8 NOISE AND VIBRATION

A *Noise and Vibration Assessment* was prepared by Wilkinson Murray (2016) (refer to Appendix N of this EIS) to assess the noise and vibration impacts arising from the construction and operation of the Proposal.

Table 8-1 sets out the relevant Secretary's Environmental Assessment Requirements (SEARs) as they relate to the Proposal, and where these have been addressed.

Table 8-1: SEARs for the Proposal relating to Noise and Vibration

Section/Number	Requirement	Where addressed?
6. Noise and Vibration	The assessment shall: a) Assess construction noise and vibration impacts associated with construction of the intermodal facility including connection to the rail link, including impacts from construction traffic and ancillary facilities. The assessment shall identify sensitive receivers and assess construction noise/vibration generated by representative construction scenarios focusing on high noise generating works. Where work hours outside of standard construction hours are proposed, clear justification and detailed assessment of these work hours must be provided, including alternatives considered, mitigation measures proposed and details of construction practices, work methods, compound design, etc	Sections 8.2.4, 8.3 and 8.4 of this EIS
	b) Assess operational noise and vibration impacts and identify feasible and reasonable measures proposed to be implemented to minimise operational noise impacts of the intermodal facility and rail link, including the preparation of an Operational Noise Management and Monitoring Plan	Sections 8.3 and 8.4 of this EIS
	c) clearly demonstrate that at each stage a best practice facility (terminal, warehousing and rail link including locomotives and rolling stock) to minimise noise emissions at the terminal and rail link will be adopted	Section 8.2.3 and Appendix N of this EIS
	d) consider the need for an automatic rolling stock wheel defect detection and response system	Section 8.2.3 and Appendix N of this EIS
	e) include a framework for on and off-site noise monitoring during operation	Section 8.4. of this EIS
	f) be prepared in accordance with: NSW Industrial Noise Policy (EPA 2000), Interim Construction Noise Guideline (DECC 2009), Assessing Vibration: a technical guide (DEC 2006), the Rail Infrastructure Noise Guideline (EPA 2013), Development Near Rail Corridors and Busy Roads	Section 8.2 of this EIS

Section/Number	Requirement	Where addressed?
	Interim Guideline (DoP 2008), and the NSW Road Noise Policy 2011.	

This Section summarises the studies undertaken previously for the MPW Concept Approval and, more recently, for the Proposal. This Section provides an assessment of potential impacts resulting from construction of the Proposal on Noise and Vibration. Measures to mitigate impacts have also been identified where they are required.

8.1 MPW Concept Approval

A *Noise and Vibration Impact Assessment* was undertaken by SLR Consulting for the MPW Concept Approval. This assessment identified the following key characteristics relating to the noise conditions of the Proposal site, relevant for subsequent studies:

- The suburbs of Casula, Wattle Grove, North Glenfield and Moorebank are the closest communities to the MPW site and include sensitive receptors that have the potential to be impacted by noise generated by the MPW Project. In these communities, receivers and land uses that are potentially sensitive to noise and vibration include residences, educational institutions, places of worship, child care facilities, aged care facilities and places of recreation
- The MPW site is located at an approximate ground level height of 15 m above Australian height datum (AHD) and immediately to the east of the Georges River and floodplain. There is steep relief on either side of the floodplain, between the MPW site and the surrounding suburbs. The nearest receptors in Wattle Grove and Glenfield are predominantly at the same ground level height as the main IMT site for the Proposal, with the exception of some receptors that are up to five meters above the residual level of the main IMT site. At Casula, the nearest receptors are approximately 10 m to 30 m above the residual ground level of the main IMT site. The location of potentially affected receivers, noise monitoring locations and measured background noise levels are shown in Figure 8-1.

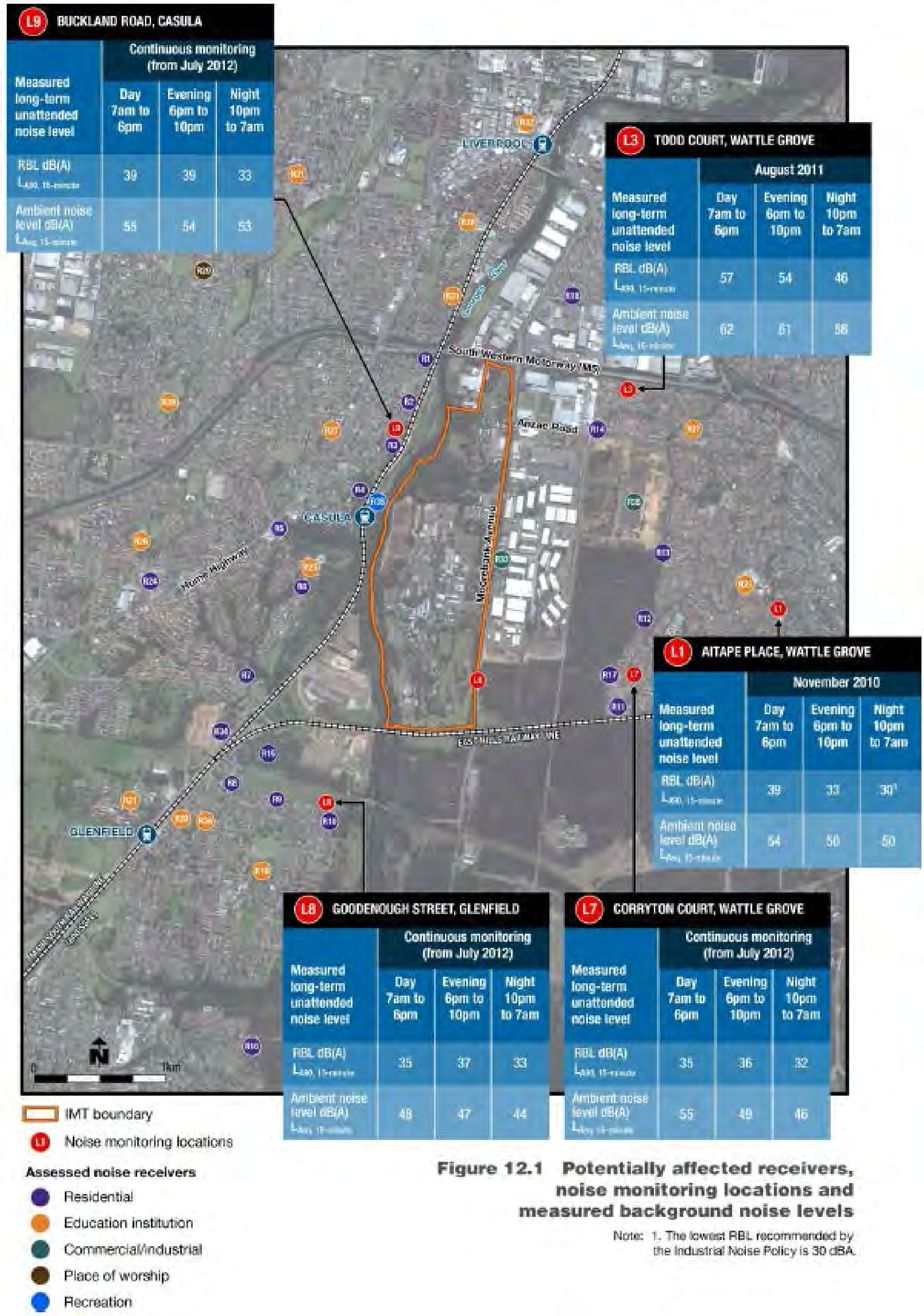

Figure 8-1: Potentially affected noise receivers surrounding the Proposal site

The assessment established background ambient noise levels and noise management levels (NMLs) at key receivers in Casula, Wattle Grove and Glenfield (refer Figure 8-1) by utilising 20 months of noise monitoring data from the MPW site and surrounding areas. This monitoring was carried out in November 2010, August 2011 and October 2011, with a continuous ambient noise monitoring survey commencing in July 2012. The noise assessment was undertaken using the following policy criteria:

- Construction noise criteria were established using the NSW EPA's *Interim Construction Noise Guidelines* (ICNG), 2009
- Operational noise criteria were established using the 'intrusiveness' and 'amenity' criteria in the *NSW Industrial Noise Policy* (INP), 2000
- Sleep disturbance criteria were established using the EPA's *Noise Guide for Local Government*
- Road traffic noise criteria were established using the EPA's *NSW Road Noise Policy*
- Rail traffic noise criteria were established using the *Rail Infrastructure Noise Guideline* (RING)
- Construction vibration criteria were established using the EPA's *Assessing Vibration: A Technical Guideline*.

Noise levels at the assessed receivers were predicted to mostly comply with the adopted NMLs, for which no additional noise mitigation is anticipated. All daytime construction works are predicted to comply with NMLs with the exception of piling works that may impact nearby receivers in Casula, Wattle Grove and Glenfield. Activities undertaken at these sites in conjunction with worst case background levels may trigger the potential requirement for noise mitigation.

Construction equipment is expected to be operated within the recommended safe working distances for construction ground vibration. Furthermore, potential ground vibration levels should be within the human comfort criteria and nearby buildings are unlikely to suffer cosmetic damage.

SoundPLAN V7.2 noise propagation software was used to create a noise prediction model for the operational phase (full build scenario at 2030) for the MPW Project. Rail noise levels were predicted in SoundPLAN using the Nordic Rail Traffic Noise Prediction Method (Kilde, 1984). The calculation parameters included the speed and length of rail freight to determine the potential noise levels at a receptor during a passby event. Noise levels were predicted in the absence of mitigation, thereby representing a worst-case scenario.

Operational noise levels are anticipated to increase throughout its progressive development phases, and varied at various receptors depending on the proximity of each receiver to prominent noise sources (e.g. trucks transporting containers, side picks, in-terminal transport vehicles and rail freight).

Rail noise from the operation of the Rail link connection is expected to comply with the RING criteria.

Road traffic noise from the MPW Project on the M5 Motorway, Moorebank Avenue and Anzac Road is expected to either comply with or have a negligible exceedance of the RNP noise criteria during the daytime and night-time at the nearest receptors, and therefore would not trigger a requirement for road noise mitigation.

The key findings of the noise and vibration assessment for the MPW Concept Approval in relation to the Proposal are shown in Figure 8-2 and are outlined in Table 8-2.

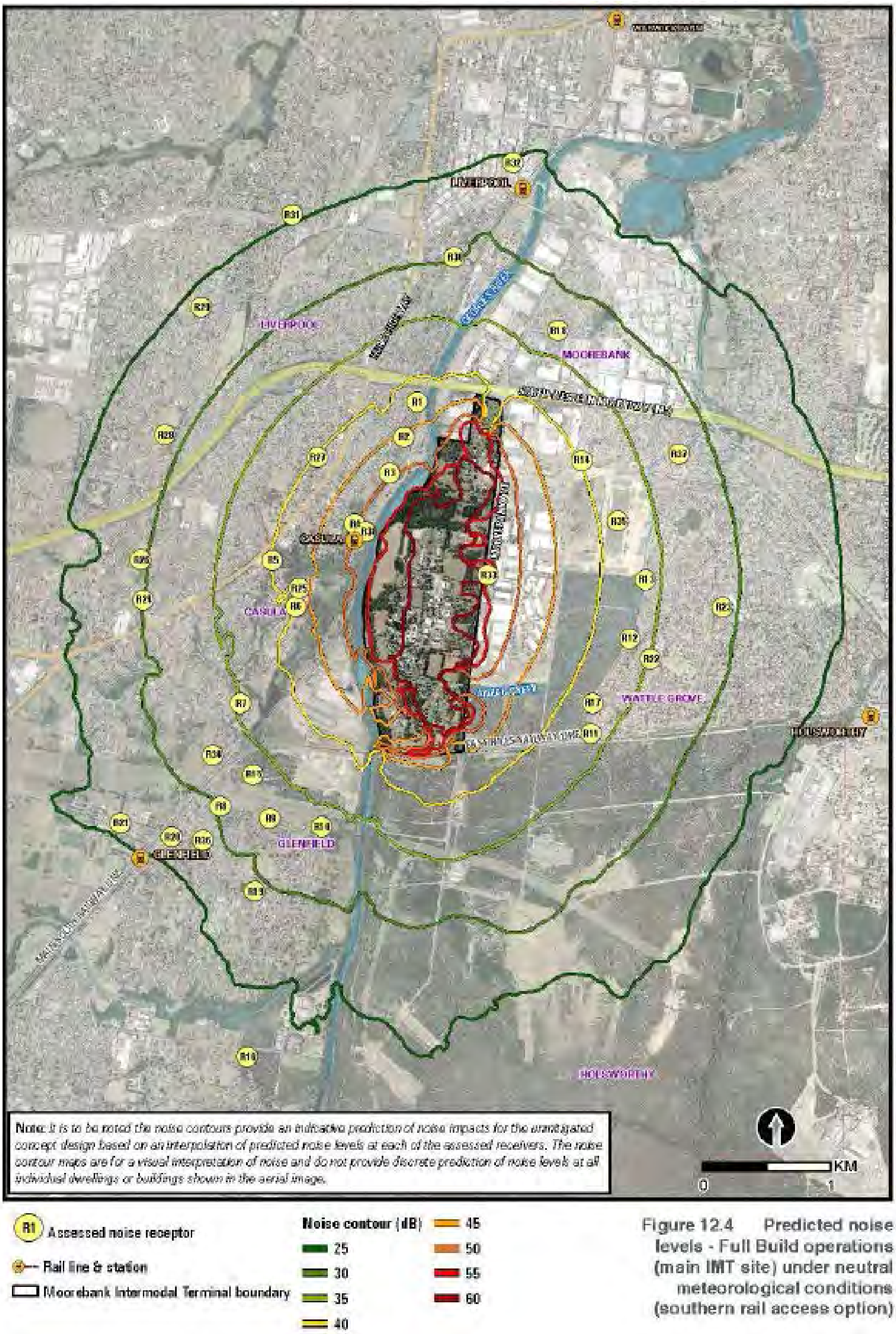

Figure 8-2: *Predicted noise levels at operational full build scenario*

Table 8-2: Noise and vibration assessment - MPW Concept Approval

MPW Concept Approval	Impact on the Proposal
During construction: ▪ Noise levels at the assessed receivers would mostly comply with the construction noise management levels (NMLs) ▪ All daytime early works would comply with the NMLs at all receivers and would not require noise mitigation ▪ At Casula, Wattle Grove and Glenfield, noise levels during piling and rail link connection construction works during the main construction phases would temporarily exceed the NMLs at certain times and under worst case conditions and would therefore trigger the need for reasonable and feasible noise mitigation measures ▪ If the recommended management and mitigation measures are implemented the potential noise levels at the assessed receivers in Wattle Grove, Casula and North Glenfield would be sufficiently controlled to achieve the adopted NMLs ▪ Construction equipment would be operated within the recommended safe working distances for construction ground vibration ▪ Potential ground vibration levels would be within the human comfort criteria and nearby buildings would be unlikely to suffer cosmetic damage	The methodology and results of the noise and vibration assessment for the MPW Concept Approval regarding construction would be reviewed and updated where necessary for the Proposal, including: ▪ The construction program and methodology used to develop the construction noise scenarios likely to occur on site for the MPW Concept Approval would be reviewed and updated where necessary for the Proposal ▪ Construction noise levels at nearby receivers would be modelled and compliance with noise management levels established in the MPW Concept Approval would be determined for the Proposal
During operation: ▪ At full build of the project during neutral meteorological conditions, operations at the interstate terminal would result in occasional exceedances of the noise assessment criteria at the nearest sensitive receivers in Casula and Wattle Grove ▪ No noise level exceedances were predicted for operational rail noise ▪ Operations would comply with sleep disturbance objectives at the nearest receivers in Casula, Wattle Grove and Glenfield ▪ Operation of the rail link connection would comply with sleep disturbance objectives ▪ Noise levels at all non-residential receivers would comply with the amenity noise criteria ▪ Any potential ground vibration caused by operations on site and the rail link connection would comply with the relevant vibration criteria	The methodology and results of the noise and vibration assessment for the MPW Concept Approval regarding operations would be reviewed and updated where necessary for the Proposal, including: ▪ Criteria for operational, road and rail traffic noise based on the MPW Concept Approval would be established for the Proposal.

MPW Concept Approval	Impact on the Proposal
for human comfort and cosmetic structural damage	

8.1.1 Conditions of Approval

The Conditions of Approval for the MPW Concept Approval relevant to the Proposal are shown in Table 8-3. These conditions of approval have been taken into account while developing the methodology for the noise and vibration assessment for the Proposal.

Table 8-3: MPW Concept Approval Conditions of Approval

Conditions of Approval		Where addressed in this EIS
Schedule 4- Conditions to be met in future development applications		
E1	To ensure the operational noise impacts are appropriately managed, the following measures must be considered in future Development Applications:	
	a) Best practice plant for both the IMEX and interstate terminal, including electronic automated container handling equipment or equipment with equivalent sound power levels;	Section 8.2.3 of this EIS
	b) The use of automatic rail lubrication equipment in accordance with ASA Standard T HR TR 00111 ST Rail Lubrication and top of rail friction modifiers;	Section 8.5.2 of this EIS
	c) Measures to ensure the rail cross sectional profile is maintained in accordance with ETN–01-02 Rail Grinding Manual for Plain Track to ensure the correct wheel / rail contact position and hence to encourage proper rolling stock steering;	Section 8.4.2 of this EIS
	d) A noise barrier on the western side of the haul road;	Section 8.2.3 of this EIS
	e) A detailed assessment of sleep disturbance impacts, including: how often noise events occur; the time of day when they occur; and whether there are any times of day when there is a clear change in the noise environment; and	Section 8.2 of this EIS
	f) A risk assessment to determine if non-tonal reversing alarms can be fitted as a condition of site entry. Alternatively, site design may include traffic flow that does not require or precludes reversing of vehicles.	Section 8.2.3 of this EIS
E2	Development Applications for both the IMEX and interstate terminal shall include a report to identify:	
	a) The extent of brake squeal across the fleet of rail vehicles that will frequently use the terminals. This should identify the number of occurrences of brake squeal, the typical noise levels associated with brake squeal (including the frequency content), and the operational conditions under which brake squeal occurs (e.g. under light braking, hard braking, low / medium / high speed, effects of temperature and weather, etc.);	Appendix N of this EIS

Conditions of Approval		Where addressed in this EIS
	b) The root cause of brake squeal, including the influence of the design, set-up and maintenance of both brake shoes and brake rigging; c) Possible solutions to mitigate or eliminate brake squeal, including modifications to brake rigging and alternative brake shoe designs and compounds; and d) Any monitoring system proposed to capture brake squeal.	

8.2 Methodology

8.2.1 Assessment methods

Investigations were carried out by Wilkinson Murray to assess noise and vibration impacts associated with construction and operation of the Proposal, including impacts from associated traffic and ancillary facilities, in accordance with relevant guidelines, criteria, policies and best practice.

The assessment identified sensitive receivers previously outlined in the MPW Concept EIS, along with existing ambient noise levels, based on 20 months of monitoring data.

A construction and operational description of the MPW Proposal in accordance with Section 4 of this EIS was used to inform noise modelling software used for this assessment.

The CadnaA acoustic noise prediction model software was used to model construction noise impacts. Sound power levels were then compared against the NMLs derived from the Rating Background Levels (RBLs) and criteria set out under the NSW EPAs *Interim Construction Noise Guideline (DECC, 2009) (ICNG)* described in Section 8.2 of this EIS. A cumulative construction impact assessment was undertaken to measure the impact of the Proposal in conjunction with the concurrent MPE Stage 1 works.

Operational noise impacts were assessed by firstly predicting noise impacts associated with dominant noise sources associated with the operation of the Proposal and developing 'worst case' operational scenarios. Scenarios expressed as $LA_{eq,\ period}$ and $LA_{eq,\ 15\ min}$ were used to describe amenity and intrusive noise impacts respectively, and were modelled to predict the noise impacts to selected receivers using the CadnaA V4.6 acoustic noise prediction software and the CONCAWE noise prediction algorithm. Sleep disturbance and cumulative operational noise impacts were assessed using similarly 'worst case' scenarios for both adverse and calm meteorological conditions, and compared against relevant criteria.

Noise impacts associated with road traffic were assessed using available traffic data according to vehicle type and period of the day for the most affected residential receivers. The predicted increase in traffic noise was quantified using the *Calculation of Road Traffic Noise* (CORTN) algorithm.

Rail noise modelling was undertaken for all trains travelling between the Proposal site and the SSFL. The MPE Stage 1 Proposal included a noise and vibration assessment that was based on a CadnaA noise model developed upon for use within the Proposal assessment. This assessment assessed the noise impacts of the construction and operation of the rail link from the MPE site to the SSFL, therefore the Proposal only needs to assess the construction of the rail link connection and the operation of 1800 m trains between the rail link connection and the SSFL. Measurements of noise emissions from freight locomotives and wagons was taken from the *Transport for New*

South Wales (TfNSW) Rail Noise Databases (Version 2, 2000)[25]. Rail noise predictions were calculated using the NORDIC rail noise prediction algorithm, implemented using CadnaA. The model has been calibrated to the 95th percentile of measured levels for freight wagons and Class 81 locomotives and is therefore conservative.

8.2.2 Noise and Vibration Criteria

Noise and vibration criteria for the MPW site was previously presented in the MPW Concept EIS. These criteria were subsequently reviewed and accepted by relevant regulatory and approval authorities, and have been retained as detailed in the following sections.

Construction noise criteria

The NSW EPA's *Interim Construction Noise Guideline* (DECC, 2009) (ICNG) recommends noise management levels (NML) to reduce the likelihood of noise impacts arising from construction activities. The ICNG NML for residential receivers are shown in Table 8-4.

Table 8-4: Construction Noise Management Levels at Residences

Time of Day	Management Level $L_{Aeq,15min}$ (dBA)	How to Apply
Recommended Standard Hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or Public Holidays	Noise affected RBL + 10dBA	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured LAeq,(15min) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to minimise noise. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the proponent should consider very carefully if there is any other feasible and reasonable way to reduce noise to below this level. If no quieter work method is feasible and reasonable, and the works proceed, the proponent should

[25] Measurements of freight locomotives and wagons are contained in the current (Version 3, 2015) and previous (Version 2, 2000) Transport for New South Wales (TfNSW) Rail Noise Databases. The latest version of the database contains a significant number of measurements of freight wagons, however does not contain any octave band information for the movements, which is a necessary requirement for the NORDIC algorithm. Therefore, octave band information has been taken from the previous version (Version 2) of the database. Locomotive data has been taken from the previous version (Version 2) of the database as it contains significantly more freight locomotive measurements.

Time of Day	Management Level $L_{Aeq,15min}$ (dBA)	How to Apply
		communicate with the impacted residents by clearly explaining the duration and noise level of the works, and by describing any respite periods that will be provided.
Outside recommended standard hours	Noise affected RBL + 5 dB	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5dB(A) above the noise affected level, the proponent should negotiate with the community.

Based on the RBL presented in *Table 8-16*, the NML for residential receivers are presented in *Table 8-5*, along with NMLs for the following out of hours (OOH) work periods:

- OOH Period 1: 6:00am – 7:00am weekdays
- OOH Period 2: 6:00pm – 10:00pm weekdays
- OOH Period 3: 7:00am – 8:00am Saturday
- OOH Period 4: 1:00pm – 6:00pm Saturday.

Table 8-5: Noise Management Levels for Residential Receivers

Receiver	Noise Management Levels				
	Standard Hours	OOH Period 1	OOH Period 2	OOH Period 3	OOH Period 4
Casula	49	44	44	44	44
Glenfield	45	40	40	40	40
Wattle Grove	45	40	40	40	40

The ICNG also recommends NML for other sensitive land uses, such as schools, hospitals and places of worship. Pertinent to this assessment, the recommended NML for schools and other educational institutions is an internal $L_{Aeq,\ 15min}$ noise level of 45 dBA. It is conservative to assume that noise levels are attenuated by approximately 10 dBA through normally open windows. Therefore, an external $L_{Aeq,\ 15min}$ noise level of 55 dBA is an equivalent NML for receivers S1 and S2. The NML for S1 and S2 apply only when these facilities are in use. The ICNG recommends an external NML of 75 dBA at industrial premises, such as I1, I2 and I3.

Construction vibration criteria

Human comfort vibration criteria have been used to assess potential vibration impacts from the Proposal, as vibration levels with the potential to cause damage to structures are typically more than ten times greater than those creating human disturbance. It is noted that vibration intensive construction plant are anticipated to be operated intermittently, and not continuously.

'Preferred' and 'maximum' vibration levels for human comfort were selected from *Assessing Vibration: A Technical Guideline* (DEC, 2006), a publication based on British Standard BS6472:1992 for vibration. Criteria for intermittent vibration, which is caused by plant such as rock breakers, are expressed as a Vibration Dose Value (VDV) and are shown in Table 8-6.

Table 8-6: Acceptable vibration dose values for intermittent vibration ($m/s^{1.75}$)

Location	Daytime[1]		Night Time[1]	
	Preferred Value	Maximum Value	Preferred Value	Maximum Value
Critical areas	0.1	0.2	0.1	0.2
Residences	0.2	0.4	0.13	0.26
Offices, schools, educational institutions and places of worship	0.4	0.8	0.4	0.8
Workshops	0.08	1.6	0.8	1.6

1. Daytime 7:00am–10:00pm; Night 10:00pm-7:00am.

Vibration intensive equipment is likely to be used during the proposed bulk earthworks. However, as the distance from vibration intensive plant to the nearest residential receiver is considered to be large (approximately 500 m), ground vibration at surrounding residential receivers would be low. On this basis, the recommended safe working distances for vibration intensive plant suggested in the Transport Construction Authority's *Construction Noise Strategy* (2012) have been adopted in this assessment to evaluate the vibration impacts. Table 8-7 sets out the recommended safe working distances for various vibration intensive plant.

Table 8-7: Recommended Safe Working Distances for Vibration Intensive Plant

Item	Description	Safe Working Distance	
		Cosmetic Damage	Human Response
Small Hydraulic Hammer	(300 kg – 5 to 12t excavator)	2m	7m
Medium Hydraulic Hammer	(900 kg – 12 to 18t excavator)	7m	23m
Pile Boring	≤ 800 mm	2m (nominal)	N/A
Jackhammer	Hand held	1m (nominal)	Avoid contact with structure

A review of the information presented in Table 8-7 indicates that human comfort vibration impacts at surrounding residences would be negligible during construction activities. The nearest residential receiver is situated far enough for impacts to be minimal in all circumstances (approximately 500 metres). Therefore, no further assessment of construction vibration is warranted.

Operational noise criteria

The *NSW Industrial Noise Policy* (INP) recommends two sets of criteria, 'intrusiveness' and 'amenity', for the assessment of operational noise. Intrusiveness criteria are only applied to residential receivers. The intrusiveness and amenity criteria established for sensitive receivers near the Proposal are presented in Table 8-8 and Table 8-9 respectively.

Table 8-8: Operational Noise Criteria – Intrusiveness

Receiver	Intrusiveness Criteria ($L_{Aeq,\ 15min}$)		
	Daytime[1]	Evening[1]	Night Time[1]
Casula	44	44	38
Glenfield	40	42 (40)	38
Wattle Grove	40	41 (40)	37

1. Daytime 7:00am–6:00pm; Evening 6:00pm–10:00pm; Night 10:00pm-7:00am.

The INP application notes recommend that intrusiveness noise criteria in the evening should not be greater than that during the daytime. Accordingly, the evening intrusiveness criteria in Glenfield and Wattle Grove have been adjusted downwards to reflect daytime levels. It should be noted that the above minor amendments to the evening intrusiveness criteria in Glenfield and Wattle Grove are inconsequential to the assessment of operational noise for both the MPW Concept, and the Proposal. Due to the proposed 24/7 operational nature of the site, noise emissions from the site are expected to vary by small amounts over the 24 hour period. The night time intrusiveness criteria is the most stringent criterion for all residential receivers near the site, and be the predominant criterion for the assessment of operational noise.

Table 8-9: Operational Noise Criteria – Amenity

Receiver	Indicative Noise Amenity Area	Time Period[1]	Amenity Criteria ($L_{Aeq,\ period}$)
Casula Glenfield Wattle Grove	Residential Suburban	Daytime	55
		Evening	45
		Night Time	40
S1, S2	School/Classroom	Noisiest 1-hour period (when in use)	35 (internal) (45 external)
I1, I2, I3	Industrial	When in use	70

1. Daytime 7:00am–6:00pm; Evening 6:00pm–10:00pm; Night 10:00pm-7:00am.

The INP amenity criterion for educational facilities is an internal $L_{Aeq,\ 1hour}$ noise level of 35 dBA. For the purposes of assessment, this criterion has been converted to an equivalent external $L_{Aeq,\ 1hour}$ noise level. It can be conservatively assumed that the attenuation of noise from outside to inside, via partially open windows, is 10 dB. Therefore, the equivalent external amenity criterion for educational facilities is 45 dBA.

Sleep disturbance screening levels

Screening levels for maximum operational noise levels during the night time period (10:00pm – 7:00am) were established in accordance with the INP, presented in Table 8-10.

Table 8-10: Sleep Disturbance Screening Levels

Receiver / Suburb	Night Time RBL	Sleep Disturbance Screening Level ($L_{A,1min}$ / L_{Amax})
Casula	33	48
Glenfield	33	48
Wattle Grove	32	47

Road noise criteria

Applicable noise criteria for proposals which have the potential to indefinitely increased traffic on roads are presented in the *NSW Road Noise Policy* (RNP) (DECCW, 2011).

The Proposal will generate additional traffic along the M5 Motorway, Moorebank Avenue and Anzac Road (refer to Section 7 of this EIS). According to the *RNP*, the M5 Motorway is classified as a Freeway, while Moorebank Avenue and Anzac Road are classified as sub-arterial roads. With regard to the permissible increase in road traffic noise from a land use development the, *RNP* states:

"*For existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level should be limited to 2 dB above that of the corresponding 'no build option'.*"

The *RNP* assessment criteria for residential land uses are shown in Table 8-11.

Table 8-11: Road Noise Criteria

Road	Category	Assessment Criteria - dBA	
		Day (7am – 10pm)	Night (10pm – 7am)
M5 Motorway	Freeway	$L_{Aeq, 15 hour}$ 60 (external)	$L_{Aeq, 9 hour}$ 55 (external)
Moorebank Avenue, Anzac Road	Arterial Road	$L_{Aeq, 15 hour}$ 60 (external)	$L_{Aeq, 9 hour}$ 55 (external)

Rail noise criteria

Airborne noise from freight rail movements are assessed using the *Rail Infrastructure Noise Guideline* (RING) (EPA, 2013). In accordance with RING, the section of the rail link between the SSFL and the Proposal site is classified as a 'non-network line servicing an industrial site'.

Appendix 3 of RING recommends that noise from a section of non-network track which extends beyond the boundary of an industrial premises should be assessed against the recommended acceptable INP amenity $L_{Aeq,period}$ noise levels.

RING does not recommend specific L_{Amax} noise levels from non-network rail lines. However, a submission from the NSW EPA to the MPE Stage 1 EIS requested that L_{Amax} noise levels associated with the operation of the Rail link be assessed in accordance with the INP Application Notes. Accordingly, the sleep disturbance screening levels presented in Section 8.2.2.4 have been adopted to assess potential sleep disturbance impacts due to the operation of the Rail link.

The relevant rail noise criteria for the assessment of potential impacts from the Rail link between the Proposal site and the SSFL are summarised in Table 8-12. L_{Amax} screening levels for rail noise are provided in Table 8-13.

Table 8-12: Rail Noise L_{Aeq} Criteria

Receiver	Indicative Noise Amenity Area	Time Period[1]	$L_{Aeq, period}$ Criteria	
			Acceptable	Recommended Maximum
Casula, Glenfield, Wattle Grove	Residential Suburban	Day	55	60
		Evening	45	50
		Night	40	45
S1, S2	School/Classroom	Noisiest 1-hour period when in use	45	50
I1, I2, I3	Industrial	When in use	70	75

1. Daytime 7:00am–6:00pm; Evening 6:00pm–10:00pm; Night 10:00pm-7:00am.

Table 8-13: Rail Noise LAmax Screening Levels

Receiver / Suburb	Night Time RBL	L_{Amax} Screening Level
Casula	33	48
Glenfield	33	48
Wattle Grove	32	47

8.2.3 Best Practice Review

The surrounding noise environment is influenced by a number of factors, including the separation distances from sensitive receivers, the location of solid objects that act as shields between a noise source and a receiver and the type and duration of noise generating sources onsite.

The INP provides the framework for both establishing appropriate noise criteria at potentially affected receivers and conducting a thorough assessment of potential noise impacts. The establishment of operational noise criteria in accordance with the INP considers both the existing ambient noise levels and the land use at each potentially sensitive receiver. Further, the RNP and the RING are used to set performance based criteria and conduct assessments of potential impacts from road traffic noise and rail traffic noise respectively. These guidelines individually establish operational criteria for developments, the achievement of which represent 'best practice' in noise management.

Project site layout and process design

The siting and layout of the Proposal provides opportunities to minimise noise levels at sensitive receivers without placing unreasonable constraints on site operations and plant selection.

Separation

Noise levels are inversely proportional to the distance of the receiver from the source. Therefore, the largest separation distances between noisy plant and activities and nearby sensitive receivers should be sought. Residential receivers in Casula, to the west of the Proposal site, are the most sensitive receivers for the Proposal due to their proximity.

The dominant noise sources associated with operation of the Proposal are the locomotives, trucks and container handling equipment operating within the IMT facility and the trucks accessing the warehousing area. The proposed location of the rail siding is very close to the eastern boundary of the Proposal site. This results in locomotives, container handling equipment and intermodal trucks being located as far as practicable away from the most sensitive receivers.

The proposed location of the warehousing buildings is close to the western boundary of the Proposal site. However, an internal access road is proposed to run adjacent to the western site boundary, to the west of the warehousing buildings. Warehousing trucks will travel along an internal access road which runs along the western boundary of the Proposal Site. Due to the Proposal site being narrow, and the need to provide separation from warehousing trucks and terminal trucks, it is not feasible to locate all truck traffic to the east of the warehousing buildings. To the extent that it is reasonable, and feasible, the warehousing layout is considered consistent with best practice.

In consideration of the proposed internal layout, the design is considered consistent with best practices as they achieve the best compromise to maximise separation distances to nearby sensitive receivers.

Shielding

Solid objects which obstruct the line of sight between a noise source and a sensitive receiver will reduce the noise levels at the receiver. The magnitude of this shielding or ‘barrier’ effect is typically in the order of 5 – 10 dBA.

The need for a noise wall along the western site boundary has been identified in Section 8.4.2.1 and used in modelling assumptions in Section 8.4.2.3. The location of the noise wall (refer to Figure 8-4) is consistent with best practice as it is located close to significant noise sources and will attenuate noise levels in both calm and adverse meteorological conditions.

A number of large warehousing buildings would be established as part of the Proposal, which offer shielding between noise sources on the intermodal terminal site area and residential receivers. Since the closest and most sensitive receivers are located to the west of the Proposal site in Casula, the ideal siting of the warehousing buildings, with a view to reducing noise levels at sensitive receivers, is along the western boundary of the Proposal site.

Container stacks can also provide significant shielding of noise to nearby receivers, however they should not be relied upon to reduce noise levels as the stacks are moved during operations. Nevertheless, the design of the intermodal terminal features container stacks on the western side of the rail siding. This configuration is considered to provide the greatest potential for shielding to the most sensitive receivers for the Proposal.

Reversing and Alarms

Audible warning systems for reversing vehicles is required for safety reasons, however these systems have the potential to increase noise levels at sensitive receivers. Further, traditional audible alarms are based on tonal or ‘beeper’ noises which have an increased potential to cause annoyance. Therefore, best practice is to design sites to avoid or at least minimise the need for vehicles to reverse.

The design of the intermodal facility in the Proposal is such that trucks are unlikely to reverse during normal operations. However, trucks accessing the warehousing area of the Proposal site will necessarily have to reverse as trucks are loaded and unloaded through their rear doors. The warehousing trucks will access the Proposal site through a public access arrangement and therefore, it is not feasible to prescribe that all trucks accessing the site are fitted with broadband reversing alarms (rather than tonal alarms).

Having regard to reach stackers operating within the IMT facility, it is not feasible to move containers between trucks and trains without reversing. Therefore, it is recommended that all reach stackers operating within the IMT facility are fitted with broadband reversing alarms in accordance with best practice.

Operational best practice - Trains

All trains accessing the MPW site from the SSFL would do so via the Rail Link. Approval for the operation of the Rail Link has been sought in the MPE Stage 1 Proposal, which includes a detailed assessment of potential noise impacts associated with the operation of the Rail link between the Moorebank Precinct and the SSFL. Following that assessment, Planning NSW has issued a set of recommended conditions for the operation of the Rail link. A sub-set of these conditions requires that:

- Wagons on the Rail link incorporate available best practice technologies for reducing wheel squeal, such as permanently coupled “multi-pack” steering wagons using Electronically Controlled Pneumatic braking with a wire based distributed power system
- Friction modifiers and automatic rail lubrication systems are installed within the Rail link
- Track grinding is carried out within the Rail link to ensure the correct profile is maintained on the track to encourage proper rolling stock steering
- A rail noise monitoring system is installed and maintained on the Rail link.

In addition to the above recommended conditions, all locomotives access the Rail link would comply with the noise limits contained in NSW EPA Environmental Protection Licence (EPL) #3142, issued to ARTC, and applicable to the operation of the SSFL.

The above suite of measures are considered best practice for reducing rail noise levels. These measures would be incorporated into the design and operation of the Rail link, and no additional measures are considered necessary for the Proposal.

Locomotive shifter

During Proposal operation, trains will enter the IMT facility from the south and come to rest at the marshalling yard adjacent to the terminal. The wagons will be broken into sections of wagons no longer than 900m, which will be shunted from the marshalling tracks into the terminal working tracks for unloading/loading. The wagons will then remain stationary during loading/unloading of containers. To leave the terminal, the locomotive will be uncoupled from the train and a locomotive shifter will be used to move the locomotive onto a vacant track at the northern end of the marshalling yard. The locomotive will travel to the southern end of the marshalling yard where a series of turnouts will be used to move the locomotive back onto the correct track for re-coupling with the wagons.

The use of the locomotive shifter as described above reduces the amount of locomotive activity on the site and therefore contributes to reducing noise emissions.

Operational best practice – Container handling

Best practice for reducing noise from container handling equipment is to migrate from diesel powered plant to diesel/hybrid power and eventually electrically powered plant. Moderate reductions may be realised when moving to diesel/hybrid powered units as the duty cycle of the diesel engine is often significantly reduced. Alternatively, full electrification of container handling equipment is typically accompanied by significant reductions in noise emissions and is considered best practice.

The primary source of noise during container handling activities is the power-plants of container handling machinery such as reach stackers and forklifts.

Since Proposal operations can comply with noise criteria, the use of hybrid or electric container handling equipment is not considered necessary and container handling for the Proposal is expected to be accomplished by conventional diesel powered reach stackers.

Noise Monitoring and Response

Where a noise assessment has shown that the potential for noise impact is sufficiently low, compliance monitoring is not always undertaken. However, when the likelihood or perceived likelihood, of noise impacts is significant or the population of potentially affected receivers is large, adoption of best practise generally requires that noise levels are monitored.

With the establishment of a noise wall along part of the western boundary of the Proposal site boundary, operations are predicted to comply with established noise criteria, however since the site will operate on a 24/7 basis and is surrounded by a large population of potentially affected receivers, it is recommended that operational noise compliance monitoring is conducted. Further details relating to noise monitoring to be undertaken is outlined in Section 8.5.2.

Best practice summary

Table 8-14 provides a summary of aspects considered in the above sections, during the best practice noise and vibration review undertaken for the Proposal.

Table 8-14: Best Practice Review Summary

Item	Best Practice Measure	Reasonable /Feasible?	Implemented?	Comment	Progression to Best Practice
Noise Assessment	Performance based criteria, based on existing noise environment and recommended maximum acceptable levels.	Yes	Yes	Assessments in accordance with NSW Government noise guidelines and policies.	N/A
Noise Monitoring and Response	Continuous real-time monitoring of operational noise levels at sensitive receivers and reactive management plan to address detected exceedances of noise limits.	Feasible, not reasonable	No	Compliance predicted for the Proposal. Regular short term attended monitoring would be considered to verify predicted levels.	May be justified for ultimate operations. To be re-assessed in future detailed assessments.
Truck queueing, idling and reversing	Gate appointment system	Yes	Yes	Will minimise truck loading/unloading wait times and resultant queueing. Trucks will be turned away from facility if arriving too early.	N/A
	Truck marshalling lanes	Yes	Yes	Minimises congestion and queueing.	N/A
	Reduction of ‘long-term’ idling	Yes	Yes	Unnecessary idling for non-MPW employees avoided through provision of information signs and communication of MPW idle reduction policy.	N/A
	Broadband reversing alarms	No	No	Truck fleet is not wholly controlled by MPW terminal operators.	N/A

Item	Best Practice Measure	Reasonable /Feasible?	Implemented?	Comment	Progression to Best Practice
	Design site to avoid reversing	Yes	Yes	The Proposal has been designed, where feasible, to significantly reduce the need for reversing of trucks.	N/A
Trains	Best practice rolling stock as identified by DP&E in MPE Stage 1 recommended conditions.	Yes	Yes	Trains will access the MPW site via the Rail link. Conditions for the Rail link to be specified in MPE Stage 1 Proposal.	N/A
Container Handling	Hybrid/Electric container handling equipment.	No	No	Hybrid/Electric container handling equipment not warranted for Proposal throughput.	May be justified for increased operations. To be re-assessed in future detailed assessments.

8.3 Existing environment

8.3.1 Sensitive receivers

Sensitive receivers identified within the MPW Concept Assessment were reviewed and refined for the purposes of the Proposal assessment. Three residential receivers and five non-residential receivers (two educational and three industrial) were identified as the most potentially affected. These locations are summarised in Table 8-15 and shown in Figure 8-3.

Table 8-15: Potentially affected receivers

Receiver / Suburb	Category	Distance to Proposal site*
Casula	Residential	350 m
Glenfield		1,800 m
Wattle Grove		640 m
All Saints Senior College (S1)	Educational	630m
Casula Powerhouse (S2)		360 m
MPE (I1)	Industrial	50 m
DJLU (I2)		50 m
ABB Site (I3)		Boundary

*Approximate minimum distance from the Proposal to potentially most affected receiver.

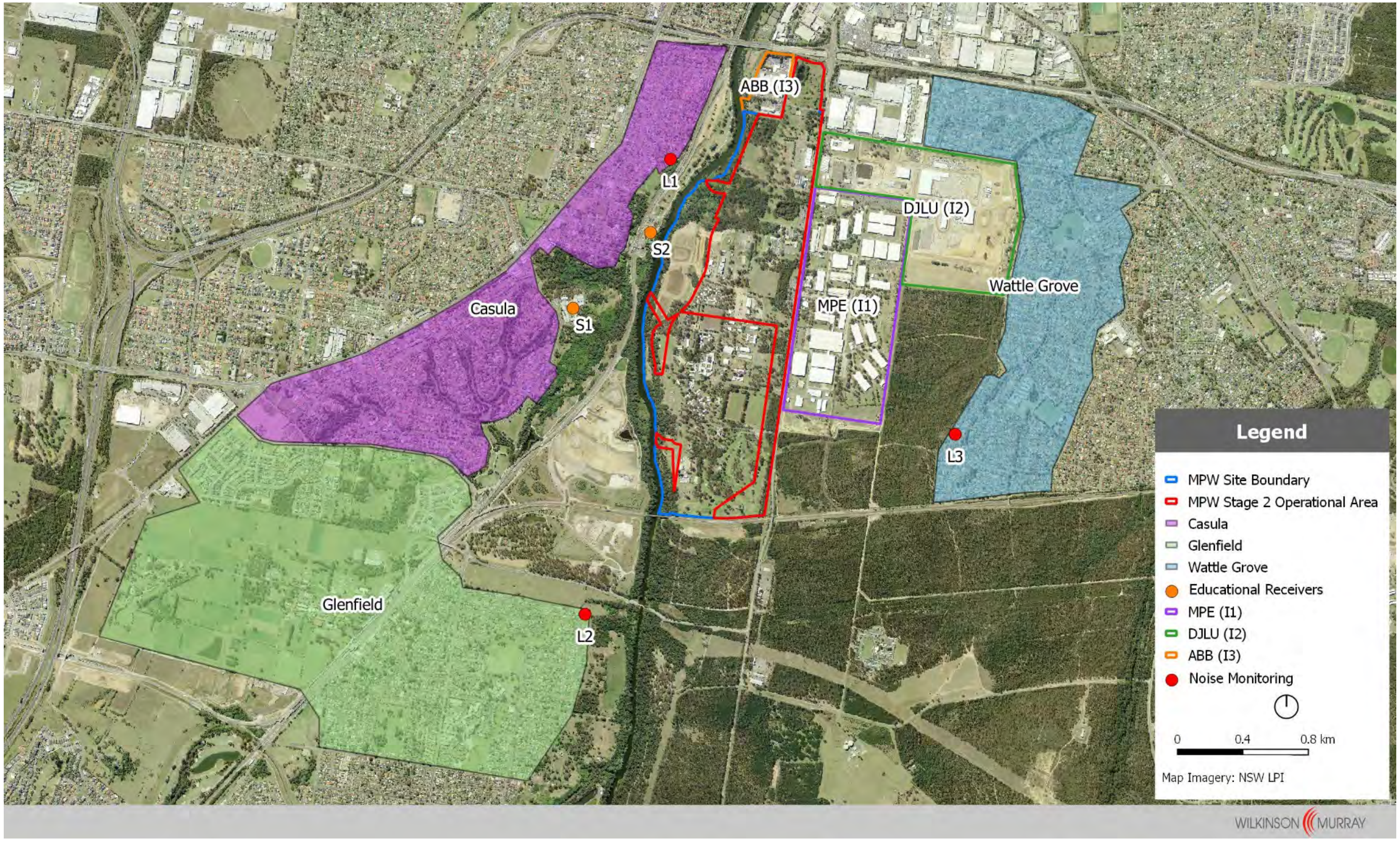

Figure 8-3: Sensitive receiver and noise monitoring locations in relation to Proposal site

8.3.2 Existing Ambient Noise Levels

Existing ambient noise levels at key residential receivers were established through existing monitoring undertaken by SLR Consulting for the MPW Concept Approval. The monitoring was undertaken in accordance with the INP, for residential receivers within Casula, Glenfield and Wattle Grove. Locations are presented in Figure 8-3 and detailed below in Table 8-16.

Table 8-16: Ambient existing noise levels at sensitive residential receivers

Suburb	Monitoring Location	Noise Levels (dBA)					
		RBL			L_{Aeq}		
		Day[1]	Evening[1]	Night[1]	Day[1]	Evening[1]	Night[1]
Casula	L1	39	39	33	55	54	53
Glenfield	L2	35	37	33	48	47	44
Wattle Grove	L3	35	36	32	55	49	46

8.3.3 Meteorological Environment

As discussed in Section 9.3.2, meteorological conditions at the Proposal site are subject to temperature inversions as a result of the predominance of stable conditions during the night.

In accordance with the INP, default parameters have been used in this assessment to include the effects of meteorological conditions that enhance noise levels. These parameters comprise an F-class temperature inversion during the night time period. As the potentially most affected receivers are located at heights similar to, or greater than the Proposal site, drainage winds are unlikely to occur with temperature inversions and as such have not been modelled.

There is potential for gradient winds to enhance noise levels at sensitive receivers, and such conditions have the potential to arise in any of the daytime, evening or night time periods. The default parameters for the assessment of gradient winds in accordance with the INP is a 3 m/s wind from source to receiver.

The CONCAWE noise propagation model divides the range of possible meteorological conditions into six separate "weather categories", from Category 1 to Category 6. Weather Category 1 provides "best-case" (i.e. lowest noise level) weather conditions for the propagation of noise, whilst weather Category 6 provides "worst-case - Adverse Meteorological Conditions" (i.e. highest noise level), when source to receiver gradient winds exist and/or there are temperature inversions. For noise modelling purposes, consistent with the INP, typical daytime "calm meteorological conditions" were modelled using Category 4 and "adverse meteorological conditions" where modelled using worst-case Category 6.

8.4 Potential impacts

Noise modelling was undertaken to determine the level of impact associated with construction and operation of the Proposal on surrounding receivers. Operational and noise emissions associated with the Proposal were modelled using the CadnaA V4.6 acoustic noise prediction software and the CONCAWE noise prediction algorithm, taking into consideration:

- Equipment noise level emissions and locations
- Shielding from structures

- Noise attenuation due to geometric spreading
- Meteorological effects (refer to comments above)
- Ground absorption
- Atmospheric absorption.

8.4.1 Construction

As discussed in Section 4, seven works periods have been identified for the Proposal construction, being:

- Works Period A – Pre-construction stockpiling
- Works Period B – Site preparation activities
- Works Period C – Bulk earthworks, drainage and utilities
- Works Period D – Moorebank avenue intersection works and internal road network
- Works Period E – IMT facility and rail link connection construction
- Works Period F – Construction and fit-out of warehousing
- Works Period G – Miscellaneous structural construction and finishing works.

A breakdown of the indicative sound power level (SWL) for each works period, comprising of indicative plant used is provided in Table 8-17.

Table 8-17: Indicative sound power levels per works period

Works Period	Equipment	Sound Power Level per Item (dBA) ($L_{Aeq, 15min}$)	Sound Power Level per Works Period (dBA) ($L_{Aeq, 15min}$)
A - Pre-construction stockpiling	Loaders Static and vibratory rollers Excavators 20-40 tonne articulated tipper trucks Scrapers Graders Water Trucks	112 109 110 110 110 109 105	117
B - Site Preparation	Loaders Static and vibratory rollers Mobile cranes Excavators Backhoes Crushing plant Dozers Mulchers 20-40 tonne articulated tipper trucks Scrapers Graders Water Trucks	112 109 110 110 105 118 118 118 110 110 109 105	124

Works Period	Equipment	Sound Power Level per Item (dBA) ($L_{Aeq, 15min}$)	Sound Power Level per Works Period (dBA) ($L_{Aeq, 15min}$)
C - Bulk Earthworks, Drainage & Utilities	Loaders Static and vibratory rollers Excavators Excavators with hammers Backhoes Crushing plant Air compressors Dozers Mulchers 20-40 tonne articulated tipper trucks Scrapers Graders Water Trucks	112 109 110 122 105 118 100 118 118 110 110 109 105	128
D – Moorebank Avenue and internal road network	Loaders Static and vibratory rollers Excavators Backhoes Concrete batching plant Concrete agitators (or similar) Concrete pumps Concrete saws Air compressors Jackhammers Dozers 20-40 tonne articulated tipper trucks Scrapers Graders Water trucks Small earthmoving equipment	112 109 110 105 113 105 103 112 100 113 118 110 110 109 105 95	122
E – IMT facility and Rail Link connection	Loaders Static and vibratory rollers Mobile cranes Excavators Backhoes Concrete batching plant Concrete agitator (or similar)	112 109 110 110 105 113 105	125

Works Period	Equipment	Sound Power Level per Item (dBA) ($L_{Aeq, 15min}$)	Sound Power Level per Works Period (dBA) ($L_{Aeq, 15min}$)
	Concrete pumps	103	
	Concrete saws	112	
	Air compressors	100	
	Jackhammers	113	
	20-40 tonne articulated tipper	110	
	trucks	109	
	Graders	105	
	Water trucks	121	
	Piling rigs	106	
	Forklifts	95	
	Small earthmoving equipment	118	
	Rail tamper	90	
	Welder		
F – Warehouse construction and fitout	Loaders	112	124
	Static and vibratory rollers	109	
	Mobile cranes	110	
	Excavators	110	
	Backhoes	105	
	Concrete batching plant	113	
	Concrete agitator (or similar)	105	
	Concrete pumps	103	
	Concrete saws	112	
	Air compressors	100	
	Jackhammers	113	
	Graders	109	
	Water trucks	105	
	Piling rigs	121	
	Forklifts	106	
	Small earthmoving equipment	95	
	Welder	90	
G - Buildings and finishing works	Loaders	112	119
	Static and vibratory rollers	109	
	Backhoes	105	
	Concrete agitator (or similar)	105	
	Concrete pumps	103	
	Concrete saws	112	
	Air compressors	100	
	Jackhammers	113	

Works Period	Equipment	Sound Power Level per Item (dBA) ($L_{Aeq, 15min}$)	Sound Power Level per Works Period (dBA) ($L_{Aeq, 15min}$)
	Water trucks	105	
	Forklifts	106	
	Small earthmoving equipment	95	
	Welder	90	

Predicted Noise Levels during standard working hours

The CadnaA acoustic noise prediction model software was used to model the noise emissions from construction of the Proposal for each of the identified construction works periods for both standard and out of hours works periods, which were then compared against the NMLs derived from the RBLs and criteria set out under the NSW EPAs *Interim Construction Noise Guideline (DECC, 2009) (ICNG)* described in Section 8.2 of this EIS. The worst-case predicted $LA_{eq,\ 15\ min}$ construction noise levels at sensitive receivers during each key works period in conjunction with respective NMLs during standard work hours is provided in Table 8-18.

Table 8-18: Predicted construction noise levels during standard hours

Receiver	Construction Works Period							NML
	Pre-construction stockpiling	Site preparation	Bulk earthworks, drainage and utilities	Moorebank Avenue and internal roads	IMT facility and Rail link connection	Warehouse construction and fit out	Buildings and finishing works	
Casula	39	46	**50**	44	47	46	41	49
Glenfield	25	32	36	30	33	32	27	45
Wattle Grove	26	33	37	31	34	33	28	45
S1	38	45	49	43	46	45	40	55
S2	37	44	48	42	45	44	39	55
I1	40	47	51	45	48	47	42	75
I2	33	40	44	38	41	40	35	75
I3	42	49	53	47	50	49	44	75

Results indicates that predicted $L_{Aeq,\ 15min}$ construction noise levels at all sites meet the NML for all construction phases, with the exception of Casula for bulk earthworks, which is predicted to exceed the established NML by up to 1 dBA. This exceedance is considered negligible and does not warrant mitigation.

Predicted noise levels during out of hours works

The assessment divided up out of hours activities into two distinct groups, according to the type of construction activities expected to be conducted. OOH Period 1 reflects the 6:00am – 7:00am timeslot on weekdays, whereupon materials delivery is the only proposed activity. The second group comprises of OOH Period 2 (6:00pm – 10:00pm weekdays), OOH Period 3 (7:00am – 8:00am Saturday) and OOH Period 4 (1:00pm –

6:00pm Saturday), whereby materials delivery and direct placement or stockpiling is expected to be undertaken. The following sub-sections outline construction predicted noise levels and exceedances against NMLs.

OOH Period 1

For OOH period 1, $L_{Aeq,\ 15min}$ noise levels at sensitive receivers were predicted with all plant operating simultaneously, with a modelled SWL of 117 dBA over the works area. The predicted levels are presented in Table 8-19. Results show that construction noise levels are not predicted to exceed applicable NML at sensitive receivers during OOH Period 1.

Table 8-19: Predicted Construction Noise Levels During OOH Period 1

Receiver	Predicted $L_{Aeq,\ 15min}$ Noise Level	NML	Exceedance
Casula	39	44	0 dB
Glenfield	26	40	0 dB
Wattle Grove	26	40	0 dB
S1	38	55	0 dB
S2	47	55	0 dB

OOH Period 2, 3 and 4

For OOH Periods 2, 3 and 4, $L_{Aeq,\ 15min}$ noise levels at sensitive receivers were predicted with all plant operating simultaneously, with a modelled SWL of 122 dBA over the works area. The predicted levels are presented in Table 8-20. Results show that construction noise levels are not predicted to exceed applicable NML at sensitive receivers during OOH Periods 2, 3 and 4.

Table 8-20: Predicted Construction Noise Levels During OOH Periods 2, 3 and 4

Receiver	Predicted $L_{Aeq,\ 15min}$ Noise Level	NML	Exceedance
Casula	44	44	0 dB
Glenfield	31	40	0 dB
Wattle Grove	35	40	0 dB
S1	44	55	0 dB
S2	43	55	0 dB

Cumulative Construction Noise

A number of large-scale construction activities are expected to occur simultaneously during the Proposal, informing the need to conduct a cumulative noise assessment. These include the approved Early Works of the MPW Project, along with the Site Preparation, Bulk Earthworks and Engineering Fill phases of the MPE Stage 1 Proposal.

The highest predicted $L_{Aeq,\ 15min}$ construction noise levels at sensitive receivers, during relevant phases, for each project have been cumulated to provide an indication of potential cumulative construction noise impacts. Predicted $L_{Aeq,\ 15min}$ construction noise levels for the MPW Early Works have been taken from *Moorebank Intermodal Terminal EIS – Noise and Vibration Impact Assessment* (SLR Consulting, 2014), while Predicted $L_{Aeq,\ 15min}$ construction noise levels for the MPE Stage 1 Proposal were taken from

SIMTA Intermodal Terminal Facility – Stage 1 – Noise and Vibration Impact Assessment (Wilkinson Murray, 2015). These levels, during standard work hours, in comparison with NMLs for the Proposal are presented in Table 8-21.

Table 8-21: Cumulative Construction Noise Levels (worst case)

Receiver	Predicted $L_{Aeq,\ 15min}$ Noise Levels				NML	Exceedance
	MPW Stage 2 Proposal	MPW Early Works	MPE Stage 1	Cumulative		
Casula	**50**	44	40	**51**	49	2 dB
Glenfield	36	40	32	42	45	0 dB
Wattle Grove	37	38	40	43	45	0 dB
S1	49	49	39	52	55	0 dB
S2	48	49	37	52	55	0 dB

Results from Table 8-21 indicate worst-case cumulative construction noise levels comply with NMLs at all monitoring locations, with the exception of Casula, which exceeds the NML at the most affected residential receivers by up to 2 dB. This is considered a negligible exceedance.

8.4.2 Operation

Noise Barriers

Warehouses and other nearby buildings are likely to provide some level of shielding to sensitive receivers. The following buildings have been included in the operational noise model:

- Proposed warehouse buildings on the Proposal site
- Warehouse buildings on the MPE site, not proposed to be demolished under the MPE Stage 1 Proposal
- Existing large buildings associated with ABB, DJLU and the industrial area to the north of the DJLU.

In addition to shielding from buildings, a noise wall, approximately 5 metres high, is proposed to be established along the western operational boundary of the Proposal site, as outlined in Section 4 and illustrated in Figure 8-4.

Figure 8-4: Noise Wall and buildings included in the noise model

Operational Noise Sources and modelling scenarios

A ‘worst case scenario’ was developed to assess the amenity noise impacts associated with operation of the Proposal, which is expressed in $L_{Aeq\ period}$. A ‘worst case 15 minute scenario’ was developed to assess the intrusive noise impacts of operation of the Proposal, which is described in terms of $L_{Aeq15min}$.

The dominant sources of noise associated with the operation of the Proposal include:

- Trucks accessing the IMT facility and warehouse areas
- Container handling equipment, specifically reach stackers
- The locomotive shifter
- Locomotives idling and moving within the IMT terminal and the Rail link connection.

As discussed in Section 7, approximately 250 trucks would enter the site each day, and travel directly to the warehousing area, via the access road along the western operational boundary of the Proposal site. A further 480 trucks would enter the site each day to access the IMT terminal. A worst case scenario of truck movements along both the terminal and warehouse access roads during the daytime, evening and night time have been modelled, based on distribution data.

For the purposes of the intrusiveness noise impact assessment, it was assumed that all 12 reach stackers would be operating during the worst-case 15 minute period, with a combined SWL of 117 dBA. This SWL was applied to the daytime, evening and night time periods. These reach stackers would be used to transfer containers to and from rail wagons. Regarding locomotives, the wort-case 15 minute scenario assumes that eight locomotive are all moving within the terminal, representing a combined SWL of 115 dBA, operating during the daytime, evening and night time. The trucks and reach stackers were distributed around the Proposal operational area in accordance with internal road arrangements.

The modelling of reach stackers for the amenity scenario is based on 6 reach stackers operating simultaneously (100% of the time), with a combined SWL of 114 dBA, on a 24/7 basis.

It was assumed that, on average, there would be eight locomotives within the rail terminal simultaneously. Some of the locomotives would be idling and stationary, while some would be moving along the length of the terminal. The locomotives have been modelled as an area source over the extent of the rail siding, with a combined SWL of 111 dBA, operating on a 24/7 basis.

Table 8-22 shows the main noise sources that would be operating on the Proposal during operational activities.

Table 8-22: Operational source sound power levels

Source	Sound Power Level at Octave Band Centre Frequency									Overall SWL (dBA)
	31.5	63	125	250	500	1k	2k	4k	8k	
Reach Stacker (diesel)	110	111	107	103	105	101	97	96	87	106
Car – 40 km/h	98	102	93	87	88	87	83	74	64	91
Truck – Idling	98	97	94	91	90	91	88	80	72	95
Truck – 10km/h	100	103	101	99	98	99	96	90	79	103
Truck – 40 km/h	91	101	103	104	103	101	98	94	86	106
Locomotive – Idling	103	107	104	101	98	93	89	88	90	100
Locomotive – 10km/h	142	126	113	99	91	86	83	80	80	106
Locomotive Shifter	75	80	82	85	89	89	89	85	83	95

Regarding sleep disturbance, transient noise events including horns, tonal reversing alarms, pneumatic trailer brakes, and 'banging' noises associated with moving containers have been identified as occurring during site operations with the potential to create sleep disturbance, refer to Section 8.4.2 of this EIS.

Modelled outcomes

The predicted $L_{Aeq,\ period}$ and $L_{Aeq,\ 15min}$ operational noise levels at nearby sensitive receivers are presented below in Table 8-23 and Table 8-24 respectively, alongside relevant criteria recommended by the INP (refer to Section 8.2 of this EIS). Noise levels are presented for calm isothermal conditions and meteorological conditions that enhance noise levels.

Table 8-23: Predicted Amenity LAeq, period Operational Noise Levels

Receiver	Predicted $L_{Aeq,\ period}$ Noise Level (dBA)				Criteria (dBA)			Exceedance
	Day[1]	Evening[1]	Night[1]		Day[1]	Evening[1]	Night[1]	
			Calm[2]	Adverse[3]				
Casula	33	33	32	36	54	45	40	0 dB
Glenfield	<20	<20	<20	<20	54	45	40	0 dB
Wattle Grove	29	29	28	33	54	45	40	0 dB
S1	<20	<20	<20	22	45 (external, when in use)			0 dB
S2	24	24	23	27	45 (external, when in use)			0 dB
I1 (MPE)	60	60	60	60	70 (external, when in use)			0 dB
I2 (DJLU)	56	56	56	57	70 (external, when in use)			0 dB
I3 (ABB)	51	48	48	48	70 (external, when in use)			0 dB

1. Daytime 7:00am–6:00pm; Evening 6:00pm – 10:00pm; Night 10:00pm-7:00am.
2. CONCAWE Category 4
3. CONCAWE Category 6

Table 8-24: Predicted Intrusive $LA_{eq,\ 15min}$ Operational Noise Levels

Receiver	Predicted $L_{Aeq,15min}$ Noise Level (dBA)				Criteria (dBA)			Exceendance
	Day[1]	Evening[1]	Night[1]		Day[1]	Evening[1]	Night[1]	
			Calm[2]	Adverse[3]				
Casula	36	36	35	**39**	44	44	38	Up to 1 dB
Glenfield	<20	<20	<20	<20	40	40	38	0 dB
Wattle Grove	28	28	28	33	40	40	37	0 dB

1. Daytime 7:00am–6:00pm; Evening 6:00pm – 10:00pm; Night 10:00pm-7:00am.
2. CONCAWE Category 4.
3. CONCAWE Category 6.

As shown in Table 8-23 and Table 8-24 the operation of the Proposal as modelled under the assumptions listed above (indicating a worst case scenario) is not expected to result in any exceedance to either the amenity or intrusive noise criteria in Glenfield and Wattle Grove, even under adverse meteorological conditions. However, during periods where noise levels are enhanced by meteorological conditions, operational noise levels are predicted to exceed the established night time intrusiveness criterion at the most affected receivers in Casula. At six residential receivers in Casula, the noise levels are predicted to exceed the criterion by up to 1 dB. Exceedances of up to 1 dB are considered negligible and can be effectively mitigated.

Regarding operational noise levels on sleep disturbance, the loudest L_{Amax} noise source, with potential to cause sleep disturbance impacts, is pneumatic trailer brakes on trucks. The L_{Amax} SWL of a truck trailer brake is up to 122 dBA. It should be noted that this is significantly louder than a tonal reversing alarm.

The predicted L_{Amax} noise levels at nearby receivers due to pneumatic trailer brakes is shown in and Table 8-25. This indicates that the predicted LAmax noise levels at sensitive receivers are less than, and therefore comply with, sleep disturbance screening levels at all monitoring locations.

Table 8-25: Predicted LA_{max} noise levels at sensitive receivers

Receiver	Predicted L_{Amax} Noise Level (dBA)		Sleep Disturbance Screening Level (dBA)	Exceendace
	Calm[1]	Adverse[2]		
Casula	43	47	48	0 dB
Glenfield	<20	23	48	0 dB
Wattle Grove	20	24	47	0 dB

Cumulative Operational Noise Impacts

It is anticipated that the Proposal site will operate concurrently with the MPE Stage 1 site. Since the noise sources within the two sites are very similar, they are expected to have noise 'signatures' which are almost identical. Therefore, it is likely that sensitive receivers will look upon the two facilities as a single noise generating activity.

The $L_{Aeq, period}$ noise levels at sensitive receivers due to the concurrent operation of both facilities have been predicted by combining the computer noise models developed for each proposal, and assessed against the relevant amenity criteria, shown in and Table 8-26.

Table 8-26: Predicted Cumulative Operational Noise Levels

Receiver	Predicted $L_{Aeq, period}$ Noise Level (dBA)				Criteria (dBA)			Exceedance
	Day[1]	Evening[1]	Night[1]		Day[1]	Evening[1]	Night[1]	
			Calm[2]	Adverse[3]				
Casula	33	33	32	36	54	45	40	0 dB
Glenfield	20	20	20	24	54	45	40	0 dB
Wattle Grove	32	32	32	36	54	45	40	0 dB
S1	29	29	29	34	45 (external, when in use)			0 dB
S2	24	24	23	27	45 (external, when in use)			0 dB
I2 (DLJU)	56	56	56	57	70 (external, when in use)			0 dB
I3 (ABB)	51	48	48	48	70 (external, when in use)			0 dB

1. Daytime 7:00am–6:00pm; Evening 6:00pm – 10:00pm; Night 10:00pm-7:00am.
2. CONCAWE Category 4.
3. CONCAWE Category 6.

As outlined in Table 8-26, cumulative operational noise levels at sensitive receivers comply with all relevant amenity criteria at all times of the day.

Glenfield Waste Services are proposing to develop a Materials Recycling Facility on a parcel of land south west of the intermodal facilities, between the Georges River and the SSFL. The facility is proposed to operate during daytime hours.

Since the cumulative operational noise levels due to the intermodal facilities are more than 10 dB below the relevant daytime criteria at all sensitive receivers, they would be considered unlikely to contribute to any exceedance of daytime amenity criteria.

Road Noise

The most affected residential receivers to potential increases in road noise resulting from the Proposal operations are those situated immediately adjacent to the M5 Motorway, on Moorebank Avenue north of the M5 Interchange, and on Anzac Road east of Moorebank Avenue. No sensitive receivers are identified along Moorebank Avenue between the Proposal site and the M5 Interchange.

For the purposes of the noise impact assessment, existing traffic volumes along Moorebank Avenue, Anzac Road and the M5 Motorway were allocated into ‘day’ and ‘night’ periods, along with the ‘mix’ of heavy vehicles expressed as a percentage. The current and predicted daily traffic volumes, based on throughput of 500,000 TEU per annum, along the identified routes are shown in Table 8-27.

Table 8-27: Traffic distribution across areas representative of sensitive areas to road noise

Location	Time[2]	Current (no Development)		Future (with Development)	
		Volume	Mix	Volume	Mix
M5 Motorway – East of Moorebank Avenue	Day	106,140	10%	106,590	10%
	Night	20,850	11%	20,980	11%
M5 Motorway – West of Moorebank Avenue	Day	124,950	11%	126,860	11%
	Night	24,460	11%	24,880	12%
Moorebank Avenue – North of M5 Motorway	Day	27,290	11%	27,970	12%
	Night	6,290	10%	6,440	11%
Anzac Road – East of Moorebank Avenue	Day	9,000	4%	9,150	4%
	Night	2,130	4%	2,180	4%

Predicted increases in traffic noise were calculated using the *Calculation of Road Traffic Noise* (CORTN) algorithm. Predicted increases at typical receivers with a 25 m setback along the M5 and a 12 m setback along Moorebank Avenue and Anzac Road are shown in Table 8-28.

Table 8-28: Predicted increases in traffic noise levels

Location	Predicted Increase (dBA)	
	Day[1]	Night[1]
M5 Motorway – East of Moorebank Avenue	0.0	0.0
M5 Motorway – West of Moorebank Avenue	0.1	0.2
Moorebank Avenue – North of M5 Motorway	0.3	0.3
Anzac Road – East of Moorebank Avenue	0.1	0.1

1. Day = 7.00am – 10.00pm, Night = 10.00pm – 7.00am

As shown in Table 8-28, increases to traffic noise as a result of the Proposal along the roads modelled are well below the 2 dBA noise goal outlined within the RNP (refer to Section 8.2 of this EIS). No mitigation of traffic noise is therefore warranted.

Rail Operations

Rail noise modelling was undertaken for all trains travelling between the Proposal site and the SSFL. Previous approval of the SSFL accounts for freight movements generated by an intermodal terminal facility in the Moorebank area. No assessment was therefore undertaken of noise emissions from movements on the SSFL generated by the Proposal.

Trains accessing the Proposal would typically comprise an 81 Class locomotive and associated rolling stock. Six trains would service the IMT facility each day, equating to 12 train movements per day which are assumed to be evenly distributed throughout the 24 hour period. Assessment methodology for rail noise is described in Section 8.2 of this EIS. Due to the use of best practice rolling stock and track maintenance, as required by the draft conditions of approval for MPE Stage 1, wheel squeal and flanging are considered unlikely to occur.

A worst case 24 hour period was selected for the assessment, which would typically involve the following trains accessing the Proposal site, distributed evenly across this time for the purposes of the assessment:

- Two trains of up to 900 metres in length, with one locomotive and 38 wagons;
- Two trains of up to 1,500 metres in length, with four locomotives and 62 wagons; and
- Two trains of up to 1,800 metres in length, with four locomotives and 74 wagons.

The predicted $L_{Aeq,\ period}$ noise levels with respect to the Proposal at sensitive receivers are outlined in Table 8-29.

Table 8-29: Predicted L_{Aeq}, period Rail Noise Levels

Receiver	Predicted Level (dBA)			Criteria (Recommended)			Exceedance
	Day	Evening	Night	Day	Evening	Night	
Casula	50	**50**	**48**	55	45	40	8 dB
Glenfield	43	43	**41**	55	45	40	1 dB
Wattle Grove	41	42	39	55	45	40	0 dB
S1	**48**	**48**	**47**	45 (when in use)			2 dB
S2	43	43	42	45 (when in use)			0 dB

The above table indicates that $L_{Aeq,\ period}$ noise levels exceed the relevant criteria at the most sensitive receivers in Casula during the evening and night time, and in Glenfield during the night time. The predicted $L_{Aeq,\ period}$ noise levels also exceed the criteria at S1.

