revised noise and vibration assessment has been undertaken and is presented below.

Airborne Construction Noise

The location of sensitive receivers and noise catchment areas surrounding Norwest Station is unchanged from those presented in EIS 1 (refer to **Figure 6.13** above). The revised predicted noise level exceedances are provided in **Table 6.26**.

Table 6.26 Revised predicted noise level exceedances at Norwest Station construction site

Receiver Area	Noise Modelling Scenario				
	Earthworks and site establishment (daytime)	Excavation of the station box (daytime)	Roadheader operation and spoil removal with acoustic shed (night-time)	Station box construction (daytime)	Station box construction (evening)
A Commercial adjoining south			N/A		N/A
B Residences to the south					
C Hillsong Church			N/A		
D Commercial adjoining north			N/A		N/A
 Compliance  ≤ 10 dB exceedance  10 dB to ≤ 20 dB exceedance  > 20 dB exceedance or L _{Aeq} (15minute) > 70 dBA					

The airborne construction noise predictions at the revised Norwest Station indicate:

- ❖ The predicted noise levels for demolition and excavation at the Norwest Station site indicate high exceedances of the NMLs for the daytime period at the nearest commercial receivers. These exceedances are 10 dB to 20 dB during earthworks / demolition and more than 20 dB during excavation. At the residences a minor exceedance of up to 7 dB is predicted during earthworks / demolition and a moderate exceedance of up to 12 dB is predicted during

excavation. At the Hillsong Church, compliance is predicted during earthworks / demolition and excavation.

- ❖ For the night-time spoil handling and roadheader activities, an acoustic shed was included in the modelling to enable compliance with the NMLs. The acoustic shed is of standard construction in the noise model.
- ❖ During station box construction no exceedances of the NMLs were predicted.

Where receivers are “highly noise affected” (ie where the predicted noise level exceeds 75 dBA) or the NMLs are exceeded by more than 20 dB, having considered all feasible and reasonable noise mitigation, the proponent may need to implement respite periods and liaise with the community as outlined in Table 6.1 of the Noise and Vibration Technical Paper for EIS 1. The TfNSW Construction Noise and Vibration Strategy (CNVS) would be implemented to manage the potential noise impacts. At Norwest Station this is anticipated to occur during the daytime earthworks and excavation activities at commercial receivers to the south.

Onsite night-time L_{Amax} truck noise

The L_{Amax} noise levels associated with individual truck movements is predicted to be 58 dBA at the nearest residential receivers on Jacqui Circuit to the south of the site. This level is equal to the sleep disturbance screening level of background plus 15 dB, but is lower than the sleep disturbance NML of 65 dBA (external). Note that noise from vehicles would be unshielded at the site access, hence the predicted noise level does not consider any attenuation from the nominal 3m perimeter site hoarding.

On the basis of the above, it is concluded that the risk of sleep disturbance due to night-time on site truck movements is low for residences on Jacqui Circuit.

The impacts of onsite night-time truck noise are the same as those predicted for the previous configuration assessed in EIS 1.

Construction traffic noise

Traffic noise levels have been predicted for residential receivers located on the proposed access routes to the Norwest Station site. In this instance, the access to the site is via Norwest Boulevard and Windsor Road which are sub-arterial roads with significant daytime flows. Given night-time spoil removal is proposed, the night-time L_{Aeq} increase and sleep disturbance have been assessed in **Table 6.27**.

Table 6.27 Norwest Station construction traffic on public roads

Site access	Access road	Predicted road traffic noise increase (dB)	External L_{Amax} NML (dBA)	Predicted L_{Amax} noise level (dBA)
Norwest	Norwest Boulevard	0.3	65	76

Table 6.27 indicates the predicted noise level increase (L_{Aeq}) associated with construction traffic would comply with the 2 dB allowance, therefore sensitive receivers are not likely to notice an increase in the average road traffic noise levels during construction. There are expected to be up to 4 movements or events per hour during the night and whilst there is an exceedance of the external

sleep disturbance NML of 65 dBA (of up to 11 dB), the L_{Amax} levels would be similar to those of other heavy vehicles already using Windsor Road and Norwest Boulevard.

The impacts of construction traffic on public roads are the same as those predicted for the previous configuration assessed in EIS 1.

Ground-borne construction noise

At the nearest commercial buildings, ground-borne noise levels are likely to be audible during daytime rock breaker activities, however airborne noise levels associated with the rock breaker works are likely to be much higher than the ground-borne noise levels and therefore more prominent. The airborne noise levels associated with rock breaker activities are included in the airborne noise modelling results.

The Hillsong HUB building, which contains a sound recording studio, is located approximately 170m from the proposed excavation works. Ground-borne noise emissions are not anticipated to be audible within the recording studio during the station excavation works.

The potential ground-borne noise impacts associated with the excavation of the main tunnels is discussed in EIS 1.

Ground-borne vibration

During rock breaker activities at the Norwest Station, vibration levels may be perceptible at the nearest commercial receivers.

At the nearest commercial building to the south of the site, attended vibration measurements would be required at the commencement of high vibration activities to ensure that vibration levels remain below the safe vibration levels associated with minor cosmetic building damage.

Conclusion

A summary of the revised noise and vibration impacts compared to that of EIS 1 is provided below:

- ❖ Moving the location of the cut and cover station box approximately 15m to the south east and slightly westward along the alignment would result in a minor change in the construction impacts on the adjacent commercial and residential receivers. The distance to the Hillsong Church is essentially the same, but due to the revised construction layout, the potential impacts are marginally lower at this receiver during the station box excavation.
- ❖ Commercial receivers to the north east of the station box are predicted to experience a decrease in construction noise, whilst those to the south west and north east are predicted to experience an increase of up to 2 dB during site establishment and up to 7 dB during station box excavation.
- ❖ At the nearest residential receivers to the south east there would be no change during site establishment and concreting, and an increase of up to 4 dB during station box excavation.
- ❖ At the Hillsong Church there would be an increase of 1 dB during site establishment, and a decrease of up to 1 dB during excavation.

Summary and justification

The submissions received from RMS, The Hills Shire Council and ComfortDelgro Cabcharge noted the potential for significant disruption to traffic on Norwest Boulevard due to the location of the station box directly beneath the roadway and the proposed cut and cover construction methodology. In response to these concerns, the location of Norwest Station has been realigned to the south. This would allow major station excavation activities to be focused within the property boundaries of the two acquired commercial buildings to the north of Brookhollow Avenue. Whilst Norwest Boulevard would still be affected by construction traffic, potentially significant and lengthy road diversions would no longer be required.

The proposed realignment of the Norwest Station box excavation would result in a number of benefits including:

- ❖ Removal of the potentially significant disruptions to Norwest Boulevard (described above).
- ❖ The retention of the indented bus bay and bus stop on Norwest Boulevard.

Whilst there would be a change in impacts from those presented in EIS 1, these are anticipated to be minor with the implementation of the revised mitigation measures identified within this report. For example the potential noise impacts would be managed by the provision of acoustic sheds or other noise barriers to reduce the impact of night-works, and the temporary closure of a section of section of Brookhollow Avenue would be managed by the retention of alternative access points.