Predicted $L_{Aeq,\ period}$ rail noise levels exceed the relevant criteria at sensitive receivers within Casula and Glenfield. Based on the INP amenity levels, these locations are already subject to significant levels of rail noise from the existing network rail lines (SSFL and the Main Southern Line). The existing numbers of rail movements due to both passenger and freight trains travelling along network rail lines in the vicinity of the sensitive receivers are significantly higher than the additional movements associated with the Proposal. Therefore, it is expected that the existing $L_{Aeq,\ period}$ levels of rail noise at the most affected receivers within Casula and Glenfield are unlikely to noticeably increase due to the Proposal.

8.5 Mitigation measures

The ambient noise monitoring surveys within Casula, Wattle Grove and Glenfield would be continued throughout the construction and operation of the Project (with annual reporting of noise results up to two years beyond the completion of Full Build). The noise surveys would quantify any potential noise from the Proposal and identify any trends/changes in the ambient noise environment during the progressive development.

The measured noise levels and contribution from the operation of the Proposal would be continually applied to the detailed design of the Proposal to ensure it includes appropriate mitigation measures to reduce and control noise during construction and operation. The monitoring data would also include any changes to the ambient noise environment from new or changed developments in the area.

In the event of any noise or vibration related complaint or adverse comment from the community, noise and ground vibration levels would be measured at the potentially affected premises, where reasonable and feasible. The measured noise and/or vibration levels would then be assessed to ascertain if remedial action is required.

8.5.1 Construction

Noise modelling results presented in Section 8.4 of this EIS indicate that minor exceedances of relevant noise criteria are expected during construction, but largely are within applicable NMLs at sensitive receivers selected for the assessment. Notwithstanding this, some additional measures to mitigate noise impacts associated with construction activities are included below to further reduce noise impacts.

A Construction Noise and Vibration Management Plan (CNVMP), or equivalent, would be prepared for the Proposal in accordance with the ICNG, and would give consideration to REMMS 5A – 5T (of the MPW Concept Plan Approval (SSD 5066)), as outlined in Appendix A of this EIS.

The ambient noise monitoring surveys undertaken within Casula, Wattle Grove and Glenfield would be continued throughout the construction of the Proposal.

In the event of any noise or vibration related complaint or adverse comment from the community, noise and ground vibration levels would be investigated. Remedial action would be implemented where feasible and reasonable.

8.5.2 Operation

As outlined in Section 8.4.2 of this EIS, a noise wall would be established along a portion of the western boundary of the Proposal site. The need for this noise wall was identified in the MPW Concept EIS, and subsequent modelling has confirmed the need for such a barrier. The indicative height and extent of the noise wall was presented in Section 8.4.2 and Appendix N of this EIS. The actual height and extent of the noise wall would be confirmed, based on further noise modelling undertaken during detailed design.

A number of measures to mitigate noise levels from the operation of the Rail link were identified in the MPE Stage 1 Proposal and the associated draft conditions of consent. No additional rail noise mitigation measures, due to the Proposal, are considered necessary.

The ambient noise monitoring surveys undertaken within Casula, Wattle Grove and Glenfield would be continued throughout the operation of the Proposal (with annual reporting of noise results up to two years beyond the completion of the Proposal).

In the event of any noise or vibration related complaint or adverse comment from the community, noise and ground vibration levels would be investigated. Remedial action would be implemented where feasible and reasonable.

Best practice noise mitigation measures would be implemented for the operational phase of the Proposal including:

- Noise monitoring
- A gate appointment system would be implemented to minimise truck loading/unloading wait times and resultant queueing. Trucks would be turned away from facility if arriving too early
- Truck marshalling lanes would be included to minimise congestion and queueing
- The provision of information signs and communication of MPW idle reduction policy.

No further mitigation measures, additional to those identified in the MCoAs and REMMs (refer to Appendix A of this EIS) or detailed above, are considered warranted for the Proposal.

9 AIR QUALITY

An *Air Quality Impact Assessment* was prepared by Ramboll Environ (2016) (refer to Appendix O of this EIS) to assess the impacts on air quality arising from the construction and operation of the Proposal.

Table 9-1 sets out the Secretary's Environmental Assessment Requirements (SEARs) as they relate to the Proposal, and where these have been addressed.

Table 9-1: SEARs for the Proposal relating to Air Quality

Section/Number	Requirement	Where addressed in this EIS
3. Air Quality	A comprehensive air quality impact assessment including:	
	a) An assessment in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (2005) (or its later version and updates)	Section 9.4 of this EIS
	b) An assessment of construction related impacts including dust and wind erosion from exposed surfaces and proposed mitigation measures and safeguards to control dust generation and other airborne pollutants and to minimise impacts on nearby receptors.	Sections 9.4 and 9.5 of this EIS
	c) An updated assessment/review of direct and indirect greenhouse gas emissions arising from this development and associated impact mitigation requirements, in reference to the Concept Plan greenhouse gas assessment.	Section 18 of this EIS

An *Air Quality Management Plan* has also been prepared by Ramboll Environ (2016) to address the SEARs. This plan builds on the recommendations provided within both the *Air Quality Impact Assessment* and *Air Quality Best Practice Review* to enable implementation of mitigation measures and further reduction of air quality impacts related to the Proposal.

SEARs relating to greenhouse gas emissions are addressed in Section 18 of this EIS and SEARs relating to cumulative impacts are addressed in Section 19 of this EIS.

This Section summarises the studies undertaken previously for the MPW Concept Approval and, more recently, for the Proposal. This Section provides an assessment of potential impacts resulting from construction of the Proposal on Air Quality (Appendix O). Measures to mitigate impacts have also been identified where they are required.

9.1 MPW Concept Approval

A *Local Air Quality Impact Assessment* (2014) was prepared by Environ Australia Pty Ltd to assess local construction air quality impacts for Early Works, and a *Regional Air Quality Assessment (2014)* was prepared by Todoroski Air Sciences to assess predicted operational air quality impacts at a "full build" Proposal scenario at 2030. The investigations were undertaken to assess commitments consistent with the SEARs associated with the MPW Concept EIS.

Onsite air quality monitoring was carried out for a range of pollutants and compared with ambient air quality data at Liverpool and Chullora to quantify baseline air quality. Regional air quality impacts during the Early Works construction phase were not assessed as their impact on the regional air environment was deemed negligible[26]. The assessment identified the following key characteristics relating to the existing air environment for the Proposal and surrounding area:

- The local air drainage profile of the area is likely to be affected by katabatic drift[27]
- The annual wind distribution pattern for the OEH Liverpool monitoring station shows that the prevailing wind direction is from the west-south-west, with south-westerly and westerly winds also occurring frequently. These winds dominate during autumn, winter and spring. Airflow from the east and south-east is more prevalent during summer. A smaller percentage of winds originate from all other directions, with the lowest frequency of winds originating from the north-eastern quadrant.
- Temperature data from Bankstown Airport indicates that January typically has the highest temperature, with a mean maximum of 28.2°C, while July is the coldest month with a mean maximum of 17.1°C. Rainfall data shows that February is usually the wettest month, with a mean monthly rainfall of 106 mm, while the driest month is usually September. The area annually experiences an average of 896 mm of rainfall per year.
- Annual average PM10 concentrations at both the onsite and OEH Liverpool stations are below the NSW EPA criterion of 30 µg/m3
- The 1-hour average annual NOx data indicate that ambient concentrations are well below the relevant OEH Criteria of 246 µg/m3
- The 1-hour average CO concentration is well below the OEH criterion. All measured CO levels taken at the Liverpool monitoring station met the OEH criterion.
- The annual average PM2.5 concentration recorded during 2013 at the OEH Liverpool station was 9.4 µg/m^3, which exceeds the NEPM advisory reporting goal of 8 µg/m^3.

The *Local Air Quality Assessment* identified 38 discrete sensitive receivers surrounding the MPW site, as shown on Figure 9-1.

Atmospheric dispersion modelling was carried out using the AMS/US-EPA regulatory model (AERMOD). The model considered the MPW Project (incremental) ground level concentrations and deposition rates, covering a seven kilometres squared area centred over the MPW site, with a grid resolution of 200 m. Additionally, model predictions were made at 38 sensitive receptor locations, representative of the local area (refer to Figure 9-1). The following findings were made:

- Incremental air pollutant concentrations and dust deposition rates associated with all modelled scenarios were predicted to be within NSW EPA criteria and NEPM advisory reporting goals at all surrounding receptor locations
- Taking elevated background airborne PM concentrations into account, no exceedance days were predicted for 24-hour average PM_{10} and $PM_{2.5}$ beyond those already recorded due to bushfire events in 2013

[26] Ambient air quality standards for the region (which are monitored by the NSW EPA) are rarely exceeded for extended periods and usually correlate with particular unexpected events such as bushfires and dust storms.

[27] 'Katabatic drift' is the term used to describe the downward motion of cold air from a high point. This can result in plume entrapment (i.e. poor dispersion of airborne pollutants) and the potential to cause greater off-site impacts.

- Exceedance of the annual average NEPM advisory reporting goal for cumulative $PM_{2.5}$ is predicted for one receptor (R33). R33 was the DNSDC facility, which is now the MPE site, located adjacent to the eastern boundary of the MPW site
- All incremental cumulative and gaseous pollutants assessed are below applicable NSW EPA assessment criterion for all scenarios.

In-principle changes to the management of the MPW site and the design, including changes to the layout, rail access and conservation area informed a *Revised Local Air Quality Impact Assessment* (Ramboll, 2015), which was issued as part of the MPW RtS. Predicted impacts arising from the updated information show only minor variance from that originally reported, and outcomes from the initial report above were retained.

A number of submissions were made both by community members and other stakeholders, including the EPA, as part of the SRtS. No further changes or additional assessment was undertaken in response to these changes.

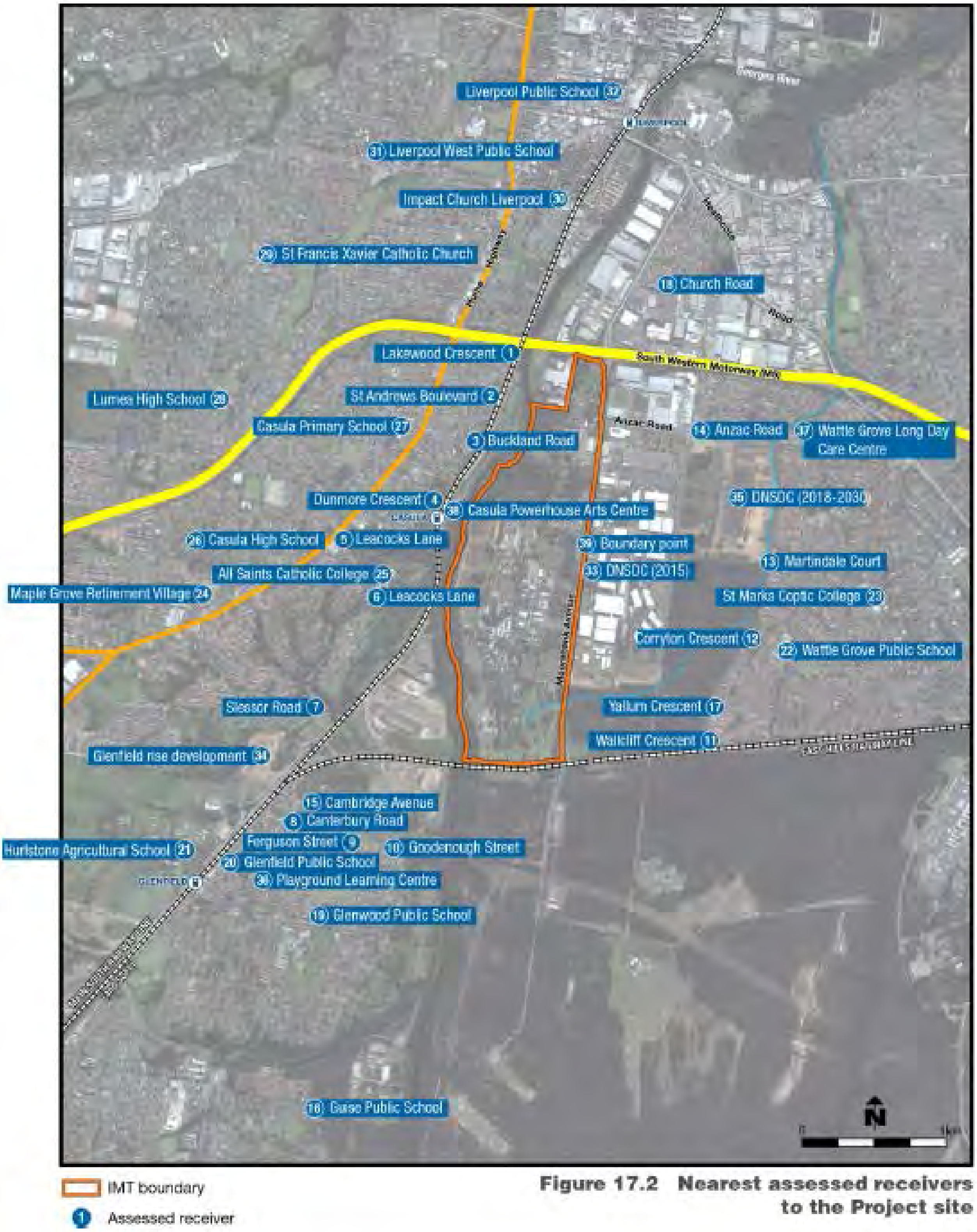

Figure 9-1: Sensitive receivers identified for Concept Approval EIS investigation

9.2 Methodology

The NSW Environment Protection Authority (EPA) *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales ("the approved methods")* (NSW EPA, 2005a) outlines guidelines, reflective of Australian community standards, intended to protect the community against the adverse effects of air pollutants. Guidelines are largely derived from epidemiological studies undertaken in urban areas with large populations where the primary pollutants are the products of combustion (National Environment Protection Council (NEPC), 2003).

Local air quality impacts from the Proposal have been assessed using a Level 2 assessment approach in general accordance with the Approved Methods. An overview of the approach to the assessment is as follows:

- Emissions are estimated for Proposal related activities, using best practice emission estimation techniques
- Dispersion modelling using a regulatory dispersion model is used to predict ground level concentrations for key pollutants from the Proposal, at surrounding sensitive receivers
- Cumulative impacts are assessed, taking into account the combined effect of existing baseline air quality, other local sources of emissions, reasonably foreseeable future emissions and any indirect or induced effects.

9.2.1 Pollutant indicators

Key emissions considered for the construction of the Proposal are fugitive dust or particulate matter (PM), generated principally through building demolition, site clearing and earthworks activities.

The key emissions considered during operations are associated with the combustion of diesel fuel. Indicators for each of these emissions sources are shown in Table 9-2.

Table 9-2: Air Quality indicators for assessment

Phase	Emission source	Air quality indicator
Construction	Fugitive dust	Particulate matter (TSP, PM_{10} and $PM_{2.5}$)
		Nuisance dust (dust deposition)
Operations	Diesel combustion	PM_{10} and $PM_{2.5}$
		Oxides of nitrogen (NO_x)
		Sulphur dioxide (SO_2)
		Carbon monoxide (CO)
		Volatile organic compounds (VOCs)

9.2.2 Assessment criteria for particulate matter and dust

Under the National Environment Protection (Ambient Air Quality) Measure (AAQ NEPM), national reporting standards were initially prescribed for 24-hour average PM_{10} concentrations (NEPC, 1998). The AAQ NEPM was varied in 2003 to include 'advisory reporting standards' for $PM_{2.5}$ (NEPC, 2003) and again in 2015 to adopt these 'advisory reporting standards' as formal standards for $PM_{2.5}$ (NEPC, 2015). The latest variation also introduces an annual reporting standard for PM_{10} and establishes long term goals for $PM_{2.5}$, to be achieved by 2025 (NEPC, 2015).

The purpose of the AAQ NEPM is to attain *'ambient air quality that allows for the adequate protection of human health and wellbeing',* and compliance is assessed through the collection and reporting of air quality monitoring data by each state and territory. These standards are therefore not necessarily applicable to the assessment of individual emission sources on sensitive receptors, but importantly require consideration. For the latter purpose, the NSW EPA's impact assessment criteria are used. In the case of $PM_{2.5}$, impacts are reported against the latest AAQ NEPM standards.

Impact assessment criteria and AAQ NEPM national reporting standards for particulate matter is provided below in Table 9-3.

Table 9-3: Impact assessment criteria and AAQ NEPM national reporting standards for PM

PM metric	Averaging period	Concentration (µg/m^3)	Purpose
TSP	Annual	90	NSW EPA impact assessment criteria
PM_{10}	24 hour	50	NSW EPA impact assessment criteria
		50	AAQ NEPM national reporting standard
	Annual	30	NSW EPA impact assessment criteria
		25	AAQ NEPM national reporting standard
$PM_{2.5}$	24 hour	25	AAQ NEPM national reporting standard
		20	AAQ NEPM national reporting standard
	Annual	8	AAQ NEPM goal for 2025
		7	AAQ NEPM goal for 2025

For the assessment of nuisance dust during construction, the NSW EPA impact assessment criteria for dust deposition were selected, reflecting the maximum increase and total acceptable dust deposition rates before dust nuisance. Cumulative annual average dust deposition rates in residential areas that are above 4 g/m^2/month are considered to constitute dust nuisance, reflected below in Table 9-4.

Table 9-4: Nuisance dust assessment criteria

Pollutant	Maximum Increase in Dust Deposition	Maximum Total Dust Deposition Level
Deposited dust	2 g/m^2/month	4 g/m^2/month

9.2.3 Assessment criteria of gaseous pollutants

VOC Speciation

While many VOC species are emitted from combustion of fossil fuels, benzene, 1,3-butadiene and polycyclic aromatic hydrocarbons (PAHs) are selected for assessment as they are categorized in the Approved Methods as “principal toxic air pollutants” and are among the species with the most stringent impact assessment criteria (refer to Table 9-5).

Speciation profiles of individual VOCs used in the *NSW GMR emissions inventory* (2007) were used for the assessment. Emissions of benzene, 1,3-butadiene, and PAHs were derived for locomotives, container handling equipment and trucks based on the percentage of total VOCs for each species, representing existing environmental conditions for the Proposal site.

Table 9-5: Speciation profiles for VOCs

Source	% of total VOC		
	Benzene	1,3-butadiene	PAHs
Locomotives*	0.22%	0.27%	0.13%
Container handling equipment**	2.03%	0.29%	0.05%
Trucks***	1.07%	0.4%	1.65%

*Based on GMR emissions presented for each compound for locomotives in Table ES-3 of NSW EPA (2012a)
**Based on GMR emissions presented for each compound for commercial off-road vehicles in Table ES-3 of NSW EPA (2012a)
***Based on diesel vehicle speciation data profiles for heavy duty diesel vehicles as presented in Table 4-74 of NSW EPA (2012b)

Impact assessment criteria for gaseous pollutants

Impact assessment criteria have been formulated for ‘criteria pollutants[28]’, at the nearest sensitive receptor to the Proposal site, and compared against the highest dispersion modelling prediction (100th percentile). Impact assessment for air toxics (i.e. VOC components of diesel exhaust emissions) are applied at, and beyond the site boundary as the 99.9th percentile of dispersion modelling predictions to yield the most stringent (i.e. worst case) criteria.

Table 9-6: Impact assessment criteria for gaseous pollutants

Pollutant	Averaging period	Concentration	
		µg/m^3 *	Pphm**
NO_2	1-hour	246	12
	Annual	62	3
SO_2	10-minute	712	25
	1-hour	570	20
	24-hour	228	8
	Annual	60	2

[28] Criteria pollutants refers to air pollutants that are commonly regulated and typically used as indicators for air quality. In the “approved methods” the criteria pollutants are TSP, PM_{10}, NO_2, SO_2, CO, ozone (O_3), deposition dust, hydrogen fluoride and lead.

Pollutant	Averaging period	Concentration	
		µg/m³ *	Pphm**
CO	15-minute	100,000	8,700
	1-hour	30,000	2,500
	8-hour	10,000	900
1,3-butadiene	1-hour***	40	1.8
Benzene	1-hour***	29	0.9
PAHs (as BaP)	1-hour***	0.4	-

*Gas volumes for criteria pollutants expressed at 0°C and 1 atmosphere, and principal toxics at 25°C

**pphm – parts per hundred million

***Expressed as the 99.9th Percentile Value.

9.2.4 Cumulative assessment methodology

Cumulative impacts were assessed by combining the air emission impacts generated from the Proposal in isolation with the following sources[29]:

- The existing ambient air quality environment, based on baseline monitoring data collected for the Proposal (refer to Section 9.3.3 and 9.3.4 of this EIS).
- Approved future emission sources, including the predicted air impacts from the construction and operation of the MPE Stage 1 Proposal.

9.2.5 Best practice review

In accordance with the REMMs for the Proposal, A *Best Practice Review for Air Quality* (BPR) was conducted by Ramboll (2016) to provide a best management practice (BMP) determination[30], presented as Appendix 5 to the *Air Quality Assessment* (Appendix O). The following definition of 'best practice' included in the Victoria *State Environment Protection Policy* (SEPP) (*Air Quality Management*) has been adopted and is considered applicable in its application to the Proposal:

'the best combination of eco-efficient techniques, methods, processes or technology used in an industry sector or activity that demonstrably minimises the environmental impact of a generator of emissions in that industry sector or activity'.

The term 'best practice' implies a degree of pragmatism, cost effectiveness and decisiveness with regard to practicability. When assessing best practice, one should

[29] It is noted that the Glenfield Waste Services (GWS) site, located to the southwest of the Proposal site, has a current SSD application for a Material Recycling Facility, capable of processing up to 450,000 tonnes of per annum of general solid waste. An Air Quality Assessment prepared for the application (SLR, 2015) indicates that concentrations of $PM_{2.5}$ from the facility would be minor (annual average < 0.2 µg/m³). As $PM_{2.5}$ is the key limiting pollutant for the operation of the Proposal, no further cumulative consideration of the GWS site is considered.

[30] In conducting a BMP determination, consideration should be given either to reasonably available techniques (RAT) or best available techniques (BAT), according to definitions of these terms under the European Union Directive on Integrated Pollution Prevention and Control. The degree of environmental risk may be an appropriate trigger for consideration of RAT or BAT.

have regard to technical, logistical and financial considerations and be proportional to the environmental risk (EPA Victoria, 2013).

The scope of the best practice review conducted included a desktop investigation of the following emission reduction aspects considered relevant to the Proposal:

- Emissions standards and emission reduction options for existing in-service locomotives (i.e. repower, retrofit) for large line haul and switching locomotives (refer to Section 9.2.5 of this EIS)
- Emission standards for non-road diesel equipment and emission reduction options for container handling equipment (CHE) (refer to Section 9.2.5 of this EIS)
- Queuing and idle reduction strategies for trucks and locomotives (refer to Section 9.2.5 of this EIS).

The review focused on the most significant air emissions (NO_x, PM_{10} and $PM_{2.5}$) from the following sources associated with the operational phase of the Proposal:

- Locomotives
- Container handling at the IMT
- The locomotive shifter
- Internal truck transfers.

Outcomes of this BPR, as summarised in Table 9-12, have been considered in light of relevant planning requirements and have contributed toward formulating mitigation and management measures as set out within Sections 9.5.1 and 9.5.2 of this EIS.

It is noted that SIMTA would have operational control over approximately 40% of locomotives entering the Proposal IMT facility, therefore control over emissions performance improvements is limited to 40% of the fleet.

Emission standards for locomotives

In Australia, Commonwealth Fuel Quality Standards mandate fuel quality for petrol, automotive diesel, biodiesel (B100) and autogas, yet no separate fuels standards apply for locomotives. In contrast, locomotive emission standards in both the EU and US are well established and trending towards increased harmonisation and more stringent limits. For this assessment, EU and US standards have been adopted as best practice. This notion (Australia harmonising standards with the US and EU) was a recommendation made by the Commonwealth of Australia Senate Community Affairs Reference Committee following a Senate enquiry into the impacts on health of air quality in Australia.

A review of international emissions standards was undertaken to determine the current best practice, and to identify the likely emission standards that may be introduced in Australia in the future.

United States Standards

The United States of America (USA) EPA follows a tiered approach to regulation of emissions from new locomotives and re-manufactured locomotives, based on the power and purpose of the locomotive and the age of the locomotive. Essentially, the more recent the locomotive manufacture or re-manufacture date, the more stringent the emissions standard, as new technologies, such as the recent application of high efficiency catalytic after treatment technology[31] become more readily available. The first

[31] High efficiency catalytic after treatment technology is a term that includes a number of technologies that can be included in vehicle exhaust systems to reduce NOx, the organic fraction of diesel particulates, gas phase hydrocarbon and carbon monoxide.

set of standards (Tier 0) is applied to locomotives originally manufactured and re-manufactured prior to 2001, while the most recent standards introduced (Tier 4) apply to new locomotives manufactured since 2015 onwards.

US Tier 0 to Tier 4 emission standards for low and high power engines are given in Table 9-7 for line haul and switch/shunting locomotive applications.

Table 9-7: US-EPA Tiered Standards for line haul and switch haul locomotives

Tier Classification	PM_{10}	HC	NO_x	CO
Line Haul Emission Standards (g/kW-hr)				
Uncontrolled	0.43	0.64	17.43	1.72
Tier 0	0.43	0.64	11.53	1.72
Tier 0+	0.27	0.40	9.66	1.72
Tier 1	0.43	0.63	8.98	1.72
Tier 1+	0.27	0.39	8.98	1.72
Tier 2	0.24	0.35	6.64	1.72
Tier 2 + and Tier 3	0.11	0.17	6.64	1.72
Tier 4	0.02	0.05	1.34	1.72
Switching Shunting Emission Standards (g/kW-hr)				
Tier Classification	PM_{10}	HC	NO_x	CO
Uncontrolled	0.59	1.35	23.33	2.45
Tier 0	0.59	1.35	16.90	2.45
Tier 0+	0.31	0.76	14.21	2.45
Tier 1	0.58	1.35	13.28	2.45
Tier 1+	0.31	0.76	13.28	2.45
Tier 2	0.25	0.68	9.79	2.45
Tier 2 +	0.15	0.35	9.79	2.45
Tier 3	0.11	0.35	6.03	2.45
Tier 4	0.02	0.11	1.34	2.45

The implementation of Tier 4 standards in the USA, which incorporate sulphur-sensitive control technologies such as catalytic particulate filters and NO_x absorbers, necessitated the mandated reduction of sulphur content within diesel fuel. As such, diesel fuel for non-road vehicles is now regulated through the *Clean Air Non-road Diesel Rule* of 2004. The rule reduced sulphur levels to 500 ppm, effective June 2007 and to 15 ppm (ultra-low sulphur diesel) for non-road fuel, effective June 2010, and locomotive and marine fuels, effective June 2012.

European Union Standards

The European Union (EU) has adopted the *Non-Road Diesel Machinery Directive* which incorporates emission standards for railroad locomotive engines in their Stage III standards (Stages IIIA and IIIB) (EU, 2004). Stage IIIB came into force from 1 January 2011 for railcars and locomotives. The standards apply to new locomotives and cover different engine rating categories. Table 9-8 shows EU emission standards for railcars and locomotives.

Table 9-8: European Union (EU) standards for locomotive engines

Category (kW)	PM	HC + NO_x	HC	NO_x	CO
Stage III A Standards (g/kW-hr)					
130 <kW (Railcars)	0.2	4.0	-	-	3.5
130 ≤kW≤560 (Railroad Locomotives)	0.2	4.0	-	-	3.5
kW > 560 (Railroad Locomotives)	0.2	-	0.5	6.0	3.5
kW > 2000 and Swept Volume > 5l/cylinder (Railroad Locomotives)	0.2	-	0.4	7.4	3.5
Stage III B Standards (g/kW-hr)					
130 <kW (Railcars)	0.025	-	0.19	2.0	3.5
130 <kW (Railroad Locomotives)	0.025	4.0	-	-	3.5

Emission reduction options for in-service locomotives

The EPA commissioned the Locomotive Emissions Project (ENVIRON, 2013), to work towards a strategy for managing and reducing diesel emissions from locomotives. This project identified potential measures to reduce emissions from new and in-service locomotives in NSW and Australia. In addition, a number of international case studies have been publicly show-cased, including:

- California (USA): since the early 1990s the California Air Resources Board (CARB) has lead the way in best practice measures to reduce locomotive emissions through state regulations, voluntary agreements and incentive programs.
- Europe: International Union of Railways (UIC) commissioned the Rail Diesel Study in 2006 (Kollamthodi, 2006) to identify measures for reducing exhaust emissions from existing locomotives and assess the practicability of engines implementing the Stage III A and Stage III B standards.

Further discussion on these case studies has been provided in the *Best Practice Review for Air Quality*, presented as Appendix 5 to the *Air Quality Assessment* (refer to Appendix O of this EIS).

A range of initiatives have been implemented more locally in Australia and internationally to address air emissions from in-service locomotives, including fleet upgrades, repowering, fuel efficiency improvements and retrofitting of after-treatment systems. The options presented below apply only to fleet under SIMTA's operational control for the Proposal.

Engine upgrades and repowering

Fleet upgrades usually focus on fleets with older engine configurations that can be upgraded to the highest tier achievable at least cost. Repowering and rebuilding schemes currently being implemented in Australia include the repowering of locomotives using modern high speed diesel engines (Gen-set engines). Emission reduction capabilities from rebuilding are dependent upon the age and class of locomotive being serviced.

Locomotive overhaul usually takes place every ten years or so, and therefore may have applicability potential as part of the Proposal if integrated into future Project development stages (depending on the age and timing of last overhaul concerning the existing fleet). Alternative drivetrain technologies that could be considered during scheduled overhaul programs are presented in Table 9-9.

Table 9-9: Alternative drivetrain technologies

Technology	Advantages	Disadvantages	Suitability for Proposal
Gen Set Switch Locomotive Battery electric hybrid switch locomotive (Green Goat)	Classified as ultra low-emitting switch locomotives (ULESL) Low implementation difficulty, technically viable and suitable for short term implementation	More expensive than traditional switch locomotives.	May be an option for the Proposal as a new switching locomotive is required.
Alternative fuels (LNG/CNG) for switching locomotives	High emission reductions.	Implementation difficulty is medium and requires design modification for existing locomotives. Medium to high economic cost and long term implementation	Long term implementation makes this not currently practical.
AC Traction	Replacement of conventional DC traction motors leads to efficiency gains	Low emissions improvement.	Long procurement process expected for Australia which means not currently practical.
Battery storage for smaller switch locomotives	Very high emission reduction and fuel savings.	Commercially viable systems currently unavailable	Not applicable as a large dual loco switcher is required
Track electrification	Local emissions benefit.	Would require SSFL to be fully electrified, requiring significant upgrade.	Not applicable.

Fuel Efficiency improvements

Potential options for integrating fuel efficiency improvements with operation of the Proposal are explored in Table 9-10.

Table 9-10: Options for fuel efficiency improvements

Technology	Advantages	Disadvantages	Suitability for Proposal
Driver Assistance Systems which assists driver in fuel efficient driving (i.e. slower acceleration	Medium emission reductions and	N/A	Existing locomotive fleet to be deployed

Technology	Advantages	Disadvantages	Suitability for Proposal
and gradual deceleration) and optimal notch setting selection.	fuel savings. Already implemented in Australian and low cost.		but could be considered during upgrade or replacement.
Idle reduction technologies, including: ▪ Automatic engine shutdown/startup systems (AESS) ▪ Auxiliary power units (APU)/ Generator sets ▪ Electrification (on board or shore connection systems) Anti-idling operational policies are discussed further later in this Section 9.5.2.	Low / medium emissions reduction with moderate fuel savings. Implementation difficulty and cost are low, depending on the system.	N/A	Existing locomotive fleet to be deployed but could be considered during upgrade or replacement.
Electronically Controlled Pneumatic (ECP) Brakes	Low / medium emissions reduction and fuel savings. Implementation difficulty and cost are considered low.	Emphasis to date has been on new rolling stock.	Existing rolling stock used but could be considered during upgrade or replacement.
Improved Aerodynamics - effects are greatest when applied along the whole train length (e.g. ordering freight cars to optimise aerodynamic profile, minimising gaps between cars).	Improvement opportunities are greatest for intermodal container trains due to these trains being characterised by significantly higher aerodynamic drag.	Low emissions reduction potential	Yes

Modified after ENVIRON, 2013

Retrofitting of after-treatment

After-treatment systems which may be retrofitted to existing locomotives on the Proposal site include:

- Diesel particulate filters (DPF). A control device which physically captures diesel particulates preventing their discharge from the tailpipe. Collected particulates need to be removed from the filter, usually by thermal regeneration. DPF can achieve significant reductions (in excess of 90%) of PM emissions.

- Selective catalytic reduction (SCR). An active emissions control measure that injects a reducing agent (usually urea) through a catalyst into the exhaust stream of a diesel engine, reducing NO_x emissions to the less harmful N_2, CO_2 and H_2O gases.
- Selective catalytic reduction with diesel particulate filters (SCR+DPF). A control measure which combines DPF with SCR to achieve reductions in both PM and NO_x.
- Exhaust gas recirculation (EGR). A control technology that reduces NO_x through lowering the oxygen concentration in the combustion chamber, as well as through heat absorption.

The feasibility of these pollution abatement strategies for fleet locomotives depends on the age and existing emission performance of the fleet. The size and weight of the after-treatment devices must also be considered as implementation may result in increased fuel consumption.

Container handling equipment

Typical mobile container handling equipment to be used for Proposal operations include reach stackers, container forklifts and yard trucks, which are generally powered by off-road compression-ignition diesel engines. Similarly to locomotives, there are no existing regulations or standards in place in Australia that limit emissions from non-road diesel engines. By contrast, emissions regulations for non-road diesel engines in the US and EU are well established, being in place since the mid 1990's. China, India, Japan and Canada also have regulated emissions limits for non-road diesel engines.

In Australia the NSW EPA is working with the Commonwealth Government Department of Environment on national measures to support the supply and purchase of lower emissions non-road diesel equipment. In addition and as part of the EPA strategy on diesel emissions, there are a number of initiatives underway for non-road diesel.

Policy objectives and strategies for non-road diesel that the EPA are investigating include:

- Ensuring new equipment complies with international emission standards
- Benchmarking best practice measures for reduction of particulate matter from non-road diesel equipment at operational industrial sites, such as coal mines
- Implementing policies such as anti-idling
- Retrofitting older equipment with diesel particulate filters

The EPA is looking in particular at proposed actions for non-road diesel vehicles used at NSW coal mines and have developed a benchmarking study looking at best practice measures for reducing non-road diesel exhaust emissions (NSW EPA, 2014b). The review looked at the costs and benefits associated with upgrading equipment with Tier 2/3 and 4 compliance equipment and in service retrofit of exhaust after treatment.

Emissions reduction options for container handling equipment that may be relevant to the Proposal, in addition to imposing emission limits for non-road diesel, are presented in Table 9-11.

Table 9-11: Emission reduction options for container handling

Category	Technology	Comment
Alternative fuels	LNG	While reductions in PM can be expected, studies comparing on-road diesel to on-road LNG yard trucks, showed significantly higher NO_x emissions from the LNG engines (CARB, 2009). Other considerations are a reduction in fuel efficiency, increased weight requirements for fuel tanks and re-fuelling infrastructure. Commercially available options for yard trucks and forklifts.
	Electrification	Diesel-electric hybrid technology commercially available for rubber tired gantry (RTG) cranes and reach sackers. Electric rechargeable technologies limited to small forklifts Electrified gantry crane systems would come close to eliminating all container handling emissions (although some diesel equipment may be needed). Generally, these are implemented at facilities designed to handle a large volume of containers (i.e, more than 750,000 per year) (CARB, 2009). Energy storage systems (ESS) can be used to capture regenerated energy that would otherwise be lost as heat in crane breaking. As the crane lowers a container, the hoist motor act as a generator, using regenerative braking, to capture the energy and use it to reduce the load of the engine through the duty cycle.
Idle reduction	Idle reduction devices	More commonly implemented on locomotives and yard trucks. Despite this, demonstration projects are currently underway relating to container handling equipment for ports in the US, which includes the installation of preheaters on reach stackers and container forklifts.
	Anti-idling policies	Anti-idling policies may also effectively reduce emissions from CHE, although the emission reduction would depend on the extent of un-necessary idling for these types of equipment.
Exhaust after treatment		Options include diesel oxidation catalysts (DOC) and diesel particulate filters (DPF).

Queuing and idle management

Operational strategies such as automation technologies and truck reservation/appointment systems may improve operational efficiency at intermodal terminals and reduce truck idling time (Corry and Kozan, 2006; Bektas and Crainic, 2007; Morais and Lord, 2006). Automation technologies employed at ports and intermodal terminals include:

- Optical character recognition to identify trucks and containers
- GPS systems to increase efficiency of container stacking and retrieval
- CCTV to monitor traffic and container activity
- Radio frequency identification devices, electronic seals and barcode for equipment and container identification and localisation
- Variable message signs to assign and direct traffic.

Unnecessary or long duration idling can be reduced through technology and/or behaviour change. The technology options for idle reduction were previously listed in Table 9-11 and include AESS, APUs and shore connection. Idle reduction technology options for trucks include APUs, fuel operated heaters, battery air conditioning systems and thermal storage systems.

Locomotives and trucks servicing the MPW IMT facility will, for the most part, be independently operated. The focus is therefore on operational strategies rather than technology upgrades. Operation strategies may include driver behaviour, education, training, and imposed idle limits.

Definition of 'long duration' idling

An evidence based approach was used to determine an acceptable threshold where idling becomes long duration. Morais & Lord (2006) assumed long duration idling for trucks corresponds to the truck propulsion engine not engaged in gear for a period greater than 15 consecutive minutes, citing a number of studies by environment protection agencies, and defined long and short-term idling as follows:

- Short idling occurs when vehicles move regularly such as in traffic, gate wait, etc. (<15 min)
- Long idling occurs when vehicles stay stationary for a long period of time, such as during train crossing, waiting for a load, sleeping, etc. (> 15 min).

The US EPA defines long duration idling for yard locomotives as greater than 15 consecutive minutes (US EPA, 2009). Also, the CARB require AESS systems for yard locomotives to limit idling to 15 minutes.

While a 15 minute period has been adopted in the international literature for 'long duration' idling, the evidence presented in *Air Quality Assessment* (Environ, 2015) for the adjacent MPE Stage 1 Proposal, indicates that the air quality risk is low using the conservative assumptions adopted for the assessment, being continuous locomotive idling (assumed to be 2 hours) and 30 minutes idling time per truck. It is therefore not considered necessary to present any additional evidence for a specific long duration idling threshold, different to what has been assumed and modelling in the Air Quality Assessment for the Stage 1 Proposal.

Best Practice Summary

An assessment of best practice measures, their relevance to the Proposal in light of air quality emissions objectives, the outcomes from the Air Quality Assessment and their feasibility has been undertaken and summarised in Table 9-12.

Table 9-12: Summary of best practice management (BPM) for the Proposal regarding air quality

Emission source	BPM	Reasonable/ feasible?	Implemented?	Comment	Progression to best practice
Locomotives	New locomotives to meet best practice international emission standards	No	No	The IMT will be serviced with an existing fleet, approximately 40% of which will be under operation control of SIMTA.	New locomotives purchased for future development stages would aim to meet Tier 3/Euro Stage IIIA or regulated emission performance.
	Upgrade / repowering existing fleet to best achievable Tier at next overhaul.	Yes	Yes	Upgrades will be as per scheduled upgrade program on existing fleet and will consider best achievable emission performance in accordance with requirements under proposed changes to the POEO (Clean Air) Regulations. Maintenance plans for existing fleet will include requirements for review of air emissions performance	Accelerated upgrade program for existing fleet for future development stages would be considered. Operational Environmental Management Plans to include benchmarks for air emissions to be implemented progressively where reasonable and feasible.
	Retrofit of exhaust after treatment	No	No	Not considered reasonable or feasible based on risk based approach.	The implementation of after treatment would be subject to a statutory legislative requirement for locomotives to meet Tier 4 or Euro Stage IIIB standards.
	Electrification for locomotive shifting	Yes	Yes	To be considered during procurement having regard to technical, logistical and financial considerations. For example, a locomotive shifter similar to that planned for MPE Stage 1 will be considered if practical.	N/A

Emission source	BPM	Reasonable/ feasible?	Implemented?	Comment	Progression to best practice
	Ultra low-emitting switch locomotives (ULESL)	Yes	Yes	To be considered during procurement having regard to technical, logistical and financial considerations	N/A
	Reduction of 'long-duration' idling	Yes	Yes	Unnecessary 'long-duration' idling to be avoided through driver training. MIC IMT idle reduction policy will be outlined in operational management plans for the site.	As locomotives are replaced and / or overhauled, the installation of automatic engine shut down/start up systems (AESS) will be considered as part of the upgrade.
	Fuel efficiency	Yes	Yes	Implemented through driver training programs.	Driver Assistance Systems which assist driver in fuel efficient driving and optimal notch setting selection will be considered as locomotives are replaced and / or overhauled.
Container handling equipment	New equipment to meet best practice international emission standards	Yes	Yes	New container handling equipment would be selected to have engines that comply with US EPA Tier 3 / Euro Stage IIIA.	New equipment purchased for future development stages would meet regulated emission performance requirements as a minimum.
	Electrification	Yes	No	Not viable for throughput less than 500,000 TEU.	Not viable for throughput less than 500,000 TEU.
	Alternative fuels/technology	Yes	No	Replacement of diesel container handling equipment not considered reasonable or feasible for the Proposal, based on risk based approach.	Any new reach stacker and container forklifts purchased for future development stages would consider practicality of alternative fuels and technologies.

Emission source	BPM	Reasonable/ feasible?	Implemented?	Comment	Progression to best practice
				Inter-terminal transfer trucks would be regulated under ADRs and national fuel standard regulations	
	Reduction of 'long-duration' idling	Yes	Yes	Unnecessary idling avoided through driver training. MIC IMT idle reduction policy will be outlined in operational management plans for the Proposal.	N/A
	Retrofit of exhaust after treatment	No	No	Not reasonable or feasible based on risk based approach.	The implementation of after treatment would be subject to a statutory requirement for off-road mobile equipment to meet Tier 4, Euro Stage IIIB or equivalent standards.
Truck queueing	Gate Appointment System	Yes	Yes	Will minimise truck loading/unloading wait times and resultant queuing. Trucks will be rejected if too early, avoiding unnecessary idling.	N/A
	Truck marshalling lanes	Yes	Yes	Will minimise congestion and queuing	N/A
	Reduction of 'long-duration' idling	Yes	Yes	Unnecessary idling for non-MPW IMT employees avoided through provision of information signs and communication of IMT idle reduction policy.	N/A
General	Automated terminal operating system	No	No	Not practical for the throughput proposed for the IMT facility as manual systems can be more efficient at this throughput.	N/A
	Use of low sulphur diesel fuel	Yes	Yes	As required under the Fuel Standard (Automotive Diesel) Determination 2001	

Emission source	BPM	Reasonable/ feasible?	Implemented?	Comment	Progression to best practice
	Air Quality Assessment	Yes	Yes	Air quality assessment to inform the risk based approach to BMP and required air quality management measures for the site.	N/A
	Air quality management plan	Yes	Yes	MIC IMT will develop, implement and maintain an air quality management plan for the construction and operation of the IMT facility.	N/A
	Community complaints line	Yes	Yes	A toll free complaints line will be established for the community to report long duration idling and smokey vehicles operating on the MPW Stage 2 site.	N/A

9.3 Existing environment

9.3.1 Sensitive receptors

Ramboll (2016) reviewed the residential and sensitive locations within the vicinity of the Proposal, located in the neighbouring suburbs of Wattle Grove, Moorebank, Casula and Glenfield. 37 sensitive receivers were located in total[32]. These locations are identified in Table 9-13, and defined geographically below in Figure 9-2.

Table 9-13: Identification of sensitive receivers surrounding the site

Name/Location	ID
Lakewood Crescent, Casula	R1
St Andrews Boulevard, Casula	R2
Buckland Road, Casula	R3
Dunmore Crescent, Casula	R4
Leacocks Lane, Casula	R5
Leacocks Lane, Casula	R6
Slessor Road, Casula	R7
Canterbury Road, Glenfield	R8
Ferguson Street, Glenfield	R9
Goodenough Street, Glenfield	R10
Wallcliff Court, Wattle Grove	R11
Corryton Court, Wattle Grove	R12
Martindale Court, Wattle Grove	R13
Anzac Road, Wattle Grove	R14
Cambridge Avenue, Glenfield	R15
Guise Public School	R16
Yallum Court, Wattle Grove	R17
Church Road, Liverpool	R18
Glenwood Public School, Glenfield	R19
Glenfield Public School, Glenfield	R20
Hurlstone Agricultural School	R21
Wattle Grove Public School	R22
St Marks Coptic College, Wattle Grove	R23
Maple Grove Retirement Village, Casula	R24

[32] R33 is now located within the MPE site. It is therefore no longer considered to be a sensitive receiver regarding air quality and is not considered further in this assessment.

Name/Location	ID
All Saints Catholic College	R25
Casula High School	R26
Casula Primary School, Casula	R27
Lurnea High School	R28
St Francis Xaviers Catholic Church	R29
Impact Church Liverpool	R30
Liverpool West Public School	R31
Liverpool Public School / TAFE NSW	R32
Glenfield Rise Development, Glenfield	R34
New DNSDC Facility	R35
Playground Learning Centre Glenfield	R36
Wattle Grove Long Day Care Centre	R37
Casula Powerhouse Arts Centre	R38

Figure 9-2: Sensitive receptor areas (Air Quality Impact Assessment, Rambol 2016)

9.3.2 Climate and meteorology

Meteorological mechanisms govern the generation, dispersion, transformation and eventual removal of pollutants from the atmosphere. The Liverpool monitoring site operated by the Office of Environment and Heritage (OEH) is considered representative of the conditions of the Proposal site, given its close proximity and similar topography.

An analysis of wind data from this site between 2011 and 2015 revealed relatively little inter-annual variability in wind speed and direction. The 2013 meteorological dataset used in the MPE Stage 1 EIS (ENVIRON, 2015b) assessment was retained for this assessment for the Proposal.

Prevailing winds

The annual recorded wind pattern within the vicinity of the Proposal site is dominated by southwest to westerly airflow. The highest wind speeds recorded at the location are most frequently experienced from the southwest to westerly direction. The average recorded wind speed for 2013 was 1.8 m/s, with a frequency of calm conditions (wind speeds less than 0.5 m/s) occurring approximately twelve percent of the time. Figure 9-3 shows the annual wind rose of recorded wind speed and direction data from the OEH Liverpool station during 2013, demonstrating the prevailing wind conditions in the area.

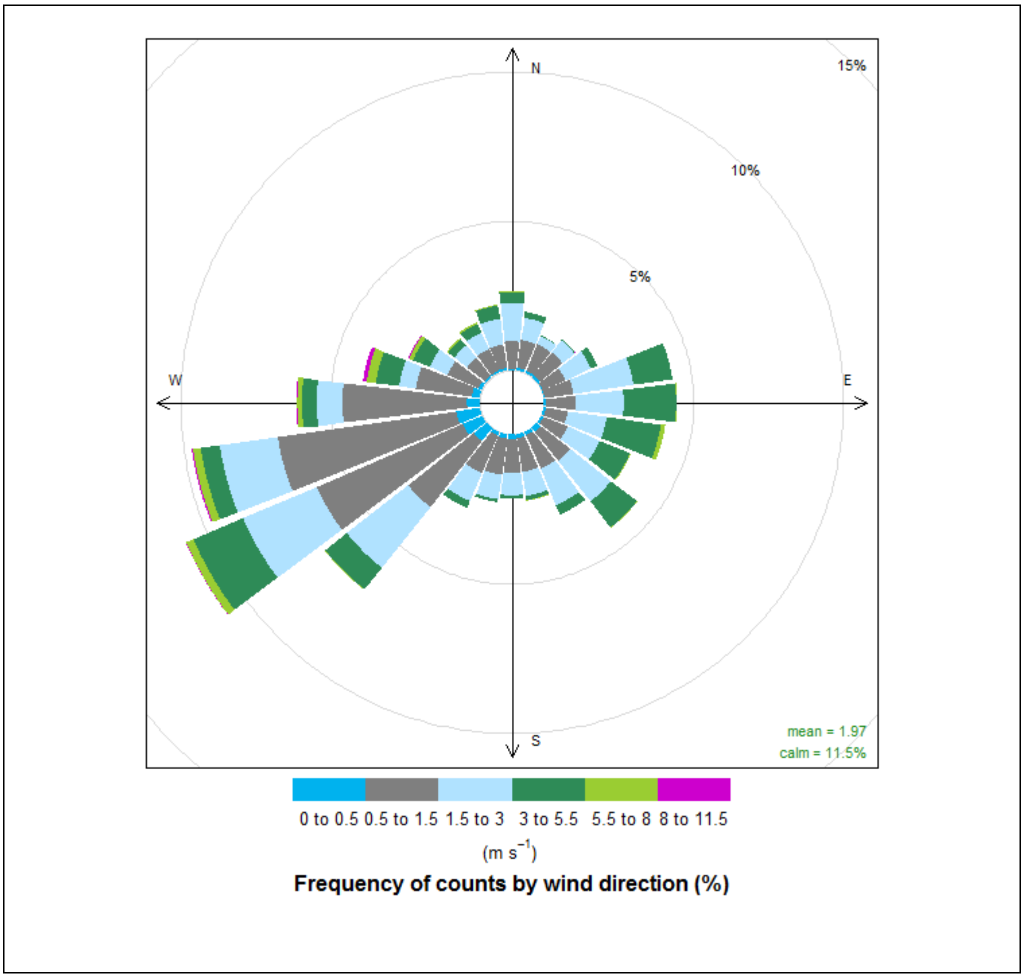

Figure 9-3: Annual wind rose - OEH Liverpool, 2013

Seasonal variation in wind speed and direction is evident with the dominant southwest to westerly component evident in the autumn, winter and spring months, while an easterly flow is evident in summer months. Wind speed is greatest during summer and spring, with the incidence of calm periods being higher in autumn and winter. Diurnal variation is also evident, with wind speeds greatest during the day, with a dominant easterly flow occurring between midday and late afternoon. Wind speeds are lower in the evening and nights, with the south westerly component becoming the dominant wind direction.

Ambient Temperature

Monthly mean temperatures range between 5°C to 18°C, with monthly mean maxima of 17°C to 28°C[33]. Highest temperatures are typically experienced during the summer months, while the lowest are generally experience between May and September. Analysis comparing monthly temperature variation data during 2013 at the OEH Liverpool station with the long-term trends (recorded regional mean, minimum and maximum temperatures) at the BoM Bankstown Airport AWS indicate that the 2013 dataset is representative of the typical conditions experienced in the region.

Rainfall

Precipitation has the potential to impact on dust generation and removal of atmospheric pollutants, and is therefore an important factor in quantifying predicted air emissions. Historical data recorded at Bankstown Airport since 1968 indicates the region is characterised by moderate rainfall, with a mean annual rainfall of 870mm, and an annual rainfall range between 493 and 1,398mm.

There is significant variation in monthly rainfall typically within the area, with the wettest periods usually during the summer and autumn months. In order to make a conservative (upper-bound) estimate of the air pollution generated as part of this assessment, wet deposition (the removal of atmospheric particles by rain) was excluded from the dispersion modelling simulations undertaken.

Atmospheric stability and boundary layer depth

The atmospheric boundary layer constitutes the first few hundred metres of the atmosphere, and is directly affected by the Earth's surface through the frictional drag of airflow or as a result of convective mixing[34]. The atmospheric boundary layer during the day is characterised by thermal turbulence via the sun heating the Earth's surface and the extension of the mixing layer to the lowest elevated subsidence inversion. Conversely, the atmospheric boundary layer during the night times are typically characterised by weak to no vertical mixing and the predominance of stable conditions. These conditions are usually associated with lower wind speeds and hence lower dilution potentials.

The Monon-Obukhov length[35] (L) provides a measure surface layer atmospheric stability. Wharton and Lundquist (2010) provide typical value ranges for L for widely referenced atmospheric stability classes, ranging from unstable to stable. AERMET, a meteorological data pre-processor, was used to determine the diurnal variation of atmospheric stability of the Proposal area based on data recorded at the OEH Liverpool station during 2013, as shown below in Figure 9-4.

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[33] Based on the long-term average record from the BoM Bankstown Airport AWS

[34] The result of the heat and moisture exchanges that take place at the Earth's surface

[35] The Monin-Obukhov length is that height at which turbulence is generated more by buoyancy than by wind shear.

Figure 9-4 illustrates that atmospheric instability increases during the daytime as convective energy increases, and declines during the night time, when atmospheric conditions are more stable. This suggests that the greatest potential for atmospheric dispersion of emissions at the Proposal site would be during daylight hours, and lowest during the night.

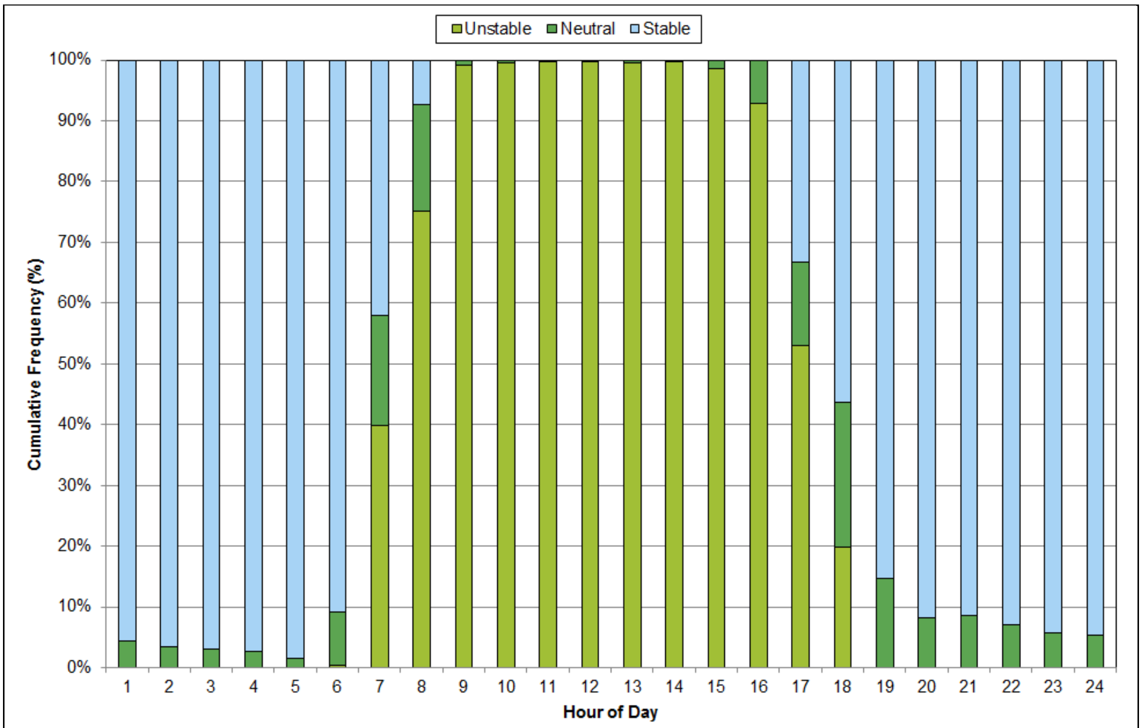

Figure 9-4: Diurnal variations in AERMET-generated atmospheric stability

Note: Boxes indicate 25th percentile, Median and 75th percentile of AERMET-generated mixing height data while upper and lower whiskers indicate maximum and minimum values.

9.3.3 Baseline ambient air quality

A number of existing and future air emission sources contribute toward the condition of the local air shed, affecting ambient background air quality. The following sources have been considered in light of the cumulative impact assessment (refer to Section 9.4.1.2 of this EIS):

- Traffic emissions from the wider road network, including the South Western Motorway (M5)
- Emissions from diesel locomotives using the Southern Sydney Freight Line (SSFL) and the East Hills rail line
- Existing commercial and industrial facilities including the Greenhills Industrial Estate and Moorebank Business Park to the north
- The Glenfield Waste Facility to the southwest of the site
- Emissions from aircraft at Bankstown Airport to the northeast
- The MPE Stage 1 Proposal.

Baseline data regarding PM_{10}, $PM_{2.5}$, NO_2, O_3 and CO from the Liverpool OEH monitoring station has been used as being representative of the Proposal site ambient air conditions[36]. SO_2 monitoring data was extracted from the Chullora OEH monitoring site, located approximately 12 km from the Proposal site.

9.3.4 Adopted background air quality

Air quality statistics for gaseous pollutants and air toxics were analysed over a five year period. The following findings were made with regard to concentration ranges and exceedances of standards:

- Annual mean PM_{10} concentrations range from 18 µg/m³ to 21 µg/m³ and on average over the past 5 years baseline concentrations are 77% of the AAQ NEPM standard
- Annual mean $PM_{2.5}$ concentrations range from 6 µg/m³ to 9 µg/m³ and on average over the past 5 years baseline concentrations are 103% of the AAQ NEPM standard
- Exceedances of the 24-hour average reporting standards for both PM_{10} and $PM_{2.5}$ have occurred in three of the past five years
- There have been no exceedances in the air quality standards over the past five years for NO_2, SO_2 and CO and in general the background air quality for these pollutants is considered good[37].

The following key considerations were made for respective air pollutants in compiling background values for the cumulative assessment, presented in Table 9-14.

- Background annual average NO_2, PM_{10} and $PM_{2.5}$ emissions were derived by averaging out data over a five year period at the nearby OEH Liverpool monitoring station between 2011 and 2015
- For short term impacts, daily varying PM10 and PM2.5 concentrations and hourly varying concentrations for NO_2 are paired with modelling predictions for assessment of cumulative impacts
- Background $PM_{2.5}$ concentrations already exceed the NEPM AAQ reporting standard. Assessment of impacts will therefore be discussed in the context on the incremental increase generated by the Proposal[38]
- The adopted background values for the cumulative impact assessment relating to CO and SO_2 values is based on the maximum background concentration recorded over the five year period 2011 and 2015. This conservative approach is considered appropriate given the relatively low background concentrations recorded for these pollutants

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[36] Ambient air quality monitoring was undertaken at the Proposal site as part of the MPW Concept EIS (Parsons Brinckerhoff, 2014a), yet was deem insufficient to adequately describe baseline air quality conditions for the purposes of this assessment. Monitoring that was carried out at the Proposal site was however considered sufficient to compare with data from the OEH Liverpool station, to conclude concentrations of pollutants at the OEH Liverpool station are generally higher and a more conservative baseline dataset for subsequent assessments.

[37] On average, baseline concentrations for NO_2 are 33% of the AAQ NEPM standard for annual mean and 42% for maximum 1 hour average. Baseline concentrations for CO and SO_2 are even lower. For example, maximum 1-hour baseline concentrations are 12% of the AAQ NEPM standard for CO and 10% for SO_2.

[38] For $PM_{2.5}$ the monthly profile shows that $PM_{2.5}$ concentrations are highest in cooler months, which is evidence of the influence of wood heater emissions. Regulatory initiatives such as wood heater compliance programs and improvements in vehicle emission standards are expected to play a role in driving down ambient concentrations in the medium term.

- The annual average TSP concentrations for the site are derived upon rations established linking concentrations of TSP from PM_{10} (ratios for urban areas generally range from 0.4 to 0.5)[39]
- Monitoring for dust deposition as part of the MPW Concept Approval was conducted at three locations across the suburbs of Wattle Grove, Casula and Glenfield. Background dust deposition levels recorded range from 0.6 g/m^2/month and 0.8 g/m^2/month, expressed as an annual average (insoluble solids).

Background air quality concentrations for the Proposal site and surrounds for key pollutants is summarised in Table 9-14.

Table 9-14: Adopted background air quality concentrations for the Proposal site cumulative assessment

Pollutant	Averaging period	Adopted background value
PM_{10}	24-hour average	Daily varying
	Annual average	19.4 µg/m^3
$PM_{2.5}$	24-hour average	Daily varying
	Annual average	8.2 µg/m^3
NO_2	1-hour average	Hourly varying
	Annual average	20.4 µg/m^3
CO	1-hour average	5.0 mg/m^3
	8-hour average	30 mg/m^3
SO_2	1-hour average	74.4 µg/m^3
	24-hour average	13.6 µg/m^3
	Annual average	2.6 µg/m^3
TSP	Annual average	48.4 µg/m^3
Dust deposition	Annual average	1 g/m^2/month

9.4 Potential impacts

The approach to assess potential air impacts generated by the Proposal follows the guidelines recommended in the NSW Environment Protection Authority (EPA) *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* ("the Approved Methods") (NSW EPA, 2005a). A detailed outline regarding the nature of the various pollutants assessed, and their potential to impact upon human health can be found in the Human Health Section (refer to Section 10 of this EIS) of this EIS.

[39] Reported in Quarterly Air Quality Monitoring Reports - http://www.environment.nsw.gov.au/aqms/datareports.htm#quarterlies

9.4.1 Construction

Emission inventory

Particulate matter and fugitive dust emissions are anticipated to generate the greatest impact with regard to air quality of the Proposal site and surrounds (refer to Table 9-2) during site preparation, bulk earthworks, drainage, utilities and road work activity periods associated with the Proposal.

Expressed in terms of TSP, PM10 and PM2.5, an emissions inventory was calculated for key Proposal construction activities (associated with activity periods outlined above), using emission factors developed by the US EPA[40], and a number of assumptions relating to material quantities, utilization of plant and equipment and the use of water carts along unsealed pavement areas. A summary of the estimated emissions for the duration of the Proposal is presented in Table 9-15.

Table 9-15: Emissions estimates for Proposal construction (kg/annum)

Source / Activity	TSP (kg/annum)	PM_{10} (kg/annum)	$PM_{2.5}$ (kg/annum)
Proposal Construction			
Hauling on unsealed roads	69,668	17,901	1,790
Trucks unloading fill	989	468	71
Material handling (excavators, FEL, stockpiles)	989	1,403	71
Dozers (vegetation stripping, topsoil clearing, fill)	20,966	4,421	2,201
Graders on road construction	9,926	3,468	308
Diesel combustion (onsite equipment)	1,555	1,555	1,469
Wind erosion	15,254	7,627	1,144
On-road trucks diesel combustion	93	93	90
Total	**119,440**	**36,936**	**7,144**
MPE Stage 1 Proposal	**61,545**	**17,960**	**8,343**

Dispersion modelling results

The Proposal construction activities have been assessed in terms of potential impacts arising from dust, TSP, PM_{10} and $PM_{2.5}$ generation. Dispersion modelling was carried out using AERMOD modelling system to predict ground level concentrations of key pollutants generated by the Proposal at surrounding sensitive receivers, based on atmospheric conditions.

The modelling results indicate that the predicted construction phase emissions comply with all relevant impact assessment criteria. As shown in Table 9-16 the maximum predicted increase in annual average PM_{10} (1.3 µg/m³), $PM_{2.5}$ (0.5 µg/m³), TSP (1.7 µg/m³) and dust deposition (0.4 g/m²/month) are considered minor, when compared against existing background conditions. The highest predicted short-term impacts occur

[40] United States Environmental Protection Agency (US EPA) AP-42 Compilation of Air Pollutant Emission Factors (US EPA, 1998b, US EPA, 2004, US EPA, 2006).

at Casula Powerhouse Arts Centre (corresponding to receptor R38) with a maximum 24-hour PM_{10} of 4.3 µg/m³ and maximum 24-hour $PM_{2.5}$ of 2.6 µg/m³.

It is important to note that the modelling predictions are conservative, particularly for short-term impacts, as it takes the annual emission total and apportions this evenly across the year and excludes wet deposition modelling (refer to Section 9.3.2 of this EIS). Construction activities will be staged and therefore only a proportion of the annual emission totals will be generated during each stage, resulting in conservatively high short-term (24-hour) predictions.

Cumulative predictions presented incorporate emission scenarios outlined in Section 9.2.4 of this EIS. For cumulative 24-hour impacts, modelling predictions are paired with daily background PM_{10} and $PM_{2.5}$ concentrations.

The background dataset contains existing exceedances of the impact assessment criteria (three days for PM_{10} and two days for $PM_{2.5}$) that correspond to natural weather events that, if included, would skew the average background air pollution levels. The cumulative 24-hour average PM_{10} is therefore presented as the 4th highest (excluding the three days already over) and the cumulative 24-hour average $PM_{2.5}$ is presented as the 3rd highest (excluding the two days already over). The results indicate that the construction for the Proposal would result in no additional days over the criteria.

Table 9-16: Construction phase - maximum modelling predictions for sensitive receptors

Pollutant	Period		Air quality goal criteria	Receptor maximum	Receptor(s)
PM_{10} (µg/m³)	24 hour maximum	Increment	50 µg/m³	4.3 µg/m³	R38
		Cumulative		48.5 µg/m³	R35
	Annual average	Increment	30 µg/m³	1.3 µg/m³	R38
		Cumulative		20.7 µg/m³	R38
$PM_{2.5}$ (µg/m³)	24 hour maximum	Increment	25 µg/m³	2.6 µg/m³	R38
		Cumulative		24.5 µg/m³	R38
	Annual average	Increment	8 µg/m³	0.5 µg/m³	R38
		Cumulative		8.7 µg/m³	R38
TSP (µg/m³)	Annual average	Increment	90 µg/m³	1.7 µg/m³	R38
		Cumulative		50.1 µg/m³	R38
Dust deposition	Annual average	Increment	2 g/m²/m	0.4 g/m²/m	R38
		Cumulative	4g/m²/m	2.7 g/m²/m	R38

9.4.2 Operation

The operational phase of the Proposal has been assessed in terms of potential impacts from PM_{10}, $PM_{2.5}$, NO_x, CO, SO_2 and VOCs. The predicted PM_{10} and $PM_{2.5}$ concentrations are presented in Table 9-17. Cumulative predictions are based on the additional MPE Stage 1 emissions and the background values derived in Section 9.3 of this EIS. As discussed previously, for cumulative 24-hour average PM_{10} and $PM_{2.5}$ concentrations, the results exclude days where the background is already over the criteria.

The operational scenario assessed for the Proposal includes operation of the IMT facility at 500,000 TEU throughput, and the operation of 215,000 m^2 of warehousing. A more detailed description of the operational function of the Proposal is presented in Section 4.2. The scenario for cumulative assessment includes the cumulative operation of the Proposal plus MPE Stage 1, incorporating a combined 750,000 TEU (500,000 TEU for the IMT facility and 250,000 TEU for the MPE site).

As outlined in Section 9.2.1 of this EIS, key pollutants assessed for the operational phase of the Proposal considered to have the greatest potential impacts are associated with diesel fuel combustion. Pollutants assessed include the following:

- PM_{10} and $PM_{2.5}$
- Oxides of nitrogen (NO_x)
- Sulphur dioxide (SO_2)
- Carbon monoxide (CO)
- Speciated HC / VOCs – benzene, 1-3-butadiene and PAHs.

Onsite activities associated with Proposal operation, anticipated to generate the above air pollutant types mentioned include:

- Diesel locomotives travelling along the Rail link to/from the IMT
- Diesel locomotives idling onsite during loading/unloading and shifting locomotives operating within the IMT
- Reach stackers/container handling equipment loading and unloading trains and trucks
- External trucks delivering / collecting containers to/from the IMT
- Internal trucks transferring containers from the IMT to warehousing
- Warehouse cooling and heating (gas fired).

The development of emission estimates requires detailed activity data, including truck numbers, fleet composition, distances travelled, times in mode, equipment types, fuel usage etc.). Based on published emission factors, this data is subsequently used to derive emission estimates for each activity, presented in the following sections.

Diesel emissions from locomotives

Emissions for locomotives travelling between the IMT and the SSFL were calculated based on the amount of fuel consumed and fuel-specific emission factors derived from the United States Environment Protection Agency (USEPA, 2009a; USEPA, 2009b). US EPA emission factors, expressed in g/kWh (grams of pollutant emissions per kilowatt-hour), were converted to kg/kL (kilograms of pollutant per kilolitre of fuel combusted) using the conversion factors given by the US EPA (US EPA, 2009a and US EPA, 2009b) and as described in NSW EPA (2012a). Emission estimates for each of the locomotive activities are calculated by multiplying the emission factors with the estimated fuel consumption, expressed in kilolitres (KL).

The following assumptions and calculations were made for the purposes of the operational air impact assessment conducted for the Proposal:

- The Proposal would be serviced using an existing locomotive fleet, of which approximately 40% of which would be under operational control of the Proposal site
- Locomotives servicing the Proposal were assumed to have an emissions performance equivalent to US EPA Pre-Tier 0 Line Haul Emission Factors[41], which provides conservative emissions estimates
- SO_2 emissions were estimated based on the sulfur content of the fuel, assuming the majority of the sulphur is oxidised to SO_2
- PM_{10} emissions were adjusted to account for the lower Australian fuel sulphur content. $PM_{2.5}$ emissions are assumed to be 97% of the PM_{10} emissions and VOC emissions are estimated from the HC emissions using a conversion factor of 1.053 (US EPA 2009a)
- Fuel consumption for each train trip was based on the average fuel consumption rate of 4.03 L/kt-km described in the *NSW EPA GMR emissions inventory for freight travel*
- The annual gross kiloton of fuel consumed per kilometre travelled was estimated from the total train weight (both for full and empty trains), the number of trains per annum and a travel distance of 4 km (accounting for the distance between IMT and SSFL). Therefore to accommodate 500,000 TEU, there would be 4,380 train movements per annum or 12 train movements per day
- Six trains per day were assumed to enter the Proposal site full, of which two would exit full and 4 would exit empty. The assumed locomotive, wagon and container weights are the same as those outlined in the MPE Stage 1 AQA (ENVIRON, 2015b)
- Fuel consumption for locomotives idling is estimated from an assumed consumption rate of 14 litres per hour and an assumed 2 hour idle time for four locomotives on each train.

The estimated fuel consumption and corresponding emission factors for various pollutants are presented in Table 9-17. The calculated total annual locomotive emissions are estimated using the assumptions and calculations outlined above, and presented in Table 9-18.

Table 9-17: US EPA Pre-Tier 0 line haul emission factors (kg/kL)

<table>
<tr><th>Source</th><th>Fuel Consumption (kL/annum)</th><th>CO</th><th>HC</th><th>NO_x</th><th>PM_{10}</th><th>$PM_{2.5}$.5</th><th>SO_2</th></tr>
<tr><td>Locomotives entering / exiting</td><td>222</td><td rowspan="2">7.05</td><td rowspan="2">2.62</td><td rowspan="2">71.5</td><td rowspan="2">1.33</td><td rowspan="2">1.29</td><td rowspan="2">0.02</td></tr>
<tr><td>Locomotives idling</td><td>491</td></tr>
<tr><td>Locomotive shifter</td><td>99</td><td>10.04</td><td>5.53</td><td>95.6</td><td>1.98</td><td>1.92</td><td>0.02</td></tr>
</table>

Table 9-18: Estimated annual emissions for locomotives (kg/annum) generated by Proposal operation

Source	CO	HC	NO_x	PM_{10}	$PM_{2.5}$	SO_2	VOC
Locomotives entering / exiting	1,564	582	15,851	294	285	4	613

[41] The emissions performance of the existing fleet in Australia is dominated by locomotives with Pre Tier 0 performances (80.7%) (ENVIRON, 2013).

Source	CO	HC	NO_x	PM_{10}	$PM_{2.5}$	SO_2	VOC
Locomotives idling	3,459	1,287	35,055	650	631	8	1,355
Locomotive shifter	992	547	9,447	196	190	2	576

Emissions from container handling

The following assumptions and data inputs were used to calculate operational emissions generated by container handling.

- The Proposal would employ up to 12 reach stackers or large diesel powered forklifts, with each reach stacker operating at 50% utilisation
- New equipment would be employed, fitted with engines compliant with US EPA Tier 3 / Euro Stage IIIA emissions standards for non-road diesel engines.

The US EPA Tier 3 Non-road diesel emission factors are provided below in Table 9-19, from which the estimated annual emissions associated with container handling are calculated (refer to Table 9-20).

Table 9-19: US EPA Tier 3 Non-road diesel emission factors (g/kWh)

Source	CO	HC	NO_x	PM_{10}	$PM_{2.5}$	SO_2
Reach stackers	3.5	0.4	3.6	0.2	0.19	0.02

Table 9-20: Estimated emissions from container handling for Proposal operation (kg/annum)

Source	CO	HC	NO_x	PM_{10}	$PM_{2.5}$	SO_2	VOC
Reach stacker	26,709	3,052	27,472	1,526	1,480	126	3,214

Emissions from traffic

The following data inputs and assumptions were made to quantify air emissions generated by operational traffic for the Proposal:

- Approximately 1,458 external truck movements are anticipated for a container throughput of 500,000 TEU, with an additional 124 internal truck movements anticipated for warehousing
- For external trucks, the travel distance is assumed to be 1.5 km (from Proposal site entrance to the junction of the M5 and Moorebank Avenue). For internal truck movements, a travel distance of 1 km is assumed for each trip
- Emission factors for vehicles in travel mode are expressed in g/km. The distance travelled in a given hour (or day) is based on the number of truck movements and total travel distance per trip
- Truck emissions (in travel mode) were calculated using aggregated emission factors developed by the NSW EPA for the 2008 Greater Metropolitan Region (GMR) emissions inventory (NSW EPA, 2012b). These factors were refined using the Air Quality Appraisal Tool (PAE Homes, 2013), and based on available fleet data for the projected year 2021. Emissions calculations assumed a commercial arterial road with 0% grade and a speed limit of 50 km/hr
- Idling emissions are expected to be accounted for by trucks in travel mode, and thus weren't considered separately
- A large number (1,642) of light vehicle movements are anticipated in association with operation of the IMT and warehousing. Emissions generated from these movements were calculated using the Air Quality Appraisal Tool, based on a 1 km travel distance and a petrol to diesel fuel usage split of 95% / 5%.

The emission estimates for trucks and light vehicles are presented in Table 9-21.

Table 9-21: Emission estimates for vehicle movements (kg/annum)

Source	CO	HC	NO_x	PM_{10}	$PM_{2.5}$	SO_2	VOC
External trucks	244	56	4,765	115	112	0	59
Internal truck movements	12	3	194	6	6	0	3
Light vehicles	672	64	216	16	15	0	68

Emissions from warehousing

The primary sources of emissions arising from the operation of warehouses for the Proposal include:

- Internal trucks transferring containers from the IMT to the warehousing area (refer above in Section 9.4.2.3 and Table 9-21).
- LNG forklifts unpacking containers within the warehousing area.
- Warehouse office heating and cooling using natural gas boilers.

It is assumed that warehousing operations would employ the use of up to 24 LNG forklifts, operating at 50% utilisation. The forklift emission estimates shown below in Table 9-22 can be calculated using the US EPA emission factors for forklifts (US EPA, 2010).

Table 9-22: US EPA emission factors for forklifts (g/kWh)

Source	CO	HC	NO_x	PM_{10}	$PM_{2.5}$	SO_2
Reach stackers	2.9	1.2	0.7	0.04	0.04	0.08

Predicted emissions generated from warehouse heating / cooling have been estimated based on an emissions factor of 150 MJ/m^2/year and a warehousing area of 215,000 m^2. The National Pollution Inventory (NPI) *Emission Estimation Manual for Combustion in Boilers* (≤30 MW wall fired boilers) was used to convert predicted energy usage into estimated emissions generated.

A summary of emissions generated by warehousing operations is provided below in Table 9-23.

Table 9-23: Predicted emissions generated by warehousing operations for the Proposal (kg/annum)

Source	CO	HC	NO_x	PM_{10}	$PM_{2.5}$	SO_2	VOC
LNG forklifts	10,287	4,120	2,336	131	127	290	4,338
Heating/cooling	3,967	N/A	4,702	348	348	6	259

Operational emissions summary

A summary of the annual operational emissions generated by the Proposal is provided in Table 9-24.

Table 9-24: Summary of annual operational emissions for the Proposal (tonnes/annum)

Source	CO	HC	NO_x	PM_{10}	$PM_{2.5}$	SO_2	VOC
Locomotives travelling, idling, shifting	6,015	2,416	60,353	1,140	1,106	13	2,544
Container handling	26,709	3,052	27,472	1,526	1,480	126	3,214
External truck movements	244	56	4,765	115	112	0	59
Employee vehicles	672	64	216	16	15	0	68
Warehousing - internal transfer, heating/cooling, forklifts	14,266	4,123	7,232	486	481	296	4,601

Emissions source contributions for various key pollutants is presented in Figure 9-5. Based on emission factors and activity data assumptions used in this report, operation of container handling equipment is the largest potential source of PM emissions while locomotives are the largest source of NOx emissions.

It is noted that the annual summary is based on the assumption (for a worst case modelling assessment) that all 12 reach stackers would operate at an average 50% load, for the entire year. In reality this would not be the case and the actual emissions across the major sources may be more evenly distributed.

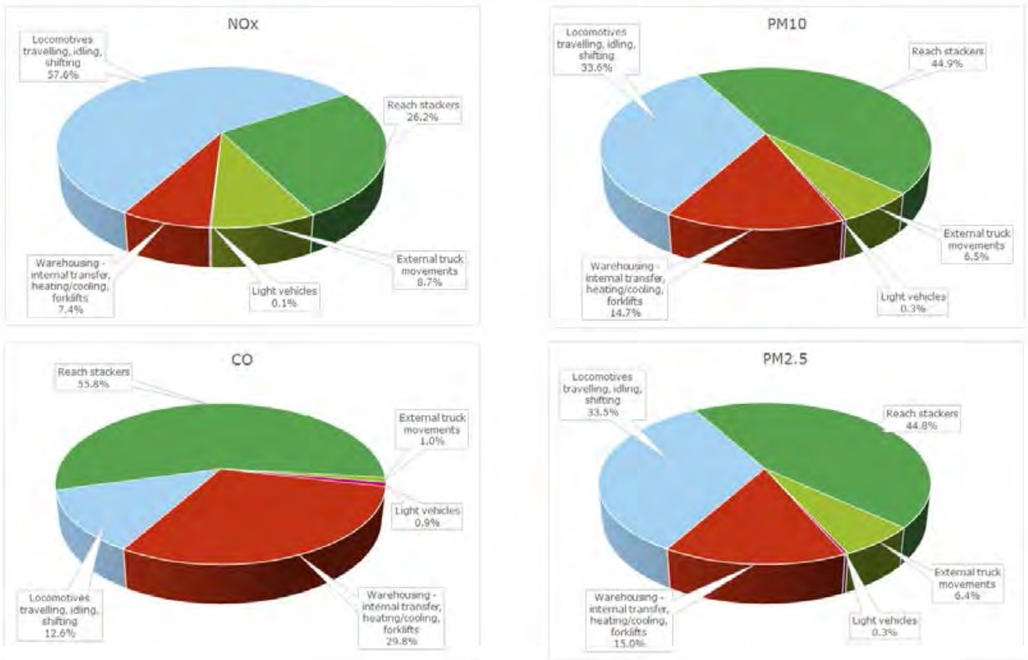

Figure 9-5: Summary of annual operational emissions by source

Dispersion modelling results

The operational phase of the Proposal was assessed in terms of PM_{10}, $PM_{2.5}$, NO_x, CO, SO_2 and VOCs. The AERMOD modelling system was used to model the dispersion of pollutants associated with Proposal operation to measure the impact of the emissions at the various sensitive receptors. Cumulative based assessments are based on the background values derived in Section 0.

For cumulative 24-hour average PM10 and PM2.5 concentrations, the summary figures exclude days where the background is already above the standard criteria.

Predictive operational concentrations for $PM_{2.5}$ and PM_{10} are presented in Table 9-25. The maximum increase in annual average PM_{10} and $PM_{2.5}$ (0.4 µg/m³) and 24-hour average PM_{10} and $PM_{2.5}$ (1.0 µg/m³) is minor when compared to existing background conditions. In consideration of these values to background air conditions, no additional exceedances of the short term impact assessment criteria are recorded.

The annual average background concentrations of $PM_{2.5}$ already exceeds the NEPM AAQ reporting standard, meaning that cumulative predictions are also above the standard at all receptors. It is noted, however, that the Proposal results in a relatively minor increase in annual average $PM_{2.5}$ (<0.4 µg/m³ at all sensitive receptors), when compared to background concentration levels.

Table 9-25: Summary of PM10 and PM2.5 modelling predictions at selected sensitive receivers

Pollutant	Period		Air quality goal criteria	Receptor maximum	Receptor(s)
PM_{10} (µg/m³)	24 hour maximum	Increment	50 µg/m³	1.0 µg/m³	R2, R3, R38
		Cumulative		48.4 µg/m³	R3, R14, R38
	Annual average	Increment	30 µg/m³	0.4 µg/m³	R2, R3, R14, R38
		Cumulative		19.9 µg/m³	R2, R3, R14, R38
$PM_{2.5}$ (µg/m³)	24 hour maximum	Increment	25 µg/m³	1.0µg/m³	R3, R38
		Cumulative		24.3 µg/m³	R3, R38
	Annual average	Increment	8 µg/m³	0.4 µg/m³	R2, R3, R14, R38
		Cumulative		8.8 µg/m³	R3, R38

Predictive operational concentrations of NO_2[42], CO and SO_2 are presented in Table 9-26. Cumulative NO_2 results were derived by combining the background concentration levels established in Section 9.3.3 of this EIS with those calculated for the MPE Stage 1 Proposal and NO_x concentrations predicted for the Proposal. The cumulative 1-hour NO_2 is derived by pairing each 1-hour average modelling prediction for MPE Stage 1 and the Proposal with the corresponding background for that hour.

Cumulative concentrations presented for CO and SO_2 (1 hour, 8 hour and 24-hour) were derived by adding the maximum predicted short term concentrations (for the Proposal and MPE Stage 1) to the maximum background concentration established in

[42] NO_2 concentrations are based on the conservative assumption that 100% of NO is converted to NO_2, both for short-term and annual average predictions. This simplified (and conservative) conversion method can be applied in this case because predictions are well below the relevant impact assessment criteria.

Section 9.3.3. Notwithstanding this conservative assumption (that the maximum modelled concentration occurs at the same time as the maximum background), all predicted concentrations are well below the impact assessment criteria.

Table 9-26: Summary of NO2, CO and SO2 modelling predictions at selected sensitive receivers

Pollutant	Period	Scenario	Air quality goal criteria	Receptor maximum	Receptor(s)
NO_2 (µg/m³)	1 hour maximum	Increment	246 µg/m³	110.7 µg/m³	R2
		Cumulative		160.5 µg/m³	R38
	Annual average	Increment	62 µg/m³	11.8 µg/m³	R3
		Cumulative		36.1 µg/m³	R38
CO (mg/m³)	1 hour maximum	Increment	30 mg/m³	0.06 µg/m³	R2, R3, R38
		Cumulative		5.1 µg/m³	R1, R2, R3, R4, R6, R11, R12, R13, R14, R17, R19, R22, R27, R28, R35, R36, R38
	8 hour maximum	Increment	10 mg/m³	0.03 µg/m³	R2, R3, R14, R38
		Cumulative		3.1 µg/m³	R1, R2, R3, R4, R5, R6, R11, R12, R13, R14, R17, R19, R22, R23, R24, R25, R27, R35, R36, R37, R38
SO_2 (µg/m³)	1 hour maximum	Increment	570 (µg/m³)	0.6 µg/m³	R2, R3, R38
		Cumulative		75.0 µg/m³	R2, R3, R38
	24 hour maximum	Increment	228 (µg/m³)	0.18 µg/m³	R3
		Cumulative		13.7 µg/m³	R1, R2, R3, R4, R14, R38
	Annual average	Increment	60 (µg/m³)	0.08 µg/m³	R3
		Cumulative		2.7 µg/m³	R1, R2, R3, R4, R7, R11, R12, R13, R14, R17, R18, R22, R23, R27, R30, R35, R37, R38

In summary, the modelling results suggest that the operation of the Proposal would comply with all relevant assessment criteria. Modelling predictions indicate that the risk of adverse air quality impacts generated by the Proposal are low, and that incremental increases in key pollutants at surrounding residential receivers would be largely indistinguishable from the existing background and the Proposal. It is therefore considered that air quality monitoring is not warranted.

9.4.3 Assessment of VOCs

The maximum predicted incremental concentrations of 1,3-butadiene, benzene and PAHs (expressed as 99.9th percentiles) are presented in Table 9-27. Impact assessment criteria were applied at and beyond the site boundary, representing the highest prediction across the modelling grid. The results therefore can be used to determine compliance. The results show that all VOCs are below the relevant assessment criteria.

Table 9-27: Assessment of VOC concentrations

Pollutant	Criteria (μg/m^3)	Predicted concentration (μg/m^3)	
		Receptor maximum	Grid maximum
1,3 Butadiene	40	0.06	0.35
Benzene	29	0.2	1.3
PAH (as BaP)	0.4	0.01	0.09

9.4.4 Assessment of regional impacts

The MPW Concept EIS included an assessment of regional air impacts undertaken by Todoroski Air Sciences (2014) [43]. The assessment predicted regional air quality impacts arising as a result of the MPW Project at full build (2030), by comparing the marginal effects of the MPW Project with respect to container transport on emissions from heavy truck and rail movements throughout the Sydney region. The approach used predictive changes in total pollutant emissions as a proxy for air quality, and used data at the local government area (LGA) scale.

The analysis revealed that the impacts of the Project at full build upon regional air quality in the Sydney basin would be insignificant. An overall marginal reduction to NO_x emissions (0.03%) was predicted owing to an anticipated reduction in heavy vehicle kilometres travelled with the transfer of road to rail. No net change was predicted for other pollutant emissions, which were quantified for the whole of Sydney region. As the Proposal would account for significantly less emissions than the MPW Project at full build, no further assessment of regional to air quality was considered necessary as the impact of the Proposal on a regional scale would also be negligible.

9.5 Mitigation measures

9.5.1 Construction

As noted above, the principle emissions to air during the construction phase would be dust and particulate matter. The construction based dust emission estimates made for this assessment assumed and factored in the use of water carts on areas of unsealed road and where graders and dozers are operating.

The *Air Quality Management Plan* (Ramboll, 2016), included within Appendix O of this EIS, would be further progressed and incorporated into the CEMP for the Proposal. Specifically, the following key aspects would be addressed in the CEMP:

[43] The term ‘regional’ implies the air quality for the Sydney region as a whole (Sydney basin).

- Procedures for controlling/managing dust
- Roles, responsibilities and reporting requirements
- Contingency measures for dust control where standard measures are deemed ineffective
- Vehicle movements would be limited to designated entries and exits, haulage routes and parking areas.

9.5.2 Operation

The *Air Quality Management Plan* (Ramboll, 2016), included within Appendix O of this EIS would be further progressed and integrated into the OEMP for the Proposal. Specifically, the following key aspects would be addressed in the OEMP in accordance with the *Air Quality Management Plan*:

- Implementation and communication of anti-idling policy for trucks and locomotives
- Complaints line for the community to report on excessive idling and smoky vehicles
- Procedures to reject excessively smoky trucks visiting the site based on visual inspection.

Best practice air quality mitigation measures would be implemented for the operational phase of the Proposal including:

Locomotives

- Ensure locomotives are well maintained in accordance with the manufacturer's specification or relevant operational plan. Update maintenance plans to include a requirement to consider air emissions and where possible improve air emission performance at next overhaul/upgrade (for SIMTA operational fleet)
- Ultra Low Emitting Switch Locomotives would be considered during the procurement process, having regard to technical, logistical and financial considerations
- Anti-idle policy and communication / training for locomotive operators
- Unnecessary idling avoided through driver training and site anti-idle policy
- Driver training for fuel efficiency.

Container Handling

- New reach stackers to achieve emissions performance equivalent to US EPA Tier 3/Euro Stage IIIA standards
- Unnecessary idling avoided through driver training and site anti-idle policy
- Equipment with smoky exhausts (more than 10 seconds) should be stood down for maintenance.

Trucks

- Gate appointment system, truck marshalling lanes and rejection of trucks that arrive early to minimise wait times and queuing.
- Development of an anti-idle policy and communication through the provision of information signs
- Unnecessary idling avoided through driver training and site anti-idle policy
- Loading and unloading coordinated to minimise truck trip distances as they travel through site.

10 HUMAN HEALTH

A *Human Health Risk Assessment* (HRA) was prepared by Ramboll (2016) (Appendix P), which assesses the impacts on human health risks relating to both air quality and noise from the construction and operation of the Proposal.

Table 10-1 identifies the Secretary's Environmental Assessment Requirements (SEARs) as they relate to human health risks and impacts, and where these have been addressed.

Table 10-1: SEARs for the Proposal relating to Human Health Risks and Impacts

Section/Number	Requirement	Where addressed in this EIS
General Requirements	A health risk assessment of local and regional impacts associated with the development, including those health risks associated with relevant key issues. The assessment should be undertaken with reference to the Centre for Health Equity Training, Research, an Evaluations' practical guide to impact assessment (August 2007) and shall include: ▪ discussion of the known potential developments in the local region; ▪ an assessment of the impact on the environmental values of public health; and ▪ an assessment of local and regional impacts including health risks.	Section 10.4 of this EIS

The following section summarises the studies undertaken previously for the MPW Concept Approval, while subsequent sections provide an assessment of potential impacts resulting from construction and operation of the Proposal on human health risks and impacts (refer to Appendix P of this EIS). Measures to mitigate impacts have also been identified where they are required.

10.1 MPW Concept Approval

A desktop based *Health Impact Assessment* (HIA) and *Human Health Risk Assessment* (HHRA) were prepared by Environmental Risk Services (EnRisks, 2014) on behalf of Parsons Brinkerhoff for the MPW Concept EIS to address the SEARs. The HIA methodology was guided by the Centre for Health Equity Training, Research and Evaluation (CHETRE), and involved a 'rapid assessment' under the HIA guidelines adopted for the assessment[44]. The assessment evaluated both direct and indirect impacts of all aspects of the Proposal on the health and wellbeing of the community, both regionally and locally (including sensitive receivers such as schools, residential areas and retirement homes) for both construction of Early Works and at operational 'full build'. The construction scenario was selected for the assessment based on 'typical' construction impacts likely to be encountered throughout the various works periods according to available information at the time of the assessment. The operational 'full build' scenario was based on a conservative 'worst case' approach in terms of the operational footprint and other impacts.

[44] The defining feature of a rapid assessment is that no new health data is collected, i.e. no project-specific epidemiological studies or health surveys are undertaken.

The HIA screening approach identified three key environmental aspects that have the potential to pose a risk to human health, thereby warranting a further detailed assessment. These items included:

- Traffic, transport and access
- Noise
- Air quality.

Baseline data were extracted from existing sources, including results from the Traffic, Noise and Air Quality investigations undertaken respectively for the MPW Concept EIS. A health impact scoping exercise was initially undertaken as part of the assessment, which involved input from key stakeholders to evaluate the potential health implications of particular environmental, socioeconomic and sustainability aspects of the Proposal in light of relevant stakeholder concerns, including those raised during community consultation.

The demographic and socioeconomic context upon which the MPW site is situated was assessed, revealing a range of community aspects that have been shown to directly influence vulnerability to a range of health risks potentially generated by the Proposal. The results of the assessment were compared against health based guidelines derived from epidemiological studies that measure the association between specific pollutants and health outcomes. The assessment concluded that:

- Traffic congestion has the potential to contribute to health impacts such as stress and anxiety. This would affect users of Moorebank Avenue during construction; however, once proposed mitigation measures are implemented, the MPW Project is anticipated to have net positive health outcomes in relation to traffic congestion
- The upgrade of Moorebank Avenue and a reduction in heavy vehicle traffic on roads within the wider network are anticipated to improve road safety
- Noise can have a range of health impacts such as sleep disturbance and cardiovascular health problems. Without mitigation, construction and operation of the MPW Project would potentially lead to health concerns; however, provided that the proposed mitigation measures are implemented, the noise levels should remain within the acceptable levels, with the likelihood of any health impact being negligible
- Emission levels of key air quality indicators generated during the construction and operation of the Proposal are estimated to within acceptable limits. Gaseous pollutants, including oxides of nitrogen, sulfur dioxide, carbon monoxide, VOCs and PAHs were all estimated to be low and acceptable. Particulate matter emissions are predicted to be dominated by larger particulates (PM_{10}) during the early construction phases (e.g. earthworks), while smaller particle emissions ($PM_{2.5}$) would increase as the use of diesel combustion sources increases over the life of the Project.
- Overall, the HIA found that the potential health risks and impacts imposed by the Project would be low, and that impacts on human health during Early Works would be negligible.

Based on these findings, the mitigation measures proposed for local air quality, noise and vibration and, traffic and access would ensure that any human health impacts remain within acceptable levels. Consistent with the conclusions of other studies prepared for the Concept Plan EIS, the Early Works phase, comprising localised building demolition and site preparations work, was considered unlikely to generate detectable health impacts beyond the site boundary and as this has already received approval (i.e. not included in the Proposal) it is not considered further in terms of HIA. There are no Conditions of Approval (prescribed under *Schedule 4 - Conditions to be met in future development applications*) relating to the Proposal for human health impacts.

10.2 Methodology

The HRA prepared for this assessment builds upon the HIA conducted previously as part of the MPW Concept EIS. Most significantly, the community consultation and conclusions underpinning the EnRisks (2014) HIA were considered applicable for the Proposal (refer to Section 10.1 of this EIS).

The HRA comprised of the following five components:

- **Issue Identification** – Identifies issues that can be assessed through a risk assessment and assists in establishing a context for the risk assessment
- **Exposure Assessment** – Identifies the groups of people who may be exposed to hazardous agents and quantifies the exposure concentrations
- **Toxicity Assessment** – Identifies hazards and health endpoints associated with exposure to hazardous agents and provides a review of the current understanding of the toxicity and risk relationship of the exposure of humans to the hazards
- **Risk Characterisation** – Provides the quantitative evaluation of potential risks to human health. The characterisation of risk is based on the review of exposure-response relationship and the assessment of the magnitude of exposure
- **Uncertainty Assessment** – Identifies potential sources of uncertainty and qualitative discussion of the magnitude of uncertainty and expected effects on risk estimates.

The following guidelines and standards have been consulted and followed where appropriate in the preparation of the assessment conducted:

- enHealth. 2012a. Environmental Health Risk Assessment: Guidelines for Assessing Human Health Risks from Environmental Hazards
- Health Impact Assessment – A Practical Guide - Centre for Health Equity Training, Research and Evaluation (CHETRE, 2007)
- enHealth. 2012b. Exposure Factors Guide
- National Health and Medical Research Council (NHMRC). 2006. Approach to Hazard Assessment for Air Quality
- National Environment Protection Council (NEPC). 2011. Methodology for Setting Air Quality Standards in Australia.

10.2.1 Air quality

The air quality component of the HRA focusses on the health impacts to key residential and sensitive locations within the vicinity of the Proposal (refer to Section 9.3.1 of this EIS) incurred from emissions generated by the operational phase of the Proposal, including the IMT facility and warehousing. Emissions to air from construction sources were not evaluated in this HRA. This approach is based on the assessment that construction air emissions would be temporary, relatively easily manageable and compliant with relevant air quality standards (refer to Section 9 of this EIS).

Operational emissions sources considered for the assessment included diesel emissions from locomotives, traffic and equipment, warehousing and commercial operations and container handling operations. The assessment was therefore focussed on health hazards associated with fugitive dust and diesel emissions, arising from increased emissions of the following key air pollutants:

- PM_{10} and $PM_{2.5}$
- Nitrogen oxides (in particular NO_2)
- SO_2
- CO
- Volatile organic compounds (VOCs)

- Polycyclic aromatic hydrocarbons (PAHs).

The assessment was based on the following assumptions and key assessment steps:

- Air quality dispersion data generated for the *Air Quality Impact Assessment* (Ramboll, 2016) (Appendix O)[45], was utilised for the assessment, along with and background levels established through previous reports and monitoring based in Liverpool
- The potential health effects attributable to key air pollutants (mentioned above) were assessed for increases in mortality, hospital admissions for respiratory and cardiovascular disease, and emergency department visits for asthma in children against baseline health statistics
- Groups identified as receptors to emissions included commercial/industrial workers, residents, school or day care students, and recreational users located within vicinity of the Proposal site
- It was assumed that residents would be present within the local area continuously for 35 years (enHealth 2012b), thereby assuming 24/7 exposure. These assumptions were also extended to school children who were assessed along with residents in one group. For commercial/industrial workers, it was assumed that exposure may occur eight hours per day, 240 days per year for 30 years (NEPC 2013). For recreational users, it was assumed that exposure may occur four hours per day, 104 days per year (two days per week) for 35 years (EnHealth 2012b, EnRisks 2014a)
- It was assumed that the Proposal would operate at the existing throughout for at least 35 years. Annual average ground level concentrations of pollutants emitted from the Proposal were calculated by averaging predicted air concentrations (over the actual time period of operation) from the source over a continuous 24-hour, 365 day per year period
- An exposure pathway assessment determined that inhalation of air was the main pathway of potential risk associated with the Proposal to human health. Other pathways therefore were not quantitatively evaluated.

To calculate the number of people potentially impacted by air pollution, 'exposure-response functions' for each outcome[46], were extrapolated. These functions are a measure of the change in the health outcome within the population for a given change in air pollutant concentrations. Different health endpoints are selected based on the main causes of potential mortality or morbidity attributable to the air pollutant. Generally, the number of attributable cases (by outcome) is calculated by applying the following equation[47]:

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[45] The operational assessment for the Proposal was based on the worst case scenario that included the assumption that all 12 reach stackers would be operating at a 50% load for the entire year.

[46] That is, mortality, hospital admissions and emergency department admissions.

[47] It is noted that, in applying this equation, it is assumed the whole population of each suburb is exposed to the highest predicted concentration of air pollutants, which would not be the case as predicted concentrations decrease with distance from the source of potential impact. The assumption that the whole population is exposed to the highest concentration of air pollutants therefore overestimates the risk posed by the Proposal and has been adopted as a conservative approach.

$$\textit{Number of attributable cases} = \textit{exposure response function (change in health outcome)per } \frac{1\mu g}{m3} \textit{ increase in pollutant x predicted air pollutant concentration x baseline incident rate (per } 100{,}000 \textit{ people) x actual population}$$

It is generally accepted by regulatory agencies that an increase in risk between 1 x 10^{-06} (1 in a million) and 1 x 10^{-05} (1 in 100,000) is considered low risk and within acceptable criteria.

Exposure response functions selected for each pollutant analysed for the HRA are provided in the following sections.

Diesel emissions and Particulate Matter – PM_{10} and $PM_{2.5}$

The results of epidemiological studies have shown that a wide range of health effects are associated with exposure to particulate matter, including respiratory, cardiovascular and cardiac disease, in addition to pneumonia, bronchitis and asthma. Table 10-2 and Table 10-3 show the adopted exposure response functions for PM_{10} and $PM_{2.5}$ respectively.

Table 10-2: Health endpoints and exposure-related functions for PM10

Health Endpoint	Averaging Period	β (Exposure Response Function per 1 μg/m³ Increase in PM_{10})
All-cause mortality 30+ years	Annual Average	0.004
All-cause mortality all ages	24-Hour Average	0.002
Mortality cardiovascular disease all ages	24-Hour Average	0.002
Hospital admissions respiratory disease 65+ years	24-Hour Average	0.003
Hospital admissions cardiac disease 65+ years	24-Hour Average	0.002
Hospital admissions pneumonia and bronchitis 65+ years	24-Hour Average	0.0013
Hospital admissions respiratory disease 15-64 years	24-Hour Average	0.003
Emergency Dept. visits asthma 1-14 years	24-Hour Average	0.015

Notes: - Exposure response functions obtained from Environment Protection and Heritage Council (EPHC 2010) and Health Effects Institute (HEI 2009).

Table 10-3: Health endpoints and exposure-related functions for PM2.5

Health Endpoint	Averaging Period	β (Exposure Response Function per 1 μg/m^3 Increase in $PM_{2.5}$)
All-cause mortality 30+ years	Annual Average	0.006
Cardiopulmonary mortality 30+	Annual Average	0.014
Mortality ischemic heart disease 30+ years	Annual Average	0.024
Mortality lung cancer 30+ years	Annual Average	0.014
All-cause mortality all ages	24-Hour Average	0.0023
Mortality cardiovascular disease- all ages	24-Hour Average	0.0013
Hospital admissions respiratory disease 65+ years	24-Hour Average	0.004
Hospital admissions cardiac disease 65+ years	24-Hour Average	0.005
Hospital admissions cardiovascular disease 65+ years	24-Hour Average	0.003
Hospital admissions ischemic heart disease 65+ years	24-Hour Average	0.004
Hospital admissions Chronic Obstructive Pulmonary Disease OPD 65+ years	24-Hour Average	0.004
Hospital admissions pneumonia and bronchitis 65+ years	24-Hour Average	0.005
Hospital admissions respiratory disease 15-64 years	24-Hour Average	0.003
ED visits asthma 1-14 years	24-Hour Average	0.0015

Note: Exposure response functions were obtained from EPHC (2010) and HEI (2009).

Abbreviations: µg/m3: microgram per cubic meter; COPD: Chronic Obstructive Pulmonary Disease ; ED: Emergency Department; PM: Particulate Matter

Nitrogen Dioxide – NO_2

The results of epidemiological studies have shown that a wide range of health effects are associated with exposure to NO_2, including respiratory disease and cardiovascular disease. Table 10-4 shows the health endpoints and adopted exposure response functions for NO_2.

Table 10-4: Health endpoints and exposure-response functions for NO2

Health endpoint	Averaging period	β (Exposure response function per 1 μg/m^3 increase in NO_2)
All-cause mortality 30+ years	Annual Average	0.0028
Cardiovascular mortality 30+ years	Annual Average	0.0028

Health endpoint	Averaging period	β (Exposure response function per 1 μg/m³ increase in NO_2)
Respiratory mortality 30+ years	Annual Average	0.0028
All-cause mortality all ages	24-Hour Average	0.001
Mortality respiratory disease all ages	24-Hour Average	0.0023
Mortality cardiovascular disease all ages	24-Hour Average	0.001
Hospital admissions respiratory disease 65+ years	24-Hour Average	0.003
Hospital admissions cardiovascular disease 65+ years	24-Hour Average	0.0014
Hospital admissions respiratory disease 15-64 years	24-Hour Average	0.001
ED visits asthma 1-14 years	24-Hour Average	0.0006

Note: Exposure response functions were obtained from EPHC (2010) and Cesaroni et al. (2013).

Sulphur Dioxide – SO_2

The results of epidemiological studies have shown that a wide range of health effects are associated with exposure to SO_2, including respiratory and cardiovascular disease. Table 10-5 shows the health endpoints and adopted exposure response functions for SO_2.

Table 10-5: Health endpoints and exposure-response functions for SO2

Health endpoint	Averaging period	β (Exposure response function per 1 μg/m³ increase in SO_2)
All-cause mortality all ages	24-Hour Average	0.0006
Mortality respiratory disease- all ages	24-Hour Average	0.0013
Mortality cardiovascular disease- all ages	24-Hour Average	0.0008
Hospital admissions respiratory disease 65+ years	1- Hour Maximum	0.002
ED visits asthma 1-14 years	24-Hour Average	0.008

Note: Exposure response functions were obtained from Jalaudin et al. (2008), Katsouyanni (2006), and Simpson et al. (2005).

Carbon Monoxide – CO

The results of epidemiological studies have shown that a wide range of health effects are associated with exposure to CO, including respiratory and cardiovascular disease. Table 10-6 shows the health endpoints and adopted exposure response functions for CO.

Table 10-6: Health endpoints and exposure-response functions for CO

Health endpoint	Averaging period	β (Exposure response function per 1 µg/m^3 increase in CO)
All-cause mortality 30+ years	8-Hour Average	0.000001
Hospital admissions cardiac disease 65+ years	8-Hour Average	0.000003
Hospital admissions cardiovascular disease 65+ years	8-Hour Average	0.0000014

Note: Exposure response functions were obtained from EPHC (2010) and Simpson et al. (2005).

Air Toxics

A number of air toxics are emitted from truck and rail activity associated with the Proposal, including benzene, 1,3-butadiene and PAHs. The critical health effect for each of the air toxics considered in the HRA is a potential increased risk of cancer. The following equation was used to calculate the lifetime cancer risk associated with the concentrations of the air toxics predicted to arise from emissions from the operation of the Proposal:

$$\boldsymbol{Increase\ in\ lifetime\ cancer\ risk} \\ = Annual\ average\ concentration\ x\ Unit\ Risk\ Factor\ (URF)$$

Annual average concentrations of each of the air toxics are low and predicted concentrations comply with the relevant air quality standards (Environ, 2015). To provide a conservative assessment of the potential health risks, the highest concentrations for each air toxic for the suburbs of Casual, Glenfield, Moorebank, Glenfield and Wattle Grove were used. The URFs from the Californian EPA Office of Environmental Health Hazard Assessment (OEHHA) were adopted for the assessment. The Unit Risk Factors (URFs) adopted in this HRA for benzene, 1,3-butadiene, and PAHs (as BAP TEQ) are presented in Table 10-7.

Table 10-7: Unit risk factors used for the calculation of excess lifetime cancer risk

Chemical	Unit risk factor (µg/m^3)$^{-1}$
Benzene	0.000029
1,3-Butadiene	0.00017
DPM	0.0003
PAHs (as BaP TEQ)	0.0011

Note: Unit risk factors were obtained from California Environmental Protection Agency (Cal/EPA) Office of Environmental Health Hazard Assessment (OEHHA). 2016. OEHHA Toxicity Criteria Database. Available at: http://oehha.ca.gov/tcdb/index.asp

10.2.2 Noise

The noise HRA was undertaken to evaluate potential health risks to surrounding residential communities from exposure to noise resulting from the operation of the Proposal. The assessment was based on the following information.

- The existing ambient noise environment at locations representative of the potentially most affected residential receivers (sensitive receivers[48]) in Casula, Glenfield and Wattle Grove were established through long-term background noise monitoring conducted in accordance with the NSW Industrial Noise Policy (Environment Protection Authority, 2000) (refer to Wilkinson Murray, 2016 – refer to Appendix N of this EIS). The locations of sensitive receivers for noise used within this assessment are located in Section 8.2.4 of this EIS
- Operational noise levels ($L_{Aeq, period}$) experienced at key receivers were extrapolated from modelling undertaken as part of the Noise Impact Assessment (Wilkinson Murray, 2016). The L_{Amax} noise levels during the night time associated with transient noise from Proposal operation were also extrapolated from this source and included in the assessment.

Predicted noise levels were compared with guideline criteria for health provided by the World Health Organisation (WHO). The WHO guidelines for community noise are designed to protect against the key health effects of annoyance, sleep disturbance, and cognitive impairment (WHO, 1999). The WHO guidelines are summarised in Table 10-8.

Table 10-8: WHO guidelines for community noise

Specific Environment	Critical health effect	$L_{Aeq, period}$ (dB A)	Time Base (hour)	L_{Amax} (dB A)
Outdoor Living Area	Serious annoyance, daytime and evening	55	16	--
	Moderate annoyance, daytime and evening	50	16	--
Dwelling, Indoor	Disturbance of speech intelligibility and moderate annoyance, daytime and evening	35	16	--
Inside Bedrooms (Indoor)	Sleep disturbance, night time	30	8	45
Outside Bedrooms (Outdoor)	Sleep disturbance, window open, night time	45	8	60
School/Preschool Classrooms, Indoor	Disturbance of speech intelligibility, information extraction, and message communications, daytime	35	During class	--
Preschool Bedrooms, Indoor	Sleep disturbance, sleep time	30	During sleep	45
School Playground, Outdoor	Annoyance, during play, daytime	55	During play	--

[48] The area identified in the air quality assessment has indicated Moorebank is included in Wattle Grove in the noise assessment. This does not change the outcomes of the report and only represents a differing interpretation of suburbs (i.e. the same sensitive receivers have been considered).

The ratio of the predicted noise level to the guidelines is termed the hazard quotient, with a hazard quotient of less than one (1) considered to be an acceptable level of risk (enHealth, 2012). A hazard quotient was calculated for each sensitive receiver, using the following equation, to gauge whether or not the Proposal would pose a noise risk from a human health perspective:

$$\boldsymbol{HQ} = \frac{predicted\ noise\ level}{health\ based\ guideline}$$

10.3 Existing environment

The HRA has considered the key air and noise pollution sources associated with the Proposal. For both air and noise aspects, there are a large number of other sources[49] within proximity to the Proposal that have the potential to affect the health of local communities. Furthermore, it is also recognised that community health is influenced by a complex range of socioeconomic factors[50]. Hence, a review of the existing health statistics, air quality and ambient noise levels for the local area surrounding the Proposal was undertaken, and compared to general regional statistics to appropriately evaluate the susceptibility of the community to potential health risks imposed by the Proposal.

Surrounding community area

The Proposal site is located within the Liverpool LGA in the Sydney south-western region. The study areas considered for both air and noise components of the HIA are summarised as follows:

- The local air shed and modelled locations used for the assessment were extrapolated from the Air Quality Impact Assessment (Ramboll, 2016), presented in Section 9.3.2 of this EIS.
- Existing baseline noise levels were extrapolated to represent the most potentially affected residential receivers in nearby surburbs including Casula, Wattlegrove and Glenfield. These levels were determined from the Noise and Vibration Impact Assessment (Wilkinson Murray, 2016), presented in Section 8.2.5 of this EIS.

Population statistics and health

Population statistics for the surrounding suburbs of Casula, Glenfield, Wattle Grove, and Moorebank were obtained from the Australian Bureau of Statistics (ABS) for the census year 2011. These figures are summarised below in Table 10-9.

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[49] Including other combustion sources, noise from road and rail, local construction/earthworks, and personal exposures (such as smoking)

[50] Including age, socio-economic status, social capital, behaviours, beliefs and lifestyle, life experiences, country of origin, genetic predisposition, and access to health and social care.

Table 10-9: Population statistics summary for surrounding areas to the Proposal

Location	Total population	% of population by key age group				
		< 5 years	5-14 years	15-64 years	65+ years	30+ years
Casula	14,696	7.9	15	67	10	49
Wattle Grove	8,192	8.7	18	69	5.2	45
Moorebank	7,595	8.4	13	66	13	60
Glenfield	7,558	6.6	12	67	14	67
Sydney South West	360,166	7.1	15	68	11	50
Greater Sydney	4,391,674	6.8	12	68	13	60
Rest of NSW (excluding Sydney)	2,512,949	6.3	13	63	18	63

As shown above in Table 10-9, the population composition in the suburbs of Moorebank, Casula, and Glenfield are largely similar to Sydney Southwest and Greater Sydney. Wattle Grove is characterised by a lower proportion of people aged 65 years and over.

According to the Liverpool Community Health Profile (South Western Sydney Local Health District [SWSLHD] 2014), the population in the Liverpool LGA is predicted to increase significantly from 188,143 people in 2011 to 288,959 in 2031. The predicted population growth in various age groups is shown in Figure 10-1. Population growth is predicted at a faster rate for younger people (people less than 69 years of age).

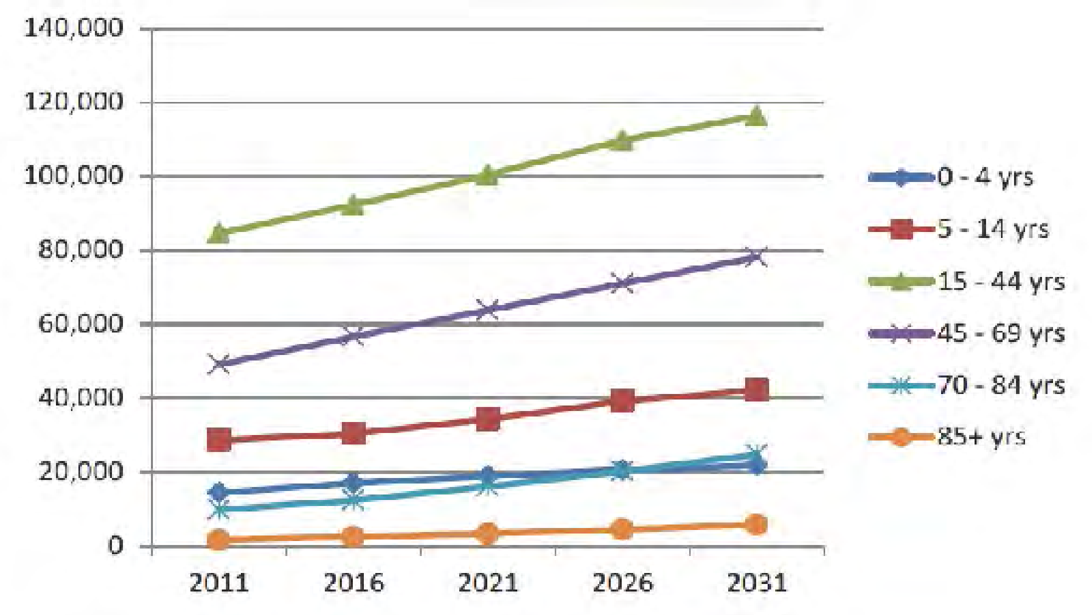

Figure 10-1: Population growth projections within Liverpool LGA (Source: SWSLHD, 2014)

Available health statistics from larger regional areas incorporating the health study area (Liverpool LGA, the larger Sydney South West Area, Greater Sydney, and NSW) were assessed alongside similar statistics for the local Liverpool LGA region, as shown in Table 10-10. The data presented suggests the baseline health status, measured in terms of chronic disease incidence, of the local population (Liverpool LGA) does not differ significantly from the data for NSW as a whole.

Of particular note, according to the SWSLHD, the prevalence rate of asthma is 6.3% in people over 16 years of age in the area. This is lower than the NSW average for the same age group.

Table 10-10: Summary of baseline health incidence for Liverpool LGA and regional areas

Health indicator	Incidence for population (rate per 100,000 population)							
	Liverpool LGA		Sydney South West Area		Greater Sydney		NSW	
Mortality								
All causes-all ages	556	a	543	b	587	c	529	b
All causes-30+ years	--	--	--	--	--	--	1065	b
Cardiovascular disease- all ages1	162	a	160	a	--	--	155	b
Cardiovascular disease- 30+ years2	--	--	--	--	--	--	299	b
Cardiopulmonary 30+ years	--	--	--	--	--	--	490	d
Ischemic heart disease 30+ years3	71	a	72	a	--	--	67	b
Respiratory disease all ages	--	--	52	e	--	--	50	f
Respiratory disease 30+ years4	--	--	52	e	--	--	50	f
Lung cancer 30+ years5	38	g	36	f	--	--	35	f
Hospital Admissions								
Respiratory disease 65+ years	--	--	--	--	--	--	4476	h
Respiratory disease 15-64 years6	--	--	--	--	--	--	899	h
Cardiac disease 65+ years7	--	--	--	--	--	--	9159	h
Cardiovascular disease 65+ years1	--	--	--	--	--	--	9159	h
Pneumonia and bronchitis 65+ years8	--	--	--	--	--	--	1236	h
Ischemic heart disease 65+ years9	--	--	2805	h	--	--	3331	h
COPD 65+ years	1678	i	1482	h	1194	j	1489	h
Asthma								
ED Visits 1-14 years[10]	--	--	--	--	--	--	804	b
Notes: [1.] Used circulatory disease mortality data.		[a] 2012-2013 data (NSW HealthStats[51]) [b] 2013 data (NSW HealthStats).						

[51] Available at: http://www.healthstats.nsw.gov.au/

Health indicator	Incidence for population (rate per 100,000 population)			
	Liverpool LGA	Sydney South West Area	Greater Sydney	NSW

[2] Used circulatory disease mortality data for 25+ years

[3] Used coronary heart disease mortality data for all ages.

[4] Used respiratory disease mortality data for all ages.

[5] Used lung cancer mortality data for all ages.

[6] Used respiratory disease hospitalisation data for 17-64 years.

[7] Used data for cardiovascular disease hospitalisation data for 65+ years.

[8] Used all pneumonia and influenza hospitalisation data.

[9] Used coronary heart disease hospitalisation data for 75+ years.

[10] Used ED presentations for asthma data for 0-17 years.

[c] 2006-2007 data (Table 2.3 in EnRisks 2014a).

[d] 2005-2007 data (Table 2.3 in EnRisks 2014a).

[e] 2010-2011 data (NSW HealthStats).

[f] 2011 data (NSW HealthStats).

[g] 2004-2008 data (SWS LHD 2014).

[h] 2013-2014 data (NSW HealthStats).

[i] 2009-2011 data (Table 2.3 in EnRisks 2014a).

[j] 2010-2011 data (Table 2.3 in EnRisks 2014a).

Abbreviations: COPD: Chronic Obstructive Pulmonary Disease; ED: Emergency Department; LGA: Local Government Area; SWS LHD: South Western Sydney Local Health District

Given the above data, it is assumed that there are no underlying health issues that would make the local communities more vulnerable to the effects of environmental factors, from the Proposal than the rest of Sydney and NSW.

Existing Air Quality

Background ambient air quality data is established and discussed in Section 9.3.3 of this EIS, which is influenced by a number of key industrial and non-industrial sources, including:

- The Glenfield Waste Disposal facility
- Traffic emissions from the existing road network (e.g. South Western Motorway M5 adjacent to the northern MPW site boundary)
- Locomotive emissions from the operation of SSFL (west of the MPW site)
- Locomotive emissions from the East Hills Rail Line (south of the MPW site)
- Emissions from aircraft at Bankstown Airport (northeast of the MPW site).

A review of local historic air quality data from the *Air Quality Impact Assessment* (Ramboll, 2016) shows recent improvements in the ambient concentrations of lead, carbon monoxide, (CO), sulfur dioxide (SO_2) and nitrogen dioxide (NO_2), yet background ambient $PM_{2.5}$ levels have consistently measured above the AAQ NEPM standard for the past five years. Existing concentrations of PM_{10} and $PM_{2.5}$ for the Liverpool area have been shown to be strongly influenced by vehicle emissions and wood heaters (Ramboll, 2016), which fluctuate depending on the time of day and season.

Existing Ambient Noise Levels

The existing ambient noise environment at locations representative of the potentially most affected residential receivers in Casula, Glenfield and Wattle Grove were established through long-term background noise monitoring conducted in accordance with the NSW Industrial Noise Policy (Environment Protection Authority 2000), as expressed within Section 8.2.5 of this EIS. The existing ambient noise levels (the equivalent noise levels averaged over a time period [$LA_{eq,\ period}$]), used for this HRA are presented in Table 10-11.

Table 10-11: Existing ambient noise levels

Suburb	LAeq, period (dBA)		
	Day	Evening	Night Time
Casula	55	54	53
Glenfield	48	47	44
Wattle Grove	55	49	46

Note: Daytime 7:00am–6:00pm; Evening 6:00pm–10:00pm; Night time 10:00pm 7:00am.

10.4 Potential impacts

A screening study was included within the Health Impact Assessment and was undertaken as part of the investigations for the MPW Concept Approval (EnRisks, 2014) to consider issues raised by the community in relation to potential health impacts associated with the Proposal. Key relevant issues raised throughout this process included:

- The health effects associated with exposure to PM_{10}, $PM_{2.5}$, SO_2 and NO_2 associated with the activities at the site
- Health effects of diesel pollution and reduced air quality
- Noise impacts generated by the Proposal, including rail noise
- Asthma concerns
- Impacts on young children.

The HRA, prepared for the Proposal, considered these key concerns having regard to air and noise emissions generated by the Proposal and impacts to human health. The following sections provide a summary of each aspect and relevant expected health outcomes.

10.4.1 Air quality

The following sections summarise the findings of the HRA for each of the key air pollutants of concern identified during the consultation process.

Diesel emissions and Particulate Matter – PM_{10} and $PM_{2.5}$

For the purposes of this HRA, it has been assumed that 100 percent of the incremental $PM_{2.5}$ (from the Proposal only) is derived from diesel sources. This is a conservative assumption, but has been justified on the basis of the inventory of $PM_{2.5}$ emission sources at the MPW site (EnRisks 2014). The increased annual incidences for health end points relating to PM_{10} and $PM_{2.5}$ emissions for the Proposal is shown in Table 10-12 and Table 10-13 respectively.

Table 10-12: Summary of increased annual incidence concerning PM10 emissions from the operation of the Proposal

Health endpoint	Exposure period	Increased annual incidence (case per year)			
		Casula	Glenfield	Moorebank	Wattle Grove
All-cause mortality 30+ years	Annual Average	0.05	0.02	0.04	0.03
All-cause mortality all ages	24-Hour Average	0.02	0.007	0.02	0.02
Mortality cardiovascular disease all ages	24-Hour Average	0.007	0.002	0.005	0.005
Hospital admissions respiratory disease 65+ years	24-Hour Average	0.03	0.01	0.03	0.01
Hospital admissions cardiac disease 65+ years	24-Hour Average	0.04	0.02	0.04	0.02
Hospital admissions pneumonia and bronchitis 65+ years	24-Hour Average	0.004	0.001	0.004	0.001
Hospital admissions respiratory disease 15-64 years	24-Hour Average	0.04	0.01	0.03	0.03
ED visits asthma 1-14 years	24-Hour Average	0.06	0.01	0.04	0.05

Abbreviations: ED: Emergency Department. PM: Particulate Matter

Table 10-13: Summary of increased annual incidence concerning PM2.5 emissions from the operation of the Proposal

Health endpoint	Exposure period	Increased annual incidence (case per year)			
		Casula	Glenfield	Moorebank	Wattle Grove
All-cause mortality 30+ years	Annual Average	0.07	0.03	0.06	0.04
Cardiopulmonary mortality 30+	Annual Average	0.07	0.03	0.07	0.05
Mortality ischemic heart disease 30+ years	Annual Average	0.02	0.007	0.02	0.01
Mortality lung cancer 30+ years	Annual Average	0.005	0.002	0.005	0.003
All-cause mortality all ages	24-Hour Average	0.03	0.008	0.02	0.02

Health endpoint	Exposure period	Increased annual incidence (case per year)			
		Casula	Glenfield	Moorebank	Wattle Grove
Mortality cardiovascular disease- all ages	24-Hour Average	0.004	0.001	0.003	0.003
Hospital admissions respiratory disease 65+ years	24-Hour Average	0.04	0.02	0.04	0.01
Hospital admissions cardiac disease 65+ years	24-Hour Average	0.1	0.04	0.1	0.04
Hospital admissions cardiovascular disease 65+ years	24-Hour Average	0.06	0.02	0.06	0.02
Hospital admissions ischemic heart disease 65+ years	24-Hour Average	0.03	0.01	0.03	0.01
Hospital admissions COPD 65+ years	24-Hour Average	0.01	0.005	0.01	0.005
Hospital admissions pneumonia and bronchitis 65+ years	24-Hour Average	0.01	0.005	0.01	0.005
Hospital admissions respiratory disease 15-64 years	24-Hour Average	0.04	0.01	0.03	0.03
ED visits asthma 1-14 years	24-Hour Average	0.006	0.001	0.004	0.005

Abbreviations: COPD: Chronic Obstructive Pulmonary Disease. ED: Emergency Department. PM: Particulate Matter

As shown in Table 10-12 and Table 10-13, the increased annual incidences of health endpoints evaluated due to PM (both PM_{10} and $PM_{2.5}$) as a result of the Proposal emissions were well below one case per year, which is below the acceptable risk level established in Section 10.2.1 of this EIS (i.e. fewer than one increased case per year of premature mortality, hospital admissions, and emergency department visits associated with cardiovascular and respiratory diseases or asthma).

Based on the estimated increased annual incidence for multiple health endpoints contributing to mortality and morbidity, there are no significant adverse health effects expected in relation to acute and chronic exposure to PM_{10} and $PM_{2.5}$ in the local area surrounding for the operation of the Proposal.

Nitrogen Dioxide – NO_2

The increased annual incidences for health end points relating to NO_2 emissions for the Proposal are shown in Table 10-14.

Table 10-14: Summary of increased annual incidence concerning NO2 emissions from the operation of the Proposal

Health endpoint	Averaging period	Increased annual incidence (case per year)			
		Casula	Glenfield	Moorebank	Wattle Grove
All-cause mortality 30+ years	Annual Average	0.9	0.4	0.9	0.6
Cardiovascular mortality 30+ years	Annual Average	0.3	0.1	0.3	0.2
Respiratory mortality 30+ years	Annual Average	0.04	0.02	0.04	0.03
All-cause mortality all ages	24-Hour Average	0.3	0.1	0.3	0.2
Mortality respiratory disease	24-Hour Average	0.07	0.02	0.06	0.05
Mortality cardiovascular disease all ages	24-Hour Average	0.1	0.03	0.08	0.07
Hospital admissions respiratory disease 65+ years	24-Hour Average	0.9	0.4	0.9	0.3
Hospital admissions cardiovascular disease 65+ years	24-Hour Average	0.9	0.4	0.8	0.3
Hospital admissions respiratory disease 15-64 years	24-Hour Average	0.4	0.1	0.3	0.3
ED visits asthma 1-14 years	24-Hour Average	0.07	0.02	0.05	0.06

As indicated in Table 10-14, the increased annual incidences were below one case per year for all health endpoints in Glenfield and Wattle Grove, which is within the acceptable risk level established within Section 10.2.1 of this EIS. The most sensitive endpoint within Casula and Moorebank for NO_2 would have the potential to encounter one (1) additional case per year of premature mortality due to all causes for people aged 30 and above, which may be attributed by the operation of the Proposal. It should be noted however that the calculations were based on a conservative assumption that all NO_x is converted to NO_2. Based on monitoring data from the Liverpool Air Monitoring station, the conversion ratio of NO_2 to NO_x is approximately 0.7, i.e. NO_2 is 70% of the monitored NO_x levels (Pacific Environment, 2015). Following adjustment for the fraction of Proposal-based emissions attributable to NO_2, short and long-term exposure to NO_x result in low health impacts within the surrounding communities and are below the acceptable risk levels (i.e. fewer than one increased case per year of premature mortality, hospital admissions, and emergency department visits associated with cardiovascular and respiratory diseases or asthma).

Sulphur Dioxide – SO_2

The increased annual incidences for health end points relating to SO_2 emissions for the Proposal are shown in Table 10-15.

Table 10-15: Summary of increased annual incidence concerning SO2 emissions from the operation of the Proposal

Health endpoint	Averaging period	Increased annual incidence (case per year)			
		Casula	Glenfield	Moorebank	Wattle Grove
All-cause mortality all ages	24-Hour Average	0.001	0.0003	0.0007	0.0008
Mortality respiratory disease- all ages	24-Hour Average	0.0002	0.00005	0.0001	0.0002
Mortality cardiovascular disease- all ages	24-Hour Average	0.0004	0.0001	0.0003	0.0003
Hospital admissions respiratory disease 65+ years	1- Hour Maximum	0.004	0.001	0.002	0.003
ED visits asthma 1-14 years	24-Hour Average	0.005	0.001	0.003	0.004

Results from the tables above show the increased annual incidences for the health endpoints evaluated due to operation of the Proposal related SO_2 exposure were all well below one case per year. The risk from exposure to SO_2 from the cumulative Proposal operations is well below the acceptable risk levels and considered negligible.

Carbon Monoxide – CO

The increased annual incidences for health end points relating to CO emissions for the Proposal are shown in Table 10-16.

Table 10-16: Summary of increased annual incidence concerning CO emissions from the operation of the Proposal

Health endpoint	Averaging period	Increased annual incidence (case per year)			
		Casula	Glenfield	Moorebank	Wattle Grove
All-cause mortality 30+ years	8-Hour Average	0.0002	0.00006	0.0002	0.0001
Hospital admissions cardiac disease 65+ years	8-Hour Average	0.001	0.0003	0.0009	0.0004
Hospital admissions cardiovascular disease 65+ years	8-Hour Average	0.00006	0.00002	0.00005	0.00002

The increase in risk associated with the emissions generated by the operation of the Proposal for the health endpoints relating to CO exposure were all well below one case per year. The health risk impose from Proposal-related CO exposure is well below the acceptable risk level, and is considered negligible.

Air Toxics

Table 10-17 Provides a summary of the excess lifetime cancer risks associated with the Proposal related exposure to benzene, 1,3-butadiene, and PAHs in consideration of the most exposed receptor identified within proximity to the Proposal (residential/school, commercial/industrial, or recreational).

Table 10-17: Summary of excess lifetime cancer risks associated with exposure to Benzene, 1,3-Butadiene, PAHs, and DPM from the operation of the Proposal

Chemical	Excess lifetime cancer risk at maximum exposed receptor		
	Residential/School	Recreational	Commercial/Industrial
Benzene	3.5E-07	1.8E-08	4.9E-08
1,3-Butadiene	6.9E-07	3.7E-08	9.3E-08
DPM	6.4E-05	3.0E-06	1.0E-05
PAHs (as BaP TEQ)	1.1E-09	5.4E-11	1.8E-10

As shown above, the excess lifetime cancer risks associated with the Proposal related exposure to benzene, 1,3-butadiene, and PAHs (as BAP TEQ) were all below the acceptable risk range of 10^{-6} to 10^{-4}. Therefore, no unacceptable cancer risks are expected in relation to chronic exposure to VOCs and PAHs in the local area surrounding the Proposal.

Regional Impacts

The Air Quality Impact Assessment (Ramboll, 2016) (Appendix O) states that the impacts associated with operation of the Proposal on regional air quality would be negligible (refer to Section 9.4.4 of this EIS). Furthermore, the HRA notes that regional air quality was considered within the MPW Concept EIS and it was concluded that any changes to regional air quality as a result of the Proposal would be negligible, or may even result in a reduction of overall emissions.

Summary

The results of the HRA found that the increase in risk due to air emissions from the operation of the Proposal are low and, in most cases, negligible. The cancer risk from the air toxics were found to be well below acceptable risk levels set by international agencies.

10.4.2 Noise

Exposure to noise can be associated with direct auditory and non-auditory health effects, including cardiovascular disease, cognitive impairment, sleep disturbance, tinnitus, annoyance and hearing impairment (WHO, 2011). Sleep disturbance is one of the most common complaints raised by noise exposed communities and can have a significant impact on health and quality of life. Guidelines for community noise, as formulated by the WHO and outlined in Table 10-8 are designed to protect communities against key health effects associated with noise.

Predicted operational noise levels at key sensitive receivers for the Proposal were determined from the Noise and Vibration Assessment (Wilkinson Murray, 2016) and presented in Section 8.3.2 of this EIS. Construction phase impacts for the Proposal were not considered for this assessment as they would be temporary and are demonstrated in the Noise and Vibration Impact Assessment to comply with the relevant standards.

The hazard quotient equation presented in Section 10.2.2 of this EIS was applied to the existing established ambient noise levels to identify the hazard quotient at each sensitive receiver for annoyance, sleep disturbance and cognitive impairment. These are outlined below in Table 10-18.

Table 10-18: Hazard quotients for existing ambient noise

Suburb	Annoyance	Sleep Disturbance	Cognitive Impairment
	$L_{Aeq, period}$	$L_{Aeq, period}$	$L_{Aeq, period}$
Casula	**1.3**	**1.4**	**1.3**
Glenfield	**1.1**	**1.1**	**1.1**
Wattle Grove	**1.3**	**1.2**	**1.3**

Note: All exceedances have been expressed in **bold lettering**

Table 10-18 identifies that the existing noise levels in the NCAs already exceed the hazard quotient of one (1). The existing noise levels are higher than those predicted relating to the operation of the Proposal, as shown below when comparing these results with Table 10-19.

Table 10-19: Hazard quotients for operational noise from the Proposal

Receiver/Suburb	Annoyance	Sleep Disturbance		Cognitive Impairment
	$L_{Aeq, period}$	$L_{Aeq, period}$	L_{Amax}	$L_{Aeq, period}$
Casula	0.7	0.9	0.8	0.7
Glenfield	0.4	0.4	0.4	0.3
Wattle Grove	0.6	0.8	0.4	0.5
All Saints Senior College (S1)	0.4	N/A	N/A	0.3
Casula Powerhouse (S2)	0.4	N/A	N/A	0.4
MPE (I1)	**1.4**	N/A	N/A	**1.4**
DJLU (I2)	**1.3**	N/A	N/A	**1.3**
ABB (I3)	**1.2**	N/A	N/A	**1.2**

All hazard quotients associated with the Proposal operation were less than 1 at the residential and school receivers, indicating that the operational noise does not pose an unacceptable risk to the health of these communities. The hazard quotients were greater than 1 for annoyance and cognitive impairment at the nearest industrial receivers. It is noted, however that the HQs for existing ambient noise already exceed 1 for annoyance and cognitive impairment.

Operational noise from rail movements

Hazard quotients were formulated for operational rail noise associated with the Proposal, as shown in Table 10-20 below.

Table 10-20: Hazard quotients for rail noise due to freight rail movements associated with the Proposal

Receiver/Suburb	Annoyance	Sleep Disturbance		Cognitive Impairment
	LAeq, period	LAeq, period	LAmax	LAeq, period
Casula	**1.1**	**1.3**	**1.3**	**1.1**
Glenfield	0.9	1.0	**1.2**	0.9
Wattle Grove	0.9	1.0	1.0	0.9
All Saints Senior College (S1)	0.9	N/A	N/A	**1.1**
Casula Powerhouse (S2)	0.8	N/A	N/A	0.9

Hazard quotients derived for operational rail noise were greater than 1 for all categories in the suburb of Casula, for sleep disturbance in Glenfield and for cognitive impairment at All Saints Senior College.

As shown above, hazard quotients are above 1 for residential receivers in Casula and Glenfield and the All Saint Senior College. These values only marginally exceed 1, which indicates that rail noise may result in a small increase in the risk of health outcomes to the community, if left unmitigated. Furthermore, when analysed in conjunction with Table 10-18, it can be seen that a similar hazard quotient is generated by ambient noise as rail noise. This suggests that additional noise impact generated by rail noise in not likely to be primarily responsible for any health impacts created by noise as part of the Proposal operation.

Total noise

Total noise levels were analysed as part of the HRA as the WHO community guidelines are designed to be applied under these conditions. For the Proposal this equates to the total noise generated by the Proposal and existing ambient background. The decibel is a log scale unit, therefore the total noise levels were calculated as the logarithmic sum of the predicted noise levels from cumulative operation of MPW Stage 2 and MPE Stage 1, rail, and existing ambient background.

The data presented in Table 10-21 show the difference between the total noise level and the existing ambient noise levels for each of the key catchment areas. As the data in Table 10-21 shows. There is no recorded recognisable difference between the existing ambient and total noise levels in each of the three noise catchments, indicating that the Proposal would have little impact on the local area, and that the existing ambient noise is the major contributor to the total noise.

Table 10-21: Predicted total noise levels from cumulative operation of the Proposal

Suburb	Daily $LA_{eq, period}$ (dBA)				
	Operational noise	Rail noise	Operational + Rail noise	Existing Ambient	Total (Proposal + Existing Ambient)
Casula	36	50	50	55	55
Glenfield	24	43	43	48	48
Wattle Grove	36	41	41	55	55

Summary

In summary, the noise from the Proposal operation meets the WHO community noise guidelines at most sensitive receivers. Exceedances occur for annoyance, sleep disturbance and cognitive impairment in the local communities from predicted operational rail noise, however since it is shown that the existing ambient noise levels alone already exceed the WHO guidelines, the additional noise created as a result of the Proposal is anticipated to have minimal impact on noise related health effects in the local area.

10.5 Mitigation measures

With regards to air quality, the results from the assessment found that increases in risk due to air emissions caused by the Proposal are low and in many cases negligible, and are in accordance with relevant guidelines. The excess lifetime cancer risks were below or within the acceptable risk range. Therefore, there are no significant adverse health effects expected in relation to acute and chronic exposure to key air pollutants associated with the operation of the Proposal in the surrounding communities.

Best practice procedures and management measures prescribed within Section 8 (for Noise) and 9 (for Air Quality) of this EIS respectively are to be implemented to further reduce levels of air and noise pollution generated as a result of the operation of the Proposal.

11 BIODIVERSITY

A *Biodiversity Assessment Report* (BAR) has been prepared by Arcadis (2016) to assess the impacts on biodiversity from the construction and operation of the Proposal.

Table 11-1 sets out the Secretary's Environmental Assessment Requirements (SEARs) as they relate to biodiversity, and where these have been addressed.

Table 11-1: SEARs for the Proposal relating to biodiversity

Section/ Number	Requirement	Where addressed in this EIS
12. Biodiversity	A Flora and Fauna assessment. The assessment shall:	
	a) assess impacts on the biodiversity values of the site and adjoining areas, including Endangered (and vulnerable) Ecological Communities and threatened flora and fauna species and their habitat, groundwater dependent ecosystems, impacts on wildlife and habitat corridors, riparian land, and habitat fragmentation and details of mitigation measures. The assessment shall be undertaken in accordance with the Framework for Biodiversity Assessment, unless otherwise agreed by OEH, by a person accredited in accordance with s142B(1)(c) of the *Threatened Species Conservation Act 1995;*	Appendix Q of this EIS
	b) consider of the OEH's *Threatened Species Survey and Assessment Guidelines* (www.environment.nsw.gov.au/threatenedspecies/surveyassessmentgdlns.htm) , any relevant draft or final recovery plans, and Commonwealth *Significant Impact Guidelines*;	Appendix Q of this EIS
	c) assess and document impacts related to the proposed project in accordance with the *Framework for Biodiversity Assessment* (OEH 2014), unless otherwise agreed by OEH, by a person accredited in accordance with s142B(1)(c) of the *Threatened Species Conservation Act 1995*. This assessment shall include consideration of any new impacts that are outside of previous assessments;	Appendix Q of this EIS
	d) include a comprehensive offset strategy, or provide an updated strategy (including any new impacts if relevant), in accordance with the NSW *Biodiversity Offsets Policy for Major Projects* including the *Framework for Biodiversity Assessment* (OEH 2014), consistent with the 'avoid, minimise or offset' principle	A comprehensive Biodiversity Offset Strategy (BOS) for the MPW Project is being prepared in response to the MPW Concept Approval.

Section/ Number	Requirement	Where addressed in this EIS
		The BOS will consider all of the relevant biodiversity impacts of the Proposal.
8.Soil and Water	a) assess impacts on surface and groundwater flows, quality and quantity, with particular reference to any likely impacts on dragonfly species listed under the *Fisheries Management Act 1994*, the Georges River and Anzac Creek;	Appendix Q of this EIS

11.1 MPW Concept Approval

The biodiversity impacts of the MPW Concept and Early Works were assessed by Parsons Brinckerhoff (PB) in an Ecological Impact Assessment (PB 2014) prepared for the MPW Concept EIS, and in a separate Framework for Biodiversity Assessment (FBA) prepared as part of the RtS (PB 2015). Although the technical papers prepared for the MPW Concept EIS addressed the biodiversity values and assessed potential impacts across the entire MPW site, only the Early Works component of the MPW Project include physical works which have been approved and impact on the biodiversity values of the development site.

The MPW Concept EIS was also prepared to address the *Environmental Protection Biodiversity Conservation Act 1999* (EPBC Act) assessment requirements for impacts to Matters of National Environmental Significance, including threatened species and ecological communities. The MPW Project was granted approval as a controlled action under the EPBC Act in mid-2016 (MPW EPBC Approval).

The vegetation within the development site consists predominantly of remnant and regrowth vegetation that has been subjected to weed invasion in some areas. Four vegetation communities were identified by PB (2014) on the development site, all of which correspond with threatened ecological communities (TECs) listed under the *Threatened Species Conservation Act 1995* (TSC Act) (Table 11-12).

Table 11-2: Vegetation communities identified on the MPW Site by PB (2014)

Vegetation community	Plant Community Type (PCT)	Corresponding Threatened Ecological Community
Castlereagh Scribbly Gum Woodland	Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin	Castlereagh Scribbly Gum Woodland in the Sydney Basin bioregion
Castlereagh Swamp Woodland	Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin	Castlereagh Swamp Woodland

Vegetation community	Plant Community Type (PCT)	Corresponding Threatened Ecological Community
Alluvial Woodland	Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin	River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions.
Riparian Woodland	Sydney Blue Gum X Bangalay – Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin	

The remainder of the development site outside of the mapped PCTs has low vegetation cover consisting chiefly of a sparse canopy composed of a mixture of planted and remnant indigenous and introduced trees within areas of cleared and disturbed land. PB (2014) considered that these areas of land no longer contain the native species diversity or vegetation structure to be classified as native vegetation communities.

Two threatened flora species were recorded within the development site: *Persoonia nutans* (listed as Endangered under the EPBC Act and TSC Act) and *Grevillea parviflora* subsp. *parviflora* (listed as Vulnerable under the EPBC Act and TSC Act). Populations of these species were recorded in patches of Castlereagh Scribbly Gum Woodland adjacent to Moorebank Avenue in the east of the development site. Six additional threatened flora species were considered to have a moderate likelihood of occurrence on the development site, based on the presence of suitable habitat and historical records of these species from the locality.

A total of 92 fauna species were recorded on the development site, comprising 87 native species and five introduced species. One threatened fauna species, Grey-headed Flying-fox (*Pteropus poliocephalus*) (listed as Vulnerable under the EPBC Act and TSC Act) was recorded flying over the development site. Ultrasonic bat call surveys on site detected probable recordings of calls of the threatened microbat species Southern Myotis (*Myotis macropus*), Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*) and Greater Broad-nosed Bat (*Scoteanax rueppellii*), all listed as Vulnerable under the TSC Act. The development site was also considered likely to provide habitat for 23 additional threatened fauna species of animals not detected during surveys; most would only be likely to utilise the intact riparian habitats adjoining the Georges River, which forms an important part of the local and regional corridor network (PB 2014).

Four fauna habitat types were identified on the development site based on field verification: riparian vegetation along the Georges River; fragmented patches of shrubby woodland; highly disturbed areas containing large remnant trees; and artificial wetlands.

No aquatic surveys were undertaken for the assessment of the MPW Concept; the results of the aquatic ecology assessment prepared for the neighbouring SIMTA Project (Hyder Consulting 2014) and another study previously conducted for the Georges River catchment (Gehrke *et al.* 2014) were reviewed. No species currently listed under the NSW *Fisheries Management Act 1994* (FM Act) were recorded in the Georges River catchment.

PB (2014) state that the Early Works are unlikely to result in the clearing of any native vegetation communities, including any threatened ecological communities or species. They are likely to result in the removal of scattered native and introduced trees and shrubs within the highly modified, park-like grounds in the east of the development site, associated with the built-up areas of the development site.

Impacts of the full build are also considered and assessed in the Technical Paper (PB 2014). Impacts considered included:

- Vegetation clearing and habitat loss
- Loss of roosting and breeding habitat in hollow bearing trees
- Direct mortality
- Loss of foraging resources
- Fragmentation and loss of connectivity
- Increased edge effects
- Noise impacts on fauna
- Light impacts to fauna
- Dust pollution
- Introduction and spread of weeds, pests and pathogens
- Fire regimes
- Increased edge effects
- Disturbance of aquatic habitat
- Disturbance of groundwater dependent ecosystems

Impact significance assessments for threatened species populations and threatened ecological communities were prepared, considering the potential impacts of the MPW Concept and proposed mitigation measures. Based on these assessments, no threatened species population or threatened ecological community listed under either the Commonwealth EPBC Act or the NSW TSC Act was considered likely to be significantly impacted.

A variety of mitigation measures were proposed to reduce and offset impacts. This included retention and enhancement of substantial areas of vegetation along the Georges River riparian corridor (including a permanent conservation area within the MPW site), and implementation of an offset strategy to mitigate unavoidable residual impacts.

The RtS for the MPW Project included assessment of the impacts of project amendments on biodiversity values. These were largely focused on changes to the rail alignment and biodiversity offset areas as a result of selection of a preferred rail access option, and revised calculation of impacts and offsets for Riparian Forest (adjacent to the Georges River).