7





REVISED ENVIRONMENTAL MITIGATION MEASURES

The list of mitigation measures presented in EIS 1 have been revised on the basis of submissions received. In some cases new measures have been added, while in others, the wording of existing measures has been adjusted. Mitigation measures that related specifically to the Epping Decline Site (Construction Site 2) have been removed as that site is no longer proposed. Additionally, revisions have been made to the Construction Environmental Management Framework on the basis of submissions received. The revised Construction Environmental Management Framework is provided in Appendix C.

7.1 Soils and groundwater mitigation measures

No.	Mitigation measure	Applicable sites*
Ground movement		
SG1	The likely effects of any groundwater drawdown would be considered as part of detailed design, including the development of a detailed modelling of geotechnical conditions.	All
SG2	Settlement criteria would be established in consultation with relevant government agencies.	All

No.	Mitigation measure	Applicable sites*
SG3	A detailed geotechnical model for the alignment and its surroundings would be developed and progressively updated during design and construction. The detailed geotechnical model would include: ▪ Full details of structures, services, basements and other sub-surface elements that may be impacted by the development of NWRL. ▪ Assessment of the predicted settlement and horizontal strain profiles caused by construction. ▪ Assessment of the predicted settlements and strains on buildings and basements. ▪ Condition surveys of buildings and structures in the vicinity of the tunnel and station excavations. Detailed modelling of identified property and infrastructure at risk from damage	All
SG4	Where settlement predictions exceed the settlement criteria, feasible and reasonable management measures to minimise potential ground settlement would be implemented.	All
SG5	Monitoring of ground settlement would include installation and monitoring of instrumentation that could include inclinometers, extensometers and surface settlement points at construction sites and along the alignment during construction and for a period of not less than six months after settlement has stabilised with particular reference to risk areas.	All
SG6	Where monitoring during construction indicates exceedance of settlement criteria (or variations to these criteria as agreed through agency consultation), all work affecting settlement would cease immediately and would not resume until fully rectified or a revised method of work has been established to ensure protection of affected structures.	All
SG7	Settlement would be accurately measured during construction with building audits and monitoring of ground movement undertaken, with any additional ground support required identified and implemented.	All
Soil salinity		
SG8	Appropriate soil salinity mitigation measures would be adopted in accordance with Western Sydney Regional Organisation of Council's Draft Salinity Code of Practice and the former Department of Infrastructure, Planning and Natural Resources' <i>Guidelines to Accompany Map of Salinity Potential in Western Sydney</i> (2002).	All

No.	Mitigation measure	Applicable sites*
SG9	Where appropriate, a soil salinity assessment would be undertaken in accordance with the DLWC <i>Site Investigations for Urban Salinity</i> (2002), including Phase 2 and Phase 3 investigation. This assessment would enable site specific mitigation measures to be developed to ensure saline soils are appropriately managed and damage to the environment and infrastructure is minimised. These investigations would be informed by the completed groundwater monitoring program.	All
Contamination		
SG10	The results from pending investigations on the presence of dense non aqueous phase liquids (DNAPLs) or contaminated groundwater plumes would be assessed and mitigation measures refined as appropriate.	All
SG11	Any contaminated areas to be directly affected by the project would be investigated and remediated prior to the commencement of construction works. All remediation works would be undertaken in accordance with the requirements of the <i>Contaminated Land Management Act 1997</i> and <i>Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites</i> (EPA, 1997b).	All
SG12	Prior to the commencement of site preparation or construction in potentially contaminated areas, a summary of soil contamination would be prepared detailing the outcomes of the Stage 2 contamination site investigations. The summary would detail, where relevant, whether or not the soil is suitable for the intended land use or can be made suitable for reuse through the application of a Remediation Action Plan (or similar).	All
SG13	An accredited Site Auditor would endorse the documentation of site contamination and any Remediation Action Plan or similar.	All
SG14	In the event of discovery of previously unidentified area(s) of potentially contaminated material, all work would cease in the vicinity of the discovery and not recommence until the extent of contamination has been assessed and if necessary, a Remediation Action Plan or similar has been prepared and endorsed by an accredited Site Auditor.	All
SG15	A Site Auditor would be required to certify that any contaminated areas have been remediated to a standard consistent with the intended land use prior to operation of the remediated site(s).	All
SG16	Bunds around fuel depots and stockpile areas would be installed to minimise the risks of contaminants reaching the water table.	All

No.	Mitigation measure	Applicable sites*
Groundwater management		
SG17	A routine groundwater monitoring plan would be established and continue throughout the construction period. Parameters to be monitored would include groundwater levels and groundwater quality with field parameters, laboratory parameters and sample frequency to be developed prior to construction.	All
SG18	A groundwater monitoring network to monitor groundwater levels and groundwater quality would be established throughout the construction phase. The groundwater monitoring network would contain monitoring wells along the whole NWRL route intersecting groundwater in both Ashfield Shale and Hawkesbury Sandstone.	All
SG19	Water sampling and testing of groundwater would be undertaken during construction to determine the most suitable treatment processes to meet the required water quality standards.	All
SG20	Groundwater quality would be subject to testing. Where it does not meet license requirements it would be treated prior to discharge.	All
SG21	Bore performance tests would be conducted, at a minimum, on bores GW100981, GW106144, GW105750 and GW102982 to accurately gauge the magnitude of drawdown from tunnel construction with post-construction bore tests. Owners of these bores would be consulted once the groundwater investigations are completed regarding potential for the construction works to impact the water bores. Appropriate mitigation measures, if required, would be developed following consultation.	Tunnels
SG22	All feasible and reasonable measures would be implemented during construction, to limit operational groundwater inflows to stations and crossovers. Any inflows would be collected and treated prior to discharge.	1, 4 – 8
SG23	The use of chemicals in tunnel construction would be minimised.	Tunnels
SG24	A groundwater water supply from the Hawkesbury Sandstone for construction purposes would be used where feasible and reasonable. Negotiations with the NSW Office of Water (NOW) would be undertaken regarding impacts and applicable licenses.	All
SG25	If Acid Sulfate Soils are encountered, they would be managed in accordance with the <i>Acid Sulfate Soil Management Advisory Committee Manual</i> .	All
Groundwater treatment		
SG26	All feasible and reasonable opportunities for groundwater reuse for construction purposes or recycling nearby would be utilised in the first instance. However it is expected that groundwater inflows and required treatment volumes would outstrip potential for water reuse for construction purposes and some discharge would be required.	1 – 8 and tunnels

No.	Mitigation measure	Applicable sites*
SG27	Where water salinity is found to be too high for discharge to creeks, brackish water reverse osmosis would be undertaken, or another treatment method to achieve water quality requirements.	1 – 8 and tunnels
SG28	Dissolved iron would typically be removed from discharge water by oxidising the Ferric ion (Fe ³⁺) to Ferrous (Fe ²⁺) which enables precipitation and physical removal.	1 – 8 and tunnels
SG29	Water turbidity would typically be treated by settling / filters.	1 – 8 and tunnels
SG30	Iron reducing bacteria in discharge water would be treated by biocide dosing.	1 – 8 and tunnels
SG31	A typical discharge into a natural waterway (where approved) would require a groundwater treatment process that includes the following steps: ▪ Inlet buffer tank, with aeration ▪ Coagulation / flocculation ▪ Dissolved air floatation (solids removal) ▪ Multimedia filtration (25 micrograms) ▪ Cartridge filtration (2 micrograms) ▪ Brackish water reverse osmosis ▪ Disposal of water brine concentrate to sewer (dependant of future environmental policies) ▪ Discharge of adequately treated water (into aquifer of origin, stormwater (creek catchments), sewer under a trade waste agreement, onsite reuse or recycling or a combination of these options).	1 – 8 and tunnels
SG32	Groundwater discharge quality would be required to comply with the relevant Environment Protection Licence	1 – 8 and tunnels
SG33	Specific processes regarding groundwater discharge and treatment methods would be identified during detailed design.	1 – 8 and tunnels
Drawdown, defects and bed cracking		
SG34	Targeted pre-excavation grouting would be carried out where necessary to limit groundwater inflows.	Tunnels
SG35	Treatment would be undertaken as required to minimise inflows and drawdown impacts where tunnels and stations are permanently drained structures.	1 – 8 and tunnels

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7.2 Construction traffic and transport mitigation measures

No.	Mitigation measure	Applicable sites*
T1	Directional signage and line-marking would be used to direct and guide drivers and pedestrians past construction sites and on the surrounding network. This would be supplemented by permanent and portable Variable Message Signs, where reasonable and feasible, to advise drivers of any potential delays, traffic diversions, speed restrictions, or alternative routes.	1 – 17
T2	The public would be notified of proposed traffic changes by newspaper, radio, project web site and other forms of community liaison.	1 – 17
T3	Co-ordination would occur with Roads and Maritime Services (RMS) via the Transport Management Centre's Traffic Operations Manager in the event of incidents or undue congestion.	1 – 17
T4	Management of pedestrian and vehicular access to and past construction sites would occur to ensure safe entry and exit procedures. Depending on the location, this may require manual supervision, physical barriers, temporary traffic signals and modification to existing signals or, on occasions, police presence.	1 – 17
T5	Access to existing properties and buildings would be maintained.	1 – 17
T6	Traffic controllers would manage heavy vehicle movements at worksites, and monitor the need for pedestrian control.	1 – 17
T7	All trucks would enter and exit the worksites in a forward direction, where feasible and reasonable.	1 – 17
T8	The management of buses at key transport interchanges, such as Castle Hill and Rouse Hill, would be reviewed during the detailed construction planning to minimise impacts on existing services.	5 and 14
T9	The T-Way operations, including car parking, would be maintained at all times during the construction of the NWRL. This includes maintained existing sight lines to T-Way bus stops and within T-Way car parks, where possible. Where this is not possible, suitable alternative measures would be implemented (eg CCTV with active surveillance) where reasonable and feasible.	9 – 14
T10	The need for, and provision of, alternative remote parking locations and shuttle bus transfers for daytime and night time construction staff would be considered for all construction sites during detailed construction planning.	1 – 17
T11	Special event bus services for Sydney Olympic Park (Royal Easter Show, and Major Sporting and Entertainment Events) would be managed, in particular, in Carrington Road at the Hills Centre Station site, to ensure minimal disruption.	6
T12	The Traffic and Transport Liaison Group established for the NWRL would consider individual events and any other special event needs and, make reasonable and feasible short-term adjustment to the construction phase activities and / or review and update detailed Traffic Management Plans.	1 – 17

No.	Mitigation measure	Applicable sites*
T13	Site traffic would be managed, where reasonable and feasible, to avoid significant movements in the AM peak in the critical southbound direction and in the PM peak in the critical northbound direction on Beecroft Road at Epping.	1
T15	Access would be maintained to sections of the pedestrian bush track at Cheltenham which would not be affected by construction works. Additionally, the provision of an alternative track would be considered during construction planning.	3
T16	Access to the Bella Vista Station site during the daytime would be at a location off Celebration Drive to the east of the Lexington Avenue intersection to minimise traffic impacts at the Celebration Drive / Lexington Avenue intersection. The Celebration Drive / Lexington Avenue intersection would be used as an access during the night and at low traffic times.	8
T17	If construction of NWRL occurs before the Schofields Road upgrade, interim upgrading of the road would be undertaken (unless otherwise agreed with Roads and Maritime Services) with improved pavement quality and wider sealed shoulders to accommodate heavy vehicle usage.	15 – 17
T18	A dilapidation report would be prepared prior to construction for all affected local roads from the construction access / egress point to the arterial road.	1 – 17
T19	An alternative pedestrian route via Ray Road and Kandy Avenue would be appropriately signposted for pedestrian movements between Epping Town Centre and the Beecroft Road M2 Motorway overbridge.	1
T20	Truck movements on Ray Road would be restricted during the AM and PM peak periods. During these times, truck access and egress to and from the site would be via Beecroft Road only.	1
T21	Staff working at the Epping Services Facility would be discouraged from parking on local roads and encouraged to: ▪ Use public transport. ▪ Car share. Park in a designated off-site area and access the site via shuttle bus.	1
T22	Where schools occur in the immediate vicinity of the construction sites, heavy vehicle movements would be minimised (where reasonable and feasible), between 8:00-9:30 am and 2:30-4:00 pm Monday to Friday (on school days).	1-17
T23	Access and egress on and off Norwest Boulevard would be outside of peak periods only.	7

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7.3 Noise and vibration mitigation measures

No.	Mitigation measure	Applicable sites*
NV1	Noise and vibration mitigation measures described in the Construction Noise and Vibration Strategy would be implemented (refer Appendix E of Technical Paper 2).	All
NV2	An acoustic shed would be constructed to reduce impact of spoil removal during night-time periods.	1, 4 – 6 and 8
NV3	An acoustic shed would be constructed at Norwest to reduce impact of vertical excavation (if required to be conducted during night-time periods).	7
NV4	An acoustic shed would be constructed to reduce impact of concrete pre-cast works during night-time periods.	9 and 10
NV5	3m high noise barriers (site hoardings) would be constructed around the perimeter of construction sites.	1 – 3, 5 – 7 and 14
NV6	6m high barriers would be constructed at Cherrybrook to manage night-time spoil truck movements.	4
NV7	3m high noise barriers (site hoardings) would be constructed at Bella Vista Station site on the north and eastern side of the main construction site and to the west of the station box.	8
NV8	Attended vibration monitoring would be undertaken at the nearest commercial building during high vibration activities to ensure vibration levels remain below safe limits.	1 and 5 – 7
NV9	Attended vibration monitoring would be undertaken at the nearest residential buildings during high vibration activities to ensure vibration levels remain below safe limits.	1, 3 and 4
NV10	Noise measurements in the Gold Class cinema complex at Castle Hill during high vibration activities would be undertaken to determine ground-borne noise levels. Depending on the results of this monitoring, discussions would be held with the cinema managers to identify additional feasible and reasonable mitigation measures such as respite period and use of alternative equipment.	5
NV11	During construction, attended measurements would be undertaken at the commencement of rock breaking activities to confirm the magnitude of the ground-borne noise emissions in the Hills Centre for Performing Arts. Alternative construction methods such as smaller rock breakers, the use of rock saws or implementation of respite periods would be considered to minimise noise impacts, and implemented where reasonable and feasible.	6
NV12	Tunnel Boring Machine works would be co-ordinated to avoid performance times when near / under the Hills Centre for Performing Arts, if feasible and reasonable.	6