The revised biodiversity assessment considered changes in biodiversity assessment and offsetting requirements under the NSW Framework for Biodiversity Assessment (FBA). The FBA Assessment in Appendix C of the RtS (PB 2015) addresses impacts to native vegetation communities and threatened species.

The Supplementary Response to Submissions (SRtS) included a revised Biodiversity Offset Strategy to incorporate changes made in response to submissions received during the EIS exhibition phase, as well as the results of additional surveys conducted within the proposed offset lands.

Although the technical papers prepared for the MPW Concept EIS addressed the biodiversity values and potential impacts across the entire development site, only the Early Works component of the proposal is approved under the MPW Concept EIS.

The Proposal needs to consider all impacts to threatened ecological communities and threatened species within the development site, given that the MPW Concept Approval excludes any impacts to native vegetation communities. Changes to the construction footprint of the MPW Project as a result of design development for the Proposal will require a revised calculation of biodiversity impacts under the FBA.

11.1.1 Conditions of Approval

The Conditions of Approval for the MPW Concept Approval relevant to the Proposal are shown in Table 11-3. These conditions of approval have been taken into account while developing the methodology for the BAR for the Proposal.

Table 11-3: MPW Concept Conditions of Approval

Conditions of Approval		Where addressed in this EIS
Schedule 4- Conditions to be met in future development applications		
E15.	All future Development Applications shall consider measures to improve the condition of the riparian corridor along the western bank of the Georges River (known as the 'hourglass land').	The 'hourglass land' will form part of the biodiversity offsets for the Proposal. Measures to improve the condition of the land will be detailed in an offset management plan in the whole-of-precinct Biodiversity Offset Strategy, which is being developed concurrently with this approval.
E16.	All future Development Applications shall consider the following riparian corridor widths (measured from the top of bank): a) a minimum of 50 m wide associated with the rail corridor; and b) a minimum of 40 m wide along the terminal site.	The width of the riparian corridor is discussed in Section 11.4.5.
E22.	All future Development Application which includes construction in the vicinity of the Amiens Wetland shall include advice from an independent wetland expert to determine whether it is artificial or a natural lake basin, its significance, and any recommendations on mitigation measures (if appropriate).	An assessment of Amiens Wetland has been conducted by an independent wetland expert (Appendix Q). The assessment is discussed in section 11.3.5.

11.2 Methodology

For the purpose of this assessment, existing environmental conditions are assumed to be those that exist upon completion of the Early Works (assessed in the MPW Concept EIS). The current assessment relies on ecological data collected and presented in the biodiversity assessments to date (PB 2014 and PB 2015) and builds on these assessments, providing:

- a revised calculation of the biodiversity impacts within the Moorebank Development Site;
- a separate calculation of additional impacts outside the Moorebank Development Site as a result of additional design development for the Proposal.

Impact calculations have been prepared in accordance with the FBA. .

Under the FBA, the area subject to impact assessment is referred to as the 'development site'. In this assessment, the development site is considered to include the Proposal site Figure 11-1). For the purposes of this assessment, the Proposal site has been divided into two areas:

- The area of the Proposal site within the Moorebank Development Site

- Areas of the Proposal site outside the Moorebank Development Site (additional areas of impact).

These areas are considered and assessed separately primarily because they have different landscape values under the FBA. Separate assessment additionally enables consistency with the assessments prepared for the MPW Concept, given that detailed assessment and review under the FBA has already been completed for the area within the Moorebank Development Site.

The current assessment was based on the following information:

- Database interrogation: databases searched were the NSW Threatened Species Profile Database (TSPD), the Vegetation Information System (VIS) classification database, the overcleared landscapes database (Mitchell landscapes) and the Directory of Important Wetlands in Australia (DIWA)
- Literature review of regional and site-specific studies in the locality of the development site
- Review of vegetation mapping, including regional studies and the mapping of the development site prepared by PB (2014) based on detailed site surveys
- Field assessment between 2010 and 2014 as detailed in PB (2014). Field assessment comprised: vegetation plots sampled in accordance with the Biobanking Assessment methodology (BBAM) Figure 11-2); targeted searches for threatened flora species; and targeted threatened fauna species using a range of survey techniques, including habitat searches, diurnal and nocturnal call-playback, mammal trapping and hair tubes, bat (harp) trapping and ultrasonic bat call detection. A tree hollow survey was also conducted in September 2011.
- Inspection of areas of native vegetation on the site by Arcadis ecologists on 3 March 2016, with particular focus on areas of additional impact within the Georges River riparian zone.
- Expert assessment of Amiens wetland.

An assessment of the Proposal using existing site data was undertaken using the Credit Calculator for Major Projects and Biobanking version 4.1, in accordance with the guidelines in the FBA (OEH 2014). The FBA calculator used for the MPW Concept FBA Assessment (PB 2015b) was updated by Alex Cockerill (Parsons Brinckerhoff) (Assessor No. 0058) using revised impact areas and vegetation classifications, in order to obtain credit values for the area of the proposal site within the Moorebank Development Site. A separate calculation was prepared by Jane Rodd (Arcadis) (Assessor No. 0023) for the additional areas of the proposal site outside the Moorebank Development Site.

This assessment has been used, along with other previous biodiversity assessments, to prepare a Biodiversity Offset Package for the development site as required under Condition of Approval D17.

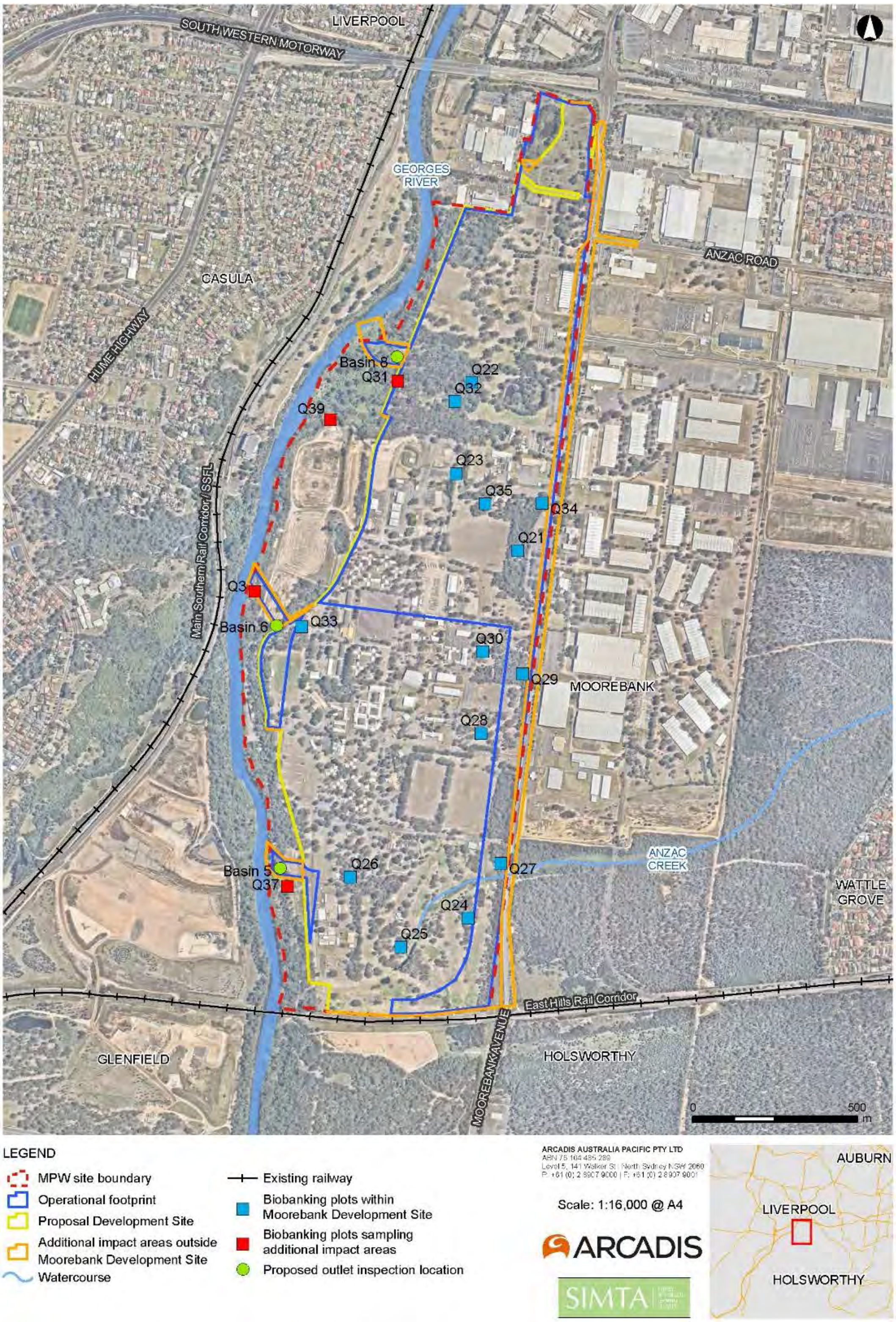

Figure 11-1: The development site

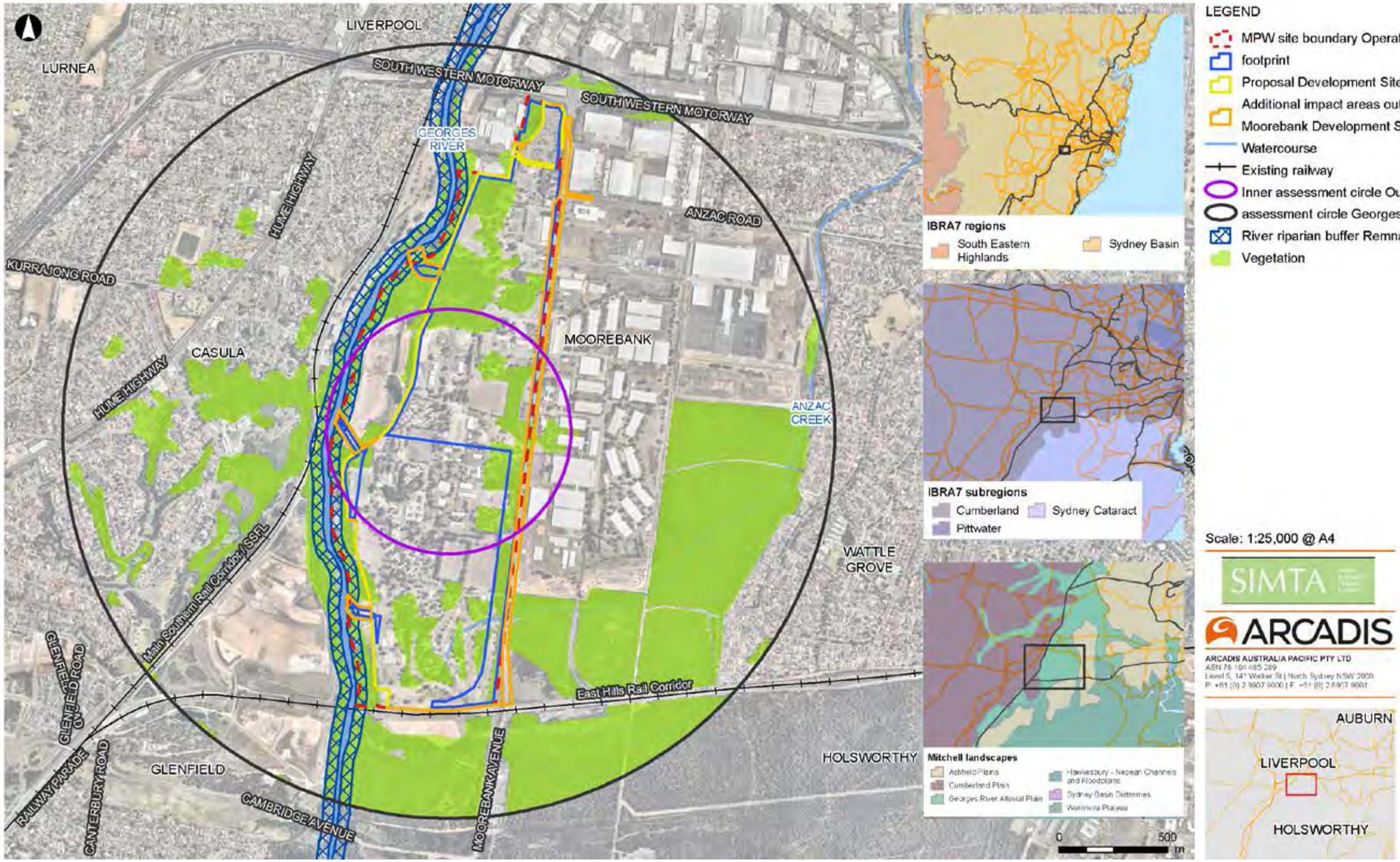

Figure 11-2: Vegetation sampling of the development site

11.3 Existing environment

11.3.1 Landscape value

The FBA requires the assessment of landscape features to describe the biodiversity values of the study area and assess the impacts of the Proposal. Landscape features relevant to the FBA calculations are shown on Figure 11-3 and summarised in Table 11-4.

The Proposal is a site-based development; as such, the landscape value has been assessed in accordance with the methodology in Appendix 4 of the FBA (OEH 2014). Two assessment circles were mapped by PB (2015) to enable assessment of landscape values, including the percent current extent of native vegetation cover within and adjacent to the development site. In accordance with the allowable combinations of inner and outer assessment circles in Table 8 of the FBA, an inner circle of 100 ha and an outer circle of 1000 ha were used. Both circles were centred on the development site and are shown on Figure 11-3.

Table 11-4: Landscape features

Landscape feature	Development site (within Moorebank Development Site)	Additional areas outside of Moorebank Development Site
IBRA (Interim Biogeographic Regionalisation for Australia) bioregions and subregions	The development site is located within the Sydney Basin Bioregion and the Cumberland Subregion classified under IBRA.	As assessed for the MPW Concept EIS
Major Catchment Area	The development site is located within the Sydney Metropolitan Major Catchment Area (MCA).	As assessed for the MPW Concept EIS
Mitchell landscapes	The development site is located within the Georges River Alluvial Plain Mitchell landscape. This Mitchell Landscape is not currently listed in the credit calculator, so the Cumberland Plain Mitchell Landscape was used following advice from OEH.	As assessed for the MPW Concept EIS
Rivers, streams and estuaries	The Georges River flows north along the western edge of the development site, where it is considered to be a 6th order stream. Anzac Creek originates from the development site and extends to the north-east; within the MPW Site, it is a 1st order stream. In addition to these named watercourses, there is a formalised drainage channel located in the north of the development site. The large	As assessed for the MPW Concept EIS

Landscape feature	Development site (within Moorebank Development Site)	Additional areas outside of Moorebank Development Site
	open channel is concrete lined and conveys stormwater in a north-westerly direction across the development site, discharging into the Georges River. Other hydrological features are restricted to constructed artificial wetlands and detention basins in the development site.	
Wetlands	Under the FBA, an important wetland is defined as one that is listed in the Directory of Important Wetlands (DIWA), or mapped under State Environment Planning Policy 14 (SEPP 14 Coastal wetlands). The Proposal site does not contain any wetlands which fall into these categories.	As assessed for the MPW Concept EIS
Native vegetation cover in landscape	The native vegetation cover in the landscape was determined with reference to the regional vegetation mapping by NPWS (2002)/Tozer et al. (2003). All native vegetation types mapped by NPWS (2002)/Tozer et al. (2003) within the inner and outer assessment circles were considered to represent the current native vegetation cover (Figure 11-3). Native vegetation cover percentages were calculated as a proportion of all land within each assessment circle that contains native vegetation. The future native vegetation cover was determined by subtracting the area of native vegetation to be cleared for the Proposal from the current summed native vegetation cover in each circle. The current percent native vegetation cover in the inner assessment circle is 16-20%, and in the outer assessment circle is also 16-20%. The respective scores for native vegetation cover are 3 and 5. The future percent native vegetation cover in the inner assessment circle is 11-15%, and in the outer assessment circle is 16-20%. The	As assessed for the MPW Concept EIS

Landscape feature	Development site (within Moorebank Development Site)	Additional areas outside of Moorebank Development Site
	respective scores for native vegetation cover are 2.25 and 5.	
Connectivity value	PB (2015) undertook an assessment to determine the existing Linkage Width Class (based on the width of a native vegetation link at its narrowest point on the development site), by determining the narrowest (most limiting) link that connects site vegetation to adjoining vegetation. They determined that the MPW Project (which included the bridge over the Georges River) would have limited impact on the existing connectivity of the Georges River riparian zone as it would not decrease the corridor width or the overstorey and understorey benchmark values.	The Proposal includes construction of three stormwater drainage outlets within the Georges River riparian zone, therefore impacts to this connecting link need to be considered in the current assessment. The Georges River is a 6th order stream and as such the riparian buffer 50 m either side is considered to be a state significant biodiversity link in accordance with Appendix 4 of the FBA. The corresponding connectivity value is 12 – which is the highest possible score for this parameter.
Patch size	The size of the largest patch of native vegetation occurring in and adjacent to the development site is the riparian corridor adjoining the Georges River, a portion of which is within the conservation area. This vegetation connects to large areas of bushland in the Holsworthy Military Area to the south, which comprises approximately 18,000 ha of continuous native vegetation. As such, the vegetation in the development site has been assigned the maximum patch size of 1001 ha. In accordance with the criteria in Table 15 of Appendix 4 of the FBA, the patch size class is considered to be extra large with a corresponding patch size score of 12 – which is the highest possible score for this parameter.	As assessed for the MPW Concept EIS
Landscape value score	The landscape value score for the areas of the Proposal site within the Moorebank Development Site is 12.8. This score comprises: Native vegetation cover – 0.8 (based on the deduction of the future	The landscape value score for additional areas of impact outside the Moorebank Development Site is 24.8. This score comprises:

Landscape feature	Development site (within Moorebank Development Site)	Additional areas outside of Moorebank Development Site
	percent native vegetation cover scores from the current percent native vegetation cover scores Connectivity value – 0 Patch size - 12	▪ Native vegetation cover – 0.8 (based on the deduction of the future percent native vegetation cover scores from the current percent native vegetation cover scores ▪ Connectivity value – 12 ▪ Patch size – 12.

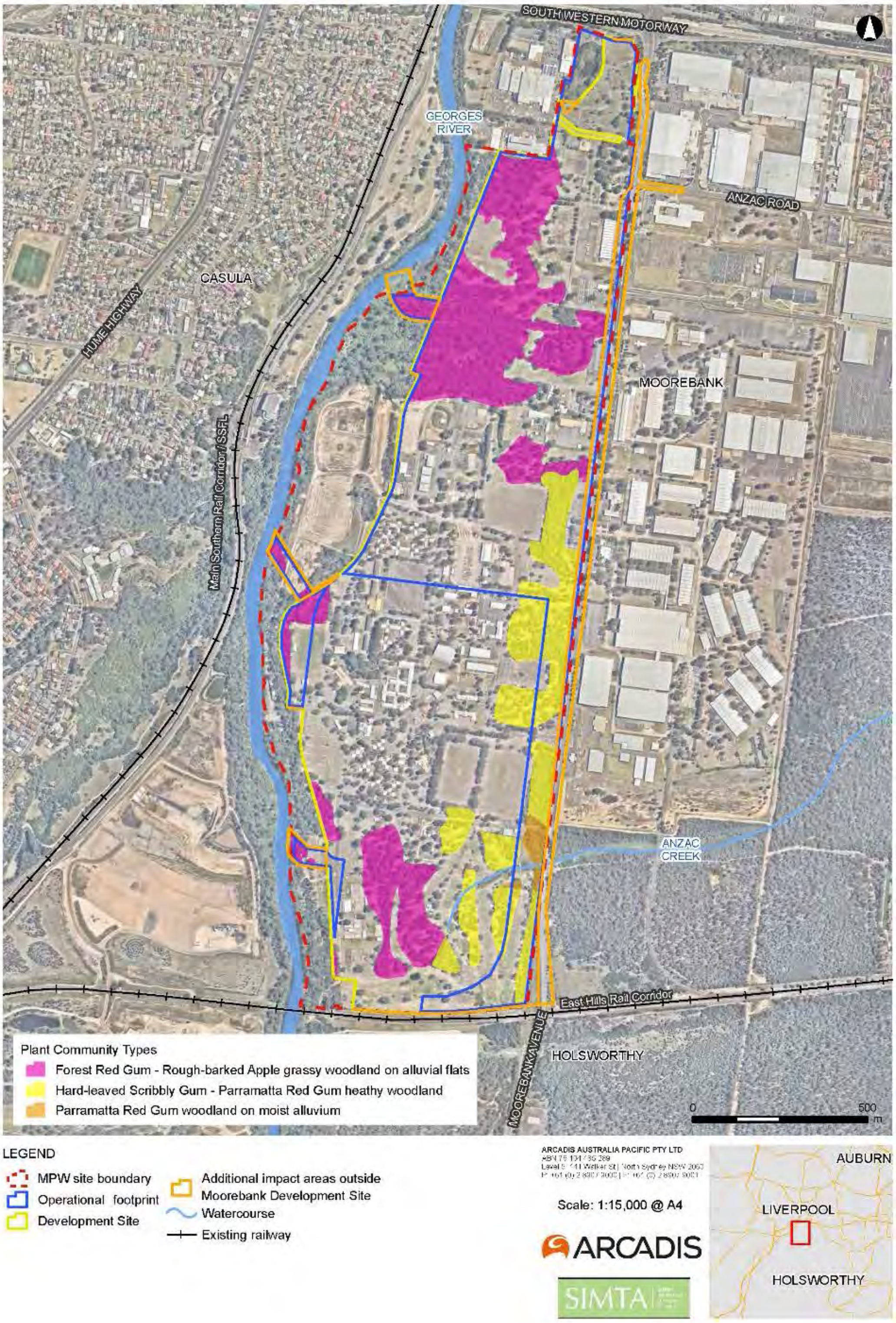

Figure 11-3: Landscape features

11.3.2 Native vegetation

The vegetation within the development site consists predominantly of remnant and regrowth vegetation that has been subjected to weed invasion in some areas. The majority of the vegetation within the development site was native and representative of threatened ecological communities listed in Schedules 1 and 2 of the TSC Act.

Plant Community Types

Four Plant Community Types (PCTs) were identified by PB (2014) following review of existing regional mapping (NPWS 2002/Tozer 2003), soil and geology attributes, landscape position and structural and floristic attributes recorded during site assessments.

PB (2014) classified the Riparian Forest on and adjoining the development site as the PCT Sydney Blue Gum X Bangalay – Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin; this PCT is typically found south of the Hacking River along the Illawarra scarp, to Nowra and throughout the Kangaroo Valley, and equivalent communities have not previously been mapped in the locality in regional vegetation mapping. The PCT Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin is considered to be a better fit for the vegetation on site and more consistent with regional vegetation mapping and classifications, therefore areas within the development site previously mapped as Sydney Blue Gum X Bangalay – Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin have been reclassified as Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin in the current assessment.

The revised PCTs identified within the development site are presented in Table 11-5 and shown on Figure 11-4.

Table 11-5: Revised PCTs in development site

Vegetation Class (Keith 2004)	PCT ID	Plant Community Type	Estimated clearance of PCT since European settlement	Area (ha) within development site (within Moorebank Development Site)	Area (ha) within additional impact areas
Sydney Sand Flats Dry Sclerophyll Forests	ME003	Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin	50%	15.51	0
Sydney Sand Flats Dry Sclerophyll Forests	ME005	Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin	45%	0.92	0

Vegetation Class (Keith 2004)	PCT ID	Plant Community Type	Estimated clearance of PCT since European settlement	Area (ha) within development site (within Moorebank Development Site)	Area (ha) within additional impact areas
Coastal Floodplain Wetlands	ME018	Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin	95%	28.94	1.68

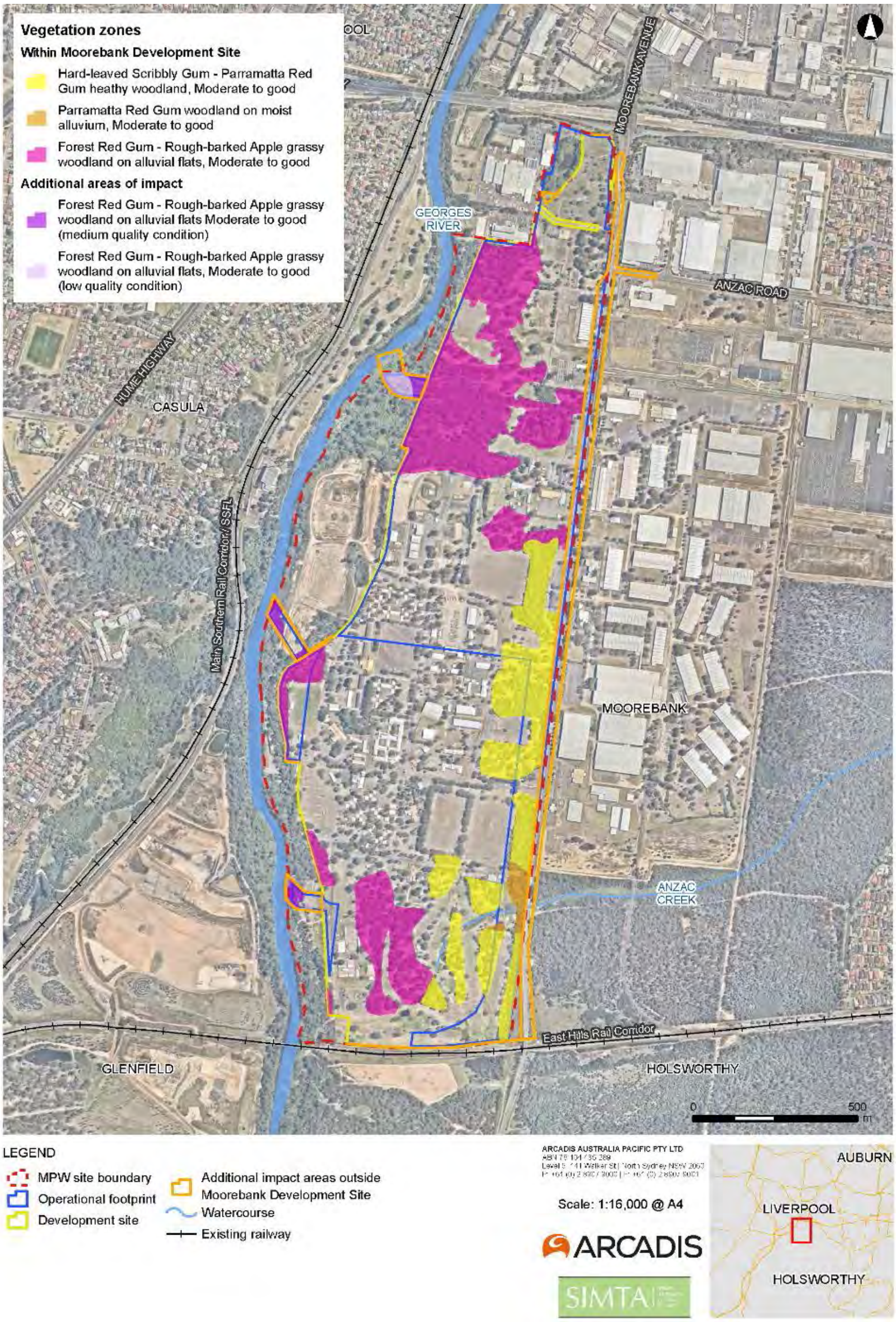

Figure 11-4: Revised PCTs on the development site

Threatened Ecological Communities

The three PCTs identified in the development site are included within the definitions of threatened ecological communities listed under the TSC Act and/or EPBC Act, as per Table 11-6.

Table 11-6: Threatened ecological communities on the development site

Plant Community Type	Equivalent TEC	TSC Act Status	EPBC Act Status
Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin	Castlereagh Scribbly Gum Woodland in the Sydney Basin bioregion	Vulnerable	Endangered
Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin	Castlereagh Swamp Woodland	Endangered	Not listed
Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin	River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions	Endangered	Not listed

Vegetation condition

The development site contained three distinct vegetation types in the moderate to good condition category. These vegetation zones in the area of the development site within the Moorebank Development Site are the same as those identified in PB (2015), except that all areas previously mapped as ME044 Sydney Blue Gum X Bangalay – Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin have been reclassified as ME018 Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin.

The vegetation zones in the additional areas of impact outside the Moorebank Development Site are also in Moderate to Good condition, however some areas in the northern basin outlet footprint are highly degraded and have been put into a separate vegetation zone (Moderate/Good – Poor). The vegetation zones identified in the development site are shown in Figure 11-4 and listed in Table 11-7.

The site value score for each vegetation zone identified in the development site was determined through assessment of site attribute data collected in vegetation plots. The site attribute data entered into the credit calculator for the current assessment is that presented in PB (2015) (see Section 6.5 of Appendix Q for further detail).

The site value scores for each vegetation zone are provided in Table 11-7

Table 11-7: Area and site value score for each vegetation zone

Vegetation Zone	Area mapped in development site	Site value score
Area of development site within the Moorebank Development Site		
Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin: Moderate/Good	15.51 ha	44.3
Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin: Moderate/Good	0.92 ha	52.17
Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin: Moderate/Good	30.62 ha	35.76
Additional areas of impact outside the Moorebank Development Site		
Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin: Moderate/Good - Medium	1.07	55.21
Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin: Moderate/Good - Poor	0.61	30.21

Noxious weeds

The Ecological Impact Assessment prepared for the MPW Concept EIS (PB 2014a) identified 12 noxious weeds listed under the Noxious Weeds Act 1993, of which nine are also listed as Weeds of National Significance (Australian Weeds Committee 2010). Review of the flora species list for the site against the current list of declared weeds for Liverpool City Council (DPI 2016) found an additional two noxious weeds, one of which is a Weed of National Significance.

Groundwater dependent ecosystems

It is probable, due to local hydrogeology, that groundwater across the development site and the wider region is interconnected. As such, if stygofauna (aquatic animals that live in groundwater) are present they are unlikely to be isolated to the vicinity of the development site.

A search of the Australian Government's Atlas of Groundwater Dependent Ecosystems was undertaken on 7 April 2016. Several GDEs with potential reliance on subsurface groundwater were identified in the locality including in the development site (Bureau of Meteorology 2016). Riparian woodland vegetation adjoining the Georges River was identified as having a high potential for groundwater interaction. Some of the fragmented patches of vegetation along the eastern boundary of the development site were identified as having a moderate potential for groundwater interaction. No data on subterranean groundwater-dependent ecosystems (GDEs) is available for the locality. The riparian vegetation on and adjoining the development site is potentially a groundwater dependent ecosystem.

11.3.3 Threatened species

Ecosystem credit species

The FBA Assessment for the MPW Concept EIS found twenty ecosystem credit species predicted to occur within the development site. Although none of the species were recorded in the development site, 13 were considered to have a moderate to high likelihood of occurrence there. The species are listed in Table 3.16 of Parsons Brinckerhoff (2015).

The following species were derived from the PCTs identified on the development site as predicted ecosystem credit species for the additional areas of impact outside the Moorebank Development Site. Most of these species were also identified in the MPW Concept EIS FBA calculation.

- Barking Owl (*Ninox connivens*)
- Black-chinned Honeyeater (eastern subspecies) (*Melithreptus gularis* subsp. *gularis*)
- Brown Treecreeper (eastern subspecies) (*Climacteris picumnus* subsp. *victoriae*)
- Bush-stone Curlew (*Burhinus grallarius*)
- Diamond Firetail (*Stagonopleura guttata*)
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)
- Eastern Freetail-bat (*Mormopterus norfolkensis*)
- Flame Robin (*Petroica phoenicea*)
- Gang-gang Cockatoo (*Callocephalon fimbriatum*)
- Greater Broad-nosed Bat (*Scoteanax rueppellii*)
- Hooded Robin (south-eastern form) (*Melanodryas cucullata* subsp. *cucullata*)
- Little Eagle (*Hieraaetus morphnoides*)
- Little Lorikeet (*Glossopsitta pusilla*)
- Painted Honeyeater (*Grantiella picta*)
- Powerful Owl (*Ninox strenua*)
- Scarlet Robin (*Phoenica boodang*)
- Speckled Warbler (*Chthonicola sagittata*)
- Spot-tailed Quoll (*Dasyurus maculatus maculatus*)
- Spotted Harrier (*Circus assimilis*)
- Swift Parrot (*Lathamus discolor*)
- Varied Sitella (*Daphoenositta chrysoptera*)
- Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*)

Each species has been assessed for potential presence in the additional areas of impact in the development site using information obtained from the Threatened Species Profiles Database (TSPD). The assessment found that of the 22 species identified in the calculator, two have a high likelihood of occurrence and 13 have a moderate likelihood of occurrence within the development site. One species, Little Eagle, was recorded in the Georges River riparian corridor, about 200 metres north of proposed basin outlet 5 (PB 2015).

Three additional ecosystem credit species not identified by the credit calculator were either recorded or tentatively identified in or adjacent to the development site:

- Grey-headed Flying-fox (*Pteropus poliocephalus*) was recorded flying over the development site.
- Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*), was recorded in the Georges River riparian corridor to the south-west of the development site
- Possible recordings of Large-footed Myotis (*Myotis macropus*) were made in the Georges River riparian corridor to the south-west of the development site.

Species credit species

Flora

The FBA Assessment for the MPW Concept EIS found 13 flora species credit species predicted to occur within the development site. The species are listed in Table 3.14 of Parsons Brinckerhoff (2015a).

Two of the threatened flora species credit species were recorded on the development site: *Persoonia nutans* (Nodding Geebung) and *Grevillea parviflora* subsp. *parviflora* (Small-flower Grevillea).

At least 16 apparent individuals (individual shrubs or groups of suckers) of *Grevillea parviflora* subsp. *parviflora* were recorded. The precise number of individuals of this species present is very difficult to gauge due to its suckering habit and the possible presence of a soil seedbank. Approximately 10 individuals of *Persoonia nutans* were present; however additional individuals may be also be represented in a soil seed bank.

Both species were recorded in the Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin in the east of the development site. The locations of the threatened flora species recorded in the development site are shown on Figure 11-5.

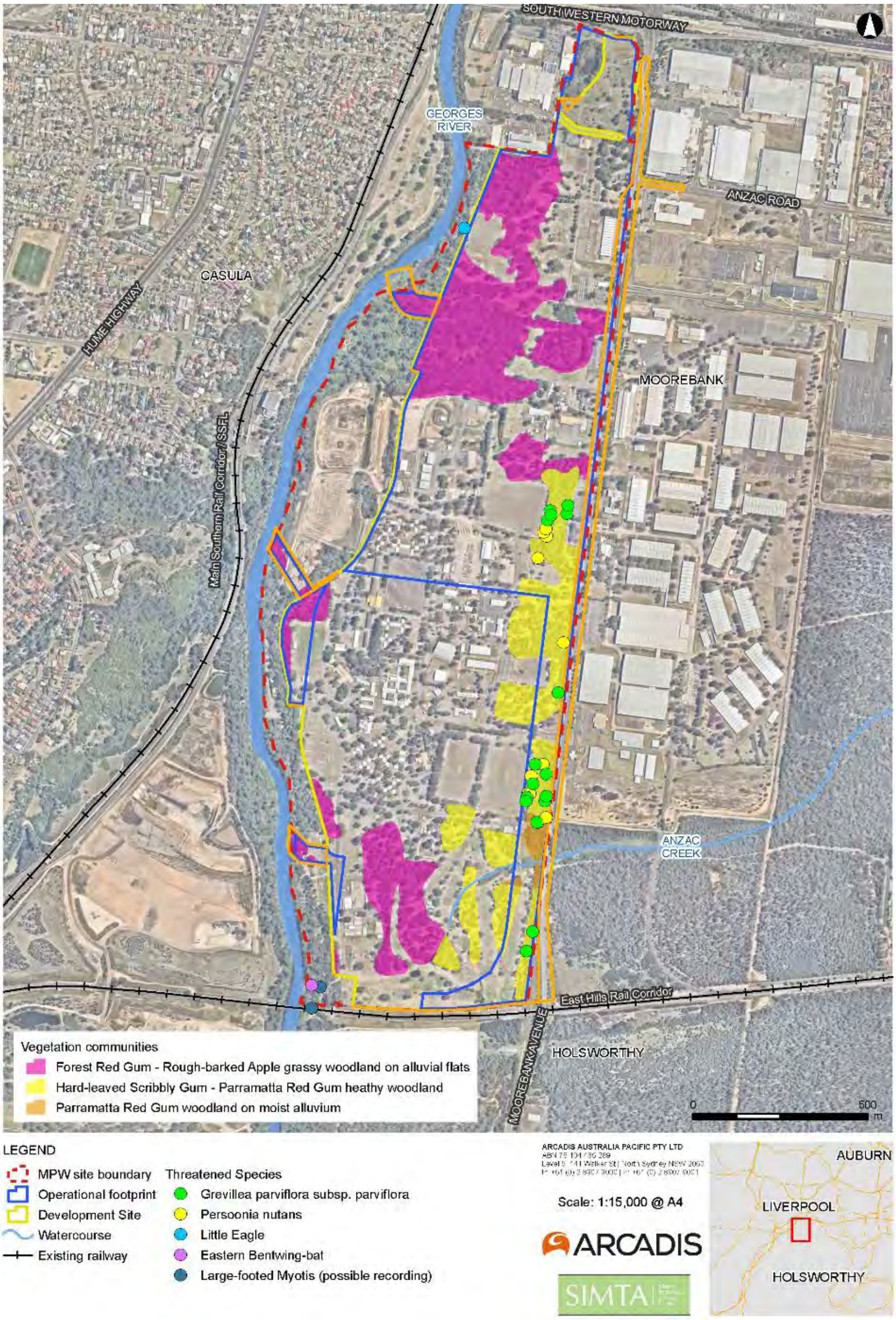

Figure 11-5: Threatened flora species recorded on the development site

A total of four species were identified in the credit calculator as predicted flora species credit species for the additional areas of impact outside the Moorebank Development Site. Most of these species were also identified in the MPW Concept EIS FBA calculation:

- *Callistemon linearifolius* (Netted Bottle Brush)
- *Cynanchum elegans* (White-Flowered Wax Plant)
- *Hibbertia sp. Bankstown*
- *Hypsela sessiliflora*

Each species has been assessed for potential presence in the vegetation zones in the development site using information obtained from the Threatened Species Profiles Database (TSPD). The assessment found that none of the predicted species is likely to occur on the development site.

Wahlenbergia multicaulis (Tadgells Bluebell) in the local government areas of Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield, listed as an Endangered Population under the TSC Act, was also predicted to occur within the development site by the credit calculator. As this population is not endangered in the Liverpool LGA, it was not considered further in the current assessment.

Fauna

The FBA Assessment for the MPW Concept EIS found eight fauna species credit species predicted to occur within the development site. Although none of the species were recorded in the development site, one (Regent Honeyeater) was considered to have a moderate likelihood of occurrence there. The species are listed in Table 3.16 of PB (2015a).

A total of seven species were identified in the credit calculator as predicted species credit species for the additional areas of impact outside the Moorebank Development Site. Most of these species were also identified in the MPW Concept EIS FBA calculation:

- Cumberland Plain Land Snail (*Meridolum corneovirens*)
- Eastern Osprey (*Pandion cristatus*)
- Eastern Pygmy-possum (*Cercartatus nanus*)
- Green and Golden Bell Frog (*Litoria aurea*)
- Koala (*Phascolarctos cinereus*)
- Regent Honeyeater (*Anthochaera phrygia*)
- Squirrel Glider (*Petaurus norfolkensis*).

Each species has been assessed for potential presence on the development site using information obtained from the TSPD. Habitat requirements for each species were assessed against the habitat values on the development site. Targeted survey methods and timing for each identified species was noted and an assessment of the presence status of each species was determined based on targeted survey results and habitat presence.

Of the seven species, none are considered likely to occur in additional areas of impact within the development site.

11.3.4 Aquatic fauna

PB (2014) assessed the aquatic fauna habitats and potential presence of threatened aquatic species through habitat assessment and reference to recent aquatic surveys in the Georges River and Anzac Creek in the vicinity of the development site.

The Georges River is a major permanently flowing waterway and is classified as Class 1 (major fish habitat) in accordance with the criteria of Fairfull and Witheridge (2003). No species currently listed under the NSW *Fisheries Management Act 1994* (FM Act) were recorded in the catchment and none were considered likely to occur in the adjacent stretch of the Georges River by PB (2014). Due to the degraded condition of the river, the native species that persist here are likely to consist of disturbance tolerant species which are less sensitive to alterations in environmental conditions than species restricted to relatively unmodified environments (PB 2014).

There are two dragonfly species currently listed under the FM Act occurring in the Sydney basin:

- Adams Emerald Dragonfly (*Archaeophya adamsi*) - Endangered
- Sydney Hawk Dragonfly (*Austrocordulia leonardi*) – Endangered.

Neither species is listed under the TSC Act or EPBC Act. The closest historical records of the Adams Emerald Dragonfly and the Sydney Hawk Dragonfly are respectively 35 km and 12.5 km from the development site.

A Threatened Dragonfly Species Survey Plan (Arcadis 2016) was prepared in consultation with DPI Fisheries as part of the MPW Concept Approval. The objective of the plan is to determine the presence or absence of threatened dragonfly species listed under the FM Act on the Georges River, adjacent to the development site.

Field assessment of potential dragonfly habitat was undertaken in September 2016 as part of the plan. The character of the Georges River within the survey area was found to be markedly different from known habitat for the targeted threatened dragonfly species. No habitats for threatened dragonfly species were detected in the survey area after an extensive ecological assessment, and it is considered highly unlikely that they occur in the surveyed area. No impact to threatened dragonflies is anticipated as a consequence of the Proposal.

11.3.5 Amiens Wetland

Amiens wetland is a small freshwater wetland on the Georges River floodplain adjacent to Amiens Road in the north of the MPW site. Dr John Porter, wetland specialist, prepared an assessment to determine whether the Amiens wetland is artificial or a natural lake basin, its significance, and recommended mitigation measures (Porter 2016). The assessment is provided in Appendix Q. The assessment was carried out using a combination of field inspection and desktop investigation.

Based on evidence from published and unpublished reports, literature, historical maps and documents, Porter (2016) concludes that the Amiens wetland is a natural floodplain wetland of the Georges River, albeit strongly impacted by weeds, vertebrate pests and pollution. Despite high levels of disturbance, the wetland is one of the last remaining examples of natural freshwater floodplain wetlands in the locality and as such has significance for biodiversity and habitat conservation.

The following recommendations/mitigation measures are suggested by Porter (2016):

- Retain and maximise conservation value by removing and controlling weeds and pests
- Install sediment traps or similar to limit siltation and particulate pollutants that may occur as a result of the Proposal
- Maintain, or improve, existing water flows to the wetland

- Maintain or enhance hydrological linkages with the Georges River, in particular to allow fish and other fauna to enter and exit the wetland
- Continue to restrict recreational access to minimise disturbance.

These mitigation measures have been incorporated into the mitigation measures detailed in Sections 11.5 and 12.5 of this EIS.

11.4 Potential impacts

Likely impacts are those impacts that may arise as a result of unmitigated activities associated with the construction of the Proposal. The impacts specified in point 12a) of the SEARs are considered below.

11.4.1 Endangered (and vulnerable) ecological communities

The Proposal will require clearing of all vegetation within the development site, including threatened ecological communities. The threatened ecological communities to be directly impacted are listed in Table 11-8.

Table 11-8: Areas of direct impact to threatened ecological communities

Plant Community Type	Equivalent TEC	Conservation status	Area of impact
Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin	Castlereagh Scribbly Gum Woodland in the Sydney Basin bioregion	Vulnerable (TSC Act) Endangered (EPBC Act)	15.51 ha
Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin	Castlereagh Swamp Woodland	Endangered (TSC Act)	0.92 ha
Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin	River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions	Endangered (TSC Act)	30.62 ha

11.4.2 Threatened flora and fauna species and their habitat

The Proposal will have direct impacts on populations of two threatened flora species listed under the TSC Act and EPBC Act. Table 11-9 summarises the impacts to these species.

Table 11-9: Impacts to threatened flora species

Threatened flora species	Conservation status	Impacts
Persoonia nutans	Endangered	10 individuals
Grevillea parviflora subsp. parviflora	Vulnerable	16 individuals

The clearing of vegetation will result in the loss of specific fauna habitat components, including live trees, tree hollows, foraging resources, groundlayer habitats such as ground timber and well-developed leaf litter. These resources offer sheltering, foraging, nesting and roosting habitat to a variety of fauna, including threatened fauna, occurring within the locality. The Proposal will require removal of over 43 hollow-bearing trees.

The assessment of ecosystem credit species associated with PCTs on the development site found that two threatened fauna species have a high likelihood of occurrence and 16 have a moderate likelihood of occurrence.

11.4.3 Groundwater dependent ecosystems

Impacts to groundwater dependent ecosystems, such as drawdown of groundwater from the root zone, may occur as a result of earthworks and geotechnical construction activities. This may have the potential to affect retained vegetation and habitat that may utilise the shallow groundwater aquifers present. The riparian vegetation in the west of the site has been identified as having high potential for groundwater interaction.

11.4.4 Impacts on wildlife and habitat corridors and habitat fragmentation

Most of the habitat to be removed for the Proposal is currently fragmented by the existing development. The vegetation in the riparian corridor adjoining the Georges River maintains connectivity with riparian vegetation to the north and south of the development site and may facilitate the movement of less mobile species, including cover-dependent species, larger terrestrial mammals and arboreal mammals. The vegetation within the basin outlet locations is currently disturbed, with high abundance and cover of exotic species including invasive weedy species.

The riparian corridor would be impacted by the removal of vegetation for construction of sediment basin outlets in three locations. Vegetation would be removed to the water's edge, creating a temporary barrier to habitat connectivity along the riparian corridor; the resulting gaps in the vegetation would range from 50 metres to 70 metres during construction. The areas to be disturbed would be recontoured and partially revegetated upon completion of the basin outlets to restore habitat connectivity.

11.4.5 Riparian land

Additional areas of riparian vegetation will be removed for the three basin outlets required for the Proposal. This additional riparian vegetation amounts to a total of 1.67 hectares of Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin outside of the area to be impacted for the MPW Concept.

The retained riparian vegetation adjoining the development site will be conserved and restored as part of biodiversity offsetting for the Proposal, within the area known as the conservation area. The conservation area ranges in width from approximately 35 metres in the north to approximately 290 metres in the centre.

11.4.6 Comparison with impacts of the MPW Concept EIS

The impacts of the Proposal are largely similar in nature to the impacts considered and assessed in the Technical Paper (PB 2014). A comparison of the impacts considered is presented in Table 11-10.

Table 11-10: Comparison of impacts assessed in PB (2014) and the impacts of the Proposal.

Impact	MPW Concept EIS impacts (full build)	Proposal impacts
Vegetation clearing and habitat loss	Vegetation clearing would occur throughout the eastern part of the development site adjacent to Moorebank Avenue and would extend to the west through the middle of the site to the existing riparian vegetation corridor along the Georges River. Three sediment basin outlets intersecting the riparian corridor were assumed to require clearing of about 10 metres wide.	Vegetation clearing would occur through similar area as assessed in the MPW Concept EIS, with the exception of the rail crossing of the Georges River (subject to separate approval) and with a greater extent of clearing for the three sediment basin outlets within the riparian zone adjoining the Georges River.
Loss of roosting and breeding habitat in hollow bearing trees	Removal of over 43 hollow-bearing trees containing hollows of a wide variety of shapes and sizes, ranging from narrow cracks and fissures in dead wood, to hollows within tree trunks with very large entrance diameters (>300mm) and large internal volumes. The majority of the hollows that would be lost are in trees located in heavily cleared areas of the development site.	Similar impacts to those identified in the MPW Concept EIS.
Direct mortality	Specimens of Grevillea parviflora subsp. parviflora and Persoonia nutans on the site would be killed during clearing unless a translocation program for these species is implemented. Fauna injury or death could occur as a result of the MPW Project's construction phase, particularly when vegetation is being cleared and existing detention basins filled.	Similar impacts to those identified in the MPW Concept EIS.
Loss of foraging resources	In addition to the displacement of resident animals and loss of shelter, vegetation clearing would result in the loss of potential foraging resources for species which shelter and breed outside the development site. This loss may impact highly mobile fauna species occurring in adjacent habitat.	Similar impacts to those identified in the MPW Concept EIS.
Fragmentation and loss of connectivity	The MPW Project would result in the removal of a substantial area of woodland/forest habitat. This habitat is currently isolated/fragmented by existing rail infrastructure, internal and	The Proposal does not include the Rail link across the Georges River.

Impact	MPW Concept EIS impacts (full build)	Proposal impacts
	external roads, built and landscaped areas, sporting fields and a golf course. The MPW Project is not likely to significantly fragment or isolate retained vegetation along the Georges River Corridor. The proposed Rail link across the Georges River would create a break in the canopy of the riparian vegetation approximately 50 m in width. The proposed overland drainage channels which form part of the stormwater infrastructure for the MPW Project would result in minor (<10 m) wide gaps in the canopy in the short term; however vegetation restoration would restore canopy connectivity in the medium term to long term.	The proposed stormwater basin outlets would be wider than considered in the MPW Concept EIS and may result in further fragmentation of the riparian corridor.
Increased edge effects	As most patches of native vegetation across the development site would be entirely removed, there would be no increase in edge effects on these patches. In the short term, the MPW Project would result in increased edge effects on the habitat of the Georges River riparian corridor due to clearing, particularly for overland drainage infrastructure. Due to the relatively narrow width of this corridor and its high edge to area ratio, edge effects are already quite severe. The short-term increase in edge effects as a result of the MPW Project is, therefore, unlikely to significantly alter the present edge effects on this habitat.	Similar impacts to those identified in the MPW Concept EIS.
Noise impacts on fauna	The wildlife of the development site is likely to be habituated to frequent noise exposure as a result of current activities on and adjoining the site. While the construction phases of the MPW Project may cause temporary disturbance to animals, the impacts from noise emissions are likely to be localised close to development site (up to100 m) and are not likely to have	Similar impacts to those identified in the MPW Concept EIS.

Impact	MPW Concept EIS impacts (full build)	Proposal impacts
	a significant, long-term, impact on wildlife populations.	
Light impacts to fauna	Under present conditions there is little light pollution of the core habitat of the development site, within the vegetation along the Georges River. Light pollution is likely to be substantially higher during the construction and operation of the MPW Project due to fixed lighting within the facility and lighting from trucks and trains.	Similar impacts to those identified in the MPW Concept EIS.
Dust pollution	Dust generated during construction may be deposited onto the foliage of adjacent native vegetation. This has potential to reduce photosynthesis, which may reduce the overall health of the vegetation adjacent to the development site through changes to vegetation structure and composition.	Similar impacts to those identified in the MPW Concept EIS.
Introduction and spread of weeds, pests and pathogens	The MPW Project has the potential to further disperse weeds into areas of native vegetation within the development site, particularly adjacent to cleared areas. The vegetation of the riparian corridor currently has a moderate to high level of weed invasion, particularly of woody and vine weeds. The habitat that would be removed for the MPW Project is already affected by pest species. Removal of this habitat would result in a reduction in habitat available to these species. In the short term this may lead to increased competition for resources (e.g. tree hollows) and increased pressure on remaining habitats. There is potential for pathogens including Amphibian Chytrid Fungus, Exotic Rust Fungi and Phytophthora Root Rot Fungus to occur on the site at present or in the future. With the implementation of hygiene procedures for the use of vehicles and the importation of materials to the site, the risk of introducing or spreading these pathogens would be low.	Similar impacts to those identified in the MPW Concept EIS.

Impact	MPW Concept EIS impacts (full build)	Proposal impacts
Fire regimes	The development site has been identified as containing bushfire prone land. With the implementation of design and management measures, the risk of the project causing a change to fire regimes that would be detrimental to biodiversity is low.	Similar impacts to those identified in the MPW Concept EIS.
Disturbance to aquatic habitat	Bridges would have multiple piers located both adjacent to the Georges River and within the Georges River floodplain. If possible, it is not intended to locate any bridge piers within the river channel itself. Impacts could include: possible disturbance to the substrate of the river or removal of submerged or emergent aquatic vegetation; shading of aquatic vegetation; potential increases in turbidity from construction runoff; accidental spillage/leakage of construction materials; loss of fringing and riparian vegetation. The section of Anzac Creek on the development site would be removed, and flows redirected through stormwater detention basins on the development site. Removal of this creek was considered by PB (2014) to be unlikely to result in a significant negative impact to the receiving waters of the remainder of Anzac Creek, as current inflows are likely to be polluted with fertilisers, pesticides and silt and would constitute only a small proportion of total inflows.	The Proposal does not include the rail link across the Georges River, therefore impacts arising from the bridge construction are not applicable. There would be potential impacts to aquatic habitats in the Georges River as a result of vegetation clearing for the proposed sediment basin outlets. Impacts to Anzac Creek would be similar to those identified in the MPW Concept EIS.
Disturbance of groundwater dependent ecosystems	Impacts to groundwater dependent ecosystems, such as drawdown of groundwater from the root zone, may occur as a result of earthworks and geotechnical construction activities. This may have the potential to affect retained vegetation and habitat that may utilise the shallow groundwater aquifers present. The Alluvial Woodland vegetation in the west of the site has been identified as having high potential for groundwater interaction.	Similar impacts to those identified in the MPW Concept EIS.

11.4.7 Impacts requiring further consideration

Under the FBA, certain impacts on biodiversity values require further consideration by the relevant consent authority. These are impacts that are considered to be complicated or severe, and a decision would be made by the relevant consent authority on whether it is appropriate for these impacts to occur, and whether additional offsets, supplementary measures or other actions may be required.

Impacts that require further consideration include:

- Impacts that will substantially reduce the width of vegetation in the riparian buffer zone bordering rivers and streams 4th order or greater
- Impacts in state biodiversity links.

The Georges River is at least a 6th order stream. The area within 50 m of the Georges River is defined as a state biodiversity link under the FBA, and several sections of this area would be subject to impacts from the Proposal.

The Georges River riparian corridor state significant biodiversity link would be impacted by the removal of vegetation for construction of sediment basin outlets in three locations. Vegetation would be removed to the water's edge, creating a temporary gap (during construction) in habitat connectivity along the riparian corridor.

The vegetation within the basin outlet locations is currently disturbed, with high abundance and cover of exotic species including invasive weedy species such as *Lantana camara*, *Ligustrum* spp., *Cardiospermum grandiflorum* and *Arundo donax.* The existing drainage infrastructure in the location of the proposed basin outlet 5 has catastrophically failed, resulting in an incised and scoured drainage line on the steep slope down to the Georges River, and there is dense cover of *Lantana camara* on the slope.

The areas to be disturbed would be recontoured and partially revegetated upon completion of the basin outlets to restore habitat connectivity. While there would be a considerable temporary and short term impact during construction of the outlets, the permanent impacts would be unlikely to significantly impede fauna movement provided that connectivity is enhanced using strategic revegetation and other fauna habitat features such as rocks and hollows logs to provide cover in these areas. The gaps in the riparian corridor vegetation as a result of the proposed basin outlets would range from 50 m to 70 m during construction, and from 20 m to 40 m following revegetation. During operations, it is anticipated that the outlets would only contain water periodically, and would therefore be unlikely to restrict fauna movement. An indicative cross-section of the proposed basin outlet, incorporating revegetation, is provided in Figure 11-6.

The riparian corridor outside of the basin outlets would be maintained as a biodiversity conservation area, and would range in width from approximately 35 m to 290 m.

The impacts to the Georges River Riparian Corridor are considered unlikely to fall into the category of impacts requiring further consideration as they:

- Will not result in a gap greater than 100 m between two areas of moderate to good condition native vegetation with a patch size greater than 1 ha
- Will not remove over-storey cover and mid-storey cover vegetation within the state significant biodiversity link to create a gap in over-storey cover vegetation greater than 100 m
- Will not create a hostile barrier within the state significant biodiversity link.

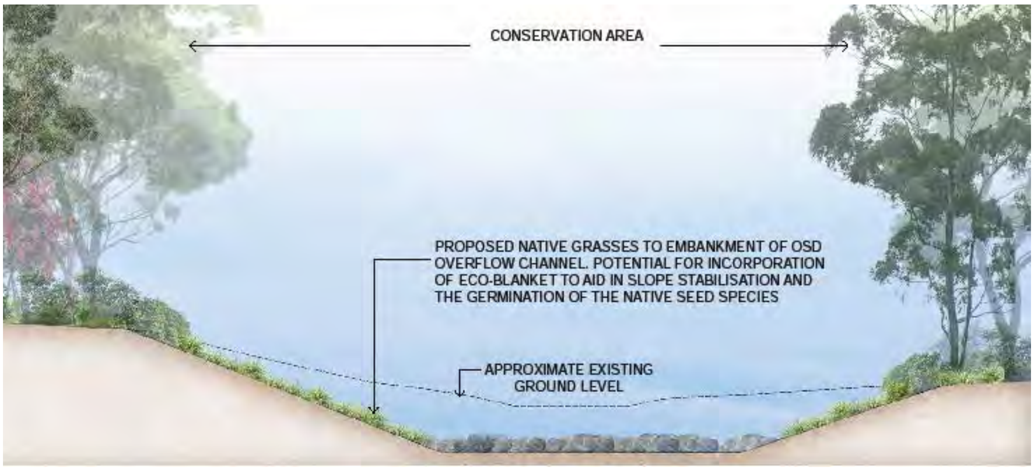

Figure 11-6: Indicative cross-section of proposed basin outlets (adapted from GroundInk 2016)

11.5 Mitigation measures

The design development of the Proposal has avoided biodiversity impacts where possible, however in some areas impacts are evident. As such, the measures in Table 11-11 should be implemented to mitigate these impacts during construction and operation.

Table 11-11: Measures to be implemented to minimise impacts on biodiversity

Mitigation measure	Outcome	Timing	Responsibility
Following detailed design and before construction, detailed flora and fauna mitigation measures would be developed and presented as part of the CEMP. These detailed measures would incorporate the measures listed below. The CEMP would address: ▪ general impact mitigation ▪ staff/contractor inductions ▪ vegetation clearing protocols including identification of exclusion zones ▪ pre-clearing surveys and fauna salvage/translocation ▪ rehabilitation and restitution of adjoining habitat ▪ weed control ▪ pest management ▪ monitoring. The plans would include clear objectives and actions for the Proposal including how to:	Flora and fauna would be managed in accordance with the requirements of the CEMP.	Pre-construction and construction	Design contractor, construction contractor

Mitigation measure	Outcome	Timing	Responsibility
▪ minimise human interferences to flora and fauna ▪ minimise vegetation clearing/disturbance ▪ minimise impact to threatened species and communities ▪ minimise impacts to aquatic habitats and species ▪ undertake flora and fauna monitoring at regular intervals.			
Vegetation clearing would be restricted to the construction footprint and sensitive areas, outside of this footprint, would be clearly identified as exclusion zones.	Prevention of over clearing of vegetation	Pre-construction and Construction	Design contractor, construction contractor
The exclusion zones would be marked on maps, which would be provided to contractors, and would also be marked on the ground using high visibility fencing (such as barrier mesh).	Prevention of over clearing of vegetation	Pre-construction and Construction	Design contractor, construction contractor
A suitably qualified ecologist would accompany clearing crews to ensure disturbance is minimised and to assist in relocating any native fauna to adjacent habitat.	Prevention of over clearing of vegetation and fauna injury/mortality	Construction	Construction contractor
The following procedures would be implemented to minimise fauna impacts from vegetation clearance: ▪ A staged habitat removal process would be developed and would include the identification and marking of all habitat trees in the area. ▪ Where reasonable and feasible, clearing of hollow-bearing trees would be undertaken in March and April when most microbats are likely to be active (not in torpor) but are unlikely to be breeding or caring for young, and when threatened hollow-dependent birds in the locality	Prevents fauna injury/mortality	Construction	Construction contractor

Mitigation measure	Outcome	Timing	Responsibility
are also unlikely to be breeding. ▪ Pre-clearing surveys would be conducted 12 to 48 hours before vegetation clearing to search for native wildlife (e.g. reptiles, frogs, Cumberland Land Snail) that can be captured and relocated to the retained riparian vegetation of the Georges River corridor. ▪ Vegetation would be cleared from a 10 m radius around habitat trees to encourage animals roosting in hollows to leave the tree. A minimum 48 hour waiting period would allow animals to leave. ▪ After the waiting period, standing habitat trees would be shaken (where safe and practicable) under the supervision of an ecologist to encourage animals roosting in hollows to leave the trees, which may then be felled, commencing with the most distant trees from secure habitat. ▪ Felled habitat trees would either be immediately moved to the edge of retained vegetation, or left on the ground for a further 24 hours before being removed from the construction area, at the discretion of the supervising ecologist. ▪ All contractors would have the contact numbers of wildlife rescue groups and would be instructed to coordinate with these groups in relation to any animal injured or orphaned during clearing.			
Within areas of high quality intact native vegetation proposed to be removed: ▪ Topsoil (and seedbank) is to be collected from native	Conservation of genetic material from local native plant communities	Construction	Construction contractor

Mitigation measure	Outcome	Timing	Responsibility
vegetation that are to be permanently cleared and used in the revegetation of riparian areas ▪ Where feasible and reasonable native plants in areas that are to be permanently cleared are to be relocated and transplanted in riparian areas identified for rehabilitation			
Relocation of fauna to adjacent retained habitat would be undertaken by an ecologist during the supervision of vegetation removal.	Prevents fauna injury/mortality	Construction	Construction contractor
An ecologist would supervise the drainage of any waterbodies on the Proposal site and would relocate native fish (e.g. eels), tortoises and frogs to the edge of the Georges River and/or the existing pond at the northern end of the Proposal site.	Prevents fauna injury/mortality	Construction	Construction contractor
The design of temporary site fencing and any overhead powerlines would consider the potential for collision by birds and bats and minimise this risk where practicable.	Prevents fauna injury/mortality	Detailed design & Pre-construction	Design contractor
The potential for translocation of threatened plant species as individuals or as part of a soil translocation process would be considered during the detailed development of the CEMP.	Reducing impacts to threatened plant species	Detailed design & Pre-construction	Design contractor, construction contractor
Important habitat elements (e.g. large woody debris) would be moved from the construction area to locations within the conservation area which would not be cleared during the Proposal, or to stockpiles for later use in vegetation/habitat restoration.	Retaining fauna habitat resources	Pre-construction and Construction	Design contractor, construction contractor
Winter-flowering trees would be preferentially planted in landscaped areas of the Proposal	Maintaining and enhancing fauna habitat resources	Detailed design, Pre-construction	Design contractor,

Mitigation measure	Outcome	Timing	Responsibility
site to provide a winter foraging resource for migratory and nomadic nectar-feeding birds and the Grey-headed Flying-fox.		and Construction	construction contractor
Erosion and sediment control measures such as silt fencing and hay bales would be used to minimise sedimentation of streams and resultant impacts on aquatic habitats and water quality.	Prevention of sedimentation and erosion leading to a reduction in water quality and degradation of aquatic habitats	Pre-construction and Construction	Design contractor, construction contractor
Opportunities for planting of detention basins with native aquatic emergent plants and fringing trees would be explored in the detailed design of the Proposal and, if practicable, implemented so that they would provide similar habitat in the medium term to that lost through the removal of existing basins.	Maintain aquatic habitat values	Pre-construction	Design contractor, construction contractor
The CEMP (or equivalent) would include detailed measures for minimising the risk of introducing weeds and pathogens.	Prevention of weed establishment and invasion	Pre-construction	
The CEMP and OEMP for the Proposal would consider and have reference to the weed removal and riparian vegetation restoration undertaken within parts of the Georges River corridor under the MPW Concept Approval (identified within the Biodiversity Offset Package for the MPW Project).	Prevention of weed establishment and invasion	Pre-construction, construction and operation	Operations contractor
The detailed design process would consider the potential groundwater impacts on groundwater-dependent ecosystems. In most cases, these impacts would be mitigated at the design phase.	Prevention of impacts to groundwater-dependent ecosystems.	Detailed design & Pre-construction	Design contractor, construction contractor, operations contractor
The OEMP would include a biodiversity monitoring program designed to detect operational impacts of the Georges River riparian corridor (within the offset site).	Minimise impacts to native riparian vegetation, retains habitat connectivity and improves native biodiversity values along	Pre-construction, construction and operation	Operations contractor

Mitigation measure	Outcome	Timing	Responsibility
	riparian corridor of the Georges River		
Ongoing monitoring of macroinvertebrate communities will be undertaken prior to, during and following construction upstream and downstream of the proposed impacts at the proposed basin outlets in the Georges River and reference locations to assist in identifying any changes in aquatic communities.	Minimise impacts to the aquatic environment in the Georges River.	Pre-construction, construction and operation	Design contractor, construction contractor, operations contractor
The proposed stormwater basin outlets would be designed to minimise biodiversity impacts by incorporating native revegetation and fauna habitat features as far as possible.	Maintaining native vegetation values and fauna connectivity in basin outlets (which are located within the proposed conservation area)	Pre-construction	Design contractor
The native vegetation and connectivity values in the proposed basin outlets would be monitored to ensure that fauna passage is maintained.	Maintaining native vegetation values and fauna connectivity in basin outlets (which are located within the proposed conservation area)	Construction and operation	Construction contractor, operations contractor

11.6 Offsetting impacts

A comprehensive Biodiversity Offset Strategy (BOS) for the MPW Project is required to be prepared and implemented under the MPW Concept Approval. The BOS will be prepared in accordance with the *NSW Biodiversity Offsets Policy for Major Projects* including the Framework for Biodiversity Assessment (OEH 2014), consistent with the ‘avoid, minimise or offset’ principle.

The BOS will be prepared with the objective to offset all biodiversity impacts within the Moorebank Precinct (comprising the MPW site and the MPE site). The BOS will consider all of the relevant biodiversity impacts of the Proposal.

11.6.1 Offset credit requirements

Under the *NSW Biodiversity Offsets Policy for Major Projects*, a biobanking agreement is required to be used to secure an offset site. The ecosystem and species credit offset requirements for the biodiversity impacts of the Proposal are detailed below.

The FBA calculator used for the MPW Concept EIS FBA Assessment (Parsons Brinckerhoff 2015) was updated by Alex Cockerill (Parsons Brinckerhoff) (Assessor No. 0058) using revised impact areas and vegetation classifications, in order to obtain credit values for the area of the proposal site within the Moorebank Development Site.

A separate calculation was prepared by Jane Rodd (Arcadis) (Assessor No. 0023) for the additional areas of the Proposal site outside the Moorebank Development Site.

The full credit reports for both calculations are provided in Appendix Q of this EIS.

Impacts on native vegetation

Loss of landscape and site value for each PCT and its associated ecosystem species, as determined using the credit calculator, is presented in Table 11-12. The PCTs to be offset are shown in Figure 11-4. The full credit report is provided in Appendix Q.

Table 11-12: Impact summary for PCTs and associated ecosystem credit species requiring offsets and their required credits

Vegetation zone	Associated EECs and/or Threatened Species	Loss in landscape value	Loss in site value score	Number of Ecosystem credits required
Area of development site within the Moorebank Development Site				
Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin (ME003): Moderate/Good	Castlereagh Scribbly Gum Woodland of the Sydney Basin bioregion (VEC) *Persoonia nutans* *Grevillea parviflora* subsp. *parviflora*	12.8	44.3	427
Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin (ME005): Moderate/Good	Castlereagh Swamp Woodland (EEC)	12.8	39.58	30
Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin (ME018): Moderate/Good	River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions (EEC)	12.8	35.76	869
Additional areas of impact outside the Moorebank Development Site				
Forest Red Gum - Rough-barked Apple grassy woodland on	River-flat Eucalypt Forest on Coastal Floodplains of the	24.8	55.21	57

Vegetation zone	Associated EECs and/or Threatened Species	Loss in landscape value	Loss in site value score	Number of Ecosystem credits required
alluvial flats of the Cumberland Plain, Sydney Basin (ME018): Moderate/Good - Moderate	NSW North Coast, Sydney Basin and South-east Corner bioregions (EEC)			
Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin (ME018): Moderate/Good - Poor	River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions (EEC)	24.8	30.21	18

Impacts on threatened species

Impacts to threatened species credit species and their associated species are summarised in Table 11-13. The full credit report is provided in Appendix Q of this EIS.

Table 11-13: Impact summary for threatened species credit species requiring offsets and their required credits

Common name	Scientific name	Status	Impacts	Number of species credits required
Nodding Geebung	*Persoonia nutans*	Endangered	10	770
Small-flowered Grevillea	*Grevillea parviflora* subsp. *parviflora*	Vulnerable	16	224

12 STORMWATER AND FLOODING

A *Stormwater and Flooding Environmental Assessment* was prepared by Arcadis (2016) (refer to Appendix R of this EIS) to assess the impacts on stormwater and flooding risk from the construction and operation of the Proposal.

Table 12-1 sets out the Secretary's Environmental Assessment Requirements (SEARs) as they relate to the Proposal, and where these have been addressed.

Table 12-1: SEARs for the Proposal relating to Stormwater and Flooding

Section/Number	Requirement	Where addressed in this EIS
8. Soil and Water	An assessment of soil and water impacts for the entire site. The assessment shall:	
	a) assess impacts on surface and groundwater flows, quality and quantity, with particular reference to any likely impacts on dragonfly species listed under the *Fisheries Management Act 1994*, the Georges River and Anzac Creek;	Section 12.3 of this EIS
	b) assess flooding impacts and characteristics, to and from the project, with an assessment of the potential changes to flooding behaviour (levels, velocities and direction) and impacts on bed and bank stability, through flood modelling, including: i. hydraulic modelling for a range of flood events; ii. description, justification and assessment of design objectives (including bridge, culvert and embankment design); iii. an assessment of afflux and flood duration (inundation period) on property; and iv. consideration of the effects of climate change, including changes to rainfall frequency and/or intensity, including an assessment of the capacity of stormwater drainage structures v. relevant provisions of the NSW Floodplain Development Manual 2005.	Section 12.3 of this EIS
	c) assess effects to downstream rivers, wetlands, estuaries, marine waters and floodplain areas, water dependent fauna and flora (including Groundwater Dependent Ecosystems);	Section 12.3 of this EIS
	d) describe any mitigating effects of the proposed stormwater and wastewater management during and after construction on hydrological attributes such as volumes, flow rates, management methods and re-use options	Section 12.3.2 of this EIS

Section/Number	Requirement	Where addressed in this EIS
	e) identification of proposed monitoring of hydrological attributes	Section 12.3 of this EIS
	f) address drainage issues associated with the development / site, including the incorporation of Water Sensitive Urban Design measures, stormwater and drainage infrastructure such as on-site detention systems to ensure peak discharges and flow velocities post development shall not exceed existing peak flows and velocities	Section 12.3 of this EIS
	g) undertake an assessment of surface water quality during construction (including reference to water quality objectives for the relevant catchment where objectives have been determined), including an identification of works that may impact water quality, and a summary of proposed mitigation measures in accordance with Managing Urban Stormwater – Soils & Construction Volume 1 2004 (Landcom) and Volume 2 (DECC 2008)	Section 12.3 of this EIS
	h) consideration of stormwater management (including monitoring) during operation of the site with the objective of maintaining or improving existing water quality taking into account the Water Quality Objectives	Section 12.4 of this EIS
	i) consider whether the existing sewerage system can cater for the proposal and whether environmental performance of the existing system will be impacted	Appendix H of this EIS
	k) include a bulk earthworks strategy detailing the volume of spoil to be extracted from the site, planned reuse and amount of material to be imported.	Appendix R of this EIS

This Section summarises the studies undertaken previously for the MPW Concept Approval and, more recently, for the Proposal. This Section provides an assessment of potential impacts resulting from construction of the Proposal on Stormwater and Flooding. Measures to mitigate impacts have also been identified where they are required.