No.	Mitigation measure	Applicable sites*
NV13	Night-time truck access at Bella Vista Station site would be via the Celebration Drive roundabout to the south of the site.	8
NV14	No external night-time construction activities (ie forklift, front end loader, or similar activities) would be undertaken at the concrete pre-cast sites.	9 and 10
NV15	Noise from conveyors at the concrete pre-cast sites would be assessed during the Construction Noise and Vibration Impact Statements (which would be prepared for each major stage of works or activity) and additional measures implemented if feasible and reasonable (eg improved enclosures, low noise idlers).	9 and 10
NV16	Noise attenuation measures would be implemented where reasonable and feasible on tunnel ventilation equipment and other items of fixed plant (eg pumps, water treatment plant, diesel generators) that would be required to operate on a 24 hour per day, seven day per week basis in support of the underground works (eg ventilation fan enclosures and silencers, and additional enclosures and silencers for diesel generating equipment). At each site the combined L_{Aeq} noise from the operation of this equipment would aim to not exceed the rating background level at nearest residential receivers.	1 – 10
NV17	Further assessment would be undertaken of the potential ground-borne noise and vibration impacts associated with work train operations within the tunnels. This study would form part of the Construction Noise and Vibration Management Plan and include an assessment of feasible and reasonable mitigation measures.	4, 6 and 8
NV18	A site management and / or physical mitigation solution would be implemented at the Epping Services Facility to ensure noise levels from onsite heavy vehicle movements during the night-time period comply with the sleep disturbance Noise Management Level. This may include restricting night-time heavy vehicle access from Beecroft Road directly into the acoustic sheds and the establishment of a dedicated unloading bay directly adjacent to Beecroft Road for night-time deliveries.	1

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7.4 European heritage mitigation measures

No.	Mitigation Measure	Applicable Sites*
Heritage items		
EH1	Rehabilitate removed areas of bushland following completion of construction works.	1
EH2	Reinstate street trees and rehabilitate / reinstate bushland around the Cheltenham Services Facility following completion of construction works.	3
EH3	Where feasible and reasonable, retain or reinstate an adequate buffer of vegetation along the northern side of Castle Hill Road opposite the Glenhope property to preserve the character of its setting and to screen the visual impacts of the station construction site in the northern outlook from the Glenhope property.	4
EH4	Where feasible and reasonable, retain or reinstate a buffer of vegetation along the western side of Franklin Road opposite Inala School.	4
EH5	If feasible, the existing mature plantings along the Old Northern Road edge of the park would be retained and protected during construction.	5
EH6	Reinstate key elements of Arthur Whitling Park in consultation with The Hills Shire Council, the Hills District Historical Society and the Castle Hill sub-branch of the RSL, where feasible and reasonable.	5
EH7	Reinstate the landscaped public parkland (Arthur Whitling Park) following completion of construction.	5
EH8	Reinstate or rejuvenate any areas of the Showground disturbed for construction works following completion of the works.	6
EH9	Re-establish planted vegetation along the eastern side of the North-West T-Way following completion of the construction works.	11 and 13
EH10	The viaduct would be designed and constructed to be as visually light and stream-lined as possible. At Mungerie, the viaduct piers would be spaced widely and, where feasible and reasonable, symmetrically on either side of the carriage loop from Old Windsor Road.	13
EH11	A buffer of trees between Mungerie and the rail corridor would be maintained. Any trees removed to facilitate construction would be reinstated on completion of works.	13
EH12	The area of the Mungerie carriage drive that would be removed during construction works would be reinstated.	13
Archaeological sites		
EH13	Further assessment of the archaeological potential and significance of the potential resource (house sites on Franklin Road and Carrington Road at sites 4 and 6 respectively, and an archaeological site south of Samantha Riley Drive at site 11) would be undertaken prior to construction to define specific mitigation measures.	4, 6 and 11

No.	Mitigation Measure	Applicable Sites*
EH14	Exposed archaeological features at Cherrybrook (should there be any) would be identified, excavated and fully recorded prior to their removal. Based on the level of significance, preparation of an interpretation plan and strategy would be undertaken for archaeological features at Cherrybrook.	4
EH15	Any exposed archaeological features and deposits related to the Parramatta to Castle Hill tramway would be fully investigated and recorded prior to their removal. Any information retrieved regarding the Parramatta to Castle Hill tramway would be used to inform the interpretation of the site for communication of the site's history.	5
EH16	Archaeological monitoring of the areas (the house site on Carrington Road at site 6, the archaeological site south of Samantha Riley Drive at site 11, and the remains of track and post holes at site 16 and site 17) that are likely to contain archaeological remains would be undertaken with recording of any identified features and/or deposits associated with the identified buildings in accordance with archaeological best practice.	6, 11, 16 and 17
EH17	The two identified brick cisterns / wells at the Kellyville Station site would be recorded in detail and retained in situ if feasible and reasonable.	11
EH18	Further research would be undertaken to assess archaeological potential and significance of the former Swan Inn. Depending on the outcomes of the research archaeological excavation and recording of features and / or deposits would be undertaken if required. Excavation would be undertaken in accordance with archaeological best practice and would occur before or in conjunction with the construction works in this area. Based on the extent and level of significance of discovered features, the preparation of an interpretation plan and strategy could be required.	13
EH19	If archaeological deposits relating to the Rouse Hill Estate are encountered during construction, recording of the surviving features and deposits would be undertaken in accordance with archaeological best practice. Depending on the extent and level of significance of any discovered features, the preparation of an interpretation plan and strategy could be required.	16 and 17

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7.5 Indigenous heritage mitigation measures

No.	Mitigation measure	Applicable sites*
IH1	Basic Phase 1 ¹ archaeological excavation would be undertaken prior to construction in the areas of impact. Phase 2 ² archaeological excavation would be carried out prior to construction in any locations deemed appropriate by the Phase 1 ¹ excavations.	3, 4, 10, 11 and 13 – 15
IH2	Detailed Phase 1 ¹ archaeological excavation in the areas of impact. Possibly Phase 2 ² archaeological excavation in any locations deemed appropriate by the Phase 1 ¹ excavations.	6, 9, 10, 12, 16 and 17
IH3	The boundary of the construction sites would be fenced to prevent construction personnel entering a Potential Archaeological Deposit or known sites outside the construction footprint.	3, 4, 6 and 11 – 16
IH4	The Indigenous Heritage component of the site induction would include information on: ▪ Aboriginal heritage conservation areas and/or no-go zones for each construction site. ▪ The legislation and penalties for impacting Aboriginal heritage objects would be conveyed to all construction managers and personnel.	1 – 17
IH5	Transport for New South Wales would consider permanent public interpretation within at least one of the new railway stations following development if an extensive and high value archaeological deposit were to be uncovered during the excavation of a site.	3, 4, 6 and 9 – 17

1 A two-phase investigation should be undertaken for each of the 27 Aboriginal heritage sites/Potential Archaeological Deposits (PAD). Basic Phase 1 would undertake determination of the extent, content, condition and integrity of each site/PAD. For sites/PADs assessed to have a low to moderate level of potential, a basic grid of test units would be sampled to determine whether the site contains a deposit worthy of more detailed investigation. Detailed Phase 1 would involve a more detailed initial stage of investigation for Sites/PADs with a moderate or high level of archaeological potential.

2 Subject to an assessment of the results from Phase 1 (by the archaeologist and Aboriginal representatives), excavation may move into Phase 2—an open area excavation of any significant deposits present. The need for and/or extent of Phase 2 cannot be determined for any site/PAD until Phase 1 has been completed. Following Phases 1 and 2, an excavation report would be prepared for the sites (combining the results of all excavation together in one report). This report would be provided to the Representative Aboriginal Parties (RAPs) and Office of Environment and Heritage (OEH) for public record. Post-impact Aboriginal Heritage Information Management System (AHIMS) cards would be completed for all sites subject to archaeological excavation; and these must be submitted to the OEH AHIMS registrar.

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7.6 Local business mitigation measures

No.	Mitigation measure	Applicable sites*
LB1	A business consultation group would be formed to monitor, consider and provide business specific advice to manage the impacts during construction. Members of the consultation group may include representatives from local councils, and the NSW chamber of commerce and industry.	1 – 17
LB2	The project has employed specialist Place Managers to act as a single, identifiable and direct point of contact for local residents, business people and community groups with the project. Place Managers would work closely with all affected local business to help ensure timely responses to queries.	1 – 17
LB3	A business impact risk register would be developed to identify, rate and help manage the specific impacts associated with construction related works for individual businesses.	1 – 17
LB4	A toll free number and website would be maintained to enable business owners and/or operators to receive prompt responses to their concerns, access information and view assistance measures in place during construction related works.	1 – 17

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7.7 Land use and community facilities mitigation measures

No.	Mitigation measure	Applicable sites*
LC1	Liaison would continue with statutory organisations, Department of Planning & Infrastructure (DP&I) and local Councils to ensure the Project is integrated with local and regional land use planning, and that environmental planning instruments reflect the planning, construction and operation of the Project, and include integrated planning provisions to enhance potential future development.	All
LC2	Consultation would continue with the community throughout the project planning and construction phases to ensure that community members have adequate information about the project, the timing and scope of activities in their local area and impacts on their local facilities and recreational areas. Area specific Place Managers have been allocated to undertake this ongoing consultation.	All

No.	Mitigation measure	Applicable sites*
LC3	Further consultation regarding the implications of the Project in relation to the Epping Town Centre Study would be undertaken with Hornsby Shire Council, Parramatta City Council and DP&I.	1
LC4	Consultation with Cheltenham Oval user groups would be undertaken as part of identifying appropriate post-construction configuration and facilities for sporting activities.	3
LC5	Consultation with stakeholders of Beecroft Reserve would be undertaken as part of identifying appropriate adjustments to walking trails both during construction (temporary adjustments) and operational phases (permanent adjustments). Enhancements or modifications to the trail network would also be considered as part of this process.	3
LC6	Consultation with schools near the Cherrybrook site would be undertaken to develop specific mitigation measures to reduce impacts on their operation and amenity.	4
LC7	Consultation would be undertaken with the Castle Hill RSL sub branch and The Hills Shire Council regarding appropriate management of the war memorial in Arthur Whitling Park. This would include consideration of possible temporary relocation and an appropriate long term solution.	5
LC8	Activities occurring in Showground buildings and pavilions to be acquired as part of the construction footprint would be re-accommodated within the Showground precinct or as otherwise agreed with the Showground Trust.	6
LC9	Consultation with Hillsong Church would be undertaken prior to construction to identify specific mitigation measures to reduce operational and amenity impacts.	7
LC10	Consultation with Emmanuel Baptist Church and Anglican Technical College Western Sydney would be undertaken prior to construction to identify specific mitigation measures to reduce operational and amenity impacts.	8
LC11	Consultation regarding the implications of the Project in relation to the Balmoral Road Release Area would be undertaken with The Hills Shire Council.	9 – 11
LC12	Consultation would be undertaken with relevant stakeholders regarding the implications of the project on the Rouse Hill Town Centre Northern Frame works.	14
LC13	Consultation regarding the implications of the project on the proposed land use plan for Area 20 would be undertaken with DP&I, Blacktown City Council and relevant stakeholders.	15 – 17

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7.8 Ecology mitigation measures

No.	Mitigation measure	Applicable sites*
E1	The ecological component of the site induction would include information on: ▪ Sensitivity of surrounding vegetation (particularly threatened vegetation). ▪ Sensitivity of threatened fauna species (birds and bats). ▪ Site environmental procedures (vegetation management, sediment and erosion control, protective fencing, weed control). ▪ Emergency and incident response/ spill management (chemical spills, fire, injured fauna).	All
E2	Pre-clearing surveys would be undertaken to identify the presence of: ▪ Hollow bearing trees and other habitat features. ▪ Threatened flora and fauna	1 – 17
E3	Prior to clearing of vegetation within the Cheltenham Services Facility construction footprint, additional targeted searches for the threatened flora species <i>Epacris purpurascens</i> var. <i>purpurascens</i> would be undertaken. The result of this survey would be submitted to DP&I, as well as the scope of any impact to <i>Epacris purpurascens</i> var. <i>purpurascens</i> and if necessary details of additional mitigation measures.	3
E4	The limits of clearing (ie edge of construction site footprint) would be clearly marked and minimised where feasible and reasonable.	1 – 17
E5	Where native vegetation is to be retained adjacent to or within construction sites, protective fencing and signage would be installed in accordance with Australian Standard 4970 – 2009 <i>Protection of Trees</i>.	1 – 17
E6	Trees containing hollows would be felled using “Slow drop” technique (or similar as agreed with DP&I). The slow-drop technique involves nudging and shaking the tree, followed by a controlled lowering of the tree to the ground.	1 – 17
E7	Where feasible and reasonable, topsoil and habitat elements (eg logs and felled trees) from sites that have few weed species would be stored and reused onsite.	1 – 17
E8	Site offices, stockpiles, machinery wash down areas, and plant storage areas would be located outside of any ecologically sensitive areas being retained onsite.	1 – 17
E9	Fuel (or other chemical) storage would be located outside all riparian zones, and at least 10m from any retained ecologically sensitive areas onsite.	1 – 17
E10	Construction sites would be revegetated using endemic native plant species where appropriate.	1 – 17
E11	A revegetation program would occur at the Cheltenham Services Facility site in consultation with Hornsby Shire Council, with the aim of re-establishing Coastal Shale-Sandstone Forest in areas not required for sporting facilities or NWRL operational purposes.	3

No.	Mitigation measure	Applicable sites*
E12	To prevent establishment or spread of weeds: ▪ Machinery would be cleaned before entering work sites ▪ Weeds would be removed from within the mapped native vegetation areas at least 10m from the edge of the construction footprint (where access allows). ▪ Cleared weed material would be disposed of at a site licensed to receive green waste.	1 – 17
E13	If practical, seeds from <i>Epacris purpurascens</i> var. <i>purpurascens</i> would be collected and released within potential habitat in the vicinity of Cheltenham oval. This would be undertaken in consultation with Hornsby Shire Council and in accordance with any conditions of a “<i>licence to harm or pick threatened species</i>” as per Section 91 of the <i>Threatened Species Conservation Act 1995</i>.	3
E14	Regular visual inspections would be undertaken of creeks above bored tunnel sections, both prior to boring to establish baseline conditions and during and / or shortly after boring. Inspections would target permanent pools and be compared to non-impacted reference sites. In the event that substantial drops in the water level of permanent pools are detected, further investigations would be undertaken to determine the cause. If changes are determined to be caused by, or suspected to be caused by, tunnelling activities, mitigation measures would be discussed with NOW and implemented as appropriate.	Tunnels
E15	To reduce disturbance to bats and nocturnal birds where reasonable and feasible, a range of measures would be undertaken, such as: ▪ Artificial lighting would be directed to where it is needed and in a downwards orientation to avoid light spillage, Artificial light would be positioned to face away from areas of native vegetation. ▪ Low-pressure sodium lamps would be used instead of high-pressure sodium or mercury lights. Where mercury lights are used, UV filters would be fitted. ▪ The brightness of lights would be reduced to as low as legally possible, and in conformance with workplace health and safety standards. ▪ Amplified speakers would be directed downwards and away from areas of native vegetation	1 – 17
E16	Biodiversity offsets would be carried out consistent with the <i>Offset Strategy</i> and any conditions of approval.	1, 3, 4, 6, 8 – 13, 15 – 17
E17	Design of waterway crossings and structures would be undertaken in accordance with relevant guidelines such as <i>Fish and Fauna Friendly Waterway Crossings</i> (Fairfull & Witheridge, 2003) and <i>Fish Passage Requirements of Waterway Crossings</i> (2003). Relevant Government Agencies would be consulted with regard to crossings and waterway structures.	3, 4, 6 and 8 – 17.