12.1 MPW Concept Approval

Parsons Brinkerhoff (2014) has prepared a Surface Water Assessment to assess commitments consistent with SEARs associated with the MPW Concept Approval, informing the MPW Concept EIS. The assessment included both Early Works (Stage 1, construction impacts) and the “full build” (operational) scenarios. The existing environmental conditions for the Proposal site are based on the information within the MPW Concept EIS, however are assumed to be upon completion of the Early Works.

The previous reporting included an assessment of the following aspects with respect to Early Works (construction) and full build (operational) phases of the MPW Project:

- Change in hydrologic regime, in particular, change in flooding, stormwater runoff quantity
- Impact of project on water quality, including sediment and erosion, stormwater quality and stormwater pollution (accidental spills etc.).

The assessment was based on conceptual scenarios assuming a worst case scenario regarding disturbance of local surface water catchments during construction for Early Works activities. An assessment of the full Build operational scenario using a conceptual stormwater management plan was also undertaken. It was established that the Proposal site comprises of the following conditions affecting surface flow drainage (refer to Figure 12-1) across the existing site:

- The MPW site is largely developed comprising of low-rise buildings, including warehouses, administrative offices, residential buildings, access roads, open areas, landscaped fields and the Royal Australian Engineers (RAE) Golf Course and Club
- The MPW site is located within the Georges River catchment, with the majority of the area draining into the Georges River, which forms the western boundary of the MPW site
- Located in the north-eastern corner of the site (refer to Figure 12-1), the Amiens wetlands[52] provide stormwater detention for flows entering the area from the M5 Motorway and adjacent catchment
- The Proposal site contains four small waterbodies (*P1 – P4*, refer to Figure 12-1), which are most likely used for attenuation and/or water quality treatment. Discharge from these ponds overtops the pond outlets and flows through informal overland channels into the Georges River
- Stormwater on the MPW site is generally conveyed via pits, pipes and open channels in a north-westerly direction across the MPW site and discharged into the Georges River. Only one of the existing stormwater pipe networks discharges into Anzac Creek
- The MPW site contains two open channels: one is a vegetated open channel in the north of the site adjacent to the ABB site, and the other is an open concrete-lined trapezoidal channel which flows westward through the site from the lowest point in Moorebank Avenue to the Georges River
- Discharges within the RAE Golf Course, in the south-east corner of the MPW site, drain by open channels to road culverts underneath Moorebank Avenue, which then discharge into Anzac Creek
- Based on the local topography, a number of land areas surrounding the MPW site partially drain into the site through open channels, box culverts, natural drainage lines and overland flows during differing rainfall events. These land areas include:
  – MPE site (former DNSDC site), east of the MPW site
  – M5 Motorway, north of the MPW site
  – Moorebank Business Park, north-east of the MPW site
  – ABB site, north of the MPW site.

[52] Further information on the Amiens wetland is provided in Section 11.

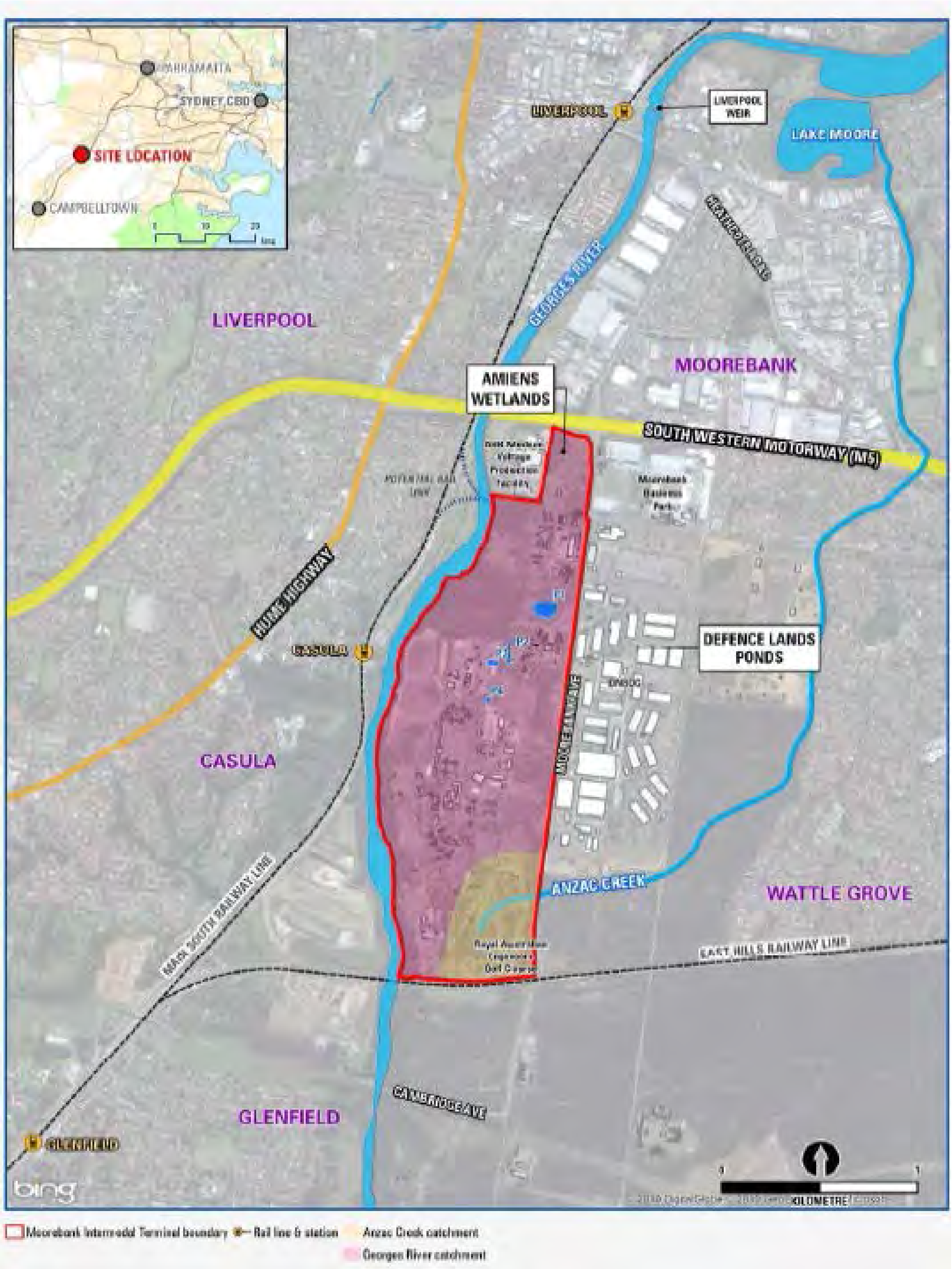

Figure 12-1: *Existing Waterbodies and drainage catchments on the MPW site prior to Early Works (PB, 2014)*

The following section refers to findings from investigations carried out to assess the anticipated impacts created by the MPW Project.

12.1.1 Water Quantity

The MPW Project at full build would result in a substantial increase in the area of impervious surfaces, with subsequent risks for hydrology (flooding) and water quality. A drainage strategy has been developed to manage this issue, including provision of overland flow paths across the site to detention basins and biofiltration systems/wetlands, from which treated water would be discharged to the Georges River through upgraded stormwater channels.

12.1.2 Flooding

Flooding impacts were assessed using a hydraulic model (HEC-RAS). The investigations were primarily desktop based however also included a site walkover. Input from Liverpool City Council (LCC) and other organizations was provided for key information relating to the local area and conditions. Key findings identified the MPW site has historically been affected by flooding from the Georges River as recently as 1988, and is most at risk of flooding in the lower terrace area of the eastern floodplain of the river. The peak 1% annual exceedance probability (1 in 100 year ARI) levels range from 11.7 to 10.4 m AHD along the western boundary of the MPW site. An area of 23.6 ha (12% of the MPW site area) was declared as ‘high flood risk’. Climate change is an additional consideration that may exacerbate flooding risks.

12.1.3 Water Quality and Groundwater

Baseline water quality data were derived from previous investigations and NSW Office of Water (NOW) water quality objectives and Australian and New Zealand Environment and Conservation Council (ANZECC) Guidelines. During construction, the key activities that have the potential to affect stormwater quality and downstream waterbodies include the potential mobilisation and erosion of soils on the MPW site due to land disturbance. Accidental spills of chemicals and other hazardous construction materials, and uncontrolled discharge of contaminants to receiving waterways, could also have an adverse impact on water quality unless carefully managed. With appropriate management, The MPW Project is expected to provide water quality benefits for the Georges River, due to the proposed treatment of stormwater prior to discharge, which would lead to a reduction in the annual load of total suspended solids, hydrocarbons and total phosphorus discharged from the MPW site. This is predicted to be consistent with the objectives of the ANZECC Water Quality Guidelines.

The MPW Project has the potential to interact with groundwater and lead to impacts such as lowering of the water table and contamination of groundwater. Potential impacts would be further considered during the development of the detailed design.

Overall, recommendations for further assessment of potential drainage and flood impacts as part of future stages are outlined in the REMMs (refer to Appendix A of this EIS).

12.1.4 Conditions of Approval

The Conditions of Approval for the MPW Concept Approval relevant to the Proposal are shown in Table 12-2. These conditions of approval have been taken into account while developing the methodology for the stormwater and flooding impact assessment for the Proposal.

Table 12-2: MPW Concept EIS Conditions of Approval

Conditions of Approval		Where addressed in this EIS
Schedule 4- Conditions to be met in future development applications		
E21.	All future Development Application shall include an assessment of soil and water impacts. The assessment shall (where relevant): a) assess impacts on surface and groundwater flows, quality and quantity, with particular reference to any likely impacts on Georges River and Anzac Creek; b) assess flooding impacts and characteristics, to and from the project (including rail link), with an assessment of the potential changes to flooding behaviour (levels, velocities and direction) and impacts on bed and bank stability, through flood modelling, including: (i) hydraulic modelling for a range of flood events (ii) description, justification and assessment of design objectives (including bridge, culvert and embankment design) (iii) an assessment of afflux and flood duration (inundation period) on property (iv) consideration of the effects of climate change, including changes to rainfall frequency and/or intensity, including an assessment of the capacity of stormwater drainage structures. c) identify and assess the soil characteristics and properties that may impact or be impacted by the project, including acid sulfate soils d) include a contamination assessment in accordance with the guidelines made under the Contaminated Land Management Act 1997 and in consultation with the EPA for the subject site including the Glenfield Waste Facility.	Section 12.3 and Appendix R of this EIS
E22.	All future Development Application which includes construction in the vicinity of Amiens Wetland shall include advice from an independent wetland expert to determine whether it is artificial or a natural lake basin, its significance, and any recommendations on mitigation measures (if appropriate).	Section 11 and Appendix Q of this EIS

12.2 Methodology

12.2.1 Water quantity

The water quantity assessment in the *Stormwater and Flooding Environmental Assessment* (refer to Appendix R of this EIS) considered the existing impervious areas and drainage patterns on the Proposal site, based on aerial photography, aerial laser survey, ground survey of the site, and a review of recent development works to form an overall catchment plan for the site. Consideration was then given to the proposed impervious and pervious areas and the drainage works to be undertaken on the Proposal site. On site drainage configurations, including culvert and slope design, were determined through flow regime analysis using the DRAINS modelling tool. Results of this modelling can be found in Section 12.4 and Appendix R of this EIS.

12.2.2 Water quality

Stormwater quality objectives and performance targets for the Proposal site were determined through a review of the following key documents:

- Liverpool Development Control Plan 2008 (Liverpool City Council, 12 November 2014) – provides general objectives and controls that apply to development within Liverpool LGA.
- Georges River Estuary Coastal Zone Management Plan (CZMP) (Georges River Combined Council's Committee, July 2013) – provides objectives and targets specifically for the Georges River Estuary and its catchment.
- SEARs for MPW Stage 2 (NSW Planning & Environment) – provides specific environmental assessment requirements and objectives for the Proposal.
- REMMs for MPW Stage 2 – requirements identified in the Concept Plan Approval (SSD_5066).

Key objectives for managing stormwater quality for the Proposal, based on the above documents include:

- Maintain or improve existing water quality.
- To protect the aquatic environment of the downstream waterways including the Georges River.
- Prevent bed and bank erosion and instability of waterways.
- Provide sufficient flows to support aquatic environments and ecological processes.
- Incorporate a Water Sensitive Urban Design (WSUD) approach.

Water quality performance targets for the Proposal derived from above documents are summarised below in Table 12-3. Adopted values for the Proposal are those provided in **bold** shaded grey**.**

Table 12-3: Water Quality Performance Targets

Item	Liverpool DCP 2008	Georges River Estuary CZMP 2013	SEARs
Total Suspended Solids (TSS)	80%	**85%**	**NorBE**
Total Phosphorus (TP)	45%	**60%**	**NorBE**
Total Nitrogen (TN)	45%	**45%**	**NorBE**
Gross Pollutants (GP)	90%	**90%**	**NorBE**

Table Key: Percentage (%) values are the pollutant reduction targets relative to post development pollutant loads without any treatment
NorBE = Neutral or Beneficial Effect (ie. 'maintain or improve existing water quality' as required by the SEARs)

The *Georges River Estuary CZEMP 2013* targets have been specifically developed for the Georges River Catchment and have been selected for the Proposal over those developed for the *Liverpool DCP 2008* as they are more stringent. The SEARs for the Proposal require existing surrounding water quality to be maintained or improved (ie. 'NorBE' / Neutral or Beneficial Effect). Determining whether NorBE values are more stringent than the *Georges River Estuary CZEMP 2013* targets depend on existing water quality conditions and the effect of the proposed WSUD treatment measures. It is therefore considered appropriate to check the performance of the design against both sets of targets, hence both are highlighted.

12.2.3 Flooding

To ascertain the existing and proposed regional flood risk to the Proposal site, the HEC-RAS model that was originally prepared for the adjacent “SIMTA Stage 1” (Hyder, 2015) was used and updated to predict ‘Base-case’ (existing) flood levels along the Georges River for the Proposal ‘base-case model’. This base-case was then adjusted to consider the raising of the Proposal site along the Georges River eastern overbank, with regard to 1 in 100 year and PMF flood events, to generate the ‘Proposal site model’ and assess the potential flood risk imposed by the Proposal. HEC-RAS modelling locations are shown on Figure 12-2, and results from the assessment are detailed in Section 12.4 of this EIS.

The existing and proposed drainage conditions for the Proposal site and adjacent Moorebank Avenue corridor were assessed using the DRAINS modelling tool, which determined indicative catchment boundaries, flow directions and OSD infrastructure (refer to Section 12.4 of this EIS). Anticipated flood durations during a PMF event along Moorebank Avenue were also assessed for impacts on possible evacuation procedures.

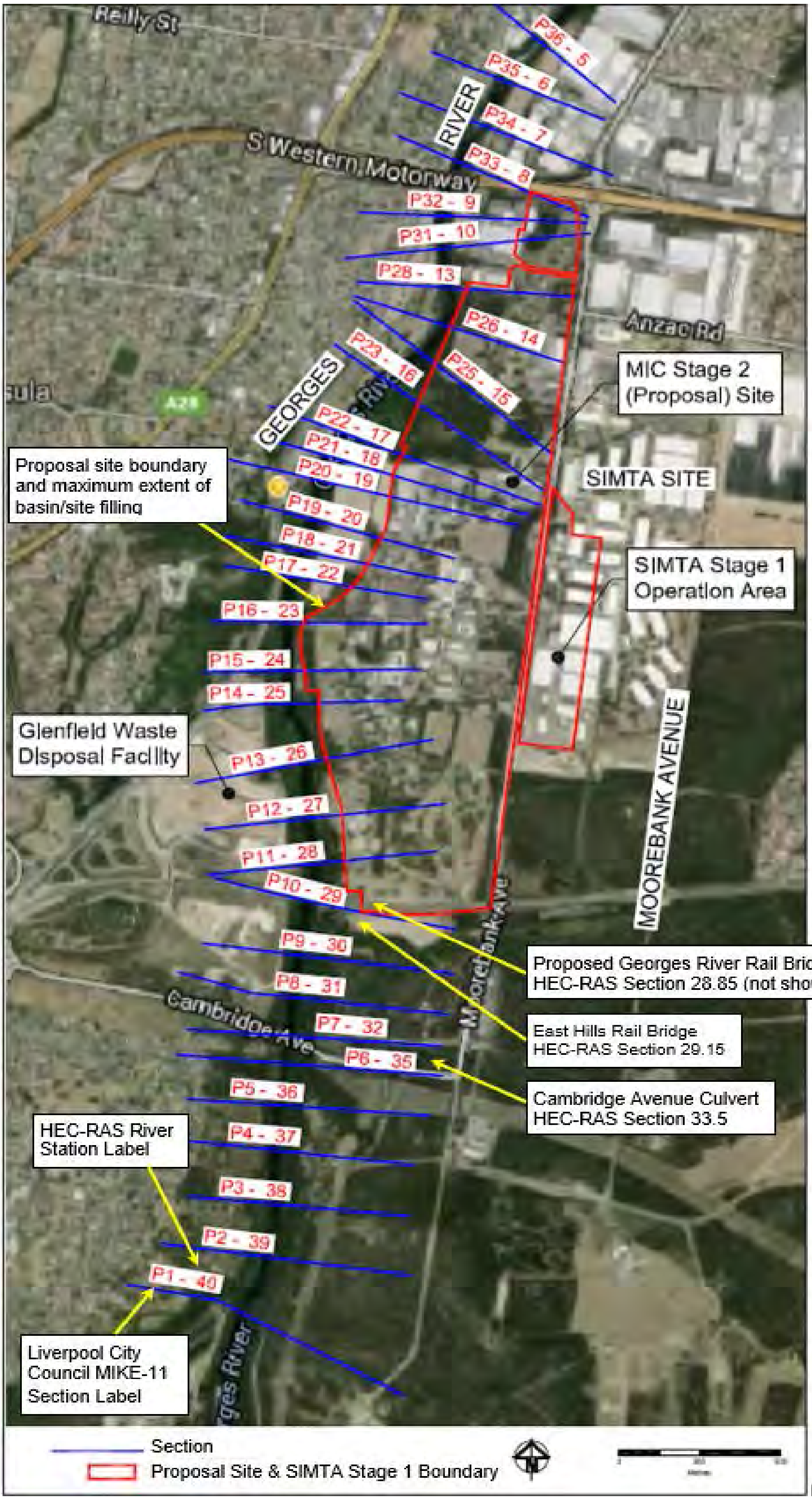

Figure 12-2: Location of HEC-RAS model locations for Proposal investigations

12.3 Existing environment

Existing environmental conditions assessed for Proposal site are assumed to be those that remain following completion of the Early Works. Early works activities approved under the MPW Concept Approval include the establishment of construction compounds, building demolition, remediation, heritage impact mitigation and establishment of the conservation area.

12.3.1 Regional Environment

The Proposal site is located entirely within the Georges River catchment, with the majority of the Proposal site draining into the Georges River (Refer to Figure 12-1). Land use within the catchment varies, and includes residential, industrial, agricultural, mining and Defence activities, and protected areas such as drinking water catchments and conservation areas. The Georges River extends approximately 60 km south-west of Sydney, with the Proposal site located in the upper section of what is referred to as the mid Georges River.

The catchment area upstream of the Project site is largely undeveloped; however, downstream the catchment is increasingly developed, extending out to the river mouth at Botany Bay. The section of river adjacent to the Proposal site is not subject to tidal influences, as a result of the Liverpool Weir, located approximately 2 km downstream (to the north of the Proposal site), which governs minimum water levels. Flooding in this reach of the river is therefore a fluvial process, i.e. it is caused by the catchment's runoff response to rainfall. Soils of the Proposal site are generally classed as 'Type F' soils, which are fine grained and require a relatively long residence time in sediment basins to achieve the TSS concentrations suitable for discharge.

Key surrounding water bodies to the MPW site (refer to Figure 12-1) and their characteristics are summarised in Table 12-4.

Table 12-4: Key waterbodies relating to the Proposal

Water body	Characteristics	Impact on Proposal hydrology
Georges River	Proposal site is contained entirely within the Georges River catchment. The Georges River forms the western boundary of the site, adjacent to the conservation area.	Main receiving waterway for discharge from the MPW site. The Georges River forms the main flooding risk to the Proposal
Amiens wetland	Wetland located in north eastern corner of the Proposal site. Area receives water from a small portion (5.9 ha) of the Proposal site	The wetland acts as an outlet controlled detention basin for the M5 Motorway and adjacent catchment, which means that if water levels in the Georges River are elevated, the basin will not release water until the levels are below the outlet pipe levels. Waters are discharged from the Amiens wetland via a piped connection to the Georges River
Anzac Creek	Waterway is heavily degraded and in general poor condition, characterised by low flow state with	Anzac creek receives surface flows from a very small portion of the Proposal site, located in the south eastern corner. The

Water body	Characteristics	Impact on Proposal hydrology
	minimal water movement dependent on local rainfall	risk of flooding to the MPW site from Anzac Creek is considered negligible.
Defence land ponds	The Proposal site contains four small waterbodies that are most likely used for attenuation and/or water quality treatment. Discharge from these ponds overtops the pond outlets and flows through informal overland channels into the Georges River.	The impact of the ponds given the size of the Proposal site is minor.

12.3.2 Local Surface Water Flows

Surface water quantity

The surface drainage of the Proposal site is influenced by the adjacent MPE site and has the potential to impact upon the local area hydrology, Anzac Creek and the Georges River. The site is characterised by relatively flat topography, with the western edge of the site boundary flowing towards and discharging into the Georges River. Surface runoff catchments and flow directions are shown in Figure 12-3.

The existing site contains seven main discharge locations, each managing the runoff from catchments of varying size and flow velocities. The locations of these discharge points, along with existing catchment boundaries and topographical contours are shown above in Figure 12-3, while detail regarding catchment size and flow velocities (associated with the 5 year, 100 year and probable maximum flood [PMF] events) for each location is provided in Table 12-5, generated via DRAINS software.

As shown in Figure 12-3, the majority of the site drains into the Georges River, principally via discharge points 10, 8, 6, 5, 4a and 4. A minor portion of the site in the south eastern corner forms part of the Anzac Creek catchment and discharges via a culvert (Shown as D on Figure 12-3) under Moorebank Avenue. There exists an open channel which conveys flows from the MPE site, through the MPW site, and into the Georges River. As shown in Table 12-5, Locations 4 and 5 under existing conditions convey runoff from the largest catchment areas, which are largely from offsite sources (such as the nearby MPE site).

Table 12-5: Comparison of Peak Flow Estimates at existing discharge locations (inclusive of both MIC and MPE sites)

Discharge Location	Site Condition	Catchment Area (ha)	Flow (m^3/s)		
			5yr ARI	100yr ARI	PMF
8 Georges River MPW site South	Existing	11.17	1.2	2.3	19
6 Georges River MPW site	Existing	55.30	9.3	16.5	88
5 Georges River MPW site	Existing	155.53	16.0	29.1	168

Discharge Location	Site Condition	Catchment Area (ha)	Flow (m^3/s)		
			5yr ARI	100yr ARI	PMF
4a MPW site (at ABB Eastern Site boundary)	Existing	26.14	4.2	7.6	44
4 Georges River MPW site North	Existing	184.47	19.4	34.8	199
10 Georges River Rail MPW site	Existing	1.48	0.0	0.1	0.6
3a Anzac Creek MPW site South-east Site Boundary	Existing	24.82	1.0	2.1	14

Early Works activities would alter the drainage regime of the Proposal site, however these changes are anticipated to be quite minor in nature and therefore would not considerably change the results identified above.

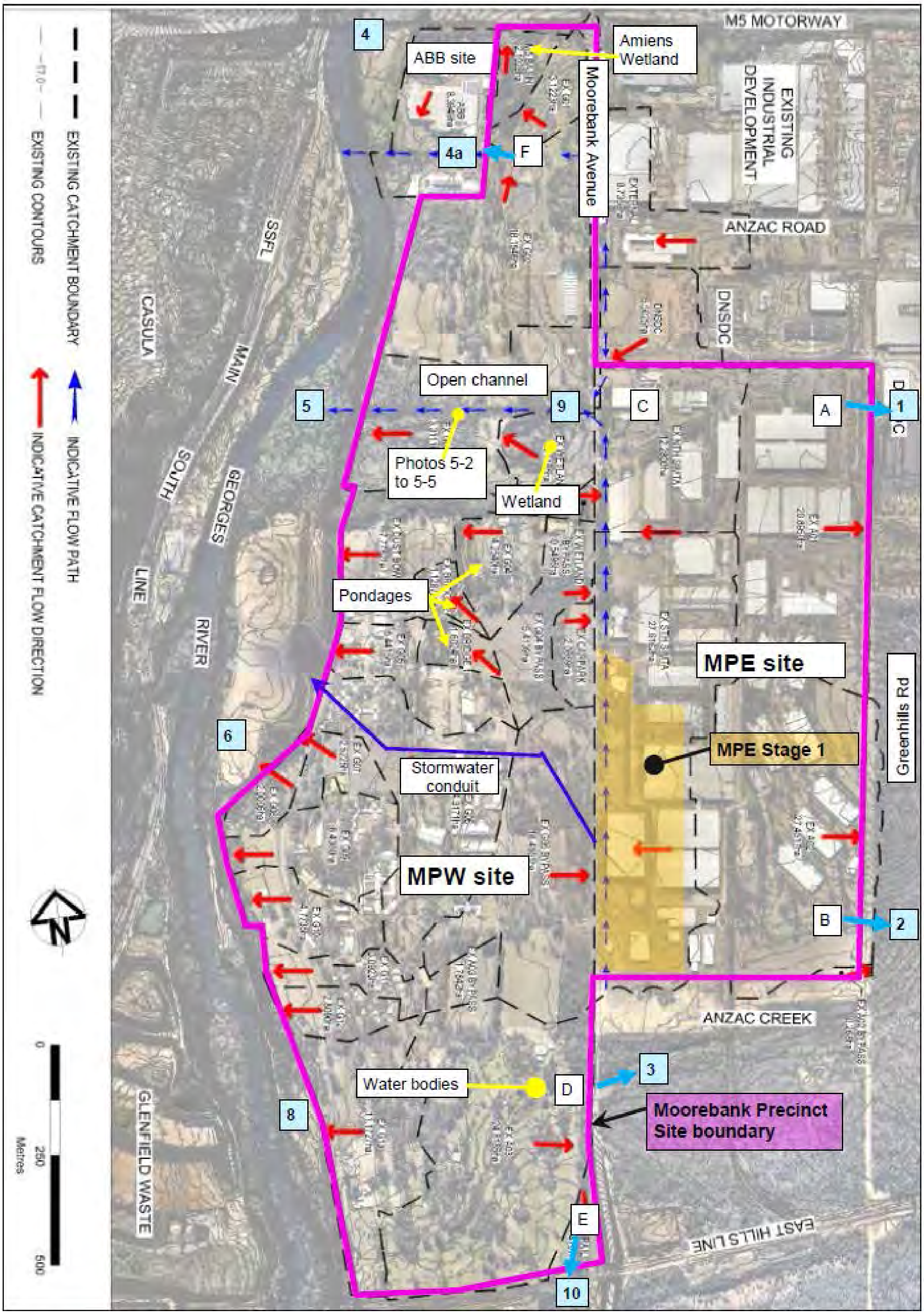

Figure 12-3: MPW Stage 2 Existing Site Conditions

Water Quality

An assessment of the existing stormwater quality from the Proposal site was undertaken using MUSIC modelling, by applying the land uses and imperviousness values for the existing conditions. Table 12-6 summarises the existing annual stormwater pollutant loads that were calculated for the Proposal site.

Table 12-6: Existing stormwater quality from the Proposal site

Pollutant type	Existing pollutant load (kg/year)
Gross pollutants	15,800
Total suspended solids (TSS)	126,000
Total phosphorous (TP)	248
Total nitrogen (TN)	1,510

12.3.3 Flooding

Flooding risk to the Proposal site is principally concentrated along the Georges River riparian corridor.

Flood plain mapping indicates that the Proposal site boundary has been defined such that it lies marginally outside the Georges River 100 year flood extent (corresponding to Flood Planning Area as per Liverpool LEP 2008). Northern areas of the Proposal site overlap areas within flood prone land, and areas within the probable maximum flood boundary (PMF) (refer to Figure 12-4). Overall, the Georges River riparian corridor (conservation area) and northern portion of the MPW site are subject to flooding in a PMF flood event.

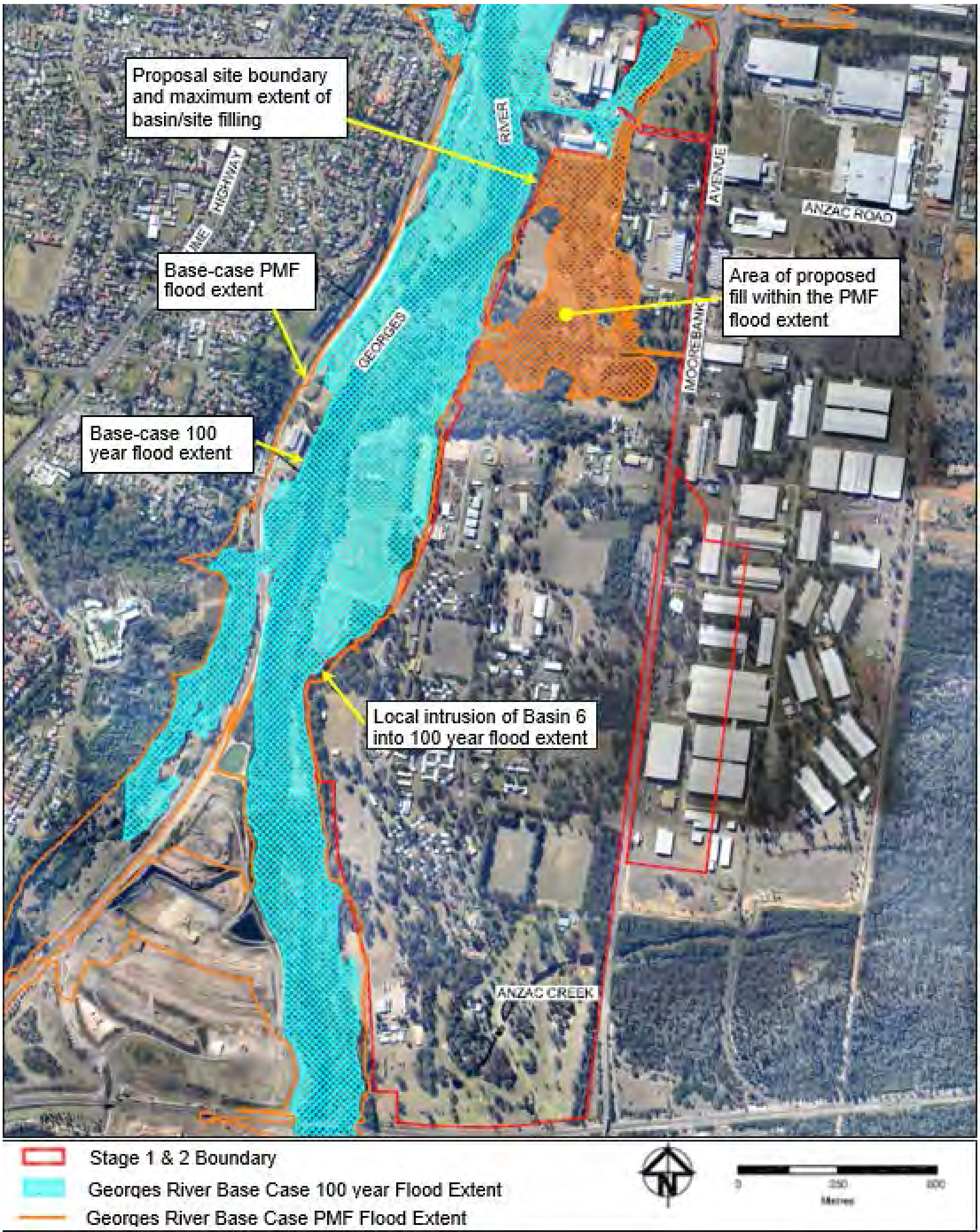

Figure 12-4: Flood mapping (Liverpool City Council, 2000)

12.4 Potential impacts

12.4.1 Construction

Stormwater quantity

During construction of the Proposal, activities that would have the greatest potential to impact upon water quantity include:

- Construction of the IMT Facility and warehouse facilities
- Continued use of construction facilities
- Ancillary works including vegetation clearance and earthworks.

The progressive nature of works, vegetation clearing and compaction of soil upon disturbed land can lead to an increase in surface water flow volume and velocity across the site, presenting a high risk of erosion, surface scouring and scouring of water channels, as well as the transportation of sand, silt and clay off-site into adjacent vegetation and waterways.

Retained or constructed hardstand areas and drainage structures within the Proposal site would naturally accelerate surface flows across the construction areas, and into nearby receivers (Georges River), while disturbed areas provide a rougher surface that assist in slowing surface water runoff and encourages infiltration of water into the soil profile. Surface water volumes and velocities, and hence level of impact would be dependent upon the location and timing of the works. The soils of the Proposal site are of the Berkshire Park Group, and have very high wind erosion potential if stripped of vegetation.

Without appropriate mitigation and management of surface flows around the site, construction activities for the Proposal are anticipated to cause significant erosion of soils and water channels leading to receiving waterways.

Stormwater quality

Potential water quality impacts created by the Proposal construction, predominantly through the disturbance of the ground surface, include:

- Vegetation clearing and demolition works
- Bulk earthworks
- Stormwater and drainage works
- Concentration of surface water flows
- Spills or leaks of substances such as oil, hydraulic fluids and fuels.

During construction, there is potential for sediment to be eroded and deposited downstream into either Georges River or Anzac Creek, in the absence of appropriate control measures. The mobilisation of sediments and pollutants has the potential to reduce the suitability of aquatic environments for some aquatic flora and fauna species (refer to Section 11 of this EIS for further detail).

The importation and placement of large amounts of fill material to level and raise the site has the potential to generate sediment laden runoff into the nearby Georges River and impacting water quality. The large area of disturbance required at the site for earthworks activities and timeframe of construction for the Proposal means there is a high potential for site runoff during typical construction activities to convey a significant sediment load, given the soil type and scale of fill materials during construction periods

The management strategies outlined in *Managing Urban Stormwater* (‘The Blue Book’) (Landcom, 2004) for management of sites with high erosion potential would therefore be adopted for any works adjacent to the Georges River.

Sediment basins are proposed generally along the western boundary of the Proposal site, with an additional basin near the south eastern corner of the Proposal site to treat any flows that may discharge to Anzac Creek. All basins are calculated in accordance with the Blue Book based on Berkshire Park group soils (‘Type F’). These soils are fine grained and require a relatively long residence time to allow settling. Sediment basins for ‘Type F’ soils are typically wet basins which are pumped out following a rainfall event when suspended solids concentrations of less than 50 mg/L have been achieved.

Flooding

Construction of the Proposal, in particular raising of the Proposal site, would have the potential to cause flooding impacts on surrounding properties during a significant rainfall event, in the absence of flood management measures. Flood risk to nearby properties and to the site itself may occur through the failure of existing or temporary water containment measures, or through a rainfall event exceeding that for which the controls for construction activities were designed to protect. The risk of regional flooding for a storm event up to the 100 year ARI or PMF event is considered negligible for all construction works outside of the Georges River riparian corridor.

Measures to mitigate potential flood risks during construction are provided in Section 12.5 of this EIS.

12.4.2 Operation

Development of the Proposal, namely through the establishment of the IMT, warehousing and ancillary facilities, would result in changes to the catchment boundaries within the Proposal site. The Proposal would increase the impervious surfaces on the site potentially resulting in an increase in surface water runoff. Changes to the flood regime within the Proposal site and surrounding area are negligible. Development of the Proposal will result in alterations to the existing catchments within the Proposal site. The amended catchments and a conceptual layout of the proposed stormwater system is shown in Figure 12-5, with further detailed plans included in Appendix R.

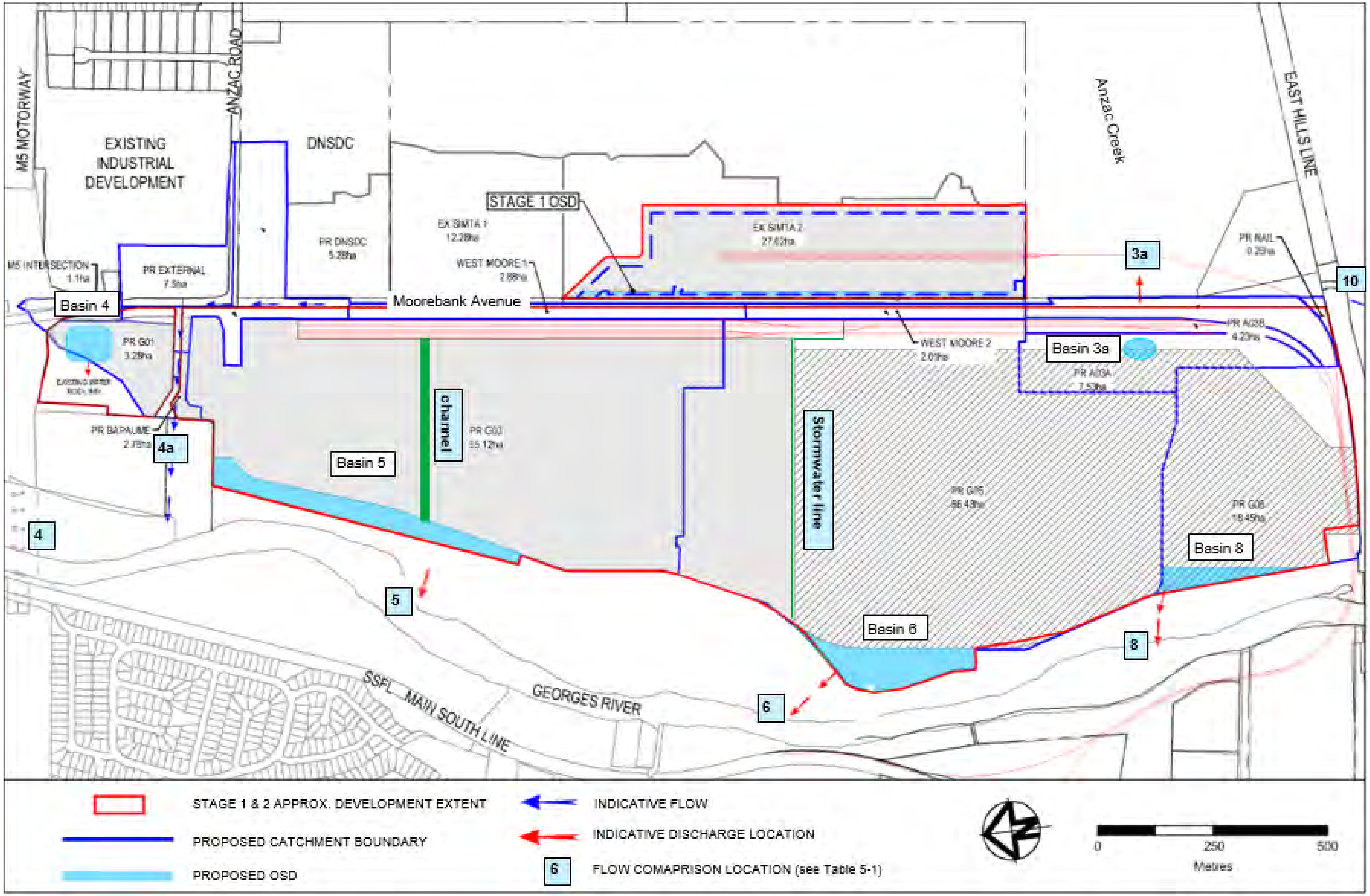

Figure 12-5: Post development catchments, surface flow direction, detention and discharge points

Stormwater quantity

Changes in stormwater quantity are predicted as a result of the Proposal, due to a general increase in areas of impervious surfaces. The existing conditions for the site include significant impervious surface areas in the form of roads and roofs. From aerial photos it has been estimated that the existing Proposal site is approximately 50% impervious. While the remainder of the site is pervious (grassed or treed), it is underlain by predominantly clay soils which limit the potential for infiltration. The Proposal would result in predominantly paved surfaces within the Proposal site. The Proposal site, on completion of development, is assumed to be approximately 95% impervious, allowing for some pervious landscaped areas. A breakdown of these figures is provided below in Table 12-7.

Table 12-7: Proposal land use areas and imperviousness

Land use	Existing		Proposed**	
	Area (ha)	Imperviousness (%)	Area (ha)	Imperviousness (%)
Roof	30.0	100	54.3	100
Road***	45.0	90	93.3	90
Vegetated/ Landscaped	75.9	5	0.0*	N/A

** Landscaped areas will be provided as part of the proposed development, however for the purpose of water quality modelling they are likely to be insignificant and have been incorporated into the pervious area associated with roads.*
*** Proposed conditions reflect the Proposal at completion of construction.*
**** Includes all impervious areas other than roofs (i.e. roads, terminal pavements, building aprons etc),*

A comparison of DRAINS modelling of existing conditions and post-development condition flows at downstream locations of the Proposal site (refer to Table 12-8) indicate that the proposed detention storages (refer to Figure 12-5 for proposed basin locations) should adequately mitigate the anticipated potential flow increases discharging from the post-development Proposal site.

Table 12-8: Comparison of flow velocities at discharge points for both existing and post development retention basins

Discharge Location	Site Condition	Catchment Area (ha)	Flow (m^3/s)		
			5yr ARI	100yr ARI	PMF
8 Georges River MPW site South	Existing	11.17	1.2	2.3	19
	Proposed	**18.45**	**0.5**	**0.9**	**27**
6 Georges River MPW site (6+8)*	Existing	55.30	9.3	16.5	88
	Proposed	**85.24**	**2.3**	**5.3**	**110**
5 Georges River MPW site (SIMTA + 5+6+8)*	Existing	155.53	16.0	29.1	168
	Proposed	**190.61**	**9.2**	**14.3**	**259**
4a MPW site (at ABB Eastern Site boundary)	Existing	26.14	4.2	7.6	44
	Proposed	**10.65**	**3.0**	**4.6**	**21**

Discharge Location	Site Condition	Catchment Area (ha)	Flow (m^3/s)		
			5yr ARI	100yr ARI	PMF
4 Georges River MPW site North (4+4a+5+6+8)*	Existing	184.47	19.4	34.8	199
	Proposed	**204.5**	**11.7**	**18.5**	**277**
10 Georges River Rail MPW site	Existing	1.48	0.0	0.1	0.6
	Proposed	**0.25**	**0.0**	**0.0**	**0.2**
3a Anzac Creek MPW site South-east Site Boundary	Existing	24.82	1.0	2.1	14
	Proposed	**11.77**	**0.5**	**1.2**	**17**

Table 12-9 below outlines performance of OSD storages (refer to Figure 12-5 for basin locations) individually and cumulatively across the Proposal site given the changes to local surface water conditions created by the Proposal.

Table 12-9: Detention Storage Performance Summary

Storage [water quality extended detention level mAHD]	Catchment Area (ha)	Event	Peak Inflow (m^3/s)	Peak Outflow (m^3/s)	Water Level (mAHD)	Volume (m^3)
Basin 4 MPW site North [11.0]	3.3	100 year	1.9	0.3	11.48	3400*
		PMF	8.2	2.0	12.10	(7450)
Basin 5 Georges River MPW site [11.3]	56.0	100 year	22.8	2.6	13.92	62800*
		PMF	105	80.0	14.70	(82600)
Basin 6 Georges River MPW site [11.6]	66.8	100 year	27.2	4.3	13.92	58100*
		PMF	125	108	14.8	(79900)
Basin 8 Georges River MPW site South [11.8]	18.5	100 year	8.2	0.9	14.49	20100*
		PMF	39	27.0	15.30	(26500)
Basin 3a Anzac Creek MPW site South-east [15.0]	8.1	100 year	3.3	0.8	15.87	3500*
		PMF	17.5	15.1	16.40	(5500)

* Approximate 100 year active storage above water quality extended detention water level (refer to Figure 5 for Basin locations)
Storage parameters and outlet configuration are included in Appendix B.
* Assumes OSD spills along approximate length of downstream wall.

The OSD storages for the Proposal site have been sized to control 100 year ARI flows for conditions entering basins with extended detention (~3 month) water levels and low flow outlets fully blocked at the onset of the storm event.

A sensitivity assessment was carried out (Arcadis, 2016) with 100 year rainfall intensities increased by 10%, considered representative to potential climate change impacts[53]. This resulted in a 0.05 metre to 0.2 metre increase in 100 years ARI water levels in the OSD storages for the Proposal. A minimum freeboard of 0.3 metres above the 100 year water level is designed to manage this.

Each of the four proposed Basins (4, 5, 6 and 8) discharging to the Georges River would include outlet channels that are:

- To be configured with energy dissipaters and scour protection
- In traversing the overbank areas of the Georges River, are to be no higher than existing ground surface levels (to avoid adverse flood impacts)
- Aligned with no less than a 45 degree entry angle into the Georges River channel.

It is likely that these outlet channels will include gabion and reno-mattress elements that accommodate grass and low vegetation.

In summary, the DRAINS modelling indicates that, the proposed OSD and stormwater management system should adequately mitigate the increase in peak flows discharging from the site as a result of the Proposal.

Rainfall increases are projected within the New South Wales Department of Environment and Climate Change (DECC) ‘Floodplain Risk Management Guideline Practical Consideration of Climate Change’ (October 2007) for Hawkesbury-Nepean catchment. To account for this potential increase, a sensitivity assessment was also carried out with 100 year rainfall intensities increases by 10%. This increase in rainfall intensities resulted in an increase in 100 year ARI water levels of approximately 0.05m to 0.2m in the OSD storages. The capacity of the OSDs has been designed to accommodate this potential increase in rainfall.

Stormwater quality

In general, operation of the Proposal has the potential to reduce stormwater quality as stormwater falling on the increased impervious surface of the Proposal operational area would have the potential to carry pollutants such as litter, sediments and nutrients used as fertiliser.

MUSIC modelling was used to determine the potential pollutant loads which would be generated by the Proposals operational area and to identify measures to reduce the pollutant load. Table 12-10 shows the estimated pollutant loads that would be generated from operation of the Proposal.

[53] Consistent with projected rainfall increases in accordance with the New South Wales Office of Environment and Heritage (OEH) ‘Floodplain Risk Management Guideline Practical Consideration of Climate Change’ (October 2007) for Hawkesbury-Nepean catchment.

Table 12-10: Modelled pollutant levels from the Proposal (MUSIC Model)

Scenario	Pollutant loads (kg/year)			
	Gross pollutants	TSS	TP	TN
Existing	15,800	126,000	248	1,510
Proposal (no treatment)	29,600	235,000	450	2,520
Percentage increase (%)	87	86	81	67

As shown in Table 12-10, without any mitigation, the Proposal would lead to an increase in pollutant loads to nearby waterways.

The key objectives for stormwater quality management for the Proposal include:

- Maintain or improve existing water quality
- To protect the aquatic environment of the downstream waterways including the Georges River
- Prevent bed and bank erosion and instability of waterways
- Provide sufficient flows to support aquatic environments and ecological processes
- Incorporate a Water Sensitive Urban Design (WSUD) approach.

Two key WSUD treatment measures are proposed to achieve the adopted performance targets:

- **Gross Pollutant Traps (GPTs):** these are primary stormwater treatment measures used as the first measure in a stormwater treatment train. For the purposes of the modelling, a device with continuous deflection screens and hydrodynamic separation to target TSS was included
- **Rain gardens:** these act as bio-retention systems and comprise of a combination of vegetation and filter substrate and treat stormwater through the processes of settling, filtration and biological uptake of nutrients. For the Proposal site, it is proposed that rain gardens would form the base of the OSD basins.

MUSIC modelling was undertaken to assess the effectiveness of the proposed stormwater treatment measures in consideration of the adopted targets. Table 12-11 provides a summary of stormwater quality performance, with and without treatment.

Table 12-11: Summary of stormwater quality performance - with and without treatment

Scenario	Pollutant Loads (kg/year)			
	Gross pollutants	TSS	TP	TN
Proposed (no treatment)	29,600	235,000	450	2,520
Proposed (with treatment)	0	23,100	101	1,180
% Reduction Achieved*	100	90	77	53
% Reduction Target	**90**	**85**	**60**	**45**

Existing	15,800	126,000	248	1,510
Reduction achieved from existing	15,800	102,900	147	330

* Percentage reduction from the developed case without treatment to the developed case with the treatment train included.

In summary, the water quality assessment identifies that the performance of the proposed treatment measures (i.e. GPTs and rain gardens) complies with the catchment specific targets of the Georges River Estuary CZMP and also the site specific targets contained in the SEARs.

It should be noted that there are a range of alternative treatment measures that could also be used to meet the required pollution reduction targets. These alternatives could include proprietary filtration devices (e.g. Spelfilter cartridge system) or other emerging technologies (e.g. floating wetlands). These alternatives may be explored further and potentially substituted during the design development process to achieve the targets specified above.

Flooding

The output results from the HEC-RAS modelling undertaken for the Proposal indicate that the potential regional flood impacts of raising the Proposal site would, up to a 100 year ARI event, be negligible, and very limited (in the order of 0.01 metres for a PMF event (for locations refer to Table 12-12).

Table 12-12: Comparison of 'Base-Case' and 'Proposed Development' Flood Levels for the Proposal

Location	100 year ARI			PMF		
	Flood Level (mAHD)		Flood Impact (mm)	Flood Level (mAHD)		Flood Impact (mm)
	Base-case Condition*	Proposed Condition		Base-case Condition*	Proposed Condition	
36	12.68	12.67	-0.01	16.24	16.24	0.00
35	12.68	12.67	-0.01	15.98	15.99	0.01
34	12.26	12.26	0.00	15.19	15.20	0.01
Cambridge Ave culvert	-	-	-	-	-	-
33	12.16	12.16	0.00	15.26	15.26	0.00
32	12.06	12.06	0.00	14.98	14.98	0.00
31	11.99	11.99	0.00	14.93	14.93	0.00
30	11.88	11.88	0.00	14.80	14.80	0.00
29.3	11.82	11.81	-0.01	14.72	14.72	0.00
29.2	11.76	11.75	-0.01	14.63	14.63	0.00
Existing. Rail	-	-	-	-	-	-
29.1	11.73	11.73	0.00	14.42	14.43	0.01
29	11.70	11.69	-0.01	14.43	14.43	0.00
28.9	11.72	11.72	0.00	14.43	14.43	0.00
MPE Stage 1	-	-	-	-	-	-

Location	100 year ARI			PMF		
	Flood Level (mAHD)		Flood Impact (mm)	Flood Level (mAHD)		Flood Impact (mm)
	Base-case Condition*	Proposed Condition		Base-case Condition*	Proposed Condition	
28.8	11.69	11.69	0.00	14.22	14.22	0.00
28.7	11.49	11.49	0.00	13.89	13.89	0.00
28	11.35	11.35	0.00	13.72	13.72	0.00
27	11.35	11.35	0.00	13.83	13.84	0.01
26	11.40	11.40	0.00	13.83	13.83	0.00
25	11.20	11.20	0.00	13.51	13.52	0.01
24	11.11	11.11	0.00	13.36	13.36	0.00
23	10.92	10.92	0.00	12.86	12.86	0.00
22	10.93	10.93	0.00	13.15	13.15	0.00
21	10.99	10.99	0.00	13.25	13.26	0.01
20	10.98	10.98	0.00	13.25	13.25	0.00
19	10.92	10.92	0.00	13.16	13.17	0.01
18	10.82	10.82	0.00	13.00	13.00	0.00
17	10.82	10.82	0.00	12.96	12.96	0.00
16	10.80	10.80	0.00	12.94	12.95	0.01
15	10.73	10.73	0.00	12.85	12.86	0.01
14	10.63	10.63	0.00	12.77	12.77	0.00

The Proposal is anticipated to incur either minor or negligible flood impacts, which is considered acceptable without further flood mitigation.

While the proposed filling of the Proposal site will raise the operational area above the regional PMF levels, areas not impacted by regional flooding can still be affected by local PMF flow regimes. DRAINS modelling undertaken at several key locations along Moorebank Avenue considered the potential flood risk from the Proposal, to facilitate flow analysis and stormwater design. Modelling results show that potential water levels driven by a PMF event would be effectively managed with the proposed drainage system discussed in Section 12.4.1 of this EIS.

Groundwater

Groundwater extraction is not anticipated to occur as part of the Proposal. Refer to Section 13 for a description of existing groundwater conditions, impacts imposed to groundwater as a result of the Proposal and proposed mitigation and management measures.

12.5 Mitigation measures

12.5.1 Construction

Stormwater

A Soil and Water Management Plan (SWMP) and Erosion and Sediment Control Plan (ESCP), or equivalent, would be prepared for the Proposal. The SWMP and ESCPs would be developed in accordance with the principles and requirements of the *Blue Book* and based on the Preliminary ESCPs provided in the Stormwater and Flooding Assessment Report (Appendix R of this EIS). The following aspects would be addressed within the SWMP and ESCPs:

- Minimise the area of soil disturbed and exposed to erosion
- Priority should be given to management practices that minimise erosion, rather than to those that capture sediment downslope or at the catchment outlet
- Divert clean water around the construction site or control the flow of clean water at non-erodible velocities through the construction area
- Provision of boundary treatments around the perimeter of construction areas to minimise the migration of sediment offsite
- Permanent or temporary drainage works (in particular OSDs) would be installed as early as practical in the construction program to minimise uncontrolled drainage and associated erosion
- Stockpiles would be located away from flow paths on appropriate impermeable surfaces, to minimise potential sediment transportation. Where practicable, stockpiles would be stabilised if the exposed face of the stockpile is inactive more than ten days, and would be formed with sediment filters in place immediately downslope
- Disturbed land would be rehabilitated as soon practicable
- The wheels of all vehicles would be cleaned prior to exiting the construction site where excavation occurs to prevent the tracking of mud. Where this is not practical, or excessive soil transfer occurs onto paved areas, street cleaning would be undertaken when necessary.
- A requirement to inspect all permanent and temporary erosion and sedimentation control works prior to and post rainfall events and prior to closure of the construction area. Erosion and sediment control structures must be cleaned, repaired and augmented as required.
- Where required, sediment basins and their outlets would be designed to be stable in the peak flow from at least the 10-year ARI time of concentration event. Sediment basins should be sized to accommodate the 5 day, 80th percentile storm event, with sufficient size and capacity to manage Type F soils. Sediment basins must be regularly cleaned to maintain the design capacity. Prior to discharge from sediment basins, water would be tested for the following parameters to identify construction impacts:
  - pH
  - Turbidity/TSS
  - Oil and grease.
- Sediment fences are to be provided around the perimeter of the site to ensure no untreated runoff leaves the site, and around the existing and proposed drainage channels to minimise sediment migration into waterways and sediment basins

- The following management measures would be implemented during works in and adjacent to Georges River to mitigate potential impacts on water quality during OSD Channel construction:
  - All reasonable efforts would be taken to program construction activities during periods when flood flows are not likely to occur
  - The construction area, on completion of construction works, would be left in a condition that promotes native revegetation
  - The management principles outlined in Managing Urban Stormwater (Landcom 2004) for sites with high erosion potential would be implemented
- Proposal site exits would be fitted with hardstand material, rumble grids or other appropriate measures to limit the amount of material transported offsite.

Flooding

The following measures would be considered during the development of the construction methodology for the Proposal to mitigate flooding impacts:

- For all site works, provide temporary diversion channels around temporary work obstructions to allow low and normal flows to safely bypass the work areas
- Locate site compounds, stockpiling areas and storage areas for sensitive plant, equipment and hazardous materials above an appropriate design flood level, outside of the PMF extent at the northern section of the site, to be determined based on the duration of the construction works

To minimise potential flood impacts during construction of the Proposal, the following measures would be implemented and documented in the SWMP:

- The existing site catchment and sub-catchment boundaries would be maintained as far as practicable
- To the extent practicable, site imperviousness and grades should be limited to the extent of existing imperviousness and grades under existing development conditions
- Smaller detention storages that provide adequate rainfall runoff mitigation during partial construction/site development would be considered.
- Temporary structures used to convey on site run-off during construction would be designed to accommodate flows during prolonged or intense rainfalls. The existing stormwater conduit conveying flows from Moorebank Avenue to the Georges River would be assessed to ensure it is adequate to accommodate run-off from the construction area

A Flood Emergency Response and Evacuation Plan (FERP), or equivalent, would be prepared and implemented for the construction phase of the Proposal to allow work sites to be safely evacuated and secured in advance of flooding occurring at the Proposal site.

12.5.2 Operation

Stormwater

Operation of the Proposal in the manner assessed would mitigate potential impacts on stormwater quality and quantity. The following principles would be adopted through the development of detailed design for the Proposal, to ensure the operation of the Proposal would not have an adverse impact on stormwater:

- Stormwater quality improvement devices would be designed to meet the performance targets identified in the *Stormwater and Flooding Environmental Assessment* (Appendix R) and civil design drawings. Maintenance of the bio-retention structures would be in accordance with the maintenance requirements set out in Gold Coast City Council's Water Sensitive Urban Design Guidelines 2007 and would be included in the OEMP

- Operational water quality monitoring is to be carried out and included in the OEMP with the objective of maintaining or improving existing water quality.

Flooding

A Flood Emergency Response Plan (FERP) would be prepared and implemented for the operational phase of the Proposal. The FERP would take into consideration, site flooding and broader flood emergency response plans for the Georges River floodplains and Moorebank area. The FERP would also include the identification of an area of safe refuge within the Proposal site that would allow people to wait until hazardous flows have receded and safe evacuation is possible.

13 GEOLOGY, SOIL AND CONTAMINATION

Golders Associates Pty Ltd (Golder) have undertaken geotechnical and land contamination investigations to determine the suitability of the MPW site for construction and operation of the Proposal to address the SEARs. This section of the EIS draws upon several reports, being:

1. The *Geotechnical Interpretive Report* (Golder, 2016a): this report provides recommendations relating to geotechnical aspects of the Proposal site for redevelopment, building on previous geotechnical and soil investigations undertaken to inform the MIC Concept Plan Approval. It is included as Appendix S of this EIS
2. The *Moorebank Intermodal Terminal Contamination Summary Report Stage 2 SSD* (Golder, 2016b): this report provides a summary of the known contamination risks for the Proposal site, the remediation works undertaken as part of Early Works activities and a discussion of possible contamination risks and remediation options for the Proposal. It is included as Appendix S of this EIS
3. The *Stormwater and Flooding Environmental Assessment Report* (Arcadis, 2016): this report includes a discussion of erosion and sediment control measures that would be implemented to minimise impacts on soils during construction of the Proposal and is included as Appendix R of this EIS.

The SEARs to be addressed as part of this EIS are provided below in Table 13-1.

Table 13-1: SEARs relevant for this EIS

Section/Number	Requirement	Where addressed in this EIS
8. Soil and Water	An assessment of soil and water impacts for the site. The assessment shall: j) identify and assess the soil characteristics and properties that may impact or be impacted by the project, including acid sulfate soils, salinity, erodibility, unstable or unsuitable ground and unrippable rock	Section 13.2.2 of this EIS
13. Contamination	a) An updated contamination assessment in accordance with the guidelines under the *Contaminated Land Management Act 1997*. The assessment shall include the potential environmental and human health risks of site contamination on the project site, a Remedial Action Plan (if required), and consideration of implications of proposed remediation actions on the project design and timing (if relevant); and	Section 13.3 of this EIS
	b) include an assessment of potentially contaminated areas in accordance with the National Environmental Protection Measure 2013 in addition to an assessment of potential areas of Perfluorinated Compounds.	Sections 13.3.3 and 13.4.2 of this EIS

13.1 Conditions of Approval

The Conditions of Approval relevant to the Proposal are shown in Table 13-2. These have been taken into account for the preparation of this EIS chapter regarding Geology, Soils and Land contamination for the Proposal.

Table 13-2: Conditions of approval relevant to the Proposal

Conditions of Approval		Where addressed in this EIS
Schedule 4 - Conditions to be met in future developments		
E21.	All future Development Applications shall include an assessment of soil and water impacts. The assessment shall (where relevant): c) identify and assess the soil characteristics and properties that may impact or be impacted by the project, including acid sulfate soils. d) include a contamination assessment in accordance with the guidelines made under the Contaminated Land Management Act 1997 and in consultation with the EPA for the subject site including the Glenfield Waste Facility.	Sections 13.2 , 13.3 and Appendix S of this EIS

13.2 Geology and Soils

13.2.1 MPW Concept Approval

Geology and soils of the MPW Concept Approval were considered in the *Phase Two Environmental Site Assessment (ESA)* (Parsons Brinkerhoff, 2014) for the Concept Plan Approval EIS (See Appendix S). The assessment identified the following characteristics relating to the geology and soils of the Proposal:

- The Proposal site and surrounding area is underlain by tertiary fluvial deposits composed of clayey sand and clay to depths of 10 m in places. The SSFL rail corridor on the western side of the Georges River is underlain by quaternary fluvial deposits of medium grained sand, clay and silt
- Quarrying activities undertaken on the western side of Georges River (the Glenfield Waste Facility) has altered the local geology of this area. A significant portion of the quaternary sand deposits have been removed and the resultant excavations filled with waste materials (including construction and building materials, shredded car tyres and asbestos waste)
- There are two main aquifer systems on the Proposal site; a perched system with alluvial soils, and a deeper aquifer from within the bedrock. Groundwater in the shallower aquifer flows towards the Georges River
- Fill material with a general depth between 0.5 m and 1 m below ground level (BGL) (with maximum depths of over 3.2 m BGL at certain locations) is present around the Proposal site as a result of site establishment and construction works undertaken during prior development on the Proposal site. Asbestos cement fragments have been detected in surface soils on the Proposal site
- The recent alluvial soils within or close to the Georges River are characterised by high acid sulphate soils risk potential
- Drilling works revealed saturated horizons between 7 and 15 m BGL within the natural alluvium aquifer. Groundwater levels were subsequently measured at depths

of between 5.2 and 12.4 m BGL (1.7 and 9.11 m Australian Height Datum (AHD)). Groundwater flow is inferred to be west to the north-west towards the Georges River

- A review of historical site land use reveals that the Proposal site has undergone considerable development over time to facilitate the makeup of the Moorebank and Steele Barracks since 1930. The soils of the site as a whole therefore are largely disturbed to facilitate the construction of roads, residential development, industrial structures, landfilling and quarrying
- Across the Proposal site, there is a potential for erosion of soils exposed through vegetation clearing, stockpiled materials, drainage lines and earthworks, and sedimentation into the surrounding Georges River and Anzac Creek. Early Works activities would not be expected to have an impact on the local stormwater catchments as existing drainage would continue to be used during this phase.

During exhibition of the MPW Concept EIS, a number of submissions were received regarding soils and contamination, yet none were directly relevant to impacts of the Proposal to geology and soils. Additional investigations and management measures, including those instructing further geotechnical site investigations to better assess the suitability of the site from a contamination perspective, were recommended.

13.2.2 Existing Environment

Geology

Geological investigations were undertaken by Golder (2016) to confirm the existing geology and soils of the Proposal site. Investigations included site works, comprising of boreholes, test pits, cone penetration tests (CPT), dilatometer (DMT) tests and geophysical surveys. The locations of geotechnical site investigations for this assessment are shown in Figure 13-1.

Figure 13-1: Locations of geotechnical investigation sites

Site investigations combined with regional geological mapping information facilitated the development of the generalised soil and rock types occurring at the Proposal site, categorised into units and sub-units, shown in Table 13-3. The general geological sequence of the Proposal site was observed to be alluvium with ironstone bands at the surface, underlain by Ashfield Shale, which is underlain by Hawkesbury Sandstone.

Table 13-3: Geotechnical model of the Proposal site

Unit		Sub-Unit		Description
1	Surficial Soils	1A	Topsoil	Variable thickness, generally associated with grass covered landscaped areas. Brown silty sand or clayey sand with rootlets.
		1B	Anthropogenic Fill	Includes waste material deposits both above and below ground.
		1C	Granular Fill	Fill areas built up over time to make way for land development. Most fill is primarily sand. Gravel encountered were generally associated with paved or hard stand areas, while sands, silty sands or clayey sands are inferred to be reworked from natural soils.
		1D	Cohesive Fill	
2	Recent Alluvium	2A	Sand	Characterised by very loose to loose sands, silts or soft clays. Not encountered during geotechnical investigation, but it is likely that Anzac Creek along with ponds at the northern part of the site contain alluvial materials.
		2B	Clay	
3	Older Alluvium	3A	Sand	Comprises sub-units of medium dense to very dense sands and silty sands (Unit 3A) and very stiff to hard silty clays (Unit 3B). In general, both units are inferred to contain iron cemented bands or dense materials, through which CPTs could not penetrate. It was not possible during investigations to delineate between units 3A and 3B on the interpretive geological sections, which will need to be considered during design of facilities on site.
		3B	Clay	
4	Shale	4A	Residual Shale Soil	Appear very thin, with abrupt transformation from the older alluvium to extremely weathered siltstone.
		4B	Extremely Low to Low Strength Shale	Found in the majority of boreholes across the site, ranging from 8.5 to 21.8 metres. The shale in general does not exhibit deep weathering, with slightly weathered to fresh and medium to high strength shale encountered within around 2 metres of the top of the unit in the majority of boreholes.

Unit		Sub-Unit		Description
		4C	Shale of medium length of higher	Generally slightly weathered to fresh and medium to high strength.
5	Sandstone	5A	Residual Sandstone Soil	Sandstone was only encountered at the southern end of the site. Residual soil was likely eroded prior to deposition of the overlying alluvial sediments. Hawkesbury Sandstone was encountered in other locations, below a shale cap.
		5B	Very Low to Low strength sandstone	
		5C	Sandstone of medium strength of higher	Unit 5C sandstone was encountered within about 2 metres of the top of the unit in the four boreholes in which it was encountered.

Sampling confirmed the following geological characteristics relating to the Proposal site:

- In general, the Proposal site contains a relatively thin surficial layer, generally about 0.5 metres thick, but up to 2 metres or more in some areas. Deeper sections correspond to filling pre-existing depressions or waste disposal (typically units 1B and 1C)
- There is a relatively rapid transition to stiff/dense alluvial deposits, made up of sands or clays (Units 3A and 3B)
- Greater thickness of sand was found in general toward the northern section of the site while more clay was found in the southern areas, although both were interbedded, consistent with the variable alluvial conditions under which they were deposited. These soils exhibited a low potential erodibility when subjected to water
- The alluvial soils beneath the Proposal site contain granular horizons, which may result in seasonally perched water tables in fill materials and sand layers, which may impede on construction activities (excavations for slopes and foundations)
- Ashfield shale rock (Units 4B and 4C) was generally found for the majority of the Proposal site area, with the exception of the southern end of the site, where Hawkesbury Sandstone was observed (Unit 5C). The shale rock forms a cap above the sandstone
- The depth to rock varies between about 8 metres to 24 metres below existing ground level. The results appear consistent with previous seismic refraction survey completed by PB in 2011, indicating rock levels varying by a similar range as investigations informing this assessment.

Hydrogeology

As discussed earlier in Section 13.2.1 of this EIS, groundwater monitoring was undertaken by PB (2011) and followed with additional monitoring by Golders (2015) using existing groundwater monitoring wells on and around the Proposal site. The majority of wells sampled were installed with screens in the soils overlying rock.

The results of the monitoring undertaken by PB in 2011 and Golders in 2015 suggest that there are two main aquifer systems on the Proposal site; a perched system containing alluvial soils; and a deeper aquifer within the bedrock. Groundwater contours prepared based on monitoring undertaken suggest the groundwater within the shallow alluvial aquifer flow westwards across the Proposal site toward the Georges River.

Groundwater occurs beneath the Proposal site generally between 8 and 12 metres below the existing ground levels, at the time of the most recent geotechnical investigation. This is deeper than the expected depth of excavations during Proposal construction.

Higher groundwater levels were encountered in the vicinity of established ponds on the Proposal site (0.8 – 2.8 metres below existing ground level), and at Anzac Creek (two metres below existing ground level). Groundwater contour maps have been provided in the Geotechnical Interpretive Report (Golder 2016) Figure A020 and A021 (refer to Appendix S of this EIS).

Soils

General Soils

Fluvial and estuarine deposits

Fluvial soil deposits comprise sands, clays and silts present on terraces adjacent to the Georges River and associated with other creeks and ponds in the area. The channel forming the Georges River is likely to have shifted over time, indicated by channel deposits, sand banks and silt flats located in and around the Proposal site. Fluvial deposits are likely to be vertically and horizontally integrated with gravels and sands near the river and further across the river floodplain, which are likely to have been impacted by man-made activities including dredging, construction and vegetation removal associated with prior land-use of the Proposal site and adjacent lands such as the Glenfield Waste Facility.

Erosion Potential

The alluvial soils of the Proposal site are potentially erodible, with previous reports noting erosion present along sections of the Western bank of the Georges River (Golder, 2016; SIMTA Stage 1 EIS, Hyder, 2015). This demonstrates that soils in the local area can be prone to erosion when exposed to concentrated water flow or where otherwise not protected. No rock outcrops were observed on the Proposal site, although some areas of the western bank of the Georges River have outcrops of sandstone close to the road bridge at Cambridge Avenue. The soils of the Proposal site have been impacted by natural and human activities, including resource extraction, deforestation and development of the Proposal site for use as a military base. There are no known areas of natural slope instability within the Proposal site area.

Acid Sulfate Soils

A review of the ASS risk maps from the OEH Spatial Data Search Tool revealed no known occurrence of ASS for the majority of the Proposal site (refer to Figure 13-2). The area lining the banks of the Georges River however has a high probability of ASS occurrence.

Soil samples were collected from 15 locations in a number of geotechnical borehole locations considered relative to potential piling locations and general site coverage, as part of the PP2 ESA (Golders, 2015). The majority of samples were collected from below the water table and/or where previous investigations had identified PASS occurrence. The pH screening results revealed a moderate to high acid generation potential at the majority of site samples, with two samples (BH104-010 and BH106_ASS), located at the south-eastern portion of the Proposal site, having concentrations exceeding the proposed action criteria. It was concluded that the soils at these sites are not associated with the oxidation of sulphates due to the low soluble sulphur recorded.