No.	Mitigation measure	Applicable sites*
E18	Any creeks, core riparian zones and vegetated buffers disturbed by the project would be revegetated with the aim of maximising their ecological value.	1 – 4 and 6 – 17
E19	If feasible and reasonable, the proposed viaduct and bridge structural elements would be placed out of the creek(s) and away from the banks.	11 – 16
E20	The areas identified as ‘likely’ or ‘potential’ Groundwater Dependent Ecosystems (GDEs) would be considered in the development of the groundwater monitoring plan. Any groundwater monitoring undertaken within these areas would include monitoring of water quality and levels.	3, 6, 9 – 13 and tunnels
E21	The potential spread of pathogens such as Phytophthora and Myrtle Rust would be addressed with appropriate mitigation during detailed construction planning.	1 - 17

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7.9 Visual amenity mitigation measures

No.	Mitigation measure	Applicable sites*
V1	Existing vegetation around the perimeter of the construction sites would be retained where feasible and reasonable to act as a visual screen.	1 – 17
V2	Cut-off and directed lighting would be used to ensure glare and light trespass are minimised.	1 – 17
V3	Where feasible and reasonable the elements within construction sites would be located to minimise visual impact, eg setting particular equipment/ structures back from the site boundaries to minimise their visual impact.	1 – 17
V4	Regular maintenance of site hoarding and perimeter site areas would be undertaken, including the prompt removal of graffiti.	1 – 17
V5	Visual mitigation would be implemented as soon as feasible and reasonable, and remain for the duration of the construction period.	1 – 17
V6	Monitoring of the effectiveness of mitigation measures would be undertaken by the relevant construction contractor. This would primarily include regular visual inspection of the condition of the various measures.	1 – 17
V7	The colour and materials of acoustic sheds at selected sites would be selected to blend into adjacent bushland or rural setting.	1 – 4 and 8
V8	The design of acoustic sheds as visual features would be considered where there is limited opportunity to make them recede.	5 and 8

No.	Mitigation measure	Applicable sites*
V9	Designing hoarding as a feature would be considered at appropriate locations. This may include artworks or project information. These would be installed as early as feasible and reasonable in the construction process.	1, 4, 6 – 8 and 14
V10	Hoardings would be designed to visually recede in more rural or bushland settings.	3 – 5, 9 – 13 and 15 – 17

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7.10 Climate change and greenhouse gas mitigation measures

No.	Mitigation measure	Applicable sites*
Climate change		
CC1	The detailed design of the drainage system would take account of increased rainfall events through flood modelling with a climate change margin (ie design can't be based on past flood levels of 1 in 100 return interval events). For example design elevation levels for tunnels, stations and transport interchange areas would be based on future climatic conditions at least up to future climate projections for 2070.	All
CC2	The detailed design of the embankments would take into account a changing climate. For example, structures would be designed to reduce water build up behind and under embankments to prevent lubrication and loss of stability.	9 – 17
CC3	Geotechnical materials would be considered in detailed design to address extreme weather related impacts. For example, avoid the use of expansive clays which may develop cracks during drought events causing greater weakness to water access, lubrication and movement during extreme rainfall events.	9 – 17
CC4	Tunnel design would allow for an increasing shrinkage margin and develop drainage systems to respond to significant changes in ground water.	Tunnels
Greenhouse gas		
GHG1	Spoil management would be undertaken in accordance with the spoil reuse hierarchy.	All
GHG2	Where feasible and reasonable local materials would be preferentially used.	All
GHG3	If feasible and reasonable low GHG intensive alternative fuels (for example biofuels) would be used in construction equipment and vehicles.	All

No.	Mitigation measure	Applicable sites*
GHG4	Vehicles with low fuel consumption ratings would be preferentially used where feasible and reasonable.	All
GHG5	Construction equipment and vehicle operators would be trained in driving practices which reduce fuel consumption.	All
GHG6	Construction equipment and vehicles would be regularly maintained to maximise fuel efficiency.	All
GHG9	A minimum of 20% of electricity needs associated with construction works would be offset.	All
GHG10	If feasible and reasonable non-potable / recycled water would be used in tunnelling operations and at the pre-cast sites.	9, 10 and Tunnels
GHG 11	If feasible and reasonable materials with lower embodied emissions would be preferentially specified for use.	All
GHG 12	An updated GHG assessment would be prepared during the detailed design stage of the project.	All

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7.11 Surface water and hydrology mitigation measures

No.	Mitigation measure	Applicable sites*
Flooding		
SW1	The need or extent of any obstructions required to be placed within waterway areas would be avoided in the first instance, and minimised if avoidance is not feasible or reasonable.	1 – 4, 6 and 8 – 17
SW2	Programming or staging any construction associated with creek/channel works or the temporary transverse culverts would be undertaken to minimise the total time that works are undertaken in the vicinity of watercourses.	1 – 4, 6 and 8 – 17
SW3	Construction equipment (or excess material) would be removed from waterway or flood prone areas if wet weather is approaching and at the completion of each day's work activity. The extent of the flood prone area would be defined during detailed construction planning.	1 – 17
SW4	Temporary levees or bunds would be strategically placed to contain potential flooding impacts resulting from any temporary works on the floodplain and minimise the risk to surrounding properties which might otherwise be affected.	1 – 17

No.	Mitigation measure	Applicable sites*
SW5	Entries to tunnel excavations would be protected against flooding by locating openings outside flood prone areas, local bunding and / or appropriate drainage.	1 – 9 and tunnels
SW6	The flood standard adopted at each tunnel entry during construction would need to be developed taking into consideration the duration of construction, the magnitude of inflows and the potential risks to the project works and personal safety.	1 – 9 and tunnels
SW7	Earthworks located within the floodplain would be staged to ensure that the extent of works exposed at any one time is minimised.	8 – 11, 16 and 17
SW8	Construction works would be staged to ensure diversion channels are in place and stabilised to enable diversion of external catchment flows around the work site.	8 – 11, 16 and 17
SW9	For the Caddies Creek and Elizabeth Macarthur Creek floodplain, embankments would be limited to 0.5m maximum height for appropriate lengths of floodplain to allow controlled overtopping (subject to confirmation with detailed modelling of final construction layouts during the detailed design phase). Consideration may also be given to implementation of additional mitigation measures for the few properties identified as being at increased or greatest risk of affectation. This could include the design of viaduct piers and local flood mitigation works such as bunding, temporary levees, regarding overbank areas or flood proofing of properties.	9 – 12
SW10	Embankments would be limited to 0.5m maximum height (subject to confirmation with detailed modelling of final construction layouts during the detailed design phase) for the construction of bridge piers across the Second Ponds Creek floodplain (Site 16).	15
SW11	Temporary structures, embankments, haul road and working pads would be removed as soon as feasible after serving their purpose.	9 – 15
SW12	Stockpile sites would be generally located outside the 20 year ARI flood. The exact level of flood immunity provided to stockpile sites would depend on the duration of stockpiling operations, the type of material stored and the nature of the downstream waterway or any other specified requirements. This would be defined during detailed construction planning.	1 – 17
SW13	The concrete batch plant and pre-cast facilities at the Balmoral Road and Memorial Avenue sites would be located outside the 100 year flood extent.	9 and 10

No.	Mitigation measure	Applicable sites*
Water quality		
SW14	Water quality mitigation measures would be implemented in accordance with relevant requirements of: ▪ Landcom <i>Managing Urban Stormwater - Soils and Construction Volumes 1 and 2</i> (often referred to as the Blue Book, 2004 and 2006). ▪ NOW <i>Guidelines for Controlled Activities</i>. ▪ ANZECC <i>Guidelines for Fresh and Marine Water Quality</i>. ▪ ANZECC <i>Guidelines for Water Quality Monitoring and Reporting</i>. ▪ <i>Water Management Act 2000</i>. ▪ Applicable Environment Protection Licences.	All
SW15	Treatment measures would be applied to water collected in sediment basins, including settling of coarse sediments, the use of flocculation for finer sediments and pH correction.	9 – 17
SW16	As a first preference, treated surface water collected in sediment basins would be reused onsite, eg for dust suppression. Additional opportunities for re-using water on site or for construction would be investigated and implemented where feasible and reasonable.	9 – 17 and tunnels
Erosion and sediment control		
SW17	Exclusion zones would be designated on construction sites to limit disturbance.	1 – 17
SW18	Re-vegetating or stabilising disturbed areas would occur as soon as feasible.	1 – 17
SW19	Cleared native vegetation would be mulched for use in erosion and sediment control where feasible and reasonable.	1 – 17
SW20	Prior to commencement of earthworks / construction appropriate erosion control measures would be installed such as sediment fencing, check dams, temporary ground stabilisation, diversion berms or site regrading.	1 – 17
SW21	Clean water runoff would be diverted away from the works or disturbed areas wherever possible.	1 – 17
SW22	Temporary sediment basins would be installed as appropriate. The exact size and layout of sediment basins would be determined as part of the Construction Environmental Management Plan (CEMP) in accordance with the requirements of the relevant Environment Protection Licence.	1 – 17
SW23	Appropriate measures would be implemented where spoil handling occurs outside acoustic sheds. This would include diversion drains and sediment basins.	1 – 17
SW24	Works staging would be undertaken to maintain flows in undisturbed or stable remediated areas.	1 – 17

No.	Mitigation measure	Applicable sites*
SW25	Specific activity procedures would be implemented for vegetation clearing and access track creation, such as minimising amount of clearing, all weather access track creation, keeping to formed tracks where feasible and reasonable and fencing of retained vegetation.	1 – 17
SW26	Surface controls to promote ground stability, limit run-off lengths and reduce run-off velocities within the work sites would be implemented.	1 – 17
SW27	Ground stability would be re-established as soon as practicable following the completion of construction.	1 – 17
SW28	Installation of any permanent scour protection measures required for the operational phase would occur as soon as practical.	1 – 17
Riparian areas		
SW29	The detailed design of viaduct and bridges spanning the waterways of Elizabeth Macarthur Creek, Caddies Creek and Second Ponds Creek would provide for minimal encroachment of piers within the main creek channel to minimise disturbance and impacts to creeks during construction and operation.	8 – 16
SW30	Temporary haul roads required to construct the bridge and viaduct would be designed to minimise the extent of encroachment within creek channels.	8 – 16
SW31	Monitoring of weather forecasts would be undertaken with commencement of in channel works when dry weather is forecasted.	1 – 17
SW32	Where water is released into local creeks, outlet scour protection and energy dissipation would be implemented. The discharge point would be at the upstream end of a large pool where feasible and reasonable, to allow for slowing of water.	1 – 4, 6 and 8 – 17
SW33	Any work platforms or access tracks required through waterway areas would be constructed of large clean rock material wrapped or underlain with geofabric (or equivalent).	4, 6 and 9 – 17
SW34	Temporary waterway crossings would be provided in preference to creek diversions. These temporary waterway crossings within key fish habitat would be designed to allow for the continuance of fish passage.	1 – 4 and 6 – 17
SW35	Temporary waterway crossings and associated scour protection would be installed to control scour to the downstream waterway due to increases in localised water velocity while minimising disturbance within the riparian area.	4, 6 and 9 – 17
SW36	Permanent diversion of small channels in localised areas would be considered for situations where the permanent works (such as bridge piers) may be required to remain adjacent to or partially obstructing the waterway in order to better facilitate construction methods and reduce potential erosion/scour problems.	1 – 17

No.	Mitigation measure	Applicable sites*
SW37	Temporary stockpile locations for both site establishment and earthworks operations would be specified prior to the commencement of construction activities. Diversion drains and erosion and sediment control measures would be in place prior to the commencement of any stockpiling activities. Material would only be stockpiled in designated stockpiling areas.	1 – 17
Contamination and spills		
SW38	Site specific controls would be developed to reduce the potential for environmental releases of potentially harmful chemicals and to reduce the risk of any such releases entering local waterways. Storage of hazardous materials such as oils, chemicals and refuelling activities would occur in bunded areas.	All
SW39	Appropriate mitigation measures including stockpiling and management of potentially contaminated material would be undertaken at building demolition sites to prevent movement of material into receiving waters.	1 – 17
Monitoring and implementation		
SW40	A qualified environmental officer would be employed to advise on appropriate controls and to monitor the implementation and maintenance of mitigation measures.	All
SW41	All site staff would be engaged through toolbox talks or similar with appropriate training on soil and water management practices.	All
SW42	A surface water quality monitoring program for the construction period would be implemented to monitor water quality upstream and downstream of the construction areas. The monitoring programme would commence prior to commencement of any construction works and would build on available water quality data.	1 – 17
SW43	Surface water and water quality monitoring would be carried out periodically and after rainfall events. Monitoring would examine a range of appropriate indicators in accordance with standard guidelines.	1 – 17
SW44	Inspection of water quality mitigation controls (eg sediment fences, sediment basins) would be carried out regularly and following significant rainfall to detect any breach in performance.	All

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7.12 Air quality mitigation measures