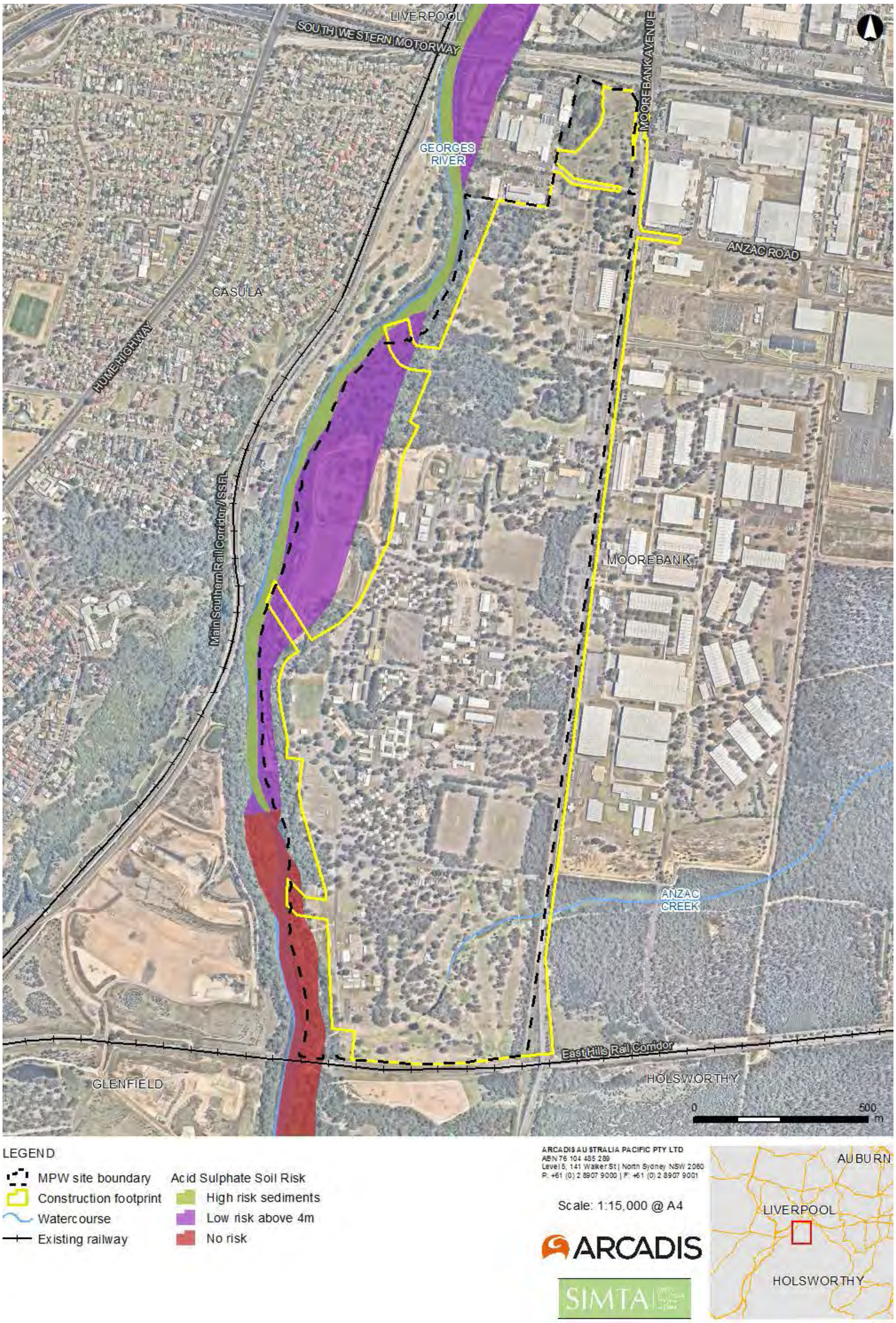

Figure 13-2: Acid sulfate soil risk potential for the Proposal (sourced from the Office of Environment and Heritage)

Soils of the Proposal site

The *Penrith Soils Landscape Map* (Soil Conservation Service of NSW, 1989) indicates the soils within the Proposal site are of the Berkshire Park Group. These are soils generally produced upon alluvial landscapes, commonly on elevated Tertiary terraces. They are comprised of shallow clayey sand soils, with frequent ironstone nodules. These soils typically are very prone to wind, sheet and rill erosion if exposed.

A thin surface layer of topsoil was generally encountered on the site, varying in thickness between approximately 0.1 m and 0.5 m. It is generally associated with well-established landscaped areas with grass cover. It generally comprised brown silty sand or clayey sand with rootlets.

In some parts of the Proposal site, anthropogenic fill (defined by the presence of waste materials, odour and discolouration) has been placed in areas of natural valleys or depressions for site levelling in the past or as above ground waste stockpiles. The largest deposit is found at the northern extent of the “dustbowl”, with several scattered deposits identified east of this location leading to the middle of the Proposal site.

In developing the site into its current form it is likely that cut/filling operations have been completed to produce level working areas and in the construction of structures over an extended period of time. Fill areas include existing road pavements and hard stand areas. Most of the fill is granular (primarily sand, Unit 1C). As the site has been in use since the 1940s, compaction of these fill materials will likely have been completed using different equipment and to different specifications than those used currently.

Fill material, comprising mainly of sands, gravels, clays and building demolition materials (bricks, concrete, metals and plastics) are common across the Proposal site subsurface to depths ranging generally from 0.5m - 1.0m BGL, with maximum depths of 3.2 m BGL.

General fill areas are mostly made up of granular sand (Unit 1C) but also sandy clay/ clayey sand fill material for road pavements and hardstand areas. In terms of fill thickness, there are two areas located at the in the middle of the site east of the dustbowl with fill thickness ranging from 1.2 m to 1.8 m thick. The fill thickness in the southern area of the Proposal varies showing a distinctly thicker area ranging from 0.8 m to 1.8 m in the far south-western corner of the Proposal site, while other areas range between 0m and 1m. Greater fill thicknesses may also be expected along former valleys and creeks across the site, behind retaining structures that are present on the lower terraced area and in areas of the site where there are slopes, which fill materials may have been end tipped historically to provide new working areas for the base.

Early Works activities may result in the importation of minor amounts of clean fill for the purposes of remediation of selected areas.

13.2.3 Potential Impacts

Construction

The greatest risk to geology and soils onsite would be during the construction phase of the Proposal when significant ground disturbance will be required to level and raise the site, while temporary stockpiling, and construction of internal roads and structures would also expose soils, creating the risk of erosion and sedimentation.

Overall, approximately 1,600,000 m^3 of clean fill would need to be imported to the site to achieve desirable surface levels. The areas of the site to be raised would be made ready for receival of materials through stripping of topsoil, levelling the site and removal of contaminated material as part of Early Works. Material brought to site would be placed and compacted within the primary earthworks area, to achieve final site levels.

Short-term and long-term stockpiling of clean fill material would also occur in this area. Key figures and methodology regarding bulk earthworks operations are provided in Section 4 of this EIS.

Golder (2016) identified the potential for perched water tables to be present within the recent and older alluvium profiles of the Proposal (sub-units 2A, 2B, 3A and 3B). These conditions have the potential to impact upon retaining walls, excavations and may lead to the softening of natural clays within the soil profile. Excavations onsite for site establishment as part of the Proposal are not anticipated to intrude upon the water table.

Erosion and sediment impacts

The importation and placement of large amounts of fill material to level and raise the site has the potential to create the following impacts across the site:

- Erosion of the levelled site
- Generation of sediment laden runoff and potential impacts on Anzac Creek and Georges River
- Dust generation during periods of rain and/or high winds, thereby degrading the quality of surrounding environments.

The following risk factors contribute to the potential for soil erosion on the Proposal site:

- Soil erodibility – The soils of the Proposal site are of the Berkshire Park Group, and have very high wind erosion potential if stripped of vegetation
- The scale of earthworks – The Proposal consists of very large scale earthworks
- The gradient of the site – The Proposal site is generally flat.

The large area of disturbance required at the site and timeframe of construction for the Proposal means there is a high potential for erosion from the Proposal site, if not properly managed.

Acid Sulfate Soils

Low risk ASS areas are located within the Proposal construction footprint, with areas shown in Figure 13-2. The Proposal is likely to trigger low risk PASS/ASS during construction of the northern and central OSD channels connecting the main site to the Georges River.

Construction works, with the exception of the OSD channels, are unlikely to expose ASS or PASS areas given the bounds of the construction footprint and areas deemed at risk as per Figure 13-2.

Once constructed, the operation of the Proposal would have little impact on soils as the site would be stabilised with materials. Stabilisation would include hardstand areas, railway ballast and landscaping, which would significantly reduce the risk of on-site erosion.

Operation

Once constructed, the operation of the Proposal would have minimal impact on soils as the site would be stabilised with suitable materials. Stabilisation would include fill materials, hardstand areas, railway ballast and landscaping, which would significantly reduce the risk of on-site erosion.

13.3 Land Contamination

13.3.1 MPW Concept Approval

A *Phase Two Environmental Site Assessment (P2 ESA)* (2014a) was prepared by Parsons Brinkerhoff and a *Post-Phase Two Environmental Site Assessment (PP2 ESA)* (2015) was undertaken by Golders Associates to inform the MPW Concept EIS for land contamination aspects.

Desktop investigations informing these studies identified a potential for subsurface contamination to have occurred as a result of prior land uses (military training, demolition and reconstruction of buildings, use and storage of potentially harmful chemicals). Potential contamination sources that were identified adjacent to the MPW site include:

- ABB site (to the north-west): Volatile organic compounds (VOCs), including trichloroethylene (TCE) were identified in soil and groundwater in the north western portion of the site. A Tier 2 quantitative risk assessment (QRA) was completed by Golders (2015) and the overall risks associated with the VOCs were considered low and acceptable for the proposed land use which includes roads, road verges, stormwater infrastructure and woodland/riparian conservation areas
- MPE site to the east: Contamination impacts including chemical wastes have been identified in groundwater sampled from monitoring wells on the western boundary of the DNSDC site
- Moorebank Business Park (north of the MPE site): The business park comprises commercial premises including showrooms and warehousing. However, due to the recent redevelopment of the site, this area is unlikely to present a potential offsite source of contamination
- Glenfield Landfill (to the south-west): This is an active landfill and waste transfer facility, which has the potential to cause environmental impacts associated with the flow of potentially contaminated groundwater within and beneath the waste fill towards the Georges River.

Contamination issues were subsequently verified via onsite investigations as part of the *Phase Two ESA* investigations. Intrusive soil sampling, in accordance with the requirements of the NSW *Contaminated Land Management Act 1997* (CLM Act), was carried out between 24 January and 10 February 2011 to ascertain the potential extent of onsite contamination, and potential soil, sediment and groundwater impacts across the MPW Site. Additionally, an unidentified explosive ordinance (UXO) specialist contractor was engaged to undertake an assessment of potential UXO in the subsurface environment and a seismic refraction survey (SRS) was undertaken by geophysical survey specialists to assess the extent of fill at various locations across the MPW Site. Key findings based from this study include:

- Several localised areas of soil contamination with concentrations of hydrocarbons, dissolved metals and heavy metals detected above the adopted (commercial/industrial) screening criteria
- Soils with acid generating potential (potential acid sulphate soils (PASS))
- Several locations containing anthropogenic fill materials, containing building rubble, plastics, bricks, concrete and asbestos containing materials (ACMs) (fragments, sheeting, pipes/conduit).
- Areas with potentially contaminating infrastructure (underground fuel storage systems, waste oil tanks and water separators).
- Overall, the majority of the MPW site was considered to have a low risk of contamination, or had contaminant concentrations below the adopted

(commercial/industrial) screening criteria. UXO investigations concluded there was a very low potential for UXO occurrence on the MIC site.

The *Post-Phase Two ESA,* prepared by Golder, sought to investigate data gaps and issues raised during the public exhibition period of the EIS and Response to Submissions Report in relation to the *Phase Two ESA* and *Preliminary Remediation Action Plan* (RAP) prepared by PB. Issues were primarily related to the potential impact of contaminated runoff into the Georges River, and the impacts associated with development on the Glenfield Landfill and release of contaminants. These further investigations gathered the information required to develop a *Remediation Specification* document to instruct the preferred remedial approach for existing areas of contamination and establish criteria for the remediation of the site. The summarised findings of the PP2 ESA are provided below:

Table 13-4: PP2 summarised findings

Contaminant/item of concern	Risk	Extent	Further Action
Acid Sulfate Soils (ASS)	When exposed to air, sulfides react with oxygen to form sulfuric acid	High potential acid sulfate soil (PASS) risk present along banks of Georges River. Acidic soils were additionally identified on the Proposal site, yet do not appear to be associated with the oxidisation of sulphates.	Management of areas within construction footprint impacting on PASS areas will be required during construction.
(Trichloroethylene [TCE])	Carcinogenic	Detected in soil, groundwater and soil vapour in a localised area in the north western corner of the site	Impact to Georges River unlikely, however further investigation required for management during Proposal
Underground Storage Tanks (UST)	Leakage of hazardous materials into surrounding soils and groundwater	The UST audit identified 2 steel USTs, 10 in-ground concrete tanks and 2 concrete septic tanks	Actions required to remediate and validate these areas will be presented in the updated Remediation Specification and Validation Plan (forming the approved RAP), carried out during Early Works.
benzo(a)pyrene (B(a)P)	Carcinogenic	Four samples within general fill throughout the Proposal site (in accordance with adopted commercial/industrial environmental screening levels)	Management required to ensure B(a)P materials are not placed in the shallow soil profile (i.e. the upper 2m depth) within an ecologically sensitive area on the

Contaminant/item of concern	Risk	Extent	Further Action
			site during redevelopment
Asbestos	Lung cancer, mesothelioma, asbestosis and other non-malignant lung and pleural disorders.	Friable asbestos found in general fill and waste stockpile areas around the Proposal site	Actions required to remediate and validate these areas will be presented in the Remediation Specification and Validation Plan and carried out during Early Works and Stage 2
Heavy Metals/Metalloids (arsenic, cadmium, chromium, copper, lead, mercury, nickel, zinc)	Impaired function of vital cellular components	Within the vicinity of the riparian area and grit blasting facility around the centre of the site (above the ecological screening levels [ESLs])	Remediation of identified heavy metals to be undertaken during Early Works. Unexpected finds to be managed under protocol outlined under the CEMP
Organochlorides (OCP)	Can bioaccumilate and cause reproductive problems	OCP impacted materials were detected beneath Building 51 and potentially occurring beneath many untested buildings across the Proposal site, which are to be demolished as part of Early Works activities	To be remediated during Early Works in accordance with Remediation Specification and validation strategy presented in the Validation Plan
Polychlorinated biphenyls (PCB)	Persistent organic pollutant	Six electrical substations were identified around the Proposal site. There is potential for PCBs to be occurring within cable fluid servicing these areas.	Disconnection of transformers, validation of potentially contaminated land and remediation if required to occur during Early Works.
Perfluoroalkyl and polyfluoroalkyl substances (PFAS)	Contamination of ground and drinking water	Several locations at the site where fire-fighting training was carried out and adjacent to Georges River.	A staged management approach to be prepared prior to Early Works and included in a Long Term Environmental Management Plan (LTEMP) which will identify the extent and

Contaminant/item of concern	Risk	Extent	Further Action
			risk and propose management measures throughout Early Works and the Proposal.
Polycyclic aromatic hydrocarbons (PAH)	PAH compounds are carcinogenic and mutagenic, and persist in the environment.	Found throughout the site at levels exceeding ecological screening levels (ESL) but below health screening criteria	To be remediated as part of Early Works in accordance with procedure set out under the Remediation Specification and Validation Plan

In addition, the PP2 ESA investigations concluded the following:

- Former PRA Yard Investigation: It was found that no intrusive investigations had been undertaken for the former PRA Yard and the status of UST presence was uncertain. A contingency protocol for managing the discovery and remediation of previously unidentified USTs (and associated pipework) will be included in the *Remediation Specification*. The area will be tested for validation and remediated if necessary as part of Early Works
- Former Village Training Area: No significant volumes of anthropogenic fill materials, or contaminated materials were encountered during intrusive investigations, however it is likely that the materials used to construct the training tunnels remain in-situ. Therefore, a contingency will be included within the Remediation Specification to allow for possible management and/or remediation of contaminated fill materials in this area, which will be carried out during Early Works.

Early Works would include widescale rehabilitation and remediation of contaminated areas. A Remediation Specification and Validation Plan and associated documentation, as mentioned above, would be prepared for these remediation works.

Specific remediation activities undertaken as part of Early Works include:

- Rehabilitation of the excavation/earthmoving training area (i.e. ‘dust bowl’)
- Remediation of contaminated land and hotspots, including areas known to contain asbestos, and the removal of:
    - Underground storage tanks (USTs)
    - Unexploded ordnance (UXO) and explosive ordnance waste (EOW) if found
    - Asbestos contaminated buildings
- Establishment of a conservation area along the Georges River, including seed banking and planting
- Vegetation removal, including the relocation of hollow-bearing trees, as required for remediation and demolition purposes.

In general, the Proposal will only impact on isolated areas of land contamination not remediated by Early Works, corresponding specifically to areas occurring within endangered ecological communities (EEC) areas, in addition to management of broadscale, ongoing contamination risks.

13.3.2 Methodology

Assessment Criteria

The *National Environment Protection (Assessment of Site Contamination) Measure* 1999, as updated 11 April 2013 (the ASC NEPM) is made under the Commonwealth *National Environment Protection Council Act* 1994 and is given effect in NSW under section 105 of the CLM Act. The purpose of the ASC NEPM is to establish a nationally consistent approach to the assessment of site contamination and to provide adequate protection of human health and the environment (ASC NEPM, s.5). The Golder (2016) assessment utilised the following assessment criteria, in accordance with the ASC NEPM, in understanding and identifying contaminants of concern potentially occurring onsite, and their extent and potential significance of impact in formulating mitigation and management measures.

The ASC NEPM establishes health, environmental and groundwater investigation levels and screening levels for contaminants; including those contaminants identified as Contaminants of Potential Concern at the site. The following paragraphs describe the guideline values applicable to the site under the ASC NEPM.

- Health investigation levels (HILs) have been developed for a broad range of metals and organic substances, including pesticides. The HILs are applicable for assessing human health risk via all relevant pathways of exposure, such as direct ingestion and dermal contact. As the Proposal would use the land for industrial purposes the HIL guideline values that are generally applicable are the HIL D - Commercial/Industrial
- Petroleum hydrocarbon management limits (Management Limits) are applicable to petroleum hydrocarbon compounds only. They are applicable as screening levels following evaluation of human health and ecological risks and risks to groundwater resources. They are relevant for sub-surface leakage of petroleum compounds has occurred and when decommissioning industrial sites, including the removal of Underground Storage Systems (UPSS). The Management Limits adopted for the Proposal are based on the commercial /industrial use of the site and the coarse nature of the soils on site
- Groundwater investigation levels (GILs) are the concentrations of a contaminant in groundwater above which further investigation or remediation is required. GILs are based on Australian water quality guidelines and drinking water guidelines and are applicable for assessing human health risk and ecological risk from direct contact with groundwater. GILs are established under the ASC NEPM for fresh water, marine water and drinking water. Fresh water' GILs have been adopted as a conservative approach
- Health screening levels for asbestos contamination in soil have been adopted within the ASC NEPM for bonded asbestos containing material (ACM), friable asbestos and all forms of asbestos. The Health Screening Levels (HSL) for asbestos are prescribed for industrial and commercial sites, based on a percentage weight of asbestos material in the soil
- ESLs/Ecological investigation levels (EILs) were adopted for total recoverable hydrocarbons within the conservation area (urban residential and public space ESLs were adopted). For other works in the conservation area the EILs were adopted, however site specific EILs were adopted for chromium III, copper, nickel and zinc.

Site Remediation Procedure

The majority of contamination remediation is to be undertaken as part of Early Works activities. The expected outcome of Early Works remediation activities is preparation of a Remediation and Validation Report (RVR), which will be provided to an accredited

NSW EPA Site Auditor for review. The Site Auditor, once satisfied, will issue a *Section A - Site Audit Statement* stating that the remediated portions of the site are satisfactory for the intended commercial/industrial use. The RVR and Site Audit Statement will be provided to the consent authority to satisfy conditions under Clause 7(1) of SEPP 55.

The portions of land that are excluded from remediation as part of Early Works refer to those situated within Endangered Ecological Communities (EECs) (See Section 13.3 of this EIS). It is proposed that the remediation of these areas is undertaken as part of the Proposal. A RVR is to be prepared and provided to the NSW EPA site auditor, detailing remediation works to be undertaken in specific areas as part of the Proposal. The overall objective for the Proposal is to remediate the site for the intended commercial/industrial use and achieve a *Section A - Site Audit Statement*.

Required remediation and/or management actions have been defined within the following documentation provided to the NSW DPE as part of the MPW Concept Approval:

- The Preliminary Remediation Action Plan (PB, 2014)
- The Validation Plan – Principles (Golder, 2015)
- The Demolition and Remediation Specification (Golder 2015)

These documents are to be used as general guiding documentation for Proposal remediation activities.

The following text describes the methods by which remediation activities would be carried out in relation to specific contaminants identified within the site.

Onsite containment of Asbestos and UXO, EO and EOW

The adopted approach would involve the isolation (containment of contaminated soils/foreign materials below a separation layer (i.e. capping). The nominal depth of cover for a commercial / industrial site should be at least 0.5 m depth for asbestos, UXO and EOW materials and 1.0 m depth for foreign materials. The capping materials should consist of fill materials proven to be free of contamination. The capping thickness may need to be increased to allow for the installation of future sub-surface utilities, or alternatively, future sub-surface utility corridors can be established by remediating all potential contamination within the proposed corridor such that future excavation activities can occur un-hindered.

Verification of the installation will need to be undertaken by the Environmental Consultant and presented to the Site Auditor within the validation report.

13.3.3 Existing Environment

The *Contamination Summary Report* (Golder, 2016) undertook a review of previous investigations to establish the extent of contamination issues remaining on the Proposal site, following extensive remediation during Early Works. The majority of the contamination would occur during Early Works. The exception to this is areas where active remediation cannot occur due to the presence of Endangered Ecological Communities (See Section 11 of this EIS).

Subsequent to Early Works contamination remediation, the following table identifies contaminants of potential concern for the Proposal.

Table 13-5: Potential contaminants remaining after Early Works completion (relevant to the Proposal)

Aspects of environmental concern	Location	Contaminants of potential concern
Stockpiles of demolition waste	The former sewerage treatment plant (STP)	Asbestos on or in soils and demolition waste materials
Stockpiles of demolition waste	Golf Course Stockpile site	Asbestos on or in soils and demolition waste materials
Fill materials and natural soils[54]	General site areas, and specific area in the north-western corner associated with ABB site	TCE, High pH soils, Metals, Asbestos, Waste Materials/Aesthetics, other organics.
Underground Services	Proposal site – General site areas	Asbestos, hazardous materials (i.e. PCB cable fluid).
Groundwater	Proposal site – General site areas, higher risk within proximity to surrounding watercourses	Chlorinated hydrocarbons, Perflourinated chemicals

The locations of active remediation (i.e. the stockpile in the vicinity of the former STP and on the Golf Course) for the Proposal are shown in Figure 13-3.

[54] Risks associated with the TCE impacts identified in the north western corner of the site have been investigated through a Tier 2 Quantitative Human Health Risk Assessment (Golder, 2015), and direct remediation actions are not warranted given the intended use of the site.

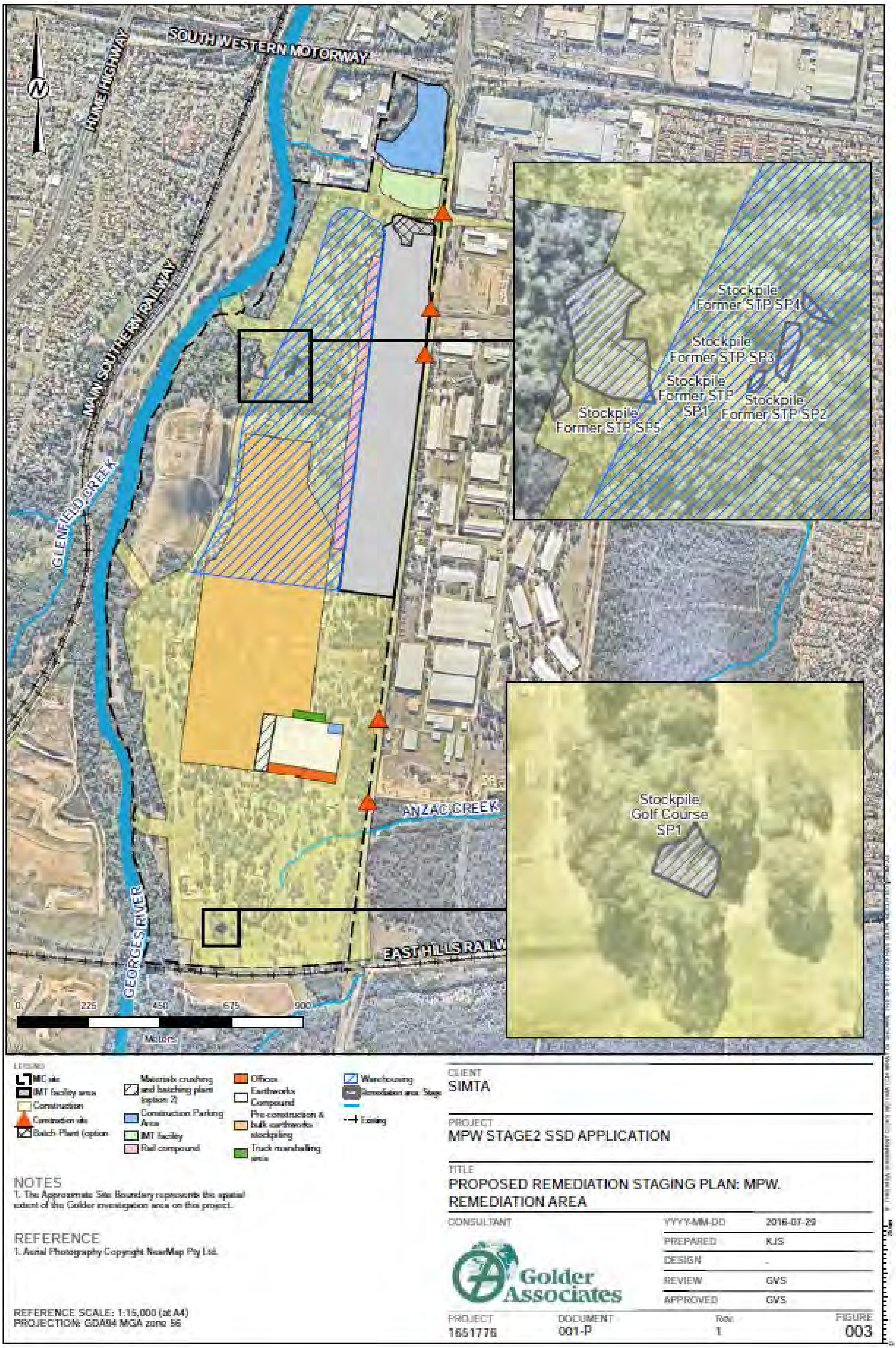

Figure 13-3: Direct remediation areas for the Proposal

There are additionally a number of broadscale contamination issues that have been identified during earlier assessments that will potentially require ongoing management and/or monitoring during any further development stages of the MPW Project (including the Proposal). Management plans would need to be prepared as part of construction documentation for future stages of development (as suitable) to address the following contaminants:

- VOC exposure
- UXO exposure
- ASS exposure
- Asbestos exposure
- PFOS exposure.

13.3.4 Potential Impacts

Construction

Contamination risks and impacts can be broadly divided into two main categories:

- Those that presently exist onsite and have built up over time (to be managed through remediation)
- Those that may be induced or created from the Proposal, either through construction or operational activities (managed through onsite management and monitoring methods).

Construction of the Proposal will have the potential to release and/or expose existing sources of contamination into the surrounding environment through disturbance of soils and groundwater. Construction activities may also pose a risk of causing contamination, if not managed appropriately. Potential exposure pathways for contamination may include:

- Direct dermal contact with contaminated soil or groundwater during construction or operation of the Proposal
- Inhalation of contaminated dust or vapour during construction or maintenance of the Proposal
- Mobilisation and/or exposure of contaminants in soil or groundwater through construction activities.

Existing contamination

Specific areas requiring direct remediation with regard to the Proposal are outlined in Table 13-6.

Table 13-6: Direct remediation activities required during MPW Stage 2 development

Name and location of remediation site	Remediation/Validation Activities
Former Sewerage treatment plant (SP1-5) Golf Course Stockpile	Step 1 - Excavation of contaminated materials and classification for offsite disposal at an appropriately licensed facility, or classified for onsite containment; Step 2 - Chasing out of residual contaminated soils to the extent practicable; Step 3 - Validation soil sampling; and excavation backfilling, where required.

The following section outlines how the various contamination aspects of concern could impact on the Proposal site should they not be managed appropriately. Mitigation measures have been provided in Section 13.5 of this EIS to minimise the risk of these contaminants on human health and the environment.

Asbestos in or on soils

Bonded ACM fragments have been identified in various areas across the site and are considered the primary asbestos impact across the shallow soils. There is also potential for redundant utilities constructed of ACM to be present across the site. The ACM within these areas is expected to be consisting of friable asbestos, asbestos pipe and asbestos sheeting. There is a low risk of human health impacts should this material become exposed and directly inhaled during site preparation works.

Remnant UXO, EO or EOW

The future users of the site may encounter remnant UXO, EO or explosive ordnance waste (EOW) items such as fired, and unfired small arms ammunition (SAA) blank training items, and fired and unfired flares / smoke grenades (including grenade levers and other components). Based on the investigations completed to date, the bulk of the UXO, EO and EOW identified on the site is expected to be small individual items, which are not anticipated to pose a significant risk to the environment or to human health if appropriately managed during the site's development (capping strategy) and implementation of the Long-Term Environmental Management Plan (LTEMP) for the site.

Anthropogenic fill deposits

Anthropogenic fill deposits (buried waste deposits) have been identified at a number of locations across the Proposal site. This material may be geotechnically unsuitable and/or may pose a low contamination risk to worker health. Without mitigation, the likelihood of human health risk associated with direct contact of asbestos containing material within anthropogenic fill deposits will be high as a result of ACM being evident within topsoil across the site and due to the variable nature of material within the anthropogenic fill sites. Notwithstanding this, management measures will be included within the CEMP and LTEMP would be implemented to minimise this risk.

Trichloroethylene (TCE)

TCE contamination has been detected in groundwater and soil vapour through previous reports in a localised area in the north western corner of the Proposal site. It is anticipated, as per Golder (2016) that this area will remain an open space/riparian zone, in which case the risks were assessed as low as workers would only temporarily access the area while constructing the OSDs for the Proposal.

Perfluoroalkyl and polyfluoroalkyl substances (PFAS)

Based on the PFAS concentrations identified in the groundwater on the site, and the evidence presented in the current literature on the bioaccumulation risks associated with PFAS, there is a risk that a complete exposure pathway exists between the PFAS source areas identified on the site and ecological receptors within the Georges River. In turn this presents a plausible pathway for human health exposure through the potential consumption of fish caught within the impacted area via recreational fishing.

Potentially Contaminating Activities

During Construction, fuels and chemicals would be stored onsite for use of machinery and equipment. There is potential for these materials to spill and spread into surrounding soil and water receivers if not managed properly during refuelling activities. Subject to the implementation of mitigation measures, identified below, the risk of contamination from construction activities is considered to be low.

Operation

Once operational, the Proposal site would be remediated to a level which is considered suitable for the operation of the Proposal. As a result, there would be a low risk to workers or the environment from contaminated soil and groundwater.

Oils, fuels, lubricants and other chemical substances would be required for the operation of vehicles, plant and machinery during operation of the Proposal. Accidental spills or leaks within the Proposal site have the potential to result in contaminants being deposited into the surrounding environment and groundwater. As the majority of the Proposal Site will be flat, with vehicle parking and refuelling within hardstand areas, it is anticipated that the risk for contamination as a result of a spill or leakage is low, provide that the measures outlined within Section 14 of this EIS are followed.

As identified in Section 14 of this EIS, dangerous goods were identified as being explicitly excluded from the types of freight that the MPW Project would handle, and therefore would also be excluded from warehouses, freight container storage and transit areas. However, during operation, a range of hazardous materials would be stored and used on site for refuelling, commercial use and maintenance/firefighting purposes. As identified within Section 14 of this EIS, materials would be stored appropriately to minimise the risk of on or off site contamination.

13.4 Mitigation Measures

13.4.1 Geology and Soils

Construction

Findings within the Geotechnical Interpretive Report (Golder, 2016 – Appendix S of this EIS) regarding excavations, earthworks, pavements and structural footings are to be considered during detailed design.

No construction mitigation measures are required for geology and soils impacts from the Proposal in addition to those provided in Sections 9 and 12 of this EIS.

Operation

During operation of the Proposal, impacts to soils would be minimal, as appropriate mitigation measures for stormwater runoff detention would be implemented, thereby reducing the risk of erosion and sedimentation resulting from excessive runoff. Upon the completion of the Proposal, all remaining areas at the site will be left in a stable condition with topsoil respread and seeded to prevent erosion in accordance with *Blue Book Guidelines* (Landcom, 2004 and DECC, 2008). These measures are outlined in Section 12 of this EIS.

13.4.2 Land Contamination

Construction

- Remediation works for the Proposal have been previously assessed and approved as part of the MPW Concept Approval. A site specific Remediation Action Plan (RAP) is not considered to be required for the Proposal. The following documentation would be utilised for the purposes of remediating the site:
  - The Preliminary Remediation Action Plan (PB, 2014a)
  - The Validation Plan – Principles (Golder, 2015b)
  - The Demolition and Remediation Specification (Golder 2015c)
  - Any other contamination documentation prepared for the remediation activities undertaken for MPW Early Works (Stage 1).
- A CEMP, prepared by the contractor, would include the preparation of a site-wide UXO, EO, and EOW management plan (or equivalent) based on the UXO Risk Review and Management Plan (G-Tek, 2016). This plan would be implemented to address the discovery of UXO or EOW during construction, to ensure a safe environment for all Project staff, visitors and contractors
- The CEMP would also identify the actions to be taken should additional contamination be identified during the development of the site (i.e. an unexpected finds protocol), and will address REMM items 8H, 8T, 8U, 8V and 8W (of the MPW Concept Approval (SSD 5066)).
- An Asbestos in Soils Management Plan (AMP) is to be implemented as part of the CEMP in accordance with the Safe Work NSW requirements, including but not limited to:
  - The Guidelines for Managing Asbestos in or on soil (2014)
  - Codes of Practice - How to Safely Remove Asbestos (2011) and How to Manage and Control Asbestos in the Workplace (2011).
- An Acid Sulphate Soils management plan (or equivalent) would be developed in accordance with the ASSMAC Assessment Guidelines (1998), for areas identified as being of low or high risk i.e. works within close vicinity of the Georges River (refer to Figure 13-2). In addition, a risk assessment quantifying the risks associated with the volumes of soil to be disturbed, the laboratory results from ASS testing undertaken, the end use of the materials and the proximity to sensitive environments is to be undertaken. All offsite disposal would be in accordance with the NSW Waste Classification Guidelines Part 4: Acid Sulfate Soils (2009).
- The existing groundwater monitoring undertaken for the Proposal would continue. A groundwater monitoring program (GMP) would be developed at the conclusion of remediation activities for the Proposal and included as part a Long Term Environmental Management Plan (LTEMP) (to be prepared for approval by the Accredited Site Auditor and in association with the OEMP). The main purpose of the GMP would be to assist in the management of groundwater contamination (particularly PFAS impacts) at the site, and to minimise potential harm to human health and the environment. The GMP would achieve the following objectives:

  - Establish whether the residual groundwater contamination plume is shrinking, stable, or increasing, and whether natural attenuation and/or migration is occurring according to expectations through line-of-evidence collection
  - Provide appropriate groundwater investigation levels (GILs) for groundwater contaminants, in accordance with the National Environment Protection (Assessment of Site Contamination) Measure 1999 (ASC NEPM). Should exceedances be identified, contingency plans for further investigations or remediation would be prepared.
  - Provide appropriate trigger levels for key contaminants (where available), based on the receptor of interest and identified contaminants
  - Serve as a compliance program, so that potential impacts to down-gradient receptors are identified before adverse effect occurs (relative to above objectives)
  - Detect changes in environmental conditions (e.g. hydrogeologic, geochemical or other changes) that may reduce the efficacy of any natural attenuation processes or that could lead to a change in the nature of impact
  - Establish groundwater conditions (i.e. concentrations and/or trends) which indicated that groundwater monitoring could be reduced or ceased and the requirements of the GMP absolved.

  The monitoring program is to be undertaken for two years post operation of the Proposal to ensure a range of seasonal and river flow variations is assessed. At the completion of the two year period, subject to analysis of results, consideration would be given to whether this monitoring is required to continue.

Operation

- At the conclusion of remediation works, a Remediation and Validation Report (RVR) is to be prepared for the Proposal to facilitate the Auditor’s review of remediation and validation activities. The RVR is to document the remediation and validation activities completed within specific areas of the Proposal, including:
  - Information relating to the materials used in the Separation Layers such as the soil types, geotextile materials, and sealant types etc. (if required)
  - An as-constructed plan of the site showing the locations, depths and materials of the Separation Layers installed at the site.
- The existing site-wide Long-Term Environmental Management Plan (LTEMP), such as the one established at the completion of Early Works, is to be revised at the completion of the Proposal remediation activities to include protocols for ongoing maintenance and/or monitoring or any long term remedial/mitigation measures to be implemented following completion of the Site Audit Statement.

14 HAZARD AND RISK

This Section outlines the hazard and risk assessment undertaken to identify potential hazards and risks from the construction and operation of the Proposal.

Table 14-1 sets out the Secretary Environmental Assessment Requirements (SEARs) as they relate to hazards and risks.

Table 14-1: SEARS for the Proposal relating to hazards and risks

Section/Number	Requirement	Where addressed in this EIS
14. Hazards and Risks	A preliminary risk screening completed in accordance with State Environmental Planning Policy No. 33 – Hazardous and Offensive Development and Applying SEPP 33 (DoP 2011), with a clear indication of class, quantity and location of all dangerous goods and hazardous materials associated with the proposal. Should preliminary screening indicate that the proposal is 'potentially hazardous,' a Preliminary Hazard Analysis (PHA) must be prepared in accordance with Hazardous Industry Planning Advisory Paper No. 6 – Guidelines for Hazard Analysis (DoP 2011) and Multi-Level Risk Assessment (DoP 2011). The PHA should: a) Estimate the risks from the facility; b) Be set in the context of the existing risk profiles for the intermodal facility and demonstrate that the proposal does not increase the overall risk of the area to unacceptable levels; and c) Demonstrate that the proposal complies with the criteria set out in the Hazardous Industry Planning Advisory Paper No. 4 – Risk Criteria for Land Use Safety Planning.	Section 14.4 of this EIS

14.1 MPW Concept Approval

The preliminary risk assessment (PRA) (Parsons Brinckerhoff, 2014) undertaken as part of the MPW Concept Approval comprised of the following components:

- Hazard identification
- Dangerous goods screening under SEPP 33
- Preliminary risk assessment
- Preliminary hazard analysis (PHA)
- Overall risks assessment

The assessment identified potential hazards associated with the MPW Project, noting that these would comprise:

- Construction and commissioning activities
- Transport of equipment and materials to site
- Rail traffic and logistics
- Road traffic and logistics

- Container loading and unloading
- Container storing
- Equipment and maintenance
- Mobile plant refuelling
- Locomotive refuelling
- Service station
- Waste disposal
- Transport of material.

The potential hazards that may arise from these activities were identified as:

- Gas leaks (natural gas, liquefied natural gas (LNG) and liquefied petroleum gas (LPG)) as a result of weld/cylinder failure, equipment failure, impact, corrosion, drive-away during loading or refuelling, other operational error, malicious damage or sabotage
- Loss of containment of flammable/combustible or corrosive liquids as a result of impact, unloading, operational error or equipment failure
- Vehicle accident during transport of a potentially hazardous material to the Project site, caused by poor road access or visibility, road conditions, other vehicles, vehicle or tank fault or driver fatigue
- Flooding as a result of extreme weather
- Inappropriate waste disposal as a result of lack of safety training and/or use of uncertified contractors.

Dangerous goods were identified as being explicitly excluded from the types of freight that the MPW Project would handle, and therefore would also be excluded from warehouses, freight container storage and transit areas. However, for operation of the MPW Project, a range of hazardous materials would be stored and used on site for refuelling, commercial use and maintenance/firefighting purposes.

Screening under SEPP 33 was undertaken as part of the MPW Concept EIS for a range of dangerous goods that would be stored on the MPW site for operational purposes. The assessment found that LNG would be the only material that would be stored or handled on site in sufficient quantity to exceed the screening limits under SEPP 33, triggering the requirement for a PHA. The PHA showed that the potential area of impact from the LNG storage location would be small, and no potential impact to sensitive land uses or residential areas was identified. More broadly the PHA indicated that the storage of diesel and flammable and combustible liquids would not pose an unacceptable level of risk to the surrounding community and would be within the recommended risk levels under the SEPP 33 guidelines. As no major effects would be felt outside the MPW site from these materials, there was considered to be little likelihood of fatality or risk to individuals or society.

The key findings of the PRA for the MPW Concept Approval in relation to the Proposal are outlined in Table 14-2.

Table 14-2: Hazard and risk assessment - MPW Concept Approval

MPW Concept Approval	Impact on the Proposal
The Preliminary Risk Assessment (PRA) has determined that the key risks/hazards associated with the Project during construction and operation phases include: gas leaks (natural gas, LNG and LPG)); loss of containment of flammable/combustible or corrosive liquids; vehicle accidents; flooding as a result of extreme weather; and inappropriate waste disposal	This key hazards and risks identified for the Proposal are consistent with those identified as part of the MPW Concept Approval (identified in Section 14.1), with the exception of risks associated with

MPW Concept Approval	Impact on the Proposal
	LPG. No LPG would be stored onsite as part of the Proposal. Mitigation measures for key hazards are identified in Section 14.5 of this EIS.
These hazards may arise from a number of activities including rail and road logistics, storage of hazardous materials, refuelling, waste disposal and equipment maintenance	The methods of release for hazards identified for the Proposal (identified in Section 14.1 of this EIS) are consistent with those identified as part of the MPW Concept EIS. Mitigation measures for key potentially hazardous activities are identified in Section 14.5.
Overall, the PRA concluded that there would be no significant increase in risk to the public as a result of the Project and, with the mitigation measure described above, the residual hazards and risks of the Project would be managed to an acceptable level	The conclusions identified in the MPW Concept Approval are consistent with those identified for the Proposal (identified in Section 14.4 of this EIS).

14.1.1 Conditions of Approval

The Conditions of Approval for the MPW Concept Approval relevant to the Proposal are shown in Table 14-3. These conditions of approval have been taken into account while developing the methodology for the hazard and risk assessment for the Proposal.

Table 14-3: MPW Concept EIS Conditions of Approval

Conditions of Approval		Where addressed in this EIS
Schedule 4- Conditions to be met in future development applications		
E23.	All future Development Applications shall be accompanied by a preliminary risk screening completed in accordance with State Environmental Planning Policy No. 33 – Hazardous and Offensive Development and Applying SEPP 33 (DoP 2011), with a clear indication of class, quantity and location of all dangerous goods and hazardous materials associated with the proposal. Should preliminary screening indicate that the proposal is 'potentially hazardous,' a Preliminary Hazard Analysis (PHA) must be prepared in accordance with Hazardous Industry Planning Advisory Paper No. 6 – Guidelines for Hazard Analysis (DoP 2011) and Multi-Level Risk Assessment (DoP 2011). The PHA should: a) Estimate the risks from the facility; b) Be set in the context of the existing risk profiles for the intermodal facility and demonstrate that the proposal does not increase the overall risk of the area to unacceptable levels; and	Section 14.4 of this EIS

Conditions of Approval		Where addressed in this EIS
	c) Demonstrate that the proposal complies with the criteria set out in the Hazardous Industry Planning Advisory Paper No. 4 – Risk Criteria for Land Use Safety Planning.	

14.2 Methodology

The Proposal has the potential to pose several environmental, human health and amenity hazards. As outlined in Section 5.3.3, the Proposal falls within the definition of a “potentially hazardous industry” or “potentially offensive industry” under the SEPP 33.

A hazard is anything or any situation with a potential for causing damage to people, property or the biophysical environment. Hazard identification was undertaken based on a review of the Proposal in the context of the site and surrounding area. In identifying hazards, operational and organisational safeguards designed to prevent or mitigate the effects of hazardous incidents have also been taken into consideration.

To determine if the Proposal is a potentially hazardous and/or offensive industry under SEPP 33 the guideline Applying SEPP 33 (DoP, 2008) was applied. Industries or projects determined to be hazardous or potentially hazardous require the preparation of a PHA in accordance with clause 12 of SEPP 33. As described in Applying SEPP 33 to determine if a PHA is required a screening test should be applied. A range of information is required to effectively apply the risk screening method, including:

- Details of all dangerous goods and otherwise hazardous materials involved in the proposed development
- Dangerous goods classifications for all Dangerous Goods held onsite
- Quantities of dangerous goods and otherwise hazardous materials involved in the proposed development
- Distance from the boundary for each hazardous substance
- Distance to the nearest residential property.

The method applied for this hazard and risk assessment included:

- The identification of existing hazards associated with the Proposal site that may present hazards during the construction phase
- The identification of the operational activities and processes to be undertaken at the Proposal site
- An assessment of the possible hazards and risks associated with the activities and processes
- Identification of the mitigation measures and management controls to manage and mitigate possible risks.

14.3 Existing environment

14.3.1 Proximity to sensitive receivers

The Proposal site is situated within the Liverpool LGA in Sydney’s South West Sub-Region, approximately 2.5 km from the Liverpool City Centre. The Proposal site is also located in the vicinity of the currently under development South West Growth Centre and a concentration of industrial and business centres in Sydney’s west and south-west.

The area surrounding the Proposal site predominantly comprises previous or existing industrial uses:

- The Holsworthy Military Area (Holsworthy Barracks) is located south-east of the Proposal site
- The MPE site, which was formerly occupied by the DNSDC, is located immediately to the east of the MPW site
- Directly north of the Proposal site, the land use is predominantly industrial and commercial, including the ABB Australia's Medium Voltage Production Facility site
- To the south-west of the Proposal site, is the Glenfield Waste Facility, which includes an existing waste handling facility and refuse disposal site
- Land use immediately east of the Proposal site and north of Anzac Road includes the privately owned Moorebank Industrial Area, which comprises approximately 200 ha of industrial development, the majority of which is located north of the M5 Motorway between Newbridge Road, the Georges River and Anzac Creek. This industrial area supports a range of industrial uses including freight and logistics, heavy and light manufacturing, and office and business park developments.

A number of residential suburbs are located in proximity to the Proposal site, as shown in Table 14-4 and detailed in Section 2.3.3.

Table 14-4: Distance from the closest residential receivers

Suburb	Distance[55] from:		
	Proposal site	Rail link connection	Rail link
Wattle Grove	1,000 m	1,000 m	1,260 m
Moorebank	630 m	1,400 m	2,500 m
Casula	330 m	1,200 m	290 m
Glenfield	820 m	1,100 m	750 m

14.3.2 Asbestos

An asbestos cement main is located on the west side of Moorebank Avenue, running parallel to a cast iron cement lined main. Both mains are privately owned services that lead into the MPW site, providing service to existing developments. Both mains continue north along Moorebank Avenue. All buildings onsite would be removed during the Early Works and therefore no risk of asbestos within building material has been identified.

14.4 Potential impacts

14.4.1 Construction

Asbestos has been identified within a water main on the east side of Moorebank Avenue (AECOM, 2016). The main leads into the MPW site, providing service to existing developments, and may be impacted during construction of the Proposal, exposing potential asbestos containing material.

During construction small volumes of fuels and chemicals would be stored on the Proposal site for use by machinery and equipment. There is potential for these

[55] Distance is measured from the closest residential receiver within this suburb.

substances to spill into the surrounding environment during refuelling activities, transport, and delivery if not managed appropriately.

The majority of remediation works required onsite would be previously completed as part of the Early Works. However, two locations have been identified as requiring remediation during the Proposal, as described in Section 13. These areas include:

- A former sewerage treatment plant, comprising of a number of five pocket areas (SP1-5), containing asbestos on or in soils and demolition waste materials located to the north-west of the dustbowl totalling 2860 m^3 in volume
- The golf course stockpile, containing asbestos on or in soils and demolition waste materials, at the south west corner of the site, with an estimated volume of 420 m^3.

Additionally, there are a number of broad-scoped contamination issues on the MPW site that may be exacerbated during construction activities for the Proposal, including:

- Buried waste materials (also known as anthropogenic fill – defined by the presence of waste materials, odour and discolouration) have been identified across many locations throughout the Proposal site. This material may be geotechnically unsuitable and/or may pose a low contamination risk. This may result in a large volume of materials requiring onsite management. Nevertheless, due to the heterogeneous nature of the waste materials, additional contaminated materials may be identified during the management process
- Asbestos has been found across many areas of the Proposal site, with no clear distribution pattern relating to land use activities.
- Trichloroethylene (TCE) contamination risk has been identified through previous reports in the north western corner of the Proposal site.
- Perfluoroalkyl and polyfluoroalkyl substances (PFAS) have been identified in the groundwater. There is growing public and regulator awareness of the issues associated with PFAS.

Mitigation measures and procedures in the event that contaminated materials are encountered during construction are outlined in Section 14.5.1.

Building demolition would be undertaken as part of Early Works. No associated risks have therefore been identified for the Proposal.

14.4.2 Operation

Dangerous goods screening

Hazardous materials are substances falling within the classification of the Australian Code for Transportation of Dangerous Goods by Road and Rail (ADG). They are materials that have potential to cause harm to human life and health, or to the environment. Dangerous goods are types of hazardous materials that may be corrosive, flammable, explosive, toxic, oxidising or water-reactive and which can be deadly and damaging to property and the environment.

Dangerous goods have been explicitly excluded from the types of freight that the Proposal would handle (i.e. they would not be accepted), and would therefore also be excluded from the Proposal's warehouse, freight container storage and transit areas. Therefore, there is considered to be no risks from dangerous goods in freight, transit or storage and no assessment has been undertaken. It is possible that some dangerous goods may be processed or stored onsite as a result of human error or intentional deception, however it is considered highly unlikely that significant quantities of dangerous goods would be present.

For operation of the Proposal, a range of hazardous materials would be stored and used on site for refuelling and maintenance/firefighting purposes. Table 14-5 describes the types of hazardous material that may be required for operation of the Proposal.

Table 14-5: Potential hazardous material onsite

Hazardous material	Use	Dangerous goods class	Approximate quantity	Screening threshold/ potentially hazardous region
Diesel	To refuel locomotives and terminal vehicles	No but C1: Combustible liquids	190 KL (in 2 separated tanks)	Excluded from screening under SEPP33 as stored separately from any flammable liquids*
Liquefied natural gas (LNG)	To refuel locomotives terminal vehicles, and warehouse equipment	Yes Class 2.1	39 KL (16 tonnes)	25-90 metres** (described below)
Natural gas	Commercial use onsite	Yes Class 2.1	N/A	Excluded from screening under SEPP33 as not in a fixed installation
Lubricants, oils and associated waste	For maintenance purposes	No but C2 combustible	<2,000 litres	n/a
Solvents and other cleaners	For maintenance purposes	Class 3 Packaging Group II	<2,000 litres	5 tonnes

** The manifest threshold for C1 Combustible Liquids is 100KL if stored separately. The Diesel to be stored on the Proposal site would be stored separately in 97 KL tanks.*

*** Potentially hazardous region is dependent on the storage tank size*

As identified in Table 14-5 a total of 16 tonnes of LNG would be stored onsite at any one time. The number and location of storage tanks would be dependent on the machinery demand requirements associated with the final warehouse uses and layout. The location of the LNG storage tank/s would maintain a separation distance such that other land uses would not be located within the potentially hazardous region. Depending on the number of tanks, and consequently tank size, the separation distances shown in Figure 14-1 would be maintained as per the screening thresholds identified in Applying SEPP 33. These distances are considered adequate to minimise potential risks associated with LNG storage. As identified in the PRA undertaken for the MPW Concept EIS, for a single storage tank of 42 tonnes the effect distance is considered to be 25-50 metres, well below the distances applied as shown below.

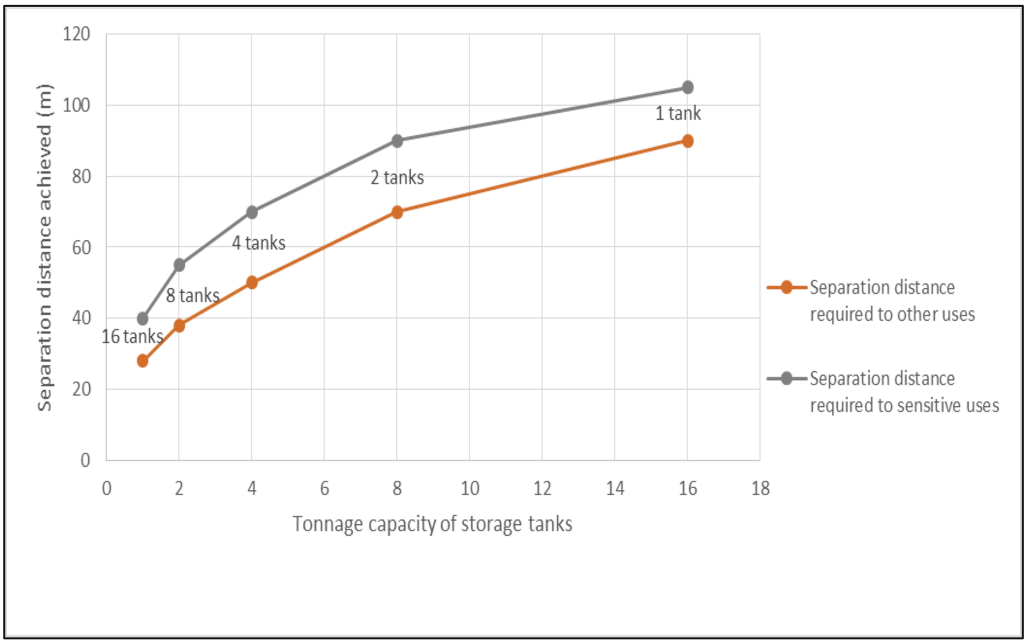

Figure 14-1: *Required LNG storage separation distances in accordance with SEPP 33*

All dangerous goods would be stored in locations and quantities below the risk levels under SEPP 33. Consequently it is considered that the proposal would not pose an unacceptable level of risk to the surrounding community and therefore no PHA is required for the Proposal. As no major effects would be felt outside the MPW site from these materials, there was considered to be little likelihood of fatality or risk to individuals or society.

Notwithstanding this the potential hazards to the environment and/or public health identified in relation to the above key risks, as well as other hazard scenarios are presented in Table 14-6. Management guidelines and mitigation measures have been identified for key hazards and risks and are presented in Section 14.5 of this EIS.

Dangerous goods transportation

The goods listed in Table 14-5 would typically be transported to the Proposal site by road. The transport and storage of dangerous goods is recognised as a high risk activity involving heavy vehicles on the public road and rail network (ADG Code, NTC, 2007). The number of road movements required for delivery of LNG to the Proposal site would be below the transportation threshold of 30 movements per week, or 500 movements per year. Transportation of solvents and other cleaners would be well below the threshold of 45 movements per week, or 750 movements per year.

Hazard identification

A number of key hazards and risks have been identified in relation to the operation of the Proposal; summarised as follows:

- **Spills and loss of containment of flammable/combustible or corrosive liquids:** This includes liquid and solid spills that may arise from result of impact, unloading, operational error or equipment failure. Depending on the material and circumstance, spills may result in damage to skin, membranes and airways as well as physical impact and injury. Spills also have potential to cause harm to the environment, particularly if liquid spills of toxic and hazardous substances enter waterways or groundwater and/or contaminate soil

- **Fire and Explosion:** Fire and explosion has the potential to cause human injury and damage to property and equipment. Fire may be caused by a number of factors including; bushfires or fire initiated onsite (e.g. from a vehicle accident or equipment)
- **Vehicle movements and machinery use:** Heavy vehicles and machinery (e.g. reach stackers and manual handling equipment) movements on the Proposal site present potential hazard in terms of incidents between vehicles and other vehicles, between vehicles and pedestrians, and between vehicles and property
- **Dangerous goods storage and transport:** Hazardous materials are substances falling within the classification of the ADG. The main type of dangerous goods used onsite include dangerous goods involved in the operational processes of the Proposal, such as chemicals associated with operations, plant and vehicle maintenance
- **Gas leaks (natural gas and LNG):** As a result of weld/cylinder failure, equipment failure, impact, corrosion, drive-away during loading or refuelling, other operational error, malicious damage or sabotage.

Methods of release

The proposed operations on the Proposal site were reviewed with reference to similar container operations to identify hazards. Consideration was given to the location of activities involving dangerous goods. These were identified to be:

- Shuttle freight train unloading/ loading via reach stackers or gantry cranes
- Loading of container trucks via reach stackers
- Temporary storage of containers in container storage area
- Transportation on-site via container trucks and machinery

Potential on-site methods of release are shown in Table 14-6. The management measures, standards and guidelines that would advise facility design and operating procedures to mitigate risks and hazards associated with the Proposal are also noted.

Table 14-6: Hazard scenarios, consequence and mitigation measures associated with the Proposal

Activity/Equipment	Cause/Comment	Effect	Consequence Range	Management standards and guidelines
Train unloading via reach stacker	Uncontrolled container during loading caused by operator error. Impact with another container, reach stacker or gantry or train.	Fire. Falling or uncontrolled heavy objects	Death. Serious injury. Loss of operating time. Increase cost.	*AS 2550.1 Cranes hoists and winches.* *Draft Code of Practice for Industrial Lift Trucks (WorkSafe Australia, 2012).* *Work Cover NSW Bridge and Gantry Crane Drivers: A guide for power crane operators (1997).* *Work Cover NSW Dogging Guide (2003).* *Work Cover NSW Rigging Guide (1995).*
Stacking containers via reach stacker	Unstable container load. Impact with other containers during operation. Lower containers misaligned.	Falling or uncontrolled objects Fire.	Death. Serious injury. Loss of operating time. Increase cost.	*AS 2550.1 Cranes hoists and winches*
	Reach stacker failure. Traffic due to vehicle accident; impact on other vehicles. Misalignment with truck due to truck movement and/or operator error.	Falling or uncontrolled objects Fire.	Death. Serious injury. Loss of operating time. Increase cost.	*Work Cover NSW Bridge and Gantry Crane Drivers: A guide for power crane operators (1997).* *Draft Code of Practice for Industrial Lift Trucks (WorkSafe Australia, 2012).* *Work Cover NSW Dogging Guide (2003).* *Work Cover NSW Rigging Guide (1995).*
Loading of trucks by reach stacker	Failure to control container attributable to operator error. Impact with reach stacker or other container.	Falling or uncontrolled objects Fire.	Death. Serious injury. Loss of operating time. Increase cost.	*Work Cover NSW Bridge and Gantry Crane Drivers: A guide for power crane operators (1997)* *Draft Code of Practice for Industrial Lift Trucks (WorkSafe Australia, 2012).*

Activity/Equipment	Cause/Comment	Effect	Consequence Range	Management standards and guidelines
On-site transport via rail cars & trucks.	Traffic due to truck accident. Rail accident. Poor road access or visibility, road conditions, other vehicles, vehicle or tank fault or driver fatigue	Failure to contain dangerous goods during on-site transport. Fire. Pressure explosion.	Death. Serious injury. Loss of operating time. Increase cost.	*Work Cover NSW Traffic Management in Warehousing (2009)* An OEMP will be prepared including traffic management procedures and operations onsite.
On-site vehicle and machinery movements.	Fuel leaks, brakes overheating and/or electrical faults.	Vehicle fire. Vehicle collision.	Death. Serious injury. Loss of operating time. Increase cost.	*Work Cover NSW Traffic Management in Warehousing (2009).* Clear signage and road markings An OEMP will be prepared including traffic management procedures and operations onsite. Operators licenced and competent Operational procedures for machinery to be outlined in the OEMP
Gas leaks (LNG)	Weld/cylinder failure, equipment failure, impact, corrosion, drive-away during loading or refuelling, other operational error, malicious damage or sabotage	Explosion Fire	Death Series injury Loss of operating time Increase cost	Use pipe of robust design, emergency isolation valves, and pressure relief system. Design the LNG storage to AS 3961-2005. Secure access from unauthorised access. Significant separation distances to residences and other assets.
Leak of LNG during transportation	Truck accident	Release of gas leading to gas cloud flash or jet fire if source of ignition or static electricity present	Death Series injury	Transport according to ADG Code, relevant standards and regulations. Ensure that contractor delivering the gas is trained, competent and certified by relevant authorities.

Activity/Equipment	Cause/Comment	Effect	Consequence Range	Management standards and guidelines
		Explosion		
Loss of containment of flammable/combustible or corrosive liquids	Impact, unloading, operational error or equipment failure	Fire Explosion	Contamination of land Death Series injury Loss of operating time	Storage in accordance with AS 1940, secondary containment for all storages, located away from drainage paths.
Inappropriate waste disposal	Lack of safety training and/or use of uncertified contractors	Contaminants release	Contamination of land Contamination of watercourses or groundwater Injury	No hazardous or regulated wastes will be disposed of on-site. All off-site disposal via approved transport operators and to approved facilities

14.5 Mitigation measures

14.5.1 Construction

The following measures would be included in the CEMP (or equivalent) to minimise hazards and risks:

- Procedures for safe removal of asbestos
- Provision for safe operational access and egress for emergency service personnel and workers would be provided at all times
- An Incident Response Plan that would include a Spill Management Procedure.

14.5.2 Operation

Dangerous goods

- To minimise the risk of leakages involving natural gas, LNG and flammable and combustible liquids to the atmosphere:
  - Appropriate standards for a gas reticulation network, including AS 2944-1 (2007) and AS 2944-2 (2007), would be applied
  - Correct schedule pipes would be used
  - Fire protection systems would be installed as required
  - Access to the Proposal site would be secure
- To minimise the risks of leakage of LNG and flammable liquids during transport:
  - The transport of dangerous goods by road would comply with the *Dangerous Goods (Road and Rail Transport) Act 2008* and the *Dangerous Goods (Road and Rail Transport) Regulation 2014*.
  - Contractors delivering the gas would be trained, competent and certified by the relevant authorities
- To minimise hazards associated with venting of LNG:
  - LNG storage would be designed to AS/NZS 1596-2008 standards
  - Access to the Proposal site would be secure
  - Adequate separation distances to residencies and other assets would be maintained
- Storage of flammable/combustible liquids would be carried out in accordance with AS 1940, with secondary containment in place in a location away from drainage paths
- Intermodal terminal facility staff involved in the transport and handling of dangerous goods would receive training in the contents of the dangerous goods provisions commensurate with their roles and responsibilities. Training is to be provided and records maintained in accordance with the appropriate competent authority (WorkCover NSW)
- The 190 KL of diesel fuel (combustible liquids of class C) would be stored on site in a separate 97 KL self-bunded container and would be stored away from other flammable materials of class 3PGI, II or III. The manifest threshold quantity under this circumstance is 100 KL for each tank. Refuelling of locomotives is likely to occur on the locomotive shifter, which would catch any spills during the refuelling process. Spill kits would be located in the vicinity of the refuelling location and staff would be trained in the use.

15 VISUAL AMENITY, URBAN DESIGN AND LANDSCAPE

Reid Campbell has undertaken an assessment of the visual amenity implications, including from light spill, associated with the Proposal to address the Secretary's Environmental Assessment Requirements (SEARs). A Landscape Plan has been prepared by Groundlink to identify the landscaping features of the Proposal and is included in Appendix E of this EIS. In addition to this a Visual Impact Assessment (VIA) (Reid Campbell, 2016), Light Spill Assessment (Arcadis, 2016) (Appendix T of this EIS), and light spill assessment of locomotive operations, included in the Rail Access Report (AECOM, 2016) (Appendix F of this EIS) have been prepared to assess the potential visual and light spill impacts of the Proposal.

Table 15-1 sets out the SEARs as they relate to visual amenity, urban design and landscape, and where these have been addressed.

Table 15-1: SEARs for the Proposal relating to visual impacts

Section/Number	Requirement	Where addressed in this EIS
11. Visual Amenity, Urban Design and Landscaping	The assessment shall: a) include a description of the visual significance of the affected landscape including an analysis of views from key vantage points	Section 15.4 and Appendix T of this EIS
	b) include artist's impressions of the development from key vantage points	Section 15.4 of this EIS
	c) assess the visual impact of the project on the landscape character of the area, including built form (materials and finishes) and the urban design (height, bulk and scale) of the proposal including views to and from the site	Section 15.4 and Appendix T of this EIS
	d) consider lighting impacts (in the local area, analyse and describe the contribution and impacts of the proposed facility on light spill at the local scale and to sensitive receivers	Section 15.4, Appendix T and Appendix F of this EIS
	e) include details of hard and soft landscaping treatment and design (including details of suitable landscaping incorporating endemic species)	Section 15.4 and Appendix E of this EIS
	f) ensure the layout and design of the development has regard to the surrounding vehicular, pedestrian and cycling networks	Section 15.4 and Appendix T of this EIS
	g) proposed management/mitigation measures to address the visual impact of the proposal	Section 15.5 of this EIS

This Section summarises the studies undertaken previously for the MPW Concept Approval and, more recently, for the Proposal. This Section provides an assessment of potential visual impacts resulting from the Proposal as assessed in the VIA (Appendix

T). Landscape and urban design measures, as well as measures to mitigate impacts have also been identified where they are required.

15.1 MPW Concept Approval

A Visual Impact Assessment (VIA), prepared by Clouston Associates, and a detailed light spill assessment, prepared by AECOM, were undertaken to inform the MPW Concept EIS.

This assessment precedes the Proposal and involves establishment of construction compounds, building demolition, remediation, heritage impact mitigation works and establishment of the conservation area. Environmental conditions assessed for the Proposal are assumed to be those that remain following completion of the Early Works (MPW Concept Approval). The assessment for the MPW Concept Approval comprised of the following:

- A landscape character and visual impact assessment, comprising:
  - Site analysis and identification of landscape character zones
  - Assessment of landscape character impacts and visibility of the MPW Project
  - Identification of key representative viewpoints to the development
  - Assessment of potential visual impacts, in which the unmitigated impact of the MPW Project on views from key representative viewpoints was assessed qualitatively, considering the sensitivity of the view and magnitude of the development in that view
  - Assessment of the cumulative visual impact of other similar nearby developments and potential developments
  - Development of mitigation strategies to mitigate landscape character and visual impacts in the ongoing development of the design.
- Light spill assessment, which involved measurement of the existing environmental conditions with respect to light spill, calculation of the potential light spill from the indicative proposed lighting design for the Project, and assessment of the potential light spill impact in specific sensitive receptor areas.

The key findings of the VIA for the MPW Concept Approval in relation to their impact on the Proposal are outlined in the table below.

Table 15-2: Visual impact assessment - MPW Concept Approval

MPW Concept Approval	Impact on the Proposal
Construction	
Impacts are predicated to range from negligible to moderate/high for different receptors.	These potential impacts during construction have been taken into consideration for the Proposal
Moderate/high impacts were predicted for many viewpoints due to the impact of tall construction equipment such as cranes that would be visible above the treeline during construction of both the IMEX and interstate IMT facilities. Other construction impacts would be associated with earthworks, clearing and vegetation removal and construction of the warehousing. Along Moorebank Avenue there would be localised visual impacts from construction fencing and the warehousing development area would be highly visible.	
The majority of construction activities would occur during standard daytime construction hours and would not require	

MPW Concept Approval	Impact on the Proposal
lighting; however, some out of hours construction work may be required. Lighting would be contained and positioned to avoid light spill to surrounding areas.	
Operation	
Impacts are predicted to range from negligible to moderate/high for different receptors.	These potential impacts during operation have been taken into consideration for the Proposal
The greatest visual impact of the Full Build development would be on public park and residential receptors on the elevated areas to the west of the Georges River and residential properties backing onto the SSFL.	
For some residential locations that overlook the MPW Project site, these receptors would also experience a noticeable change in the brightness of the area on clear nights.	
The warehousing development would front Moorebank Avenue and would dominate views towards the MPW site from the east. The visual impacts would reduce as landscaping is established.	

15.1.1 Conditions of Approval

The Conditions of Approval for the MPW Concept Approval relevant to the Proposal are shown in Table 15-3. These conditions of approval have been taken into account while developing the methodology for the VIA for the Proposal.

Table 15-3: MPW Concept EIS Conditions of Approval

Conditions of Approval		Where addressed in this EIS
Schedule 4- Conditions to be met in future development applications		
E4.	Development Applications for either the IMEX or interstate terminal shall consider the effect of headlight glare on surrounding sensitive receivers.	Section 15.4.2, Appendix F and T of this EIS
E17.	All future Development Applications for new built form must include detailed landscape plans identifying the vegetation to be removed or relocated and the location of replacement and additional landscaping.	Section 15 and Appendix E of this EIS
E18.	All future Development Applications shall include detailed landscape plans including relevant details of the species to be used in the various landscaped areas (preferably species indigenous to the area), including details of the informal native and cultural avenue plantings, and other soft and hard landscape treatments, including any pavement areas and furniture.	Section 15 and Appendix E of this EIS

15.2 Methodology

The following methodology was undertaken for assessment of potential visual impacts of the Proposal.

Table 15-4: Visual impact assessment method

Assessment method	Description
Visual impact assessment methodology	
Viewpoint identification	The viewpoints selected were re-created to match those represented in the Clouston Associates *Landscape Character and Visual Impact Assessment* report prepared for the MPW Concept EIS. The viewpoints are detailed further in Table 15-5 and Figure 15-1.
Site inspection	A site inspection was undertaken to confirm the relevance of viewpoint locations identified in the Clouston Report and to evaluate the existing visual character of the area and specifically identify locations that would potentially be subject to visual impacts from the Proposal.
Visualisation of the development	Based on the built form and urban design principles outlined in the MPW Concept EIS, a digital three dimensional model was developed using AutoDesk REVIT that included the components of the development that would potentially be visible beyond the Proposal site. Views were generated of the model that matched the positions of key viewpoints and were combined with photographs from these viewpoints to create simulated views of the Proposal.
Assessment of visual impact	The visual impact from the key viewpoints was then assessed qualitatively on the basis of the criteria described below in Table 15-5. Views at a variety of distances from the site were considered, however it is noted that the MPW site is primarily surrounded by vast amounts of vegetation to the west and the MPE site to the east providing an extensive buffer to local residential areas and other existing developments.
Light spill assessment methodology	
Lighting concept	A lighting concept for the Proposal was developed based on the operational requirements of the Proposal to be compliant with Australian Standard AS4282- 1997, 'Control of Obtrusive Effects of Outdoor Lighting' for the flood-lighting system. The light spill was then modelled using agi32: version 16.7 and visual lighting design software.

The viewpoint locations are all within two kilometres of the Proposal site and are detailed in Table 15-5 and shown in Figure 15-1.