No.	Mitigation measure	Applicable sites*
General		
A1	Working face and areas of open excavation would be kept to a minimum, where feasible and reasonable.	1 – 17
A2	Water suppression would be used for active earthwork areas, stockpiles, gravel roads and loads of soil being transported to reduce wind-blown dust emissions.	1 – 17
A3	Waste or any other material would not be burnt on construction sites.	1 – 17
A4	The amount of excavated material held on site would be minimised.	1 – 17
A5	Areas of exposed earth would be minimised by staging construction activities and progressively landscaping and vegetating completed areas as the construction activities proceed, where feasible and reasonable.	1 – 17
A6	Enclosed rubble chutes and conveyors would be used where feasible and reasonable. Drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment would be minimised and/or water used to suppress dust emissions from such equipment.	1 – 17
A7	Cutting, grinding or sawing equipment would only be used in conjunction with suitable dust suppression techniques such as water sprays or local extraction.	1 – 17
A8	Wind breaks, which may include site hoardings, would be constructed, where construction works are in close proximity to sensitive receptors and where feasible and reasonable.	1 – 17
A9	Dust generating activities would be assessed during periods of strong winds and rescheduled, where required.	1 – 17
A10	All vehicles carrying loose or potentially dusty material to and/or from the site would be covered.	1 – 17
Spoil stockpiles		
A11	Stockpiles would be located away from sensitive receivers, where feasible and reasonable, and protected from the elements through barriers, covering or establishing a cover crop.	1 – 17
Haul roads		
A12	Longer term and/or heavily used haul roads would generally be sealed. The criteria for sealing haul roads would be defined during detailed construction planning. Sealed haul roads would be regularly cleaned.	1 – 17
A13	Unsealed haul roads would be regularly damped down with fixed or mobile sprinkler systems.	1 – 17
A14	Vehicular and foot traffic would be restricted to designated areas.	1 – 17

No.	Mitigation measure	Applicable sites*
A15	Appropriate site speed limits would be imposed and signed on haul routes.	1 – 17
A16	Wheel-wash facilities or rumble grids would be provided and used near site exit points, and a street-cleaning regime would be implemented to remove any dirt tracked onto roads.	1 – 17
Demolition		
A17	Water suppression would be used during demolition as required.	1 – 17
A18	The insides of buildings would be stripped where feasible and reasonable, before demolition.	1 – 17
A19	Biological debris (such as bird nests and droppings) would be bagged and removed or damped down prior to building demolition.	1 – 17
A20	Debris screens or sheeting would be used to screen buildings, where dust-producing activities are taking place.	1 – 17
A21	An asbestos survey would be undertaken of buildings that would be demolished as part of the NWRL construction works. The survey would be conducted by a suitably qualified person.	1 – 17
A22	Asbestos handling and management would be in accordance with: ▪ <i>NSW Occupational Health & Safety Act 2000.</i> ▪ <i>NSW Occupational Health & Safety Regulation 2001.</i> ▪ <i>Code of Practice for the Safe Removal of Asbestos 2nd edition</i> (NOHSC, 2005). ▪ <i>Code of Practice for the Management and Control of Asbestos in Workplaces</i> (NOHSC, 2005). ▪ <i>NSW Protection of the Environment Operations (Waste) Regulation 2005: 'Section 42 Special Requirements Relating to Asbestos Waste'.</i> ▪ <i>AS2601:1991 Demolition of Structures.</i>	1 – 17
Vehicles and equipment		
A23	Engines of onsite vehicles and plant would be switched off, if left idling for extended periods of time.	1 – 17
A24	Low emission vehicles and plant fitted with catalysts, diesel particulate filters or similar devices would be used, where feasible and reasonable.	1 – 17
A25	Plant would be well maintained and serviced in accordance with manufacturers' recommendations.	1 – 17
A26	Haul routes and plant (including generators) would be sited away from sensitive receivers, such as dwellings and schools, where feasible and reasonable.	1 – 17
A27	Vehicle emissions would be minimised through methods such as using alternative modes of transport, such as encouraging car pooling by construction workers, and maximising vehicle utilisation by ensuring full loading and efficient routing.	1 – 17

No.	Mitigation measure	Applicable sites*
A28	Precautions would be implemented to prevent the occurrence of smoke emissions or fumes from site plant or stored fuel oils.	1 – 17
Tunnel ventilation		
A29	Dust extraction and filtration systems would be installed for tunnel excavation works and deep excavation with limited surface exposure.	1 – 8 and tunnels
A30	Bag filters would be dampened prior to emptying.	1 – 8 and tunnels
Concrete batch plant and pre-cast facilities		
A31	Truck unloading activities at concrete batching plants would be carried out in a way that minimises potential fugitive dust emissions, such as a silo or two sided enclosure.	9 and 10
A32	Water sprays would be utilised in concrete batch plants to reduce the emissions from the dumping of aggregate into the storage bins.	9 and 10
A33	Bulk cement and other bulk fine powder materials would be stored in silos with dust filters and suitable emission control systems to prevent escape of material and overfilling during delivery.	9 and 10
A34	Sand and aggregate stockpiles at concrete batch plants would be stored in hoppers, bunkers, storage bins or similar which shields the materials from winds.	9 and 10

* Site 1 - Epping Services Facility, Site 3 - Cheltenham Services Facility, Site 4 - Cherrybrook Station, Site 5 - Castle Hill Station, Site 6 - Hills Centre Station, Site 7 - Norwest Station, Site 8 - Bella Vista Station, Site 9 - Balmoral Road, Site 10 - Memorial Avenue, Site 11 - Kellyville Station, Site 12 - Samantha Riley Drive to Windsor Road, Site 13 - Old Windsor Road to White Hart Drive, Site 14 - Rouse Hill Station, Site 15 - Windsor Road Viaduct, Site 16 - Windsor Road Viaduct to Cudgegong Road, Site 17 - Cudgegong Road Station and Tallawong Stabling Facility, and Tunnels

7.13 Waste management mitigation measures

No.	Mitigation measure	Applicable sites*
W1	All waste would be assessed, classified, managed and disposed of in accordance with the <i>Waste Classification Guidelines</i> (DECC, 2008).	All
W2	All waste materials removed from the sites would only be directed to a waste management facility lawfully permitted to accept the materials.	All
W3	Excavated material and spoil would be beneficially reused on the project site or other sites, where feasible and reasonable, in accordance with the spoil reuse hierarchy.	All
W4	Appropriate storage, treatment and disposal procedures would be implemented for any contaminated spoil.	1 – 17

No.	Mitigation measure	Applicable sites*
W5	Cleared site vegetation would be mulched for reuse in rehabilitation and landscaping works. Topsoil generated during site preparation activities would be stockpiled for reuse in landscaping activities.	1 – 17
W6	Initial and ongoing education would be provided to staff and sub-contractors regarding the importance of appropriately managing waste.	1 – 17
W7	Recyclable wastes, including paper at site offices, would be stored separately from other wastes. Storage facilities would be secure and recyclables collected on a regular basis.	1 – 17
W8	Reusable materials would be stored separately, in secure facilities.	1 – 17
W9	Worksites would be free of litter and good housekeeping would be maintained.	1 – 17
W10	Vermin proof bins would be utilised onsite.	1 – 17
W11	Waste oil, other liquid wastes and spillages would be collected and stored in bunded areas.	1 – 17
W12	Trucks transporting wastes off site would be appropriately licensed to carry the materials to appropriately licensed waste facilities.	1 – 17
W13	Waste truck loads would be covered, and tailgates secured prior to trucks leaving the worksite.	1 – 17
W14	Centralised reporting and auditing of waste volumes and disposal destinations would be employed.	1 – 17
W15	Construction waste would be minimised by accurately calculating materials brought to the site and limiting materials packaging.	1 – 17
W16	Materials such as (noise hoarding, site fencing, and so on) would be reused or shared, between sites and between construction contractors where feasible and reasonable.	1 – 17

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NORTH WEST RAIL LINK