Table 15-5: Viewpoint locations

Viewpoint ID	Location	Type
View 01	Southern section of Leacock Regional Park	Public space
View 02	Leacock Regional Park and associated residential heritage properties backing onto the parklands.	Public space

Viewpoint ID	Location	Type
View 03	Carroll Park and associated residential properties backing onto the park	Public space
View 04	Casula Powerhouse Arts Centre	Public space
View 05	Georges River Casula Parklands	Public space
View 06	St Andrews Park and associated residential properties surrounding the park, as well as properties that back onto the SSFL	Residential
View 07	Junction of M5 South Western Motorway and Moorebank Avenue	Public road/Industrial
View 08	Moorebank Avenue heading south.	Public road/Industrial

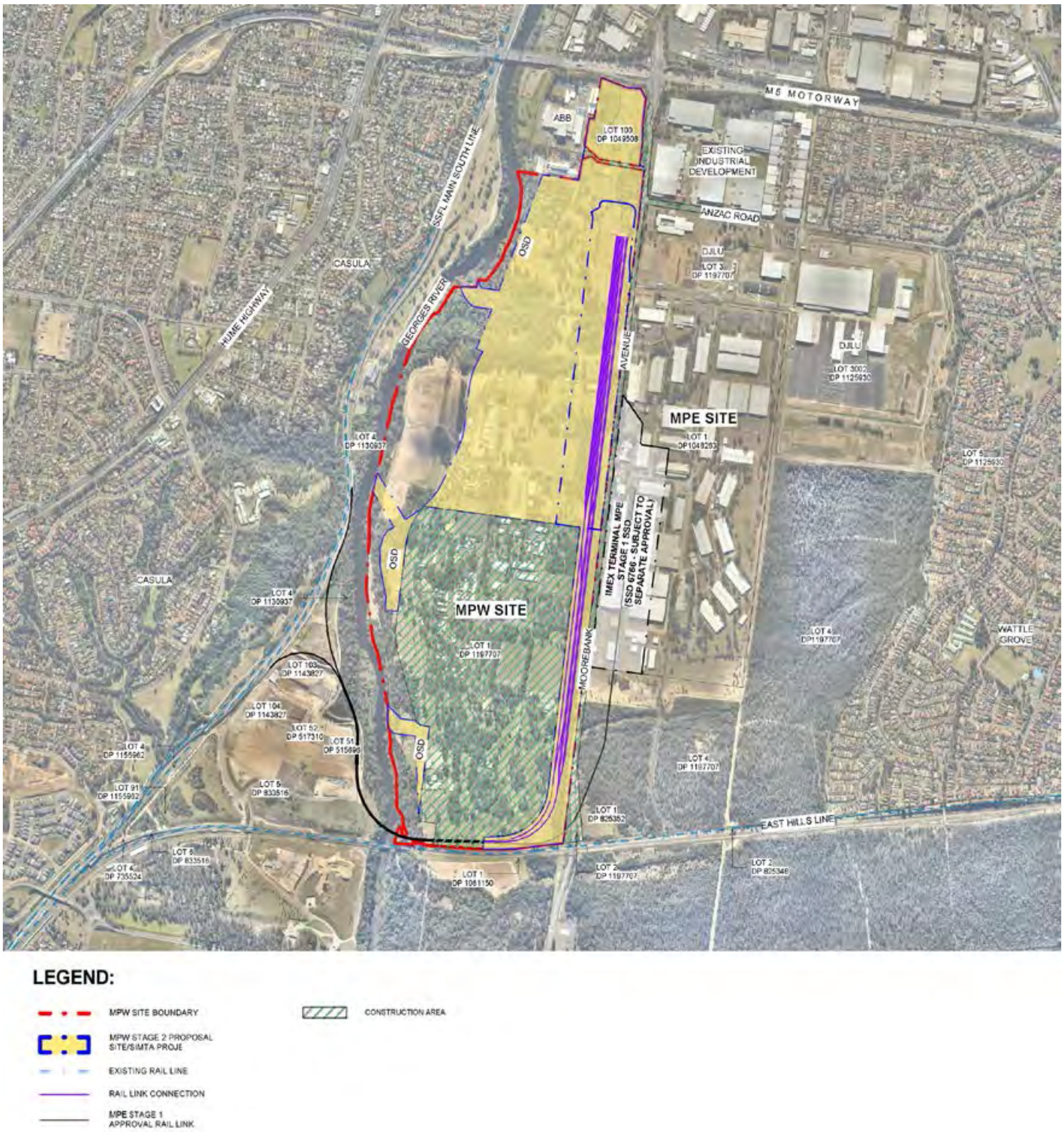

Figure 15-1: Viewpoint locations

The visual impact of the selected viewpoints were evaluated on a qualitative basis. The visual impact of the Proposal was assessed using a range of criteria against which the relative importance of each observer location was determined, including: context, setting, site elements, site character, adjacent development, distance to view (foreground, middle-ground and background), land use, visual prominence of the development, and potential changes to the view setting.

For each viewpoint, these criteria were addressed under three categories, described in Table 15-6 below.

Table 15-6: Visual impact assessment criteria

Criteria	Description
Visual adaptation	Visual adaptation describes any significant changes to the landscape and visual amenity that is likely to occur as a result of the Proposal from a particular view point, and the ability of that view point to adapt to that change.
Visual sensitivity	Visual sensitivity refers to the likely duration of views and number of observers from a given viewpoint and is independent of the 'prominence' of the Proposal. In locations where visual amenity has a higher perceived importance, and the duration of views and number of observers is greater than surrounding areas, the resulting visual sensitivity is regarded as being higher.
Visual impact	The visual impact is a result of the visual adaptation and the visual sensitivity and is summarised on a qualitative basis.

The resulting overall visual impact rating for each viewpoint was then determined using the following assessment matrix.

Visual Adaptation

Visual Sensitivity	High	Moderate/ High	Moderate	Low/ Moderate	Low	Negligible
High	High	High	Moderate/ High	Moderate/ High	Moderate	Negligible
Moderate/ High	High	Moderate/ High	Moderate/ High	Moderate	Moderate	Negligible
Moderate	Moderate/ High	Moderate/ High	Moderate	Moderate	Low/Moderate	Negligible
Low/ Moderate	Moderate/ High	Moderate	Moderate	Low/ Moderate	Low/Moderate	Negligible
Low	Moderate	Moderate	Low/ Moderate	Low/ Moderate	Low	Negligible
Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible

15.3 Existing environment

The Proposal site is surrounded by land owned by SIMTA, the Department of Defence and other industrial users (as shown in Figure 1-1), including:

- The MPE site and the Defence Joint Logistics Unit (DJLU) to the east

- Commonwealth of Australia Land to both the east and the south
- Existing Moorebank industrial developments known as 'Amiens and Yulong' to the north-east
- The residential suburb of Casula to the north-west and west, separated from the Proposal site by the Georges River and the SSFL and passenger rail line.
- The existing East Hills Railway Line, which runs in an east-west direction, to the south of the Proposal site
- The Wattle Grove residential area (primarily low density), extensive commercial and industrial developments and major motorways, further to the east and north of the Proposal site.

The Proposal site is within close proximity to the M5 Motorway, which intersects with Moorebank Avenue approximately 800 m to the north of the north-east site boundary. Moorebank Avenue runs in a north-south direction and provides a direct connection between the Liverpool City Centre and the M5 Motorway on/off ramps to the north and the Glenfield/Macquarie Fields residential areas to the south.

Surrounding natural elements include:

- Georges River, which runs along the western boundary of the Proposal site
- Leacock Regional Park, which is a publicly accessible recreation area and is located on the western side of the Georges River
- Existing landscape and vegetation generally running along the western boundary following the banks of the Georges River. This bushland is primarily regenerated vegetation and it provides significant screening to much of the north-west and west surrounding areas
- The Glenfield Waste management facility, which is located south-west of the Proposal site, separated by the Georges River.

15.4 Potential impacts

This section includes consideration of potential visual impacts during construction and during the operational elements of the Proposal (including lighting impacts). Visual impacts have taken into consideration the landscaping and urban design measures that would be included for the Proposal.

15.4.1 Construction

Landscape and Urban Design

The construction phase includes a number of temporary structures, including ancillary facilities, batching plant, offices, workshop etc, which would have short term and temporary impacts on the surrounding streetscape. These temporary structures are likely to be visible from areas such as Moorebank Avenue, the nearby passenger rail lines and potentially nearby residential areas of Casula and Wattle Grove. However, given the temporary nature of impacts no landscaping measures are considered necessary.

Visual

The following construction works would be likely to be visible from surrounding areas:

- Vegetation clearing and building demolition
- Establishment and decommissioning of ancillary facilities, including batch plant
- Earthworks, including stockpiling of material

- Installation of drainage and utilities
- Construction of rail sidings, locomotive shifter and refuelling area
- Construction of access and egress point connecting to Moorebank Avenue, including signage and truck processing gates
- Construction of the administration office, engineering workshop and services
- Construction of warehousing precinct (including associated infrastructure and services)
- Construction of the Rail link connection.

During the above works, the most visible elements are likely to be equipment, such as cranes and piling rigs. These are likely to be visible from areas such as Moorebank Avenue, the nearby passenger rail lines and potentially nearby residential areas of Casula and Wattle Grove.

Based on their location and the works proposed, the visual impact during construction has been assessed for the viewpoints identified in Figure 15-1 and Table 15-5, using the criteria and ratings defined in Section 15.2.

Table 15-7: Visual impacts during construction

Viewpoint ID	Visual Adaptation	Visual Sensitivity	Visual Impact
View 01	Low	Low	Low
View 02	Low/Moderate	Moderate	Moderate
View 03	Moderate	Moderate	Moderate
View 04	Low	Moderate	Low/Moderate
View 05	Negligible	Moderate	Negligible
View 06	Low	Moderate/High	Moderate
View 07	Moderate	Low	Low/Moderate
View 08	High	Low	Moderate

As shown in Table 15-7, the viewpoints with the highest visual impacts during construction are:

- View 02: Leacock Regional Park and associated residential heritage properties backing onto the parklands
- View 03: Carroll Park and associated residential properties backing onto the park
- View 06: St Andrews Park and associated residential properties surrounding the park, as well as properties that back onto the SSFL
- View 08: Moorebank Avenue heading south.

However, given the low rise nature of the construction works and the maximum visual impact rating of moderate at any view point, it is unlikely that these works would be overly intrusive and that any visual impacts would be localised and temporary in nature.

Other sources of visual impact during construction, such as the establishment of hoardings and construction fencing would potentially create localised visual impacts primarily along Moorebank Avenue and also in areas visible to Casula.

Light spill

Lighting would be required during construction of the Proposal within ancillary facilities, and on plant and equipment. The impacts of light spill during construction are expected to be minor as it would be localised and temporary in nature. In addition, this lighting would be designed and located to minimise the effects of light spill on surrounding sensitive receivers, including residential areas and the proposed conservation area.

15.4.2 Operation

Landscape and Urban Design

As the Proposal site is bounded to the west and south by areas of native vegetation, the proposed landscape design aims to integrate the Proposal into the broader environment. The landscape features proposed for the Proposal site are described in Table 15-8.

Table 15-8: Landscape features of the Proposal

Location	Description
Main site access from Moorebank Avenue	The landscape of the main site entrance from Moorebank Avenue aims to provide an easily-oriented pathway for visitors and workers of the Proposal site. Vehicular, pedestrian and bicycle entry would all be integrated into one cohesive entry. Planting, once mature, would provide significant screening between the Proposal site and Moorebank Avenue. This will include a range of local species that have been selected for their unique forms, colours and textures.
IMT facility and Rail link connection	The IMT facility and Rail link connection would be carefully integrated into the surrounding proposed landscape setting. The planting layout would ensure that safe sight lines are maintained whilst providing shade to employees, visitors and to the carpark area. The landscape is to feel open, with clear sight lines and ample surveillance opportunities within the site. Planting in the IMT facility, office area, car parking and along the eastern boundary of the Rail link connection would be informal, with groups of trees, shrubs and swathes of groundcovers. This would serve to enhance the natural characteristics of the landscape.
Warehousing and freight village	Landscaping along the western edge of the warehousing and freight village and within the car parking areas would minimise visual impacts on visual receptors to the west and provide shade and amenity for users. Planting would include a mixture of native canopy trees and understorey planting, including a range of local species that have been selected for their unique forms, colours and textures.
Moorebank Avenue (Proposal site eastern boundary)	The landscape of the Moorebank Avenue frontage provides a visual screen to the Proposal site from the roadway while reinforcing the identity of the area with the use of local plantings. All planting would be informal, with groups of trees, shrubs and swathes of groundcovers. This would serve to enhance the natural characteristics of the landscape. A high diversity of species would help to integrate the site into the surrounding area.
Western, northern and southern boundaries	Landscaping along the northern, western and southern boundaries visually connects the Proposal site with the greater landscape and provides a biological connection between the site and its greater landscape context.

Location	Description
	All planting would be informal, with groups of trees, shrubs and swathes of groundcovers. This would serve to enhance the natural characteristics of the landscape. A high diversity of species would help to integrate the Proposal site into the surrounding area.

The buildings and structures included in the Proposal would be of a high design quality. The building colours and finishes would be compatible and blend with the surrounding land uses, including non-reflective colours. A schedule of the indicative colour palette for proposed office buildings and other structures is provided in the Architectural Drawings (Appendix D) and summarised in Table 15-9.

Table 15-9: Materials and finishes

Infrastructure	Item	Indicative materials	Indicative colour palate
IMT facility	Roof	Metal - Colourbond (or similar)	Mix of: ▪ Colourbond Dune ▪ Dulux Sulphur ▪ Colourbond Surfmix ▪ Colourbond Shale Grey ▪ Colourbond Monument ▪ Colourbond Woodland Grey
	Windows	Aluminium framed glazing	
	Doors	Aluminium framed glazing Roller shutter doors	
	Structural posts	Steel	
	Walls	Cladding	
Security fence	Palisade fence	Steel	Dulux Black or Dulux Maximus
	Chain wire fence	Chain wire	N/A
Warehouses and freight village	Roof	Metal - Colourbond (or similar)	Mix of: ▪ Colourbond Dune ▪ Colourbond Surfmix ▪ Colourbond Windspray ▪ Colourbond Shale Grey ▪ Colourbond Monument Corporate colour schemes: ▪ Wax Way ▪ Honey Dew ▪ Silver Star ▪ Terracotta Chip ▪ Manor Red ▪ Light Leather ▪ Deep South
	Windows	Aluminium framed glazing Metal framed louvres	
	Doors	Aluminium framed glazing Roller shutter doors	
	Structural posts	Steel	
	Walls	Cladding	

The landscape and urban design features identified above would promote integration of the Proposal site with the surrounding land uses and minimise the visual impact associated with the Proposal, described below.

In addition, the vegetation within the Georges River riparian corridor (i.e. the conservation area) would be retained and maintained as a proposed biodiversity offset site (refer to Section 11 and Appendix Q of this EIS).

Visual

The extensive native bushland areas, Department of Defence facilities on neighbouring lands, the MPE site and the general pattern of industrial type development surrounding the Proposal site screens the Proposal from much of the greater sensitive surrounding areas – primarily residential. Furthermore, the landscape and urban design features, described above, would further screen the Proposal as well as integrate the Proposal with surrounding land uses, minimising the visual impact.

Potential views would occur along viewing corridors created by Moorebank Avenue and where topography provides some elevation above potential obstructions to views, such as from Casula to the west.

A summary of the visual impacts is included in Table 15-10.

Table 15-10: Summary of visual impacts during operation

Viewpoint ID	Visual Adaptation	Visual Sensitivity	Visual Impact
View 01	Low	Low/Moderate	Low/Moderate
View 02	Low/Moderate	Moderate	Moderate
View 03	Moderate	Moderate	Moderate
View 04	Low	Moderate	Low/Moderate
View 05	Negligible	Low/Moderate	Negligible
View 06	Low	Moderate	Low/Moderate
View 07	Moderate	Low	Low/Moderate
View 08	High	Low	Moderate

Table 15-11 details the visual impact from individual key viewpoints identified through the digital viewshed analysis during daylight hours. The visual impacts have included consideration of the landscape and urban design features described above.

Night time visual impacts are discussed below as part of the light spill assessment.

Overall, as the Proposal is in keeping with the surrounding land uses and any impacts would be effectively minimised through the use of landscaping and urban design, the maximum anticipated visual impact at any view point would be Moderate. The proposed landscape and built form treatments would result in an improvement in the visual amenity of the entire site and would increase the current level of screening of the site. Urban design and planning principles assist with the breakdown of the bulk and scale of the development and contribute to the creation of one cohesive landscape.

Table 15-11: Operational visual impacts

Viewpoint ID	Visual Adaptation	Visual Sensitivity	Visual Impact
View 01 Leacock Regional Park	**Low** **Prominence of the Development** At this location the landscaped park slopes up from the street level toward a ridge which overlooks the Proposal site. Dense vegetation covers the eastern side, limiting clear lines of site beyond. The park is frequented by local residents. There are no residential properties within the park. **Landscape Compatibility** The current view from this location is primarily riparian vegetation that sits in the middleground with no view of any site buildings due to screening provided by the vegetation. In the foreground of the view is the SSFL and the Glenfield waste facility (not within the Proposal site). Distant vegetation is visible at the rear of the foreground treeline. There are trees in the foreground as well as large trees behind the residential dwellings that are highly prominent.	**Low/Moderate** Being a public open park that is frequented by locals with no residential properties within the park, the visual sensitivity would be low/moderate.	**Low/Moderate** There would be limited visibility from this viewpoint looking east from Leacock Regional Park towards the Proposal due to screening provided by vegetation and the natural slope of the land. The top of the warehouses, office buildings and light posts may be visible while partially screened by vegetation The visual amenity would be unchanged within this view corridor as the landscape amenity would remain unaffected, therefore there would be no visual impact.
View 02 Leacock Regional Park	**Low/Moderate** **Prominence of the Development** This view location looks east towards the Proposal site. The view is at an elevated location which sits above the Proposal site overlooking an assortment of vegetation in	**Moderate** The views shown from this viewpoint are taken from Leacock Regional Park, a dog-friendly park that is frequented by dog-walkers and pedestrians. There are many walking tracks that run along the Georges	**Moderate** Views of the Proposal site from this viewpoint would primarily be screened by existing vegetation. There may however be noticeable removal of vegetation to be cleared from the main site.

Viewpoint ID	Visual Adaptation	Visual Sensitivity	Visual Impact
	the foreground, the Georges River, and then continued dense vegetation beyond. The vegetation screening that runs along the edge of Leacock Regional Park and the Georges River corridor is the most prominent feature of this viewpoint. Although the viewpoint is at a slightly higher elevation than that of the Proposal site, the vegetation in the foreground and background screens to majority of the Proposal. **Landscape Compatibility** The view of the existing landscape at this location shows scattered trees and shrubbery in the foreground with dense vegetation leading up to the horizon. The immediate existing landscape is highly compatible with the development and would require no alterations. Vegetation in the background would require some clearing where the development footprint intersects with it. This however should not be visible from this location.	River that link up with the Casula Powerhouse Arts Centre. Due to this, the visual sensitivity would be moderate. The heritage item listed Glenfield Farm is located within close proximity to the view location and is identified as a sensitive receiver. Existing tree planning and vegetation in the area would however provide some screening of views to the proposed development and as such reduce the visual sensitivity.	
View 03 Carroll Park	**Moderate** **Prominence of the Development** This view location is taken from an elevated point in in the West looking down toward the SSFL. The area has extensive views over the Proposal site. **Landscape Compatibility**	**Moderate** Being a residential area the visual sensitivity would be relatively high. Several houses within the area and users of the park land would be able to see the Proposal from this location with it being moderately prominent. Most views however would be of short duration and therefore	**Moderate** There would be moderate visibility from this viewpoint east across the Georges River to the Proposal. The existing landscape amenity would change as a result of the development however retained existing and new vegetation would sufficiently to screen the majority of the Proposal with only the

Viewpoint ID	Visual Adaptation	Visual Sensitivity	Visual Impact
	The site is densely populated with vegetation including tall trees and medium to small bushes that can be seen covering the majority of the Proposal site. As such most of the Proposal would be screened by existing vegetation on the site. The existing landscape is moderately compatible with the proposed development. There would be some clearance of vegetation on the Proposal site however.	the visual amenity would be reduced, suggesting a moderate sensitivity.	tops of warehouses, light poles and some operational equipment being visible. As such there would be a moderate to high visual impact at this viewpoint location.
View 04 Casula Powerhouse Arts Centre	**Low** **Prominence of the Development** This view looks east towards the riparian vegetation zone that runs along the banks of the Georges River. All views of the Proposal site are heavily obscured by dense vegetation. **Landscape Compatibility** This location is situated on flat ground elevated above the banks of the Georges River, looking towards dense vegetation comprising of tall trees and small to medium sized bushes. The existing landscape is highly compatible with the Proposal and would not require any alteration as a result of the development.	**Moderate** As the area is publically accessible and offers some amenity to the community, the visual sensitivity is moderate in this location. The natural topography and existing vegetation heavily enclose the area limiting exposure to the east and densely screening the majority of the Proposal.	**Low/Moderate** Glimpses of the Proposal may be visible from this location through the existing vegetation and above the tree line with the tops of warehouses and light poles potentially protruding. This however would not likely be substantial enough to detract from the amenity of the area, suggesting a relatively low visual impact.
View 05	**Negligible** Prominence of the Development	**Low/Moderate** The Parklands offer an area of some amenity to the public with large open spans	**Negligible** This viewpoint location has little to no visibility of the Proposal site and

Viewpoint ID	Visual Adaptation	Visual Sensitivity	Visual Impact
Georges River Casula Parklands	This viewpoint is located to the west of the Proposal site looking north towards the bank of the Georges River and M5 motorway overpass. The Proposal would not be visible from this viewpoint. The SSFL and powerhouse access road are visible in the background to the west. **Landscape Compatibility** The Casula Parklands is a mix of maintained grassland, landscape and vegetation including trees and shrubs that heavily populate the riparian vegetation area that runs along the bank of the Georges River. This provides a moderate buffer and screening to the Proposal site and no clearing is required in this area, therefore the landscape is highly compatible with the Proposal.	of landscaping accessible to the community. As such the visual sensitivity of the location would be moderate, however it is lowered by the lack of upkeep and the density of vegetation, which limits user movements to designated pathways and roads. In addition, access points are restricted by the SSFL and Georges River.	development. Any proposed built form would be obstructed by dense riparian vegetation along the riparian corridor and Casula Parklands. The existing visual amenity therefore would have little to no change, suggesting no visual impact.
View 06 St. Andrews Park	**Low** **Prominence of the Development** This view location looks east toward the Proposal site. There is a highly vegetated area obscuring any direct view of the site. The Proposal would therefore not likely be visible from this area and would be screened by a thick riparian corridor along the Georges River. The SSFL in the foreground runs within close proximity and is the prominent built feature from this viewpoint location.	**Moderate** Being a publically accessible park in a residential area, the visual sensitivity in this location would be high. However, the existing infrastructure in the foreground lowers the visual sensitivity of the area.	**Low/Moderate** The Proposal would not likely be visible from this area however some built form features such as light poles may protrude above the tree line suggesting a low visual impact.

Viewpoint ID	Visual Adaptation	Visual Sensitivity	Visual Impact
	Landscape Compatibility In the foreground is an existing Rail line with its associated service and access roads and power lines above. Directly beyond is the Georges River which has dense vegetation running along either side of its banks. This vegetation would require some clearance further east towards the proposed development, however none of this clearance would be visible from this location suggesting a highly compatible landscape.		
View 07 Junction of M5 Motorway and Moorebank Avenue	**Moderate** **Prominence of the Development** This viewpoint looks south down Moorebank Avenue with existing industrial facilities on the east and industrially zoned land to the west. The road is lined with large trees on either side that provide some screening of the Proposal site. The primary areas for access and egress to the Proposal site would be visible from this location. **Landscape Compatibility** The addition of new industrial elements to this landscape would be compatible with this landscape. The addition of road upgrades to the area would mean some clearing of vegetation,	**Low** The existing industrial land use would suggest a low visual sensitivity in this location. A sensitive receiver identified as Kitchener House, a heritage item, sits in the immediate foreground of this view location. This receiver is however currently in a primarily industrial area and as such visual sensitivity for the location would remain low, with the heritage item remaining relatively unaffected. Introduction of urban design principles as part of the proposed landscape strategy would help to improve the existing landscape treatment of the area. As such visible portions of the Proposal would improve visual sensitivity in the vicinity.	**Low/Moderate** The Proposal would be prominent from this location. However, the land-use compatibility creates a low visual sensitivity and therefore there would be a low to moderate visual impact from this viewpoint. Heritage items would be relatively unaffected due to the existing industrial nature of the area.

Viewpoint ID	Visual Adaptation	Visual Sensitivity	Visual Impact
	however this would not detract any further from landscape compatibility.		
View 08 Moorebank Avenue heading south	**High** **Prominence of the Development** This portion of Moorebank Avenue consists of industrial facilities on either side of the road. The Proposal would be highly prominent from this location with relatively unobstructed views of the Proposal site. At this location, sections of the Rail link connection would be visible in the middle ground with the primary container yard in the background. For the purposes of creating a realistic assessment of the potential visual impact of the container yard and operating equipment, container heights have been staggered generally at maximum stacking height. **Landscape Compatibility** From this viewpoint, the Proposal would have a high impact on this existing landscape amenity, as it would require clearance of most existing vegetation. At this location operational equipment and containers yards would likely be of a larger scale than most elements in the immediate foreground and so would be visible.	**Low** The industrial land use at this location creates a low visual sensitivity in general along the Moorebank Avenue corridor. This particular viewpoint does however have dense existing vegetation on the western side of the road, which increases visual amenity. Most users of the area however, would be travelling in vehicles between existing industrial areas and for nominal durations. Therefore the overall visual sensitivity of the area is low.	**Moderate** The Proposal would be highly prominent at this location. However, the land use compatibility and low visual sensitivity would mean that the proposed development may, through considered urban design principles, improve the amenity of the area. This suggests a low to moderate visual impact from this viewpoint location.

Viewpoint ID	Visual Adaptation	Visual Sensitivity	Visual Impact
	To increase compatibility, a landscape buffer zone of varying width is proposed to help break down the prominence of any built form. This would provide visual interest that would help reduce change to the existing landscape amenity and decrease prominence of the Proposal, suggesting a moderate landscape compatibility.		

This section provides simulated views of the Proposal site from viewpoints where potential impacts were identified from the table above (refer to Figure 15-2 – Figure 15-17).

Figure 15-2: View 01 Existing view

Figure 15-3: View 01 Simulated view

Figure 15-4: View 02 Existing view

Figure 15-5: View 02 Simulated view

Figure 15-6: View 03 Existing view

Figure 15-7: View 03 Simulated view

Figure 15-8: View 04 Existing view

Figure 15-9: View 04 Simulated view

Figure 15-10: View 05 Existing view

Figure 15-11: View 05 Simulated view

Figure 15-12: View 06 Existing view

Figure 15-13: View 06 Simulated view

Figure 15-14: View 07 Existing view

Figure 15-15: View 07 Simulated view

Figure 15-16: View 08 Existing view

Figure 15-17: View 08 Simulated view

Light Spill

The Proposal is considered a 'commercial area' in accordance with *AS4282-1997* '*Control of Obtrusive Effect of Outdoor Lighting* (AS4282-1997).

The light spill was modelled at relevant boundaries as shown in Figure 15-18.

The illuminance and luminous intensity have been assessed during post curfew hours as follows for both boundaries.

- Boundary 1.0 – Residential area in dark surrounds – recommended maximum vertical illuminance of 1lux (lx) and a luminous intensity emitted by luminaires of 500 candela (cd)
- Boundary 2.0 – In commercial areas or at boundary of commercial and residential areas – recommended maximum vertical illuminance of 4lx and a luminous intensity emitted by luminaires of 2,500cd.

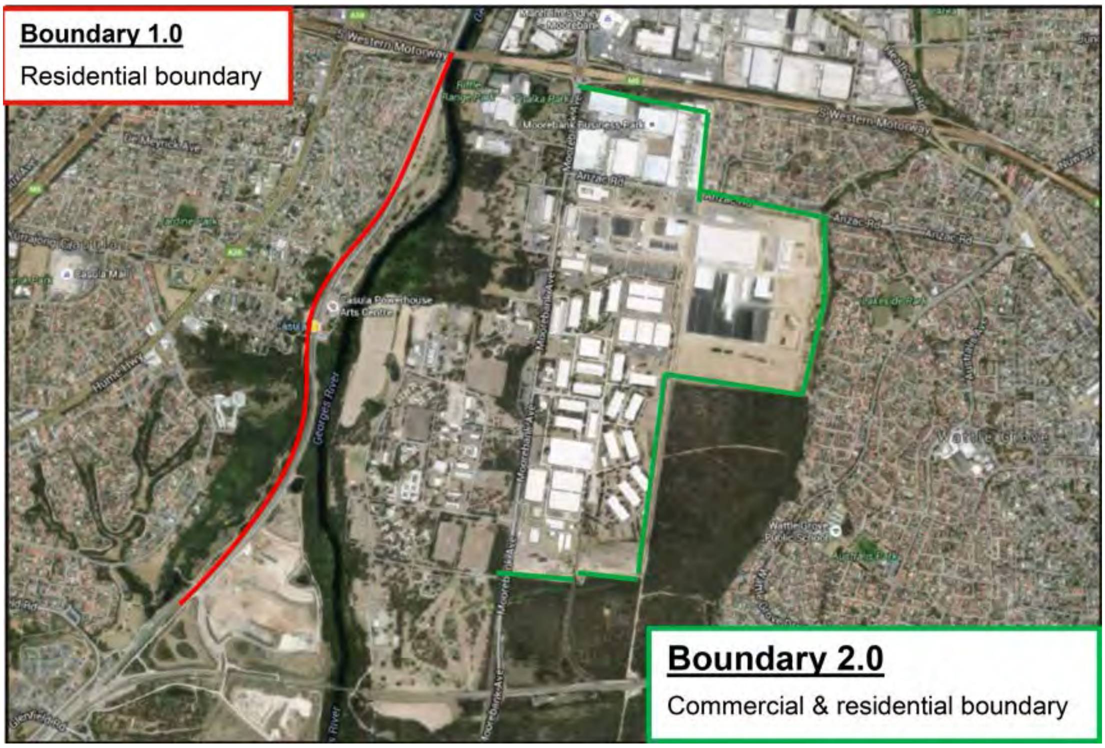

Figure 15-18: Light spill boundaries

The light source type, the luminaire make and model, luminaire aiming, pole positions and heights proposed for the Proposal site would ensure minimal direct light spill from static site lighting. Pole heights would vary between 13.5 m and 21 m. The lighting selected for the Proposal has been selected to result in minimal light spill on the surrounding area. The calculations of light spill in a vertical plane directed back towards the centre of the Proposal site show that lighting would be in compliance with, and not exceed, the requirements of AS4282-1997.

Figure 15-19 and Figure 15-20 shows the light spill in a vertical plane directed back towards the centre of the Proposal site. As can be seen by this figure, minimal effect on adjacent properties and on the environment would be achieved by the appropriate selection of light source, luminaire, luminaire mounting height and luminaire aiming.

Lighting associated with forklifts and vehicles would generally not be of concern since the light source is fixed to be downward aiming and the loading/unloading is within the container yard, which is far away from the Proposal site boundary. Other smaller mobile vehicles may have headlights and rotating warning beacons. Mobile and transitory lighting effects from forklifts and trucks were therefore not included in the permanent site lighting spill light calculations.

In addition, an assessment of the potential light spill from the operation of locomotives was included in the Rail Access Report (refer to Appendix F of this EIS). It was determined that there are no sensitive receivers along the route of the Rail link connection apart from motorists on Moorebank Avenue travelling in the opposite direction to an operational locomotive and who may be impacted by headlight glare from the oncoming locomotive. The impact of such headlight glare would be mitigated by the installation of appropriate screen planting within the buffer zone between the Moorebank Avenue road reserve and the Rail link connection.

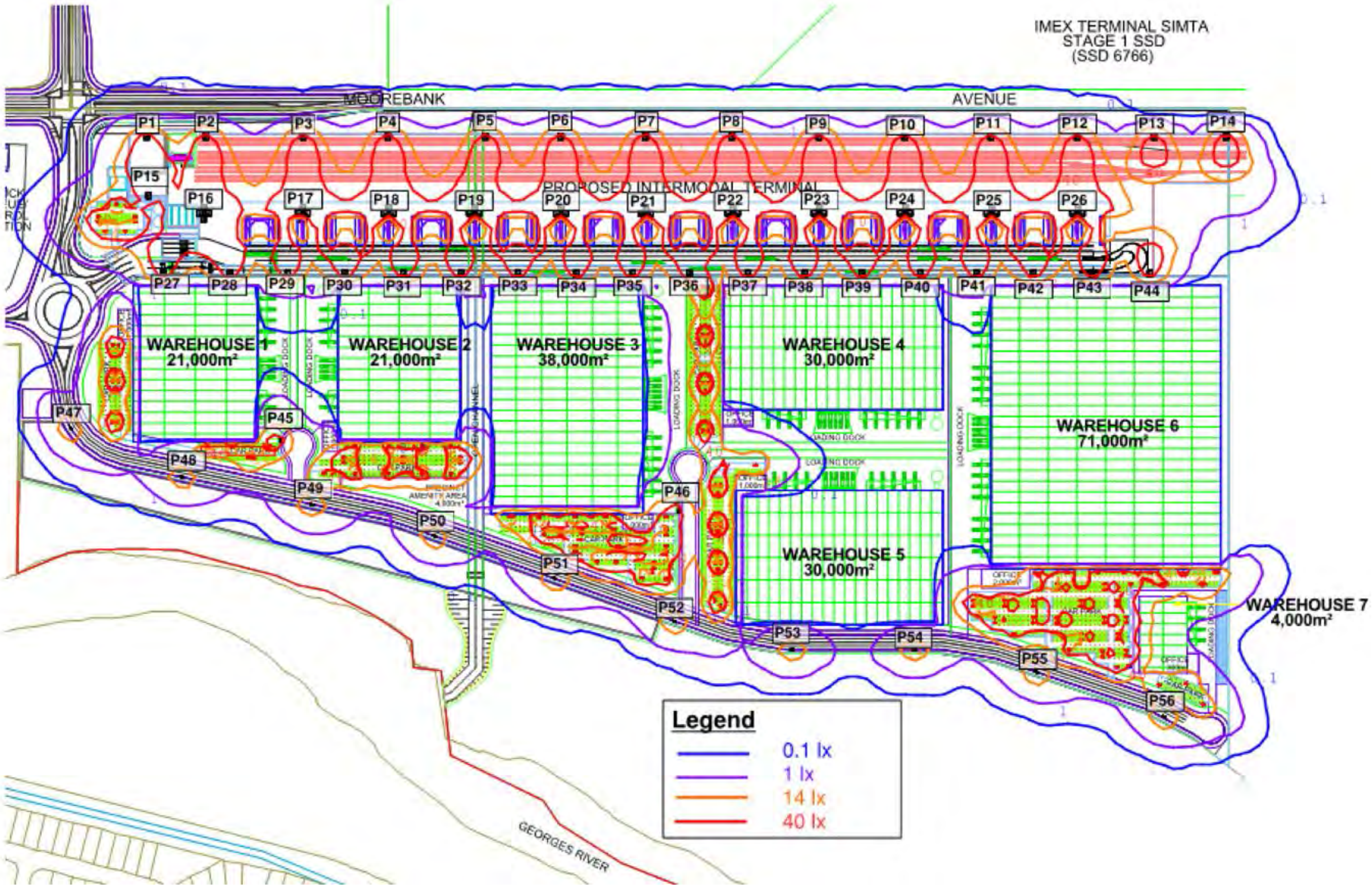

Figure 15-19: General site layout (North) showing light spill isolux curves both external and internal to the site

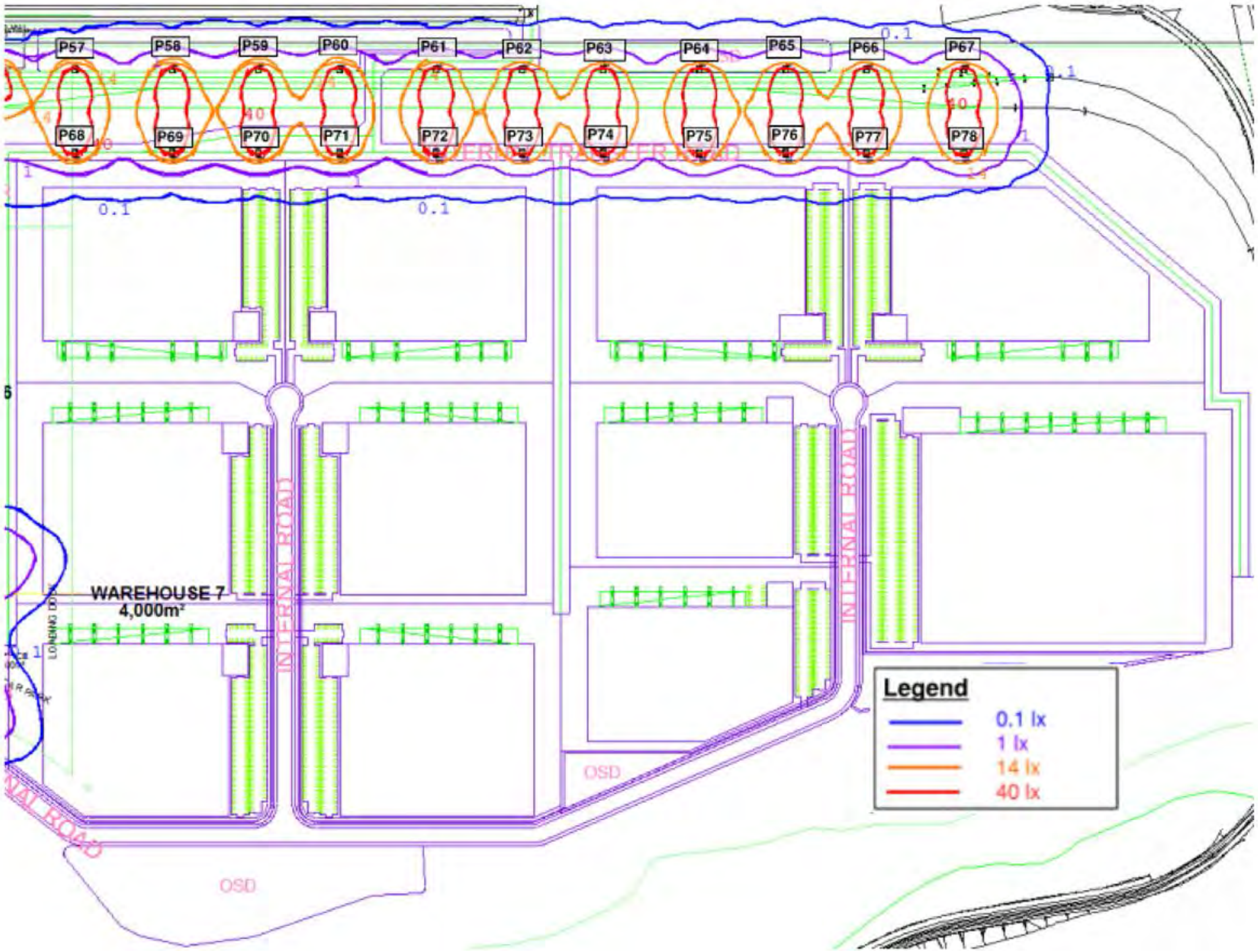

Figure 15-20: General site layout (South) showing light spill isolux curves both external and internal to the site

15.5 Mitigation measures

15.5.1 Construction

The following actions would be considered for implementation for mitigation of the visual impact during construction of the Proposal.

- Existing vegetation around the perimeter of construction area would be retained where feasible and reasonable
- The early implementation of landscape planting would be investigated in order to provide visual screening during the construction of the Proposal
- Elements within the construction area would be located to minimise visual impacts as far as feasible and reasonable, e.g. setting back large equipment from site boundaries
- Construction lighting, on both ancillary facilities and plant and equipment, would be designed and located to minimise the effects of light spill on surrounding sensitive receivers, including residential areas and the proposed conservation area
- Design of site hoardings would consider the use of artwork or project information
- Regular maintenance would be undertaken of site hoardings and perimeter areas including the prompt removal of graffiti
- Re-vegetation/landscaping would be undertaken progressively
- Where required for construction works, cut-off and directed lighting would be used and lighting location considered to ensure glare and light spill are minimised.

15.5.2 Operation

The landscape design for the Proposal would integrate the Proposal site into the broader environment to the greatest extent possible. Landscaping would be used to visually soften, and screen the Proposal site and would be maintained during operation.

The following general mitigation measures would be applied, where reasonable and feasible, for the landscaping of the Proposal:

- Use of species that are local to the area
- Use of trees to provide a uniform canopy cover within vegetated areas
- Use of local species as understory planting to support and enhance local habitat values
- Use of seeds collected within the local area for planting to reinforce the genetic integrity of the region, where possible.

Regarding light spill from the Proposal the following mitigation measures would include:

- Lighting would be designed to minimise impacts on surrounding existing and future residents and the proposed conservation zone
- The use of shields on luminaire lighting to minimise brightness effects would be considered
- Asymmetric light distribution-type floodlights would be selected as part of the proposed lighting design (i.e. the light is directed specifically to the task with minimal direct light spill to the surrounding area)
- Low reflection pavement surfaces would be considered to reduce brightness
- The quantity of light and energy consumption in parts of the Proposal site that are not active would be minimised, while retaining safe operation.

16 INDIGENOUS HERITAGE

An *Aboriginal Heritage Impact Assessment* was prepared by Artefact (2016), which assessed the impacts on Indigenous heritage from the construction and operation of the Proposal (refer to Appendix U of this EIS).

Table 16-1 sets out the Secretary's Environmental Assessment Requirements (SEARs) as they relate to Indigenous heritage, and where these have been addressed.

Table 16-1: SEARs for the Proposal relating to Indigenous heritage

Section / Number	Requirement	Where addressed in this EIS
9. Aboriginal Heritage	a) Consider impacts to Aboriginal heritage (including cultural and archaeological significance), in particular impacts to Aboriginal heritage sites identified within or near the project should be assessed. The identification of cultural heritage values should be guided by the Guide to investigating, assessing and reporting on Aboriginal Cultural Heritage in NSW (DECCW 2000). Where impacts are identified, the assessment shall demonstrate effective consultation with Aboriginal communities in determining and assessing impacts and developing and selecting options and mitigation measures (including the final proposed measures) in accordance with the Aboriginal cultural heritage consultation requirements for proponents 2010 (DECCW); and b) Describe attempts to avoid impacts to cultural heritage values and identify any conservation outcomes. Where impacts are unavoidable, the EIS must outline measures proposed to mitigate impacts. Any objects recorded as part of the assessment must be documented and notified to OEH.	Sections 16.3, 16.4 and 16.5 of this EIS

This section summarises the studies undertaken previously for the MPW Concept Approval and, more recently, for the Proposal. The section provides an assessment of potential impacts resulting from construction of the Proposal on indigenous significance as assessed in the *Aboriginal Heritage Impact Assessment* (Artefact, 2016) (refer to Appendix U of this EIS). Measures to mitigate impacts are also identified where they are required.

16.1 MPW Concept Approval

An Aboriginal Heritage Assessment, prepared by Navin Officer Heritage Consultants (NOHC, 2014) on behalf of Parsons Brinkerhoff, was undertaken to inform the MPW Concept EIS. This assessment comprised of a literature review, the preparation of an Aboriginal consultation program, field survey and testing procedures as well as a significance and impact assessment. Consultation, involving field survey participation was undertaken with the following registered Aboriginal parties (RAPs)

- Tharawal Local Aboriginal Land Council (TLALC)
- Cubbitch Barta Native Title Claimants Aboriginal Corporation (CBNTCAC)
- Darug Land Observations (DLO)

- Darug Custodian Aboriginal Corporation (DCAC)
- Darug Aboriginal Cultural Heritage Assessments (DACHA)
- Darug Aboriginal Landcare Incorporated (DALI)
- Banyadjaminga
- Gandangara Local Aboriginal Land Council (2010) (GLALC)
- Tocomwall Pty Ltd (2010).

The field survey identified five artefact sites (MA1-5), three scarred trees (MA6-8) and three potential archaeological deposits (MAPAD1, MAPAD2 and PAD2) as well as sampling three representative landforms according to the predictive statements made for the area (MRSA1-3).

NOHC (2014) established that Early Works activities, as per the Southern rail access option, will result in direct disturbance to the following recorded Indigenous heritage items within the MPW Concept Approval:

- Scarred trees MA6 and MA7
- Artefact occurrences MA2, MA4 and MA5
- Portions of MA9, MA10 and MRSA2 (subsequently updated to MA14).

Based on the recommendations of the assessment, the following mitigation measures were proposed for the impacts caused by Early Works:

Design and Early Works

- If the southern rail access option is selected, a combined geotechnical and archaeological assessment should be undertaken to assess the nature of any deposit and the need for further archaeological investigation and/or salvage
- Options for avoidance of impacts at MA6 and MA7 would be explored during the detailed design phase. If impacts cannot be avoided, consultation would be undertaken with the registered Aboriginal parties regarding options for specialist investigations (e.g. a suitably qualified specialist in eucalypts of the Sydney region and dendrochronology may be engaged to formally assess the age of the trees and their scars) and culturally appropriate mitigation strategies
- An archaeological salvage excavation program would be implemented to conserve archaeological deposits of moderate to high archaeological/scientific significance located within the construction footprint (items recorded at MA5 and MA9). Consideration would be given to conserving both sites in situ, within open space reserves, or an extension of the proposed conservation zone
- A surface salvage program would be carried out to conserve surface artefacts located within the construction footprint (items recorded at MA1, MA2, MA3 and MA4). Salvage of surface artefacts would be undertaken prior to any impacts in these areas
- No further archaeological investigations are warranted at MRSA3 or PAD2.

Construction

The Unanticipated Discoveries Protocol described in Appendix 9 of the Technical Paper 10 – Aboriginal Heritage Impact Assessment in Volume 7 would be followed in the event that historical items or relics or suspected burials are encountered during construction works.

Operation and ongoing

- Consultation would be ongoing with the registered Aboriginal parties throughout the life of the Project and would include:
  - Consultation on the future care and management of recovered Aboriginal objects
  - Methodologies for any future investigations; and finalisation of management and mitigation strategies subject to detailed design.

The key findings of the NOHC report (2014) for the MPW Concept Approval in relation to their impact on the Proposal are outlined in the table below.

Table 16-2: Aboriginal Heritage Assessment - MPW Concept Approval results and items for MPW Stage 2 Assessment

MPW Concept Approval results	Impact on MPW Stage 2 Proposal
The archaeological field survey and subsurface testing demonstrated that the areas of greatest Indigenous significance and archaeological value is the riparian corridor along the Georges River, which is assessed to be of moderate to high significance at local and regional levels. Part of this area would be disturbed during construction of the proposed rail link. However, the Project's main construction footprint is outside the boundary of this corridor.	No construction works are proposed within the Georges River Riparian corridor (conservation buffer zone).
The remainder of the Project site is of low heritage significance due to the effects of European land use - including vegetation clearance, land surface modification, building construction, modification and removal, which have compromised the integrity of any archaeological traces that may exist in the area.	This information is to be used for context in future assessment across the MPW Site
The Project's main construction footprint is located in areas initially considered to be of low Indigenous archaeological potential, which were subsequently assessed to be of no Indigenous heritage significance.	
While the majority of identified Indigenous recordings within the Project footprint would be directly affected, the areas of highest sensitivity would primarily be conserved.	
The Project would affect less than a quarter of the Tertiary terraces within the Project site that are identified to be archaeologically sensitive.	
Impacts to Indigenous sites would occur from direct ground disturbance, indirect ground disturbance (e.g. vehicle movements) and removal of trees.	
Three scarred trees of possible Indigenous origin (MA6, MA7 and MA8) have the potential to be of moderate to high scientific and educational value.	Further assessment of MA6 and MA7 required. MA8 is not located within the construction footprint and therefore will not be impacted by the Proposal.
Sites MA5 and MA9 are also identified as being of moderate to high archaeological significance and/or Indigenous cultural value.	A salvage plan is proposed to be prepared and implemented before impact to these sites during Early Works. Following salvage these sites would no longer be a constraint during the Proposal.
Salvage excavation works for sites MA1, MA2, MA3, MA4, MA5 and MA9 would be undertaken.	
MA10, MA14 and portions of the tertiary terrace are in densely vegetation areas, and would require	Further assessment is required as part of Proposal

MPW Concept Approval results	Impact on MPW Stage 2 Proposal
extensive EEC clearing in order for salvage of these items.	
Part of PAD 2 would be salvaged as part of the MPE Stage 1 works.	Any remaining areas of PAD2 within the project footprint would need to be assessed during development stages following Early Works.

16.1.1 Conditions of Approval

The Conditions of Approval for the Proposal are shown in Table 16-3. These conditions of approval have been taken into account while developing the methodology for the Indigenous heritage assessment for the Proposal.

Table 16-3: Conditions of Approval

Conditions of Approval		Where addressed in this EIS
Schedule 4- Conditions to be met in future development applications		
E19.	All future applications relevant to MA6 and MA7 (Scarred Trees) shall include a consideration of options for managing impacts, including evidence of consultation with Registered Aboriginal Parties.	Section 16.3 and Appendix U of this EIS
E20.	Any future Development Application shall assess heritage impacts of the proposal. a) The assessment shall Consider impacts to Aboriginal heritage (including cultural and archaeological significance), in particular impacts to Aboriginal heritage sites identified within or near the project. Where impacts are identified, the assessment shall demonstrate effective consultation with Aboriginal communities in determining and assessing impacts and developing and selecting options and mitigation measures (including the final proposed measures).	Section 6, 16.3 and Appendix U of this EIS

16.2 Existing Environment

16.2.1 Study Area

The spatial layout of items salvaged as part of Early Works and those remaining for the Proposal are shown in Figure 16-1.

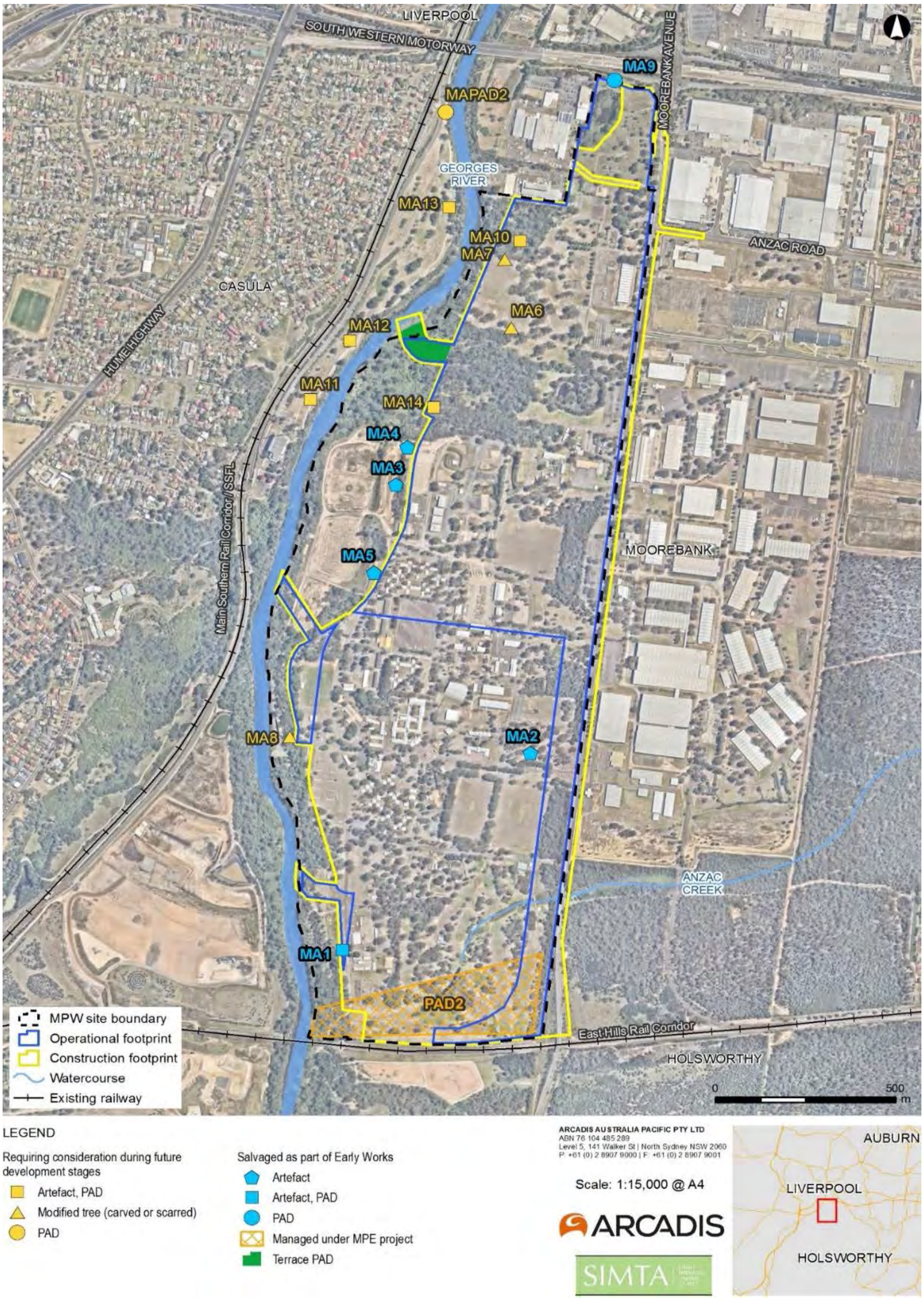

Figure 16-1: Indigenous heritage items remaining following Early Works

16.2.2 Knowledge of Indigenous heritage

The following previous archaeological investigations contribute to existing knowledge regarding Indigenous heritage value of the Proposal site:

Table 16-4: Previous Archaeological investigations

Study description	Conducted by	Date undertaken	Key Findings
A desktop review of the proposal for MPW Concept Approval	NOHC	2011	
Aboriginal Cultural Heritage Assessment (CHAR) of SIMTA Site	AHMS	2012	
Aboriginal heritage assessment for MPW Concept Approval EIS	NOHC	2014	Refer to Section 16.1 of this EIS
Aboriginal heritage assessment addendum – Archaeological subsurface testing of MRSA2	NOHC	Sept 2014	Boundaries of MRSA2 were refined to reflect the concentration of artefacts and the site was designated MA14. The site was recommended for salvage as part of Early Works prior to any impacts occurring.
Aboriginal heritage assessment addendum – Scarred Tree Assessment (MA6 and MA7)	NOHC	2015	Core samples were taken from both trees at locations adjacent to and distant from the scars and analysed. The estimated age range for MA6 was calculated to be between 265 and 219 years old. This indicates that it is likely that MA6 is a culturally modified tree, although this cannot be conclusively determined. The estimated age for MA7 was calculated to be 86 years old. This younger age indicates that it is less likely that MA7 is a culturally modified tree. Navin Officer Heritage Consultants recommended that the management of these sites should be in line with their assessed cultural significance as determined by RAPs involved with the project.
Test Excavation Report for nearby SIMTA Site	AHMS	2015	A test excavation program was conducted within the MPW Stage 1 project area to further determine the nature and extent of the Indigenous heritage resource of PAD2 and PAD3.

Comprehensive contextual background information concerning the Proposal site is presented in the MPW Concept EIS, and summarised in the *Aboriginal Heritage Impacts Assessment Report* (Artefact, 2016).

AHIMS Search

An extensive Aboriginal Heritage Information Management System (AHIMS) search of the Proposal site was undertaken on the 29 January 2016, yielding 16 sites within and adjacent to the Proposal site (Refer to Table 16-5 below).

Table 16-5: Site type and frequency from extensive AHIMS search

Site Type	Frequency	Percentage of total sites (%)
Artefact	5	31
Artefact with PAD	5	31
Modified tree (carved or scarred)	4	25
PAD	2	13
Total	**16**	**100**

Discrepancies in the naming of sites assigned by NOHC (2014), AHMS (2012) and the AHIMS register from previous reports has led to the creation of Table 16-6 below to clarify names in referencing archaeological sites within this EIS. Where sites are registered, the AHIMS name is used, and where sites are not registered, the names used by NOHC have been followed.

Table 16-6: Site names used in this report

AHIMS #	AHIMS name	NOHC Name	AHMS name	Name used in this report
45-5-4281	MAPAD2	MA13	-	MAPAD2
45-5-4427	MA13	-	-	MA13
-	-	MRSA2/MA14	-	MA14
-	-	PAD2	PAD2/MA14	PAD2

An Aboriginal archaeological sensitivity map, developed by NOHC for the MPW Concept EIS identified archaeologically sensitive landform areas in relation to the Proposal site. The likely incidence of Indigenous sites along Georges River riparian corridor is expected to be relatively high, given its value in prehistory as a source of food, camping locations, raw materials and fresh water. These areas are shown in Figure 16-2.

Figure 16-2: Predicted areas of sensitivity for Aboriginal archaeology (Artefact, 2016)

16.2.3 Assessment Methodology

An Aboriginal Heritage Impact Assessment was prepared by Artefact (2016) in accordance with the following 'best practice' guidelines:

- Office of Environment and Heritage (OEH) 'Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales' (2010)
- 'Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation' (2005)

Aboriginal consultation for the Proposal built on consultation undertaken for the MPW Concept EIS, in accordance with OEH Guidelines (refer to Section 16.1 of this EIS). A number of government agencies and Local Aboriginal Land Councils were consulted to identify stakeholders that may hold cultural knowledge relevant to determining the significance of Indigenous objects and places.

Scar trees MA6, MA7 and MA8 identified during previous investigations were revisited, in order to discuss cultural heritage values and management with RAPs. A site visit was organized for June 2016 and attended by Alyce Howard from Artefact Heritage and representatives of the following registered Aboriginal stakeholder groups:

- Tharawal Local Aboriginal Land Council (TLALC)
- Gandangara Local Aboriginal Land Council (GLALC)
- Cubbitch Barta Native Title Claimants Aboriginal Corporation (CBNTCAC)
- Darug Custodian Aboriginal Corporation (DCAC)
- Tocomwall

An additional site visit was conducted in July 2016 to further determine recommendations for scar tree and artefact management. Representatives of the following organisations were on site:

- TLALC
- GLALC
- CBNTCAC
- DCAC
- DACHA

It was agreed by all stakeholders on site at the time of the visit that a favourable option for future management of MA6 and MA7 would be to have an arborist relocate the scarred trees to a TLALC property near Thirlmere. The trees would be maintained at the TLALC property, mounted and housed in weather resistant structure, provided all costs of relocation and construction of the housing is covered by the proponent.

All stakeholders were contacted by phone in August 2016 to finalise recommendations regarding ongoing management of the scar trees MA6 and MA7. This further consultation identified that the relocation of the scar portions of both trees to the TLALC property would be an acceptable solution. Further detail regarding mitigation measures for scar trees are outlined in Section 16.5 of this EIS.

16.2.4 Investigation Findings

Indigenous heritage investigations included a revised desktop update of all Indigenous sites and PADs based on the MPW Concept Approval (NOHC, 2014; NOHC, Sept 2014; NOHC 2015) and an assessment of their archaeological significance. A summary of this assessment is provided in Table 16-7.

Table 16-7: Site identification and assessment of Significance

Site Name	AHIMS number	Site Details	Archaeological Significance
To be salvaged as part of Early Works			
MA1	45-5-4283	3 surface artefacts and PAD. Test excavation revealed a low density subsurface artefact scatter and disturbed deposits	Low
MA2	45-5-4273	Isolated surface artefact in a disturbed context	Low
MA3	45-5-4274	Isolated surface artefact in a disturbed context	Low
MA4	45-5-4275	3 surface artefacts in a disturbed context	Low
MA5	45-5-4276	3 surface artefacts, test excavation yielded a moderate density subsurface artefact scatter. Geomorphological analysis revealed relatively intact deposits	Moderate-high
MA9	45-5-4280	Initially identified as a PAD, test excavation yielded a moderate density subsurface artefact scatter. Geomorphological analysis revealed relatively intact deposits.	Moderate-high
To be salvaged as part of the Proposal			
MA6	45-5-4279	Potentially culturally modified tree. Identified as part of Early Works approval. Subsequent dendrochronological analysis attributed an age of 265-219 years placing the creation of the scar either before or shortly after the arrival of Europeans in Australia.	High
MA7	45-5-4277	Potentially culturally modified tree. Identified as part of MPW Concept Design investigation. Subsequent dendrochronological analysis attributed an age of 86 years placing the creation of the scar c. 1928 after the area had been subsumed for military purposed. This decreases the likelihood of the scar being of cultural origin. However, RAPs agree that cultural scarring practices continued well into the European occupation period and age does not discount this tree from being culturally modified.	Low (note that cultural significance remains high)
MA10	45-5-4282	Initially identified as a PAD, test excavation yielded moderate density subsurface artefact scatter. Geomorphological analysis revealed relatively intact deposits. Additional excavation in the western portion of the site was undertaken in 2014. However, the results of additional test excavation have not yet been produced. Furthermore, though this site was addressed in	Low-moderate

Site Name	AHIMS number	Site Details	Archaeological Significance
		the EIS, it was not included in the MCoA. As such, salvage investigation may be necessary as part of the Proposal.	
MA14	Not registered	Test excavation identified relatively undisturbed artefacts and archaeological deposit within the area of potential. Though this site was addressed in the EIS, it was not included in the MCoA. As such, salvage investigation may be necessary as part of the Proposal.	Moderate to high
MPW Stage 2 Terrace PAD	Not registered	Identified during current investigation. Results from excavation of MA10 and MA14 provide enough information to assess significance.	Moderate
Tertiary terrace (between MA 10 and MA14)	Not registered	Identified by NOHC. Not fully managed under Early Works as the MPW Concept EIS placed a portion of it within a conservation zone that would not be impacted.	Moderate
Not impacted or managed as part of a separate project			
MA8	45-5-4278	Potentially culturally modified tree. Identified as part of MPW Concept EIS investigation. This tree is located outside of the MPW Stage 2 construction zone and was not assessed further.	Moderate-high
MA11	45-5-4425	Surface artefact site and PAD (part of the MAPAD2 complex). Test excavation yielded a low density subsurface artefact scatter in a disturbed context.	Low
MA12	45-5-4426	Surface artefact site and PAD (part of the MAPAD2 complex). Test excavation yielded a low density subsurface artefact scatter in a disturbed context.	Low
MA13	45-5-4427	PAD site recorded on AHIMS. This site is not discussed in any of the previous reporting by NOHC (2014, 2015) or AHMS (2012, 2015)	Unknown
PAD2	Not registered	Test excavation identified a moderate density subsurface artefact scatter, with intact deposits present beneath an upper layer of fill. AHMS (2015) indicated this site has high research potential. AHMS (2015) excavation only targeted the eastern southern and western margins of the PAD. OSL Dating retrieved dates of 18, 000 yBP for the lower assemblage and 3-4,000 yBP for the upper assemblage.	High

Site Name	AHIMS number	Site Details	Archaeological Significance
MAPAD2	45-5-4281	Surface artefact site and PAD (part of the MAPAD2 complex). Test excavation yielded a single artefact and relatively intact subsurface deposits. NOHC designated this location as MA13.	Low
MRSA3	N/A	Test excavation did not yield any artefacts (NOHC 2014) – determined not an Indigenous site	Not a site
PAD3	N/A	Identified as a PAD by AHMS (2012). Test excavation did not yield any artefacts (AHMS 2015) – determined not an Indigenous site	Not a site

A total of 20 areas and sites were initially recorded. Test excavations determined that MRSA3 and PAD3 are not Indigenous archaeological sites and MA13 is of unknown archaeological significance, and therefore will not be listed further in this report.

Of the remaining 17 areas and sites deemed as being relevant to the proposal:

- Eight sites (MA1, MA2, MA3, MA4, MA7, MA11, MA12 and MAPAD2) are deemed to be of low archaeological significance
- MA10 (also called MRSA1 and PAD1) have been assessed as having low-moderate archaeological significance
- The MPW Stage 2 Terrace PAD and the Tertiary Terrace (between MA10 and MA14) are deemed to be of moderate archaeological potential
- Four sites (MA5, MA8, MA9 and MA14) have been assessed as having moderate-high archaeological significance
- One site and one area (MA6 and PAD2 respectively) have been assessed as having high archaeological significance.

16.3 Potential impacts

16.3.1 Construction

The impact assessment carried out was based upon findings of the MPW Concept EIS, and are based on impacts generated as a result of the Proposal, involving direct ground disturbance, indirect ground disturbance (e.g. vehicle movements) and removal of trees.

The impacts incurred to identified Indigenous sites and areas of PAD are detailed in the table below. Impact to a number of recorded sites will be avoided by the Proposal, while others will require impact mitigation and management.

Table 16-8: Summary of impact extent and consequence for relevant heritage items

Site name	AHIMS ID	Type of harm	Degree of harm	Consequence of harm
To be salvaged as part of Early Works				
MA1	45-5-4283	Direct	Total	Total loss of value
MA2	45-5-4273	Direct	Total	Total loss of value
MA3	45-5-4274	Direct	Total	Total loss of value
MA4	45-5-4275	Direct	Total	Total loss of value
MA5	45-5-4276	Direct	Total	Total loss of value
MA9	45-5-4280	Partial	Partial (portion of extended site boundary within construction area)	Partial loss of value
To be salvaged as part of the Proposal				
MA6	45-5-4279	Direct	Total	Total loss of value
MA7	45-5-4277	Direct	Total	Total loss of value
MA10	45-5-4282	Direct	Total	Total loss of value
MA14	Not registered	Direct	Total	Total loss of value
MPW Stage 2 Terrace PAD	Not registered	Direct	Total	Total loss of value
Tertiary terrace	Not registered	Direct	Partial (partially within construction footprint)	Partial loss of value
Not impacted or managed as part of a separate Project				
MA8	45-5-4278	None	None (outside of construction footprint)	No loss of value
MA11	45-5-4425	None	None (outside of construction footprint)	No loss of value
MA12	45-5-4426	None	None (outside of construction footprint)	No loss of value
MA13	45-5-4427	None	None (outside of construction footprint)	No loss of value

Site name	AHIMS ID	Type of harm	Degree of harm	Consequence of harm
MAPAD2	45-5-4281	None	None (outside of construction footprint)	No loss of value
PAD2	Not registered	Direct	Total (MPE Stage 1)	Total loss of value

In summary, the key impact assessment findings for the Proposal are:

- Direct impacts would be incurred to MA6, MA7, MA10, MA14, MPW Stage 2 Terrace PAD and the Tertiary Terrace as part of the Proposal. Impact mitigation/management measures for these items as part of the Proposal are prescribed in Section 16.5 of this EIS
- Direct impacts to sites MA1, MA2, MA3, MA4, MA5 and MA9 would be incurred during Early Works and managed as part of the MPW Concept Approval, therefore no mitigation as part of the Proposal is recommended
- Management of PAD2 would be undertaken as part of the MPE Stage 1 Proposal.

16.3.2 Operation

No impacts to Indigenous heritage were identified for the operational phase of the Proposal.

16.4 Mitigation measures

16.4.1 Construction

It was found that mitigation measures are required to carry out the following activities:

- Management of scar trees MA6 and MA7
- Staged salvage excavation of MPW Stage 2 Terrace PAD
- Staged salvage excavation of the tertiary terrace (between MA10 and MA14)
- Salvage excavation of MA10
- Salvage excavation of MA14.

These findings are based on the assumption that all other mitigation measures identified in the MPW Concept EIS, the Aboriginal Heritage Technical Paper prepared for MPW Concept EIS, additional heritage reporting prepared for Early Works Approval, the REMMs and MCoA have been conducted during Early Works. Where any of those tasks have not been completed during Early Works they will need to be addressed as part of Early Works, prior to construction works commencing.

Assuming that all mitigation measures identified in the MPW Concept EIS and associated documentation are carried out, it is recommended that:

- The scar portions of MA6 & MA7 would be removed by a qualified arborist and relocated to the TLALC property at Thirlmere, or a suitable area identified in consultation with Registered Aboriginal Parties (RAPs). The trees should be mounted and housed in a weather protected structure. All costs associated with the removal, relocation and housing of the trees would be covered by the Proponent. The relevant RAP would be responsible for the maintenance of the housing once established

- Staged salvage excavation of selected areas should be conducted as part of the Proposal, in consultation with RAPs. These stages include:
  - Part 1 would involve dispersed pits placed along transects within the Terrace PAD and the tertiary terrace (between MA10 and MA14 – refer to Figure 16-2 of this EIS)
  - Part 2 would involve open area salvage excavation, targeting the artefact concentrations identified by NOHC at MA10 and MA14, as well as any additional artefact concentrations identified during Part 1
- Where changes are made to the Proposal and areas not assessed by this report or previous reports (NOHC 2014, NOHC Sept 2014, AHMS 2015) are to be impacted, further Indigenous heritage investigation and consultation should take place
- An Aboriginal Cultural Heritage Assessment Report (ACHAR) (also known as a Cultural Heritage Management Plan) would be prepared as part of the CEMP for the Proposal and would outline ongoing management/mitigation measures relating to MA6 and MA7
- An unexpected finds procedure should be included in the ACHAR and in place for the construction phase of the Proposal
- If suspected human remains are located during any stage of the construction works, work should stop immediately and the NSW Police and the Coroner's Office should be notified. The Office of Environment and Heritage, RAPs and an archaeologist should be contacted if the remains are found to be Indigenous
- Consultation with RAPs would continue throughout the life of the Proposal, as necessary. Ongoing consultation with RAPs would take place throughout the reburial of retrieved artefacts and in the event of the discovery of any unexpected Indigenous objects.

16.4.2 Operation

No impacts to Indigenous heritage were identified for the operation phase of the Proposal and as such no mitigation measures are required.

17 NON-INDIGENOUS HERITAGE

A Non-Indigenous (Historic) Heritage Impact Assessment (Artefact, 2016) (Appendix V of this EIS) has been prepared, which assessed the impacts on non-indigenous heritage from the construction and operation of the Proposal.

Table 17-1 sets out the Secretary Environmental Assessment Requirements (SEARs) as they relate to non-Indigenous Heritage, and where these have been addressed.

Table 17-1: SEARS for the Proposal relating to non-indigenous heritage

Section / Number	Requirement	Where addressed in this EIS
10. Historic Heritage	a) Consider impacts to historic heritage. For any identified impacts, the assessment shall: Include a statement of heritage impact Be undertaken by a suitably qualified heritage consultant(s)	Section 17.4 of this EIS
	Outline the proposed mitigation and management measures (including measures to avoid significant impacts and an evaluation of the effectiveness of the measures). Mitigation measures should include (but not be limited to) photographic archival recording and adaptive re-use of buildings or building elements on site) Note: Where historical excavation is proposed, the heritage consultant undertaking the assessment must meet the NSW Heritage Council's Excavation Director criteria	Section 17.5 of this EIS Archival recording and adaptive reuse of archaeological items on site to be undertaken during Early Works

This section summarises the studies undertaken previously for the MPW Concept EIS and, more recently, for the Proposal. This section provides an assessment of potential impacts resulting from demolition of existing buildings on the MPW site as assessed in the *Non-Indigenous (Historical) Heritage Impact Assessment* (Artefact, 2016) (refer to Appendix V of this EIS). Measures to mitigate and manage impacts have also been identified where they are required.

17.1 MPW Concept Approval

A Non-Indigenous Heritage Assessment was prepared by Navin Officer Heritage Consultants (NOHC, 2014) to inform the MPW Concept EIS which covers Early Works activities.

The assessment for MPW Concept EIS comprised of a desktop review, field surveys, test excavations and a follow-up assessment of heritage significance and impacts to individual items and for the MPW site as a whole as it relates to Early Works activities.

The following sites were identified as having nil or low significance and archaeological potential, and no further mitigation was proposed at these sites:

- Farm
- 19C Farm
- Orchard
- 1912-1 (former building)

- 1912-2 (former building)
- SM – 1 (Former loading stage)
- SM – 2 (Former siding and sand loading bins).

A number of items were recognised as potential items of interest. These items have been categorised into archaeological features, potential archaeological deposits, and LEP listed items within the vicinity of the site, and are categorised as such in the following sections.

17.1.1 Archaeological Features

Archaeological features identified on the MPW site include**:**

- MH1 - Explosive Detection Dog (EDD) Cemetery and Memorial Recording
- MH2 - Drainage ditches (military origin)
- MH3 - Portion of light rail (not in situ)
- MH4 - Portion of light rail (not in situ)
- MH5 - Large above ground concrete slab (military origin)
- MH6 - Commemorative garden
- MH7 – Liverpool Golf Course
- CUST Hut
- RAAF STRARCH Hangar
- Building 99 (B99)
- RAE Chapel elements remaining following the MUR Project.

17.1.2 Potential Archaeological Deposits

Potential Archaeological Deposits (PADs) identified on the MPW site include**:**

- MHPAD 1: Site thought to be the location of WWI and WWII period quarters
- MHPAD 2: Site corresponds to the former location of a number of WWII period buildings.

17.1.3 Liverpool Local Environmental Plan 2008 listed items

Liverpool Local Environment Plan 2008 (LLEP) listed items located within the vicinity of the Proposal site include:

- Kitchener House
- Glenfield Farm (Listed on the State Heritage Register and the Register of National Estate)
- The former Casula Power Station, located on the western side of the Georges River to the Project area
- Railway viaduct, Main Southern Railway Line (item 11), located approximately 200 m south of the former Casula power station
- Railway viaduct, Main Southern Railway Line (item 12), located adjacent to Woodbrook Road, Casula.

17.1.4 Mitigation Measures proposed as part of MPW Concept Approval

Based on the recommendations made during the assessment, the following mitigation measures were proposed for the impacts incurred on non-indigenous heritage attributable to Early Works:

- Archival recording would be undertaken prior to Early Works for:
  - CUST Hut earthen floor (subject to investigations to be undertaken during Early Works)
  - RAE Museum and Australian Army Museum of Military Engineering Collections
  - Transport Compound Workshop (Building 99)
  - Dog Cemetery (MH1)
  - Commemorative Gardens (MH6)
  - Remaining elements of the RAE Chapel.
- A non-indigenous heritage interpretation strategy would be developed for the Project to address the tangible and intangible values of the Project site, including consideration of commemorative signage within the MPW site
- An archaeological salvage program would be carried out for all archaeological deposits that are directly affected by the Project
- MHPAD1 and MHPAD2 contain archaeological deposits assessed to be of local significance in the context of the history of military housing and training at Moorebank. Salvage of these archaeological deposits would be undertaken during Early Works, prior to any impacts in these areas

  Potential archaeological deposits have been identified at the CUST Hut; however, access to these deposits was not available at the time of this investigation as the building was still extant. When access is available the same mitigation measures would apply as for MHPAD1 and MHPAD2, pending confirmation of the existence of such deposits at this site
- Consideration is to be given for items noted for archival recording above for adaptive reuse and/or relocation.

17.2 Conditions of Approval

The Conditions of Approval for the MPW Concept EIS relevant to the Proposal are shown in Table 17-2. These conditions of approval have been taken into account while developing the methodology for the Non-Indigenous Heritage Assessment for the Proposal.

Table 17-2: Conditions of Approval

Conditions of Approval		Where addressed in this EIS
Schedule 4- Conditions to be met in future development applications		
E20	Any future Development Application shall assess heritage impacts of the proposal. b) The assessment shall consider impacts to historic heritage. For any identified impacts, the assessment shall: (i) outline the proposed mitigation and management measures (including measures to avoid significant impacts and an evaluation of the effectiveness of the measures). Mitigation measures should	Section 17 and Appendix V of this EIS

Conditions of Approval		Where addressed in this EIS
	include (but not be limited to) photographic archival recording and adaptive re-use of buildings or building elements on site) (ii) be undertaken by a suitably qualified heritage consultant(s) (iii) include a statement of heritage impact.	

17.3 Existing environment

17.3.1 Study Area

Existing environmental conditions for this assessment are those remaining upon completion of the Early Works (assessed in the MPW Concept EIS). All non-indigenous heritage items remaining onsite would be salvaged as part of Early Works.

Figure 17-1 outlines the Proposal construction footprint, the items to be salvaged as part of Early Works, and the LEP listed heritage items within vicinity of the Proposal site.

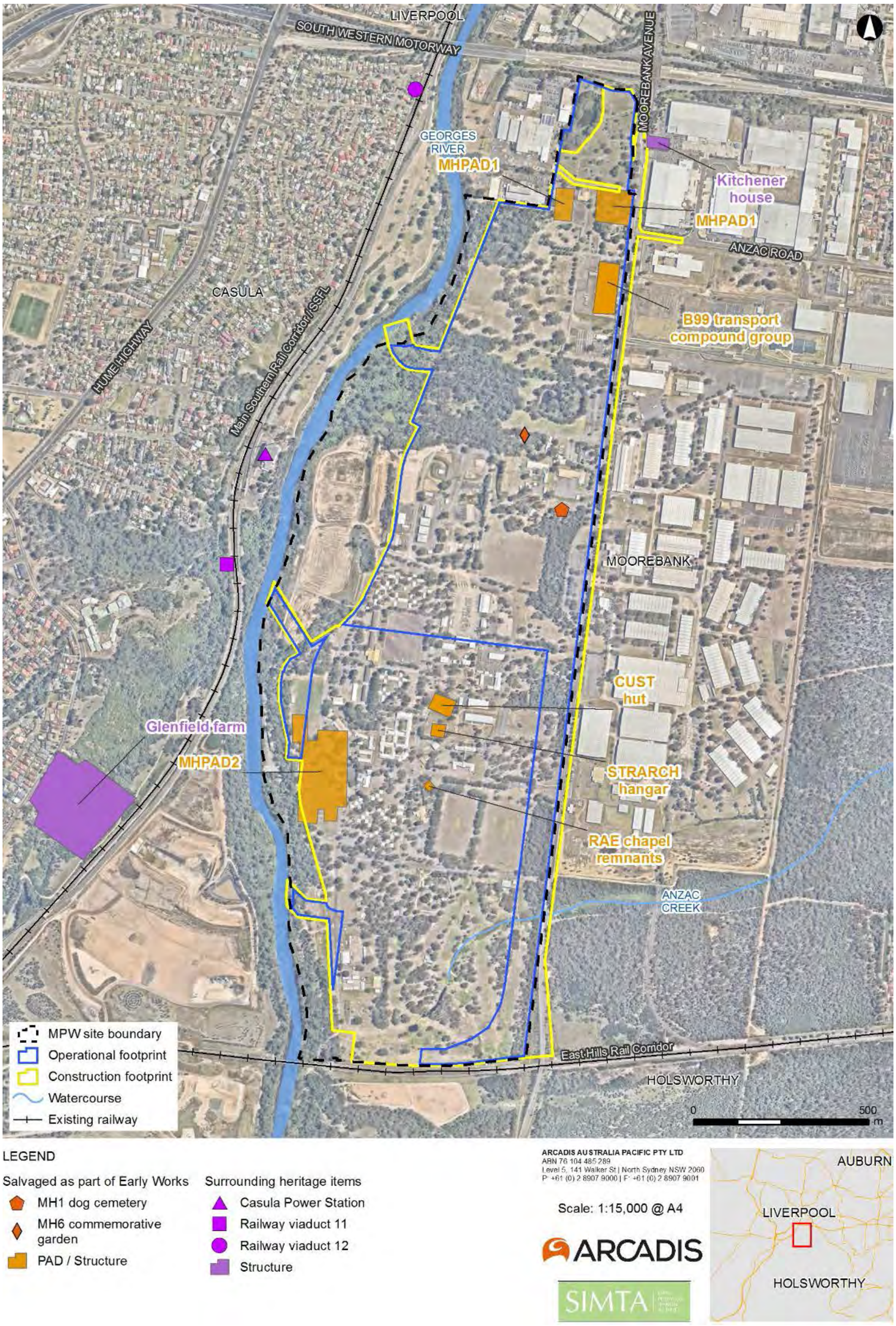

Figure 17-1: Non-indigenous Heritage Items addressed within MPW Early Works and LEP items within vicinity to the site

17.3.2 Historical Background

A detailed description of background context information relating to the MPW site is summarised in Table 17-3.

Table 17-3: Historical background summary for the Proposal site

Year	Occupation	Details
1798-1891	Pre-Military Occupation and use	Thomas Moore acquired land along the eastern bank of the Georges River in 1805. Over the next 15 years Moore received almost 8000 acres of land in grants. Moore partook in agricultural activities on his land. Before his death, Moore transferred his Moorebank estate of approximately 6,400 acres, together with lots he owned in the township of Liverpool, to the church to be held in trust. He similarly left his house and grounds to the church for the establishment of a college for young Protestant men, which later became the Moore Theological College, which was transferred to Newtown in 1891. Up to and after the property was sold in the mid-1880s, many tenants undertook farming and rural pursuits on the land. On the western side of the George's River, Eber Bunker was initially granted 400 acres of land which he named Collingwood. Dairy and tenant farming were undertaken on the property. Following Bunkers' death his land underwent significant change as a result of disposal and development. This area was developed as a golf course in the later twentieth century, and has also seen the recent construction of the Southern Sydney Freight Line.
1894-1915	Military Occupation	From 1811 the Liverpool area was subject to extensive defence involvement. From 1870 annual training military camps were routinely held at Richmond, Campbell Fields, Windsor, the Royal National Park, and Campbelltown. 1894 saw the first military use of Moorebank Estate with artillery, cavalry, light horse, engineer and medical units being used for training in mock military engagement. Brigadier-General J.M. Gordon submitted a plan to the Military Board for a tract of land, including Moorebank, to be resumed for military purposes. Lord Kitchener, after being invited by the government to Australia, spent time staying in a still extant cottage on the eastern side of Moorebank Avenue, the cottage is listed on the NSW State Heritage Inventory. Up to 1915 a number of military buildings were established, including: ▪ A Military Isolation Camp ▪ Mobilisation Stores ▪ Small Arms Ammunition Stores ▪ A rifle range ▪ Official Moorebank Parade Ground.
1914-1918	World War I: Liverpool Camp	Liverpool Camp was utilised by the Australian Imperial Force (AIF) to train new recruits during World War I. Internees at the Old Army Camp at Holsworthy were made

Year	Occupation	Details
		to quarry sandstone, build stone structures and construct a branch of the railway line.
1919-1939	The Inter War Period	The end of World War I saw the buildings at Liverpool Camp used infrequently. Training camps continued to be intermittingly held. During the 1930s Moorebank was used as a Voluntary Trades School. In 1933 a train track was opened for the purpose of sand mining as part of the Moorebank Sand Company, but was no longer in use by May 1938, and the light rail line was later removed during World War II. Despite this activity, most of Moorebank was bushland until the late 1930s.
1939-1945	World War II: Engineers at Moorebank	A military school of engineering was temporarily established at the Liverpool Military Camp. In 1940 the new military school of engineering established the field engineering wing at Moorebank, training camp buildings were built at Moorebank.
1949-1950s	Post War: decline and redevelopment in the 1940s and 1950s	A three phase rehabilitation and redevelopment of the SME site began in the late 1940s until the late 1950s. A chapel was established, with the first service being held on Christmas Day 1957, it was succeeded a decade later buy a purpose built chapel.
1960s - 1970s	Expansion in the 1960s and 1970s	Development during this time included: ▪ A mock Vietnamese village ▪ Two new double story barracks ▪ A new chapel.
1980s-onwards	Development and Organisational Changes from the 1980s onwards	Development during this time included: ▪ A major rebuild of SME's buildings and facilities ▪ The 2nd Training Group, the Eastern Region Cadet Wing and the Education Wing moved from Ingleburn to SME. ▪ During 2003-5 a Vietnam War Memorial was erected at Steele Barracks (previously known as the School of Military Engineering).

17.3.3 Heritage Values

The Non-Indigenous (Historic) Heritage Impact Assessment (Artefact, 2016) (Appendix W) builds upon the investigations and assessments undertaken to inform the MPW Concept EIS (NOHC, 2014). There is one item, the Moorebank Cultural Landscape, remaining for further assessment for this EIS under the Proposal.

In addition, the following heritage items located adjacent to the Proposal require assessment for impact under the Proposal:

- Kitchener House
- Glenfield Farm
- Casula Power Station

A description of relevant heritage items, and their significance as identified on heritage registers is provided below.

On-site items

Moorebank Cultural Landscape

The Moorebank Cultural Landscape significance relates to the numerous phases of land use and occupation spanning from pre-European settlement (Aboriginal occupation) to today relating to the Moorebank area, which includes the Proposal site. The various site toponyms, buildings, spatial organisation, memorials, archaeological deposits and landforms have tangible associations with Thomas Moore, the Australian Army and the Indigenous community. The archaeological deposits identified have the potential to yield further information that would contribute to a further understanding of the areas cultural history. The Moorebank Cultural Landscape has been assessed to be of local and Commonwealth significance in terms of historical associations, research potential, technological characteristics, uniqueness, and Indigenous cultural values (albeit not listed on the Commonwealth Heritage register).

Surrounding items

Kitchener House

Located outside the MPW site boundary, this privately owned building is a Federation cottage used by Lord Kitchener in 1910 to review the status of the Australian Army. The house is representative of the military history of the Liverpool area and the British – Australian links at the turn of the 20th Century. Kitchener House is one of the best preserved Federation bungalows in the Liverpool area. This item is listed locally (Item 58 “Kitchener House” under the Liverpool LEP (2008).

Glenfield Farm

Glenfield farm is an exceptional collection of structures, built in the 19th century, representing one of the last remaining rural farm complexes in use within NSW. The farm provides valuable evidence of the architectural style and construction method of its time. It is associated with prominent 19th century figure Dr Charles Throsby and in the 20th century with James Leacock, an eminent colonial officer and innovative dairy farmer respectively. This item is listed locally (Item 14 “Glenfield Farm”) under the Liverpool LEP (2008).

Casula Power Station

The site known commonly as The Powerhouse Regional Arts Centre (Casula Powerhouse) is representative of the development of the Casula area throughout the 1950’s through the structure’s design and use as a power station during a period of expanded industrial activity and residential growth. The structure consists of the main powerhouse structure with several smaller ancillary buildings, and three large steel tanks presumably for water storage. The structure itself holds technical significance in showcasing the technologies used in energy generation during this period. The site consists of the Power Station Complex, located adjacent to the railway line to the east of Casula Station. This item is listed locally (Item 10 “Casula Powerhouse”) under the Liverpool LEP (2008).

17.4 Potential Impacts

Subsequent to activities assessed under the MPW Concept EIS (including Early Works), and consistent with the SEARs prescribed for this EIS, a summarised Statement of Heritage Impact for the Moorebank Cultural Landscape and four sites adjacent to the proposal (indirect impact) is provided below. It should be noted that removal of the CUST Hut and STARCH Hangar is to be undertaken during Early Works through a process involving the tendering of each item to interested parties for adaptive reuse. These items are therefore not assessed within this section.

17.4.1 Construction

Moorebank Cultural Landscape

The net impact generated by the Proposal would be likely to result in disturbance to archaeological deposits, removal of landscape elements, partial loss of the existing landscape setting, historical associations and the landscape's research potential. The retention of portions of bushland vegetation and some cultural heritage values would assist in preserving the existing cultural values of the Moorebank landscape, along with the archival recording of archaeological items disturbed as a result of the Proposal construction.

Kitchener House

No physical impacts to Kitchener House are anticipated to occur during construction. Visual impacts to this item have been assessed and are included in the Visual Amenity, Urban design and Landscape Report (Appendix T of this EIS). Noise impacts to this item have been assessed as part of the Noise and Vibration Impact Assessment, included as Appendix N of this EIS.

Glenfield Farm

No physical impacts to Glenfield Farm are anticipated to occur during construction. The visual impacts anticipated as a result of the Proposal are assessed in the Visual Amenity, Urban design and Landscape Report (Appendix T of this EIS). Noise impacts, including the anticipated impacts of rail noise to the heritage item are assessed as part of the Noise and Vibration Impact Assessment, included as Appendix N of this EIS.

Casula Power Station

Construction activities would not have a direct physical impact on this item. Any residual visual impacts have been considered are assessed in the Visual Amenity, Urban design and Landscape Report (Appendix T of this EIS). Construction noise impacts are assessed as part of the Noise and Vibration Impact Assessment, included as Appendix N of this EIS.

17.4.2 Operation

Kitchener House

The Proposal would have an indirect visual impact on the view from Kitchener House following the construction of warehouses (Refer to Appendix T of this EIS for Visual Amenity, Urban Design and Landscape Report). Operational noise impacts to Kitchener House were considered and assessed as being within acceptable noise criteria limits (refer to Appendix N of this EIS for Noise and Vibration Assessment).

Glenfield Farm

No direct physical impacts are anticipated to occur to this item as a result of the Proposal. Visual impacts during operation have been assessed as part of the Visual Amenity, Urban design and Landscape Report (Appendix T of this EIS), while noise impacts, including the anticipated impacts of rail noise on the heritage item, have been assessed as part of the Noise and Vibration Impact Assessment, included as Appendix N of this EIS.

Casula Power Station

No direct physical impacts are anticipated to occur to this item as a result of the Proposal. Visual impacts during operation have been assessed as part of the Visual Amenity, Urban design and Landscape Report (Appendix T of this EIS), while noise impacts, including the anticipated impacts of rail noise to the heritage item, have been assessed as part of the Noise and Vibration Impact Assessment, included as Appendix N of this EIS.

17.5 Mitigation Measures

Table 17-4: Mitigation measures – Non-indigenous heritage

Impact	Item	Management measure
Construction		
Impacts to heritage items onsite	Moorebank Cultural landscape	▪ Naming of roads would consider previous School of Military Engineering (SME) street names. ▪ Naming of buildings and roads (in addition to above) would consider commemoration of significant events and individuals related to the Moorebank Cultural Landscape
Impacts to surrounding heritage items	Kitchener House	No additional management required as impacts are negligible
	Casual Power Station	No additional management required as impacts are negligible
	Glenfield Farm	No additional management required as impacts are negligible
General (ongoing management)	Unexpected finds	An unexpected finds protocol (or equivalent) would be included within the CEMP. If unexpected finds are identified during works, a suitably qualified archaeological consultant would be engaged to assess the significance of the finds and the NSW Heritage Council notified. In this instance, further archaeological work or recording may be required.
Operation		
No operational mitigation measures are required for non-indigenous heritage impacts from the Proposal.		

18 GREENHOUSE GAS

A review of direct and indirect greenhouse gas (GHG) emissions was prepared by Arcadis, which assessed the impacts on greenhouse gas emissions from the construction and operation of the Proposal.

Table 18-1 sets out the Secretary's Environmental Assessment Requirements (SEARs) as they relate to GHG emissions, and where these have been addressed.

Table 18-1: SEARs for the Proposal relating to greenhouse gas emissions

Section/Number	Requirement	Where addressed in this EIS
3 (c) Air Quality	An updated assessment/review of direct and indirect greenhouse gas emissions arising from this development and associated impact mitigation requirements, in reference to the Concept Plan greenhouse gas assessment.	Section 18 of this EIS

This Section summarises the studies undertaken previously for the MPW Concept Approval and, more recently, for the Proposal. This Section provides an assessment of potential impacts resulting from construction of the Proposal on GHG emissions. Measures to mitigate impacts have also been identified where they are required.

18.1 MPW Concept Approval

A greenhouse gas assessment was undertaken by Parsons Brinkerhoff as part of the MPW Concept Approval. The assessment described the potential GHG emissions and impacts which were projected to be generated as a result of the construction phases (Phases A, B and C) and operational phases (Phases B, C and Full Build) of the MPW Project.

The assessment considered emissions from the sources outlined in Table 18-2.

Table 18-2: Emissions sources used in the MPW Concept EIS Greenhouse Gas Assessment

Phase	Scope	Emission Source
Construction	Scope 1	Transportation of materials (via heavy vehicles) Light vehicles for staff use Stationary energy including fuel use for construction equipment and diesel onsite generator Woody vegetation clearing
	Scope 2	Consumption of purchased energy from the grid
Operation	Scope 1	Operational fuel usage in locomotives, vehicles and equipment Liquefied natural gas Municipal wastewater Synthetic gases used in refrigeration
	Scope 2	Consumption of purchased energy from the grid

The assessment also considered the changes in GHG emissions due to the replacement of heavy vehicle freight traffic between Port Botany and Moorebank with rail freight. It assessed these emissions in terms of vehicle kilometres travelled for project-related heavy and freight vehicles and the redistribution of background traffic (i.e. light and non-heavy vehicles driven by the general public).

18.2 Methodology

This Assessment has been prepared in accordance with the following general principles and procedures:

- The World Resources Institute/World Business Council for Sustainable Development (WRI/WBCSD) The Greenhouse Gas Protocol – A Corporate Accounting and Reporting Standard Revised Edition (WRI/WBCSD, 2004)
- *National Greenhouse and Energy Reporting (Measurement) Determination 2008* (DoE, 2014a)
- The Department of Environment (DoE) National Greenhouse and Energy Reporting System Measurement: Technical Guidelines for the Estimation of Greenhouse Gas Emissions by Facilities in Australia (NGER Technical Guidelines) (2014b)
- National Greenhouse Accounts (NGA) Factors (DoE, 2015a).

18.2.1 Scope

Under ‘the Greenhouse Gas Protocol’ (WRI/WBCSD, 2004), a Proposal’s direct and indirect emissions sources can be delineated into three ‘scopes’ (Scope 1, Scope 2 and Scope 3) for GHG accounting and reporting purposes. Further details of GHG operational scopes are outlined below:

- **Scope 1: Direct Greenhouse Gas Emissions -** Scope 1 emissions are direct GHG emissions from sources that are owned or controlled by SIMTA. Scope 1 can include direct emissions sources such as fuel consumption within machinery used during construction and operation
- **Scope 2: Indirect Greenhouse Gas Emissions –** These account for GHG emissions arising from purchased electricity consumed on-site. Scope 2 emissions are considered indirect as they occur at an off-site facility where electricity is generated. Scope 2 emissions associated with the Proposal include the electricity that would be consumed within facilities once operational
- **Scope 3: Other Indirect Greenhouse Gas Emissions** – Scope 3 emissions are those that are a consequence of the Proposal, but occur outside the site’s operational boundary and are not under SIMTA’s control, such as construction vehicles and delivery materials to the Proposal site. Scope 3 emissions are an optional reporting category that allows for the treatment of all other indirect emissions.

In accordance with the scope of the MPW Concept EIS Greenhouse Gas Assessment, a quantitative review of the potential Scope 1 and 2 GHG emissions of the Proposal was undertaken. A qualitative assessment of the potential impacts of these emissions on the environment was then developed.

18.2.2 Assumptions and exclusions

This assessment has been undertaken using the best available data at the time of writing. Assumptions have been outlined, where appropriate, to maintain transparency.

General assumptions used for the calculation of GHG emissions include:

- Quantification of potential emissions from the Proposal has been undertaken in relation to carbon dioxide (CO_2) and other non-CO_2 GHG emissions, including methane (CH_4) and nitrous oxide (N_2O). To report these emissions, they are converted to carbon dioxide equivalents (CO_2-e) as specified under the Kyoto Protocol. The Global Warming Potential (GWP) adopted for each GHG is as follows: carbon dioxide GWP of 1; methane GWP of 25; and nitrous oxide GWP of 298, as detailed in the NGA Factors (DoE, 2015a)

- Standard construction work hours were assumed to be 11 hours per day and 5.45 days per week, except for the importation and stockpiling of clean fill during construction works periods A and C, assumed to be 16 hours per day and 5.69 days per week
- Only plant and machinery that would significantly contribute to CO2-e emissions were considered in the assessment
- All cleared vegetation would be composted
- Scope 3 emissions are an optional reporting category that allows for the treatment of all other indirect emissions than those identified as either Scope 1 or Scope 2. Scope 3 emissions have not been calculated as part of this assessment.

Construction

GHG emissions during construction were calculated by estimating the fuel usage of plant and equipment assumed to be required for the specific activities during the construction phase. It was assumed that diesel generators would be used throughout the entire construction period instead of drawing upon the electricity grid, therefore only Scope 1 emissions were calculated.

The calculated fuel usage was converted into tonnes of CO_2-e using factors and methods from the NGA Factors (DoE, 2015a) and NGER Technical Guidelines (DoE, 2014b).

Removal of vegetation during construction would result in the loss of carbon sequestration. The loss of carbon sequestration, while not a true GHG emission, would result in less CO_2 being removed from the atmosphere. Consequently, the loss of sequestration has been assessed as a Scope 1 source of emissions.

Different vegetation types characteristically sequester carbon at different rates and to a different extent. The loss of sequestration was estimated based on the vegetation types to be removed, the likely tonnes of dry vegetation per hectare, and the average emissions factor (TAGG, 2013). Loss of sequestration included all carbon pools including woody, non-woody, debris and soil. To provide a conservative estimate it was assumed that all carbon removed is converted to CO_2 and released to the atmosphere.

Operation

The GHG emissions assessment for the operation of the Proposal was based on the Greenhouse Gas Assessment undertaken by Parsons Brinkerhoff as part of the MPW Concept Approval. The MPW Concept Approval assessment included Scope 1 emissions arising from:

- Light and heavy vehicles
- Locomotives
- On-site equipment, including vehicles for transfer of containers and goods, switch engines and stand-by power generation
- Natural gas usage (used for heating for administration buildings, maintenance and repair facilities and the customs buildings)
- Waste-water treatment
- Refrigerant (HFC R134a) usage (assuming 2% of full containers would be refrigerated)

- Sulfur hexafluoride (SF_6) usage (in switchgear, based on comparisons with similar Sydney infrastructure projects)

Scope 2 emissions were calculated for:

- Electricity to be used on site (purchased from grid) for the container storage yard, IMT facility, refrigerated containers, buildings and warehouse facilities.

The above assumptions were revised for this Proposal as follows:

- The vast proportion of light vehicle usage would be comprised of trips by staff to and from work, which are deemed as Scope 3 emissions and therefore outside the scope of this assessment. The remaining small proportion of emissions arising from on-site activities are deemed immaterial to this assessment
- Diesel heavy vehicles were excluded, as these vehicles would no longer be owned by SIMTA and therefore are deemed as Scope 3 emissions
- The MPW Concept EIS was based on 1.55 million TEUs per annum (an IMEX facility operating at 1.05 TEUs per annum and an interstate facility operating at 0.5 million TEUs per annum), compared to the Proposal at 0.5 million TEUs per annum. Therefore, a factor of 32% was applied to the energy usage assumptions for locomotives, and SF_6 emissions, made under the MPW Concept Approval Greenhouse Gas Assessment in order to estimate these emission sources under the operation of the Proposal.
- The MPW Concept Approval was based on 300,000m^2 of warehousing, compared to the Proposal at 215,000m^2 of warehousing. Therefore, a factor of 72% was applied to the energy usage assumptions for on-site equipment usage.
- GHG emissions due to wastewater treatment were excluded, as treatment would no longer occur onsite
- Natural gas usage was excluded, as it has since been determined there would be no additional gas demand for the Proposal (refer to Appendix H of this EIS)
- Refrigerated containers would no longer be stored at the IMT facility under the Proposal, however some warehousing may be refrigerated. For the purposes of these calculations, it was assumed that 2% of the warehouse space would be refrigerated.
- Emissions arising from electricity usage were calculated using the updated electricity load for the Proposal (refer to Appendix H of this EIS).

As some emissions factors have been updated by the Federal Government since the MPW Concept Approval Greenhouse Gas Assessment was undertaken, these updated emissions factors were used to calculate the Scope 1 and 2 GHG emissions for the Proposal.

Table 18-3: Revisions made to the MPW Concept EIS operational GHG emissions assumptions

Emission Sources (from MPW Concept EIS)	MPW Concept EIS annual energy usage assumptions	Proportion of energy usage which applies to the Proposal	Explanation
Light vehicles used for staff and onsite activities	313,279 L (petrol)	N/A	The majority of these emissions are from light vehicle usage for staff trips to and from work – these emissions are Scope 3 and hence are excluded from this assessment. The remaining small proportion of emissions arising from

Emission Sources (from MPW Concept EIS)	MPW Concept EIS annual energy usage assumptions	Proportion of energy usage which applies to the Proposal	Explanation
			light vehicle usage for onsite activities are deemed immaterial to this assessment.
Diesel heavy vehicle use	1,983,827 L (diesel)	0%	Emissions arising from diesel heavy vehicle use are excluded as this fleet would no longer be owned by SIMTA (therefore categorised as Scope 3 emissions)
IMEX locomotive trains	1,068,600 L (diesel)	32%	Locomotive usage assumed to be proportional to the scope of TEU throughput
Interstate locomotive trains	93,600 L (diesel)		
Fuel use for equipment fleet (forklifts, sidepicks, switch engines and stand-by power generation)	3,075,568 L (liquefied natural gas (LNG) and diesel)	72%	On-site equipment usage assumed to be proportional to the scope of the warehousing floor space
Intermodal terminal vehicles	6,964,200 L (LNG)		
Natural gas distributed in a pipeline	6,903 GJ	0%	Natural gas usage no longer part of Proposal
Wastewater treatment on-site	315 personnel	0%	Onsite wastewater treatment no longer part of Proposal
SF_6 losses	0.2 t	32%	SF_6 losses assumed to be proportional to the scope of TEU throughput
Refrigerant (HFC R134a) losses	19.0 t	N/A	Refrigerant losses assumed to arise from warehouses rather than containers, and hence calculations were updated
Purchased electricity use (storage yard, rail terminal, reefer storage box, flooding lighting, onsite buildings, and warehousing)	136,617,564 kWh	N/A	Emissions arising from electricity usage were based on the updated electricity load of the Proposal for this assessment

18.3 Existing environment

Existing accounts of greenhouse gases provided by the Commonwealth Department of the Environment and Energy (DoEE) estimate that approximately 525.2 mega-tonnes (Mt) of CO_2-e were emitted in Australia in 2014 (DoEE, 2016a).

As per the Intergovernmental Panel on Climate Change (IPCC), and reported within Australia's Greenhouse Gas Inventory, fuel combustion in transportation forms a sub-sector of the energy sector. The combined energy subsectors (including transport) were the largest source of GHG emissions in Australia in 2014, comprising 77% of Australia's total emissions (405.6 Mt CO_2-e) (DoEE, 2016a).

The transport sector accounted for around 23% (92.9 Mt CO_2-e) of Australia's GHG emissions in 2014 and 24% of total GHG emissions in NSW (DoEE, 2016a). Nearly 85% of emissions produced by the transport sector are attributable to the road transport subsector.

Commercial and institutional industries contributed to just 1.31% of the energy sector in Australia in 2014 (DoEE, 2016a).

18.4 Potential impacts

18.4.1 Construction GHG Emissions

GHG emissions during construction were calculated for each construction works period (see Figure 4-9 for the construction layout), as outlined below.

Construction works period A would involve the importation and stockpiling of approximately 400,000m^3 of clean fill and associated site preparation works, over a 3 month period. GHG emissions would arise from diesel fuel usage by earthmoving and vegetation clearing plant. Table 18-4 outlines estimated Scope 1 emissions arising from construction works period A (note – plant and equipment used for installation of temporary construction compounds are accounted for in Table 18-12).

Table 18-4: Construction works period A – Pre-construction stockpiling – estimated GHG emissions

Construction Activity	Scope 1 emissions (tCO_2-e)	Scope 2 emissions (tCO_2-e)
Minor clearing and grubbing	85	-
Implementation of erosion and sediment controls, including temporary sedimentation basin	24	-
Construction of pads for stockpiling and office/amenities and temporary access roads	175	-
Installation of temporary construction compound, including amenities and office	-	-
Importation and stockpiling of approximately 400,000m3 of clean fill	790	-
TOTAL	**1,074**	**-**

Construction works period B would involve site preparation for the remainder of the works, and is assumed to run over a 3 month period. GHG emissions arising from this phase relate to diesel fuel utilised by plant and equipment for earthmoving, vegetation clearing and plant/materials handling. Estimated scope 1 emissions arising from construction works period B are outlined in Table 18-5 (note – plant and equipment used for installation of fences, hoardings, site office and amenities are accounted for in Table 18-12).

Table 18-5: Construction works period B – Site preparation activities – estimated GHG emissions

Construction Activity	Scope 1 emissions (tCO_2-e)	Scope 2 emissions (tCO_2-e)
Clearance of remaining vegetation	361	-
Implementation of erosion and sedimentation controls for remainder of site	66	-
Hard stands for staff parking, laydown areas and temporary batch plant	32	-
Installation of batch plant	1	-
Construction of access roads and site entries	37	-
Installation of fencing / hoardings, site offices / amenities	-	-
TOTAL	**459**	**-**

Construction works period C would involve the importation, stockpiling and placement of 1.2 million m^3 of clean fill, plus drainage, utilities and material crushing, over an estimated time period of 3 years. GHG emissions arising from this works period relate to diesel fuel usage by earthmoving plant, concrete batch plant and associated equipment for concrete pouring, plus crushing and screening equipment. Estimated scope 1 emissions arising from construction works period C are outlined in Table 18-6.

Table 18-6: Construction works period C – Bulk earthworks, drainage and utilities – estimated GHG emissions

Construction Activity	Scope 1 emissions (tCO_2-e)	Scope 2 emissions (tCO_2-e)
Importation, stockpiling and placement of 1.2m m3 of clean fill	4,390	-
Installation of OSDs, drainage and utilities	759	-
Crushing of demolition waste from Early Works, on-site spoil reuse and oversized fractions from imported fill	78	-
TOTAL	**5,227**	**-**

Construction works period D would involve an upgrade to Moorebank Avenue intersection and construction of the internal road network, over an estimated time period of nine months. GHG emissions arising from this works period relate to diesel fuel usage by earthmoving and road construction plant, concrete batch plant and associated equipment for concrete pouring. Estimated scope 1 emissions arising from construction works period D are outlined in Table 18-7.

Table 18-7: Construction works period D – Moorebank Avenue intersection works and internal road network – estimated GHG emissions

Construction Activity	Scope 1 emissions (tCO_2-e)	Scope 2 emissions (tCO_2-e)
Remove existing pavements	17	-
Earthworks, drainage, utilities and road base	849	-
Asphalt and concrete pavement, concrete kerbs and gutters	96	-
Road markings, signage, landscaping	8	-
TOTAL	**961**	**-**

Construction works period E would involve the construction of the IMT facility and Rail link connection, which is planned to be undertaken over a period of 15 months. GHG emissions arising from this construction works period relate to diesel fuel usage by earthmoving plant, materials handling plant, concrete batch plant and associated equipment for concrete pouring. Estimated GHG emissions for construction works period E are outlined in Table 18-8.

Table 18-8: Construction works period E – IMT facility and Rail link connection construction – estimated GHG emissions

Construction Activity	Scope 1 emissions (tCO_2-e)	Scope 2 emissions (tCO_2-e)
Importation and placement of engineering fill and ballast material	663	-
Construction of rail hardstand and rail	379	-
Construction of IMT facility slab / foundations	7	-
Structural works for IMT facility	66	-
Internal fit-out of IMT facility	29	-
TOTAL	**1,130**	**-**

Construction works period F would involve the construction and fit-out of the warehousing, estimated to run over a period of 2.5 years. GHG emissions arising from this works period relate to diesel fuel usage by earthmoving plant, concrete batch plant, equipment required for concrete pouring, piling equipment, and materials handling equipment. Estimated GHG emissions for works period F are outlined in Table 18-9 (note – plant required for the establishment of site offices, compound, temporary fences and hoardings are included in Table 18-12 and emissions generated by external pavement works are accounted for in Table 18-7).

Table 18-9: Construction works period F – Construction and fit-out of warehousing – estimated GHG emissions

Construction Activity	Scope 1 emissions (tCO_2-e)	Scope 2 emissions (tCO_2-e)
Establishment of compound, site offices, temporary fences / hoardings	-	-
Earthworks	542	-
Foundations and slabs	65	-
Structural works	265	-
Internal fit-out	263	-
External pavement works (accounted for in Part D)	-	-
Landscaping	143	-
TOTAL	**608**	**-**

Construction works period G involves miscellaneous works to complete the Proposal, including decommissioning of the construction area, commissioning of operational facilities, landscaping and rehabilitation, over a period of 3 months. GHG emissions arising from this works period relate to diesel fuel usage by earthmoving plant, materials handling equipment and landscaping plant. Estimated GHG emissions arising from construction works period G are outlined in Table 18-10.

Table 18-10: Construction works period G – Miscellaneous structural construction and finishing works – estimated GHG emissions

Construction Activity	Scope 1 emissions (tCO_2-e)	Scope 2 emissions (tCO_2-e)
Decommissioning of the construction area, commissioning of operational facilities, rehabilitation and landscaping	316	-
TOTAL	**316**	**-**

Vegetation would be removed during construction works periods A and B, comprising of:

- 17ha of Eucalypt Open Forest
- 31ha of Eucalypt Tall Open Forest.

Table 18-11 outlines the estimated GHG emissions associated with the carbon sequestration loss due to vegetation clearing (note – emissions arising from diesel fuel usage by vegetation clearing plant and mulchers is included in Table 18-4 and Table 18-5).

Table 18-11: Construction vegetation clearing – estimated GHG emissions

Construction Activity	Scope 1 emissions (tCO_2-e)	Scope 2 emissions (tCO_2-e)
Vegetation carbon sequestration loss	20,811	-
TOTAL	**20,811**	**-**

Certain items of plant and equipment would be required throughout most or all of the construction period, such as cranes, excavators, telehandlers and diesel generators (to power site offices, amenities, mobile lighting and other equipment not included in the above Phases). Table 18-14 outlines the estimated GHG emissions associated with the diesel usage of this equipment throughout the construction works.

Table 18-12: General construction activities – estimated GHG emissions

Construction Activity	Scope 1 emissions (tCO_2-e)	Scope 2 emissions (tCO_2-e)
General construction works	1,327	-
TOTAL	**1,327**	**-**

In total, it is estimated that 32,724 tCO2-e (Scope 1) would be generated by the construction of the Proposal. Figure 18-1 demonstrates the contribution of each construction element to the total generation. Carbon sequestration loss due to vegetation removal comprises 64% of the emissions, with Phase C (bulk earthworks, drainage and utilities) contributing 16% of the emissions.

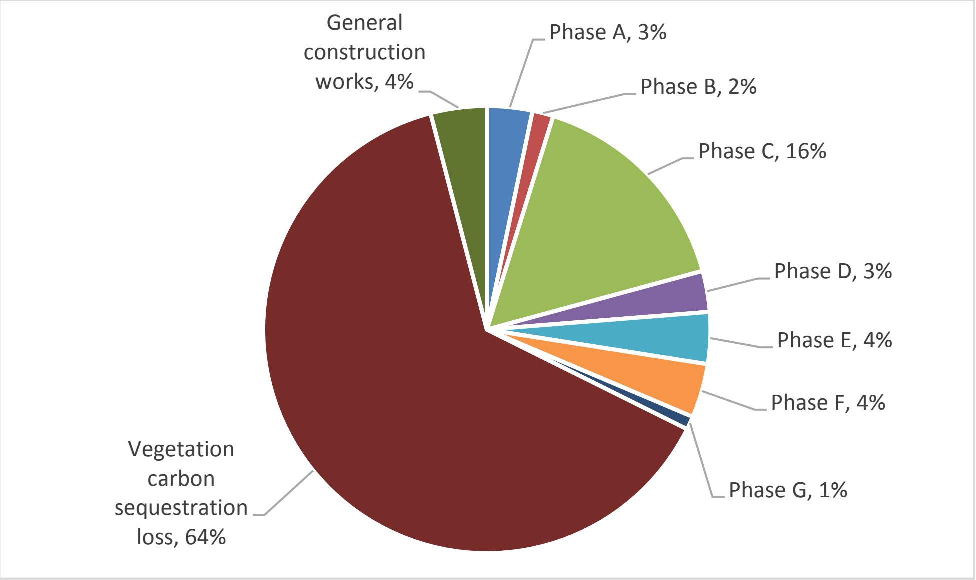

Figure 18-1: Composition of construction GHG emissions

18.4.2 Operation GHG Emissions

Scope 1 and 2 GHG emissions during operation of the Proposal would be generated by:

- Light vehicles (for onsite usage)
- On-site equipment used for operation of the Proposal, such as forklifts, sidepicks, switch engines and stand-by power generation
- SF_6 losses arising from its use in switchgear
- Refrigerant losses arising from refrigerated warehouse space
- Electricity purchased from the grid to service the rail terminal, carparks, internal roadways, and warehousing.

Table 18-13 outlines the Scope 1 and Scope 2 GHG emissions estimated to be annually generated by the Proposal, once fully operational.

Table 18-13: Estimated operation GHG emissions

Emission Source	Energy usage assumptions	Scope 1 emissions (t/CO_2-e/yr)	Scope 2 emissions (t/CO_2-e/yr)
Locomotive trains	371,904 L/yr (diesel)	1,012	-
Fuel use for equipment fleet	4,450,673 L/yr (LNG and diesel)	8,994	-
SF6 losses	0.06 t/yr	1,471	-
Refrigerant (HFC R134a) losses	0.024 t/yr	34	-
Electricity use	53,691,354 kWh/yr	-	45,101
TOTAL		**11,511**	**45,101**

Freight transport emissions

The purpose of the assessment of freight transport GHG emissions is to provide an indication of the GHG emissions associated with the Proposal from the change in freight distribution methods and locations. This section, consequently, describes the total GHG emissions associated with freight transport without apportioning the relevant responsibility for these GHG emissions. As a result, freight distribution GHG emissions have been assessed, and calculated, as Scope 1 emissions.

The MPW Concept EIS Greenhouse Gas Assessment found that there would be an overall reduction of approximately 7,300 tCO_2-e per year as a result of shifting freight transport from road to rail. It also found that there would be a minor increase in background traffic emissions, amounting to 884 tCO_2-e per year.

An estimate of the reduction in GHG emissions for the Proposal associated with the change in transport mode was calculated by applying the factor of 32% (see Section 18.2.2 - Operation) to the estimation of 7,300 tCO_2-e per year, resulting in a reduction of 2,355 tCO_2-e per year. The increase in background traffic emissions were assumed to be similar to that calculated under the MPW Concept EIS Greenhouse Gas Assessment.

This resulted in a total reduction of 1,471 tCO_2-e per year (Scope 1) due to the changes in freight transport under the Proposal.

18.5 Summary of GHG emissions

A summary of the GHG emissions estimated to be generated by the Proposal is outlined in Table 18-14. The total annual emissions of the Proposal amount to 0.01% of Australia's total annual GHG emissions (525.2 Mt CO_2-e)[56] and 0.07% of Australia's total transport emissions (92.9 Mt CO_2-e).

[56] DoEE, 2016a

Corporate GHG emissions of over 50,000 tCO2-e per year, or facility emissions of over 25,000t CO2-e per year, will trigger reporting requirements under the *National Greenhouse and Energy Reporting* (NGER) *Act 2007*.

Obligations under the NGER Act are based on which members have operational control over facilities, that meet a facility threshold or that contribute to meeting a corporate-level threshold. The potential liabilities under the NGER Act would be identified by the proponent to determine any requirements for monitoring and reporting. Monitoring and reporting of GHG emissions would be carried out for the operation of the Proposal on an annual operational basis for incorporation into NGER reporting for the operationally controlling corporation.

Table 18-14: Summary of GHG emissions generated by Proposal

Proposal Stage	Scope 1 emissions (tCO_2-e)	Scope 2 emissions (tCO_2-e)	Total emissions (tCO_2-e)
Construction (emissions over entire construction period)	32,724	-	32,724
Operation (annual emissions)	11,511	45,101	56,612

18.6 Mitigation measures

The following actions would be implemented, where reasonable and feasible, for mitigation of GHG emissions during construction:

- Construction works would be planned to minimise double handling of materials
- Construction/transport plans would be incorporated within the CEMP to minimise the use of fuel during construction
- Fuel efficiency of the construction plant/equipment would be assessed prior to selection, and where practical, equipment with the highest fuel efficiency and which uses lower GHG intensive fuel (e.g. biodiesel) would be used
- On-site vehicles would be fitted with exhaust controls in accordance with the *Protection of the Environment Operations (Clean Air) Regulation 2010,* as required
- Regular maintenance of equipment would be undertaken to maintain good operations and fuel efficiency
- Where practicable, trucks removing waste from the site or bringing materials to the site would be filled to the maximum amount allowable, depending on the truck size and load weight, to reduce the number of traffic movements required
- The mitigation measures, management strategies and abatement opportunities presented would be reviewed and considered where appropriate for incorporation into the Construction Environmental Management Plan (CEMP).

The following actions would be implemented, where reasonable and feasible, for mitigation of GHG emissions during the operation of the Proposal:

- Energy efficiency design aspects would be incorporated wherever practicable to reduce energy demand
- Fuel efficiency of the operation plant/equipment would be assessed prior to selection, and where practical, equipment with the highest fuel efficiency and which uses lower GHG intensive fuel (e.g. biodiesel) would be used

- Energy-efficient guidelines for operational work would be considered and implemented where appropriate and regular maintenance of equipment would be undertaken to maintain fuel efficiency
- Methods to reduce losses from industrial processes (refrigerants and SF6) would be investigated during detailed design
- Consideration would be given to undertake further investigation and implementation of cost negative abatement opportunities
- Investigate and, where possible, implement key performance indicators (KPIs) for plant efficiency and GHG intensity

The mitigation measures, management strategies and abatement opportunities presented in this report would be reviewed and considered where appropriate for incorporation into the Operational Environmental Management Plan (OEMP).

19 CUMULATIVE IMPACTS

This section provides an assessment of the cumulative impacts arising from the Proposal in conjunction with the Early Works phase of the Proposal, the adjacent MPE Project as well as other planned or proposed developments on the local area.

Table 19-1 sets out the Secretary's Environmental Assessment Requirements (SEARs) as they relate to cumulative impacts, and where these have been addressed within this section.

Table 19-1: SEARs for the Proposal relating to cumulative impacts

Section/Number	Requirement	Where addressed in this EIS
General Requirements	Where relevant, the assessment of the key issues below, and any other significant issues identified in the risk assessment, must include: ▪ consideration of potential cumulative impacts due to other development in the vicinity.	All Sections of this EIS

This section summarises the studies undertaken previously for the MPW Concept Approval and, more recently for the Proposal. This section provides an assessment of cumulative impacts resulting from the construction and operation of the Proposal. Measures to mitigate impacts have been identified where they are required.

In addition to the issues that require consideration or assessment of cumulative impacts in the SEARs, this section also provides a discussion of the cumulative impacts associated with several additional environmental aspects, which were considered likely to result in potential cumulative impacts. The following environmental aspects were considered:

- Traffic and Transport
- Noise and vibration
- Air Quality
- Human health
- Biodiversity
- Hazard and risk
- Visual amenity, urban design and landscape

19.1 MPW Concept Approval

An assessment was undertaken by Parsons Brinkerhoff (2014) as part of the MPW Concept EIS to consider the cumulative impacts of the MPW Project with the impacts of the adjoining MPE Project and other surrounding developments. The assessment considered each Project cumulatively at full build.

The SEARs for the MPW Concept Approval required the consideration of cumulative impacts associated with the MPW Project and the adjacent MPE Proposal. Rail network constraints[57] and freight demand analysis revealed that assessing both Projects at maximum allowable capacity under both the MPE and MPW Concept Approvals was

[57] Cumulative assessment scenarios undertaken for the MPW Concept Approval were based on identified rail network constraints restricting total throughput via the SSFL at 1.7 million TEUs a year.

not appropriate. Three scenarios were therefore assessed ranging in combined annual throughput of between 500,000 TEU and 1.55 million TEU, based on operations of both Projects at the year 2030. Assessment of each cumulative scenario took into consideration the qualitative and quantitative impacts to the MPW site and the surrounding community during the operational phase. A summary of these scenarios is provided below.

Table 19-2: Cumulative impact scenarios

Scenario	MPW site	MPE site
Cumulative impact scenario 1	▪ IMEX terminal at 1.05 million TEU per year ▪ Interstate terminal at 500,000 TEU per year ▪ 300,000 sq. m warehousing	▪ 300,000 sq. m warehousing
Cumulative impact scenario 2	▪ IMEX terminal at 500,000 TEU per year ▪ Interstate terminal at 500,000 TEU per year ▪ 300,000 sq. m warehousing	▪ IMEX terminal at 500,000 TEU per year ▪ 300,000 sq. m warehousing
Cumulative impact scenario 3	▪ Interstate terminal at 500,000 TEU per year ▪ 300,000 sq. m warehousing	▪ IMEX terminal at 1 million TEU per year ▪ 300,000 sq. m warehousing

The approach to assessing the impacts of the cumulative scenarios involved:

- Qualitative assessment of cumulative construction impacts, where construction activities and scheduling are expected to overlap. Construction related cumulative scenarios included:
  - Both projects under construction (no operational elements)
  - One project under construction during operation of the other
  - A mixture of construction and operational activity occurring simultaneously on both projects.
- Assessment of the cumulative operational impacts once both sites are fully developed, i.e. at Full Build (2030), including quantitative assessment of the key focus areas of air quality, noise, traffic and biodiversity and a qualitative assessment of other environmental issues.

The cumulative construction impact assessment was carried out at a time when construction timing and phasing of the two adjacent proposals was unknown. Therefore a high level approach was undertaken assuming some overlap at key stages of construction.

The operational assessment assumed a worst case scenario of both projects operating at maximum allowable capacity in the year 2030, considering major cumulative impacts relating to traffic, local air quality, noise and vibration and biodiversity impacts. Other cumulative operational impacts were assessed qualitatively at high level.

The methodology and results of the cumulative construction and operational assessments undertaken for the MPW Project have been summarised in Table 19-3.

Table 19-3: Cumulative impacts identified for key issues in the MPW Concept EIS

Issue	Cumulative impacts identified in the MPW Concept EIS
Traffic	**Methodology** The approach to assessing the cumulative traffic and transport impacts of the MPW Project and MPE Project included: ▪ Calculating the expected traffic generation from each project at the maximum allowable capacity under the MPE and MPW Concept Approvals (2030) ▪ Modelling the proposed future intersection upgrades along Moorebank Avenue using SIDRA to forecast the operation of the network for 2030, at full operation of the MPW Project and the MPE warehousing development. **Construction impact assessment** It was determined that the cumulative traffic impacts on the local road network during concurrent construction of the MPW Project (Phase A) and the MPE Project (Stage 2) are not likely to be significant. The majority of the road upgrade works associated with the MPW Project would be undertaken during the early phases of Phase A when construction of the MPE Project would not be occurring. The intersection upgrades required to provide access to the MPE site are not likely to overlap with the construction period for the MPW Project. The potential partial overlap of the Early Works and MPE Stage 1 Proposal would not be likely to result in more than minor increases in traffic movements above those already occurring for the MPE Stage 1 Proposal. **Operation impact assessment** The analysis undertaken found that intersections along Moorebank Avenue would experience an increase in Degree of Saturation (DoS) and delay times, however all intersections would operate with a satisfactory Level of Service (LoS) or better, except the intersection of Moorebank Avenue and Anzac Road. It was recommended that intersection upgrades would be required at Moorebank Avenue, Anzac Road and Bapaume Road to address the impacts under the assumptions associated with scenario 3.
Air Quality	**Methodology** The cumulative air quality assessment included consideration of the potential impacts of each of the three cumulative scenarios of the MPW Project and MPE Project. The approach to assessing the cumulative air quality impacts included: ▪ Analysis of appropriate background air quality data and representative meteorological conditions (to determine the existing climate and ambient air environment to be used in air quality modelling) ▪ Reviewing potential air emission sources for the operational phases of the MPW Project and the MPE Project ▪ Developing an air emission inventory of all potential local air pollutant sources for the Proposal and the MPE Project ▪ Quantitative assessment of potential local air quality impacts during operation of the MPW Project and MPE Project, using the AMS/US-EPA regulatory model (AERMOD).

	Construction impact assessment During construction, potential cumulative impacts to air quality would predominately be the generation and deposition of dust and particulate matter from activities including vegetation clearing/earthworks, demolition and handling of spoil. Wind erosion is recognised as a risk on site from exposed surfaces during site preparation and access road construction. It was anticipated however that the scheduled timing for the construction of the two developments would avoid any major cumulative impacts with regard to air quality. **Operations impact assessment** The incremental air pollutant concentrations assessed for the operation of both Proposals were predicted to be within the NSW EPA and NEPM criteria for all three cumulative scenarios. Ambient background exceedances of the NSW EPS 24-hour for PM_{10} and $PM_{2.5}$ were recognised at the closest receptor to the Project site boundary. However, this was concluded to be the result of extensive bushfire that took place in 2013.
Noise and vibration	**Methodology** The cumulative noise and vibration impacts of the MPW Project and the MPE Project included: ▪ Undertaking a quantitative assessment of potential impacts at nearest receivers for the operation of the MPW Project and MPE Project ▪ Assessing potential noise and vibration from road and rail traffic movements on the surrounding transport networks for the MPW Project and MPE Project. The noise impacts for the cumulative scenario 1 were assessed under both unmitigated neutral and adverse meteorological conditions. However, due to limited availability of assessment information, the impacts of cumulative scenarios 2 and 3 were only assessed for neutral conditions as information on adverse metrological conditions was not available. **Construction impact assessment** It was determined that the worst case noise conditions for the MPW Project would not overlap with the worst case construction phase for the MPE Project, which is expected to be in Stage 1. On this basis, the noise impacts generated during the overlapping construction of the MPW Project and MPE Project were considered likely to be minor. In terms of the potential overlap of the Early Works and the MPE Stage 1 Proposal, the cumulative impacts of both projects would not likely result in more than a minor increase above the levels already experienced for construction of Stage 1. **Operations impact assessment** Modelling undertaken to assess cumulative noise and vibration impacts of the MPW Project with the MPE Project found that, depending on the scenario assessed, potential exceedances may occur during the evening and night time in Casula, under neutral meteorological conditions only.
Biodiversity	**Methodology** In relation to impacts on biodiversity, all three cumulative scenarios assessed concluded that the MPW Project and MPE Project would cumulatively result in the loss of vegetation.

	Impact assessment It was assessed that the cumulative effect of development on both sites would result in the removal of approximately 75– 84 ha of vegetation. However, no population of any species of local occurrence known or likely to be present on the Proposal site is considered likely to be on the verge of a critical threshold for habitat loss or degradation. Any increase in the cumulative impact of both the MPW Project and the MPE Project would require corresponding increase in the provision of suitable offsets.
Heritage	**Methodology** The cumulative Indigenous and non-Indigenous impacts have been assessed by considering the combined impact of development on the MPW Project with the MPE Project (i.e. disturbance area). **Impact assessment** The assessment found that previous and existing activities on each of the sites has resulted in a high level of disturbance to the site. The assessment found the cumulative impacts on Indigenous heritage from the MPW and MPE Projects would be negligible, however further testing is required to confirm this. The impact on European heritage on the MPE site including the loss of WWII buildings, would further compound the rarity and representativeness of any remaining heritage items both within the MPW site and the wider landscape.

Cumulative impacts for other aspects, including human health, hazards and risks, hydrology, greenhouse gases, visual, regional air quality, social impacts and waste and resources management were considered and no significant impacts were anticipated. Measures to mitigate cumulative impacts identified would include measures already proposed as part of the MPW Concept EIS in combination with measures proposed for the MPE Project. The measures would be confirmed at detailed design and subsequent applications. There are no Conditions of Approval (prescribed under *Schedule 4 - Conditions to be met in future development applications*) relating to the Proposal for cumulative impacts. It was demonstrated that, with the appropriate mitigation measures applied throughout both sites, the Project can achieve compliance with environmental requirements.

19.2 Methodology

19.2.1 Surrounding developments identified

MPE Concept Plan Approval

Concept Plan Approval (MP 10_0193) for an IMT facility at Moorebank, NSW (the Moorebank Precinct East Project (MPE Project)) was received on 29 September 2014 from the NSW Department of Planning and Environment (DP&E). The Concept Plan for the MPE Project involves the development of an IMT, including a rail link to the Southern Sydney Freight Line (SSFL) within the Rail Corridor, warehouse and distribution facilities with ancillary offices, a freight village (ancillary site and operational services), stormwater, landscaping, servicing, associated works on the eastern side of Moorebank Avenue, Moorebank.

MPE Stage 1 Proposal

The MPE Stage 1 Proposal (SSD 6766) involves the construction and operation of Stage 1 of the MPE Concept Plan comprising of the following components:

- An IMT facility operating 24 hrs, seven days a week with a capacity to handle up to 250,000 TEUs including: truck processing and loading areas; rail loading and container storage areas; and an administration facility and associated car parking
- A Rail link connecting the southern end of the site to the SSFL
- Associated works including: rail sidings; vegetation clearing, remediation and levelling works; and drainage and utilities installation.

Glenfield Landfill

This proposed SSD (SSD - 13_6249) involves the development of a Materials Recycling Facility within the bounds of the current landfill site at Glenfield. The proposal has been put forward by Glenfield Waste Services (GWS) and is on land owned by the GWS Group.

The proposal would involve expanding and relocating the existing recycling facility to unfilled (virgin) land on the southern portion of the Glenfield Waste Facility site, south of the East Hills Rail Corridor. The proposal will be located across approximately five hectares in four differentiated but adjoining areas, and positioned to avoid existing landfill cells.

The facility would have capacity to process and/or recycle approximately 450,000 tonnes per annum (tpa) of non-putrescible waste, consisting primarily of commercial and industrial, and construction and demolition waste for reuse in secondary markets. Traffic access to the facility would utilise the existing main southern entry of the Glenfield Waste Facility site off Cambridge Avenue. Trucks would enter via Cambridge Avenue to an inspection point and then proceed to a receival area.

The SEARs for the proposal were issued in December 2013.

19.2.2 Assessment approach

This assessment considers both construction and operational cumulative scenarios associated with the Proposal and surrounding developments identified above (namely, the MPE Stage 1 Proposal). The construction cumulative scenario has taken account of activities overlapping within the vicinity of the Proposal site according to scheduling information. These activities include the final stages of Early Works activities, the construction activities associated with the Proposal, and the latter stages of MPE Stage 1 construction activities.

The operational cumulative impact scenario considers the Proposal operating at 500,000 TEU throughput combined with the MPE Stage 1 Proposal operating at 250,000 TEU throughput, incorporating a total of 750,000 TEU throughput for the two sites running concurrently.

The Glenfield Recycling Facility (Materials Recycling facility) Proposal was issued with SEARs in December 2013 (SSD 13_6249). Cumulative assessment modelling has considered the constraints presented by this development where applicable.

Traffic and Transport

To assess cumulative impacts associated with traffic and transport, separate construction and operational cumulative scenarios were selected to best represent worst-case conditions. The cumulative scenarios for both construction and operation identified the traffic impacts of MPE Stage 1 Proposal in terms of best available information at the time of writing.

The cumulative construction traffic scenario assessed impacts during the peak construction period[58]. This scenario assumed that the peak construction period would occur concurrently with MPE Stage 1 operation in mid-2018. It also assumed the new site access at Moorebank Avenue/Anzac Road intersection is constructed. SIDRA modelling on the predicted delays and LoS was calculated for relevant intersections and access points for the existing traffic conditions (without the Proposal) and was compared with delays and LoS for the peak construction period in 2018.

Regarding the cumulative operational traffic assessment, it was understood that the Proposal would be operating at the same time as the MPE Stage 1 Proposal as early as 2019. The assessment therefore analysed Proposal operations in conjunction with the operation of MPE Stage 1 at two separate time frames: 2019 and 2029 at the eight key intersections impacted by the Proposal, during the AM and PM peak periods. The baseline data used for the operational assessments focussed on the estimated network performance of the surrounding area without the Proposal “no-worsening of the without Proposal intersection performance” approach[59]. Intersection modelling was undertaken using traffic analysis software (SIDRA V.7) and the LoS criteria as outlined in greater detail in Section 7.2 and Appendix M of this EIS.

Other aspects affecting traffic distribution, including hours of operation for this assessment are consistent with those outlined within Section 7.2 and Section 4 of this EIS.

Noise and Vibration

A cumulative noise and vibration assessment for the Proposal was carried out by Wilkinson Murray (Appendix N of this EIS) for both construction and operational scenarios.

The cumulative construction noise scenario accounted for the cumulative predicted noise impacts associated with Proposal construction activities, MPW Early Works activities and MPE Stage 1 construction works. The highest predicted $L_{Aeq,\,15min}$ construction noise levels at sensitive receivers during relevant phases for each concurrent project were used for the assessment to attain a worst-case construction cumulative scenario to assess against the NMLs established for the Proposal[60].

The cumulative operational noise assessment included the concurrent operation of the Proposal with the MPE Stage 1 Proposal. As is noted in Section 8.4.2.4 of this EIS, The $L_{Aeq,\,period}$ noise levels at sensitive receivers due to the concurrent operation of both facilities have been predicted by combining the computer noise models developed for each proposal, and assessed against the relevant amenity criteria.

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[58] The peak construction period with respect to traffic is anticipated during the overlap in works periods C, D, E and F, which are each described in Section 4.3 of this EIS (Project Description).

[59] The “without Proposal” traffic forecast is based on traffic growth forecasts from the RMS LMARI AIMSUN traffic model. Refer to Section 7.2 of this EIS for greater detail on network operational performance without the Proposal.

[60] Predicted $L_{Aeq,\,15min}$ construction noise levels for the MPW Early Works have been taken from *Moorebank Intermodal Terminal EIS – Noise and Vibration Impact Assessment*, prepared by SLR Consulting, dated October 2014. Predicted $L_{Aeq,\,15min}$ construction noise levels for the MPE Stage 1 project have been taken from *SIMTA Intermodal Terminal Facility – Stage 1 – Noise and Vibration Impact Assessment*, prepared by Wilkinson Murray, dated May 2015.

Due to the large separation distances between the Proposal and nearby sensitive receivers, construction and operational vibration impacts are considered unlikely. Further detail regarding vibration impacts created as part of the Proposal are outlined in Section 8.2.2 of this EIS.

Air Quality

A cumulative impact assessment of air quality for both the construction and operation of the Proposal has been undertaken by Ramboll (2016, Appendix O). Cumulative impacts for air quality were assessed by combining the air emission impacts generated from the Proposal in isolation with the following sources[61]:

- The existing ambient air quality environment, based on baseline monitoring data collected for the Proposal (refer to Section 9.3.3 and 9.3.4 of this EIS)
- Approved future emission sources, including the predicted air quality impacts from the construction and operation of the MPE Stage 1 Proposal.

The key air pollutants of concern during the construction phase of the Proposal are fugitive dust or particulate matter (PM), generated during demolition, site clearing and earthworks. During operations, the key emissions are associated with the combustion of diesel fuel.

The air quality goals for the Proposal (in accordance with NSW EPA impact assessment criteria and the AAQ NEPM National Reporting Standard) are commonly assessed against cumulative emissions values (rather than incremental impacts). These impact assessment criteria are outlined in Section 9.2.2 of this EIS. Sensitive receptors, baseline ambient air quality data, emissions inventory data and dispersion modelling data outlined in Sections 9.3 and 9.4 of this EIS were used to carry out both the construction and operational cumulative assessments.

Human Health

A cumulative operational health impact assessment has been undertaken by Ramboll (2016) to assess the changes in health outcomes as a result of the concurrent operation of the Proposal and the MPE Stage 1 Proposal with regard to noise and air emissions. Construction phase impacts for the Proposal would be temporary in nature and effectively controlled and therefore were not assessed in detail within this Section. Guidelines and standards outlined in Section 10 of this EIS were used for the cumulative assessment.

For the air quality cumulative component of the assessment, key assumptions, chemicals of potential concern, health endpoints and exposure-response functions outlined in Section 10.2.1 of this EIS were used, along with the modelling data generated as part of the Air Quality Impact Assessment (Appendix O of this EIS). It is generally accepted by regulatory agencies that an increase in risk between 1×10^{-06} (1 in a million) and 1×10^{-05} (1 in 100,000) of the health end point assessed is considered low risk and within acceptable criteria. For cumulative noise related health impacts, the WHO guideline values, sensitive receivers, key information and assessment parameters described in Section 10.2.2 of this EIS remain appropriate.

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[61] It is noted that the Glenfield Waste Services (GWS) site, located to the southwest of the Proposal site, has a current SSD application for a Material Recycling Facility, capable of processing up to 450,000 tonnes of per annum of general solid waste. An Air Quality Assessment prepared for the application (SLR, 2015) indicates that concentrations of $PM_{2.5}$ from the facility would be minor (annual average < 0.2 µg/m³). As $PM_{2.5}$ is the key limiting pollutant for the operation of the Proposal, no further cumulative consideration of the GWS site is considered.

Biodiversity

An assessment of cumulative impacts arising from the Proposal, the MPE Stage 1 Proposal and the Glenfield Waste Facility was undertaken by Arcadis. The assessment is based on the information provided for the "Moorebank Precinct West – Stage 2 Proposal, Biodiversity Assessment Report" undertaken by Arcadis (2016) for the Proposal (Appendix Q of this EIS), and the "Technical Paper 3 - Ecological Impact Statement" undertaken by Parsons Brinkerhoff (2014) for the MPW Concept Approval. The assessment methodology outlined in Chapter 11 of this EIS for Biodiversity was followed where relevant for the cumulative impact assessment.

Hazard and Risk

A qualitative assessment of the cumulative hazard and risk impacts of the Proposal and the MPE Stage 1 Proposal has been undertaken, which considered hazardous materials and dangerous goods handling, and bushfires.

Visual Amenity

A qualitative cumulative visual assessment was undertaken to identify any potential increase to visual sensitivity and impact to the surrounding area as a result of the Proposal and surrounding developments, over and above the Proposal.

19.3 Existing environment

With respect to the key aspects covered in this cumulative assessment, the existing environment is discussed in detail in the following sections:

- Traffic and Transport: Section 7 of this EIS
- Noise and Vibration: Section 8 of this EIS
- Air Quality: Section 9 of this EIS
- Human Health: Section 10 of this EIS
- Biodiversity: Section 11 of this EIS
- Hazard and Risk: Section 14 of this EIS
- Visual Amenity: Section 15 of this EIS.

19.4 Potential impacts

19.4.1 Traffic and Transport

Construction

The cumulative construction traffic assessment for the Proposal assessed the performance of the following key intersections and access point during the peak construction period, taking into account the Proposal and the MPE Stage 1 Proposal:

- Moorebank Avenue/Anzac Road intersection – IMT facility and Rail compound access (upgraded as part of the Proposal)
- M5 Motorway/Moorebank Avenue intersection – surface interchange
- Moorebank Avenue/Chatham Avenue intersection – Earthworks compound access

The modelled LoS for existing conditions at key intersections is included in Section 7.3 of this EIS, which generally shows a good to satisfactory LoS for the intersections modelled. The modelled average delay and LoS at key intersections and access points considering the cumulative construction scenario are summarised in Table 19-4.

Table 19-4: Modelled LoS with the Proposal cumulative construction scenario

Intersections	Intersection Control	AM Peak		PM Peak	
		Avg. Delay (seconds)	LoS	Avg. Delay (seconds)	LoS
Moorebank Avenue / Anzac Road	Updated signal with 4th leg providing access to MPW site	41	C	35	C
M5 Motorway / Moorebank Avenue	Existing Signal	24	B	31	C
Moorebank Avenue / Chatham Avenue	Existing Signal	24	B	10	A

As shown in Table 19-4, during the peak construction period, the SIDRA model predicts minor impacts to delay and LoS at all intersections assessed during both the AM and PM peak periods.

The upgraded Moorebank Avenue/Anzac Road intersection with the new access road to the MPW site would operate satisfactorily at LoS C in both the morning and afternoon peak hour during the peak construction period. The proposed M5 Motorway/Moorebank Avenue intersection would operate at a LoS B and C during peak construction period. The proposed access at the existing Chatham Avenue traffic signal would operate at LoS A in both morning and afternoon peak. The SIDRA analysis indicated that construction traffic from the proposed access point at Chatham Avenue would not adversely impact through traffic on Moorebank Avenue.

Operation

In the cumulative development scenario with the addition of traffic from MPE Stage 1, approximately 2,778 truck trips (2-way) and 2,815 car trips (2-way) are estimated to and from the precinct each week day.

The operational cumulative assessment analysed the performance of eight key intersections relevant to the Proposal both with and without cumulative development (identified as the Proposal combined with the MPE Stage 1 Proposal) during peak morning and evening periods at 2019 and 2029[62]. Table 19-5 and Table 19-6 below show the predicted LoS of the eight key intersections in a “business as usual” scenario (i.e. without the Proposal) and with the Proposal.

[62] It is important to note that the values presented in Table 19-5 and Table 19-6 (with cumulative development) represent the traffic conditions that include the proposed upgrades and intersection improvements, which account for performance improvements.

Table 19-5: Intersection Level of Service with and without Cumulative Development Scenario – 2019

Intersection	Layout	2019 without Cumulative Development				Layout	2019 with Cumulative Development			
		AM Peak (8-9am)		PM Peak (5-6pm)			AM Peak (8-9am)		PM Peak (5-6pm)	
		Delay (sec)	LoS	Delay (sec)	LoS		Delay (sec)	LoS	Delay (sec)	LoS
Moorebank Avenue / Anzac Road / MPW access road	Existing Layout	24	B	16	B	With Upgrade & Improve Signals	42	D	44	D
M5 Motorway / Moorebank Avenue	Existing Layout	49	D	27	B		21	B	35	C
M5 Motorway / Hume Highway	Existing Layout	134	F	32	C	Improve Signals	56	D	30	C
Moorebank Avenue / Newbridge Road	Existing Layout	61	E	60	E	With Upgrade & Improve Signals	42	D	35	C
Moorebank Avenue / Heathcote Road	Existing Layout	66	E	63	E		71	F	33	C
M5 Motorway / Heathcote Road	Existing Layout	78	F	69	E	Improve Signals	32	C	35	C
Cambridge Avenue / Glenfield Road	Existing Layout	8	A	12	A	Existing Layout	7	A	12	A
Cambridge Avenue / Canterbury Road	Existing Layout	10	A	7	A		8	A	7	A

Table 19-6: Intersection Level of Service with and without Cumulative Development Scenario – 2029

Intersection	Control	2029 without Cumulative Development					2029 with Cumulative Development			
		AM Peak (8-9am)		PM Peak (5-6pm)			AM Peak (8-9am)		PM Peak (5-6pm)	
		Delay (sec)	LoS	Delay (sec)	LoS		Delay (sec)	LoS	Delay (sec)	LoS
Moorebank Avenue / Anzac Road / MPW access road	Upgraded Signals	52	D	95	F	With Upgrade & Improve Signals	52	D	57	E
M5 Motorway / Moorebank Avenue	Signals	74	F	125	F		35	C	53	D
M5 Motorway / Hume Highway	Signals	155	F	129	F	Improve Signals	75	F	39	C
Moorebank Avenue / Newbridge Road	Signals	78	F	94	F	With Upgrade & Improve Signals	43	D	51	D
Moorebank Avenue / Heathcote Road	Signals	78	F	153	F		62	E	85	F
M5 Motorway / Heathcote Road	Signals	78	F	336	F	Improve Signals	34	C	69	E
Cambridge Avenue / Glenfield Road	Roundabout	10	A	7	A	Existing Layout	8	A	8	A
Cambridge Avenue / Canterbury Road	Roundabout	14	B	10	A		15	B	8	A

The Proposal, when assessed cumulatively in accordance with the scenarios outlined above, would result in the following changes:

- **Moorebank Avenue / Anzac Road**: This intersection with cumulative development traffic and proposed upgrades, the modelling predicted a LoS D in 2019 and LoS E in 2029 which is comparable to without the Proposal traffic with LoS B in 2019 and LoS F in 2029
- **M5 Motorway / Moorebank Avenue**: This intersection with cumulative development traffic and proposed upgrades, the modelling predicted a LoS C in 2019 and LoS D in 2029 which is better than without the Proposal traffic with LoS D in 2019 and LoS F in 2029
- **M5 Motorway / Hume Highway**: This intersection with cumulative development traffic and proposed upgrades, the modelling predicted a LoS D in 2019 and LoS F in 2029 which is better than/comparable to without the Proposal traffic with LoS F in 2019 and 2029
- **Moorebank Avenue / Newbridge Road**: This intersection with cumulative development traffic and proposed upgrades, the modelling predicted a LoS D in 2019 and 2029 which is better than without the Proposal traffic with LoS E in 2019 and LoS F in 2029
- **Moorebank Avenue / Heathcote Road**: This intersection with cumulative development traffic and proposed upgrades, the modelling predicted a LoS E/F in 2019 and 2029 which is better than/comparable to without the Proposal traffic with LoS F in 2019 and 2029
- **M5 Motorway / Heathcote Road**: This intersection with cumulative development traffic and proposed upgrades, the modelling predicted a LoS C in 2019 and LoS E in 2029 which is better than without the Proposal traffic with LoS F in 2019 and 2029
- **Cambridge Avenue / Glenfield Road and Cambridge Avenue / Canterbury Road**: The modelling indicated satisfactory roundabout operations at both locations with LoS A/B with and without the Cumulative development traffic.

Overall results show that the key intersections in vicinity to the Proposal site in the presence of the cumulative development and associated proposed upgrades would on average perform better than the predicted network without Proposal developments for both 2019 and 2029 scenarios.

19.4.2 Noise and Vibration

Construction

The cumulative construction noise levels for each of the selected receivers (worst-case) is presented in Section 8.4.1 of this EIS. The results show that cumulative construction noise levels are predicted to comply with the NML at all receivers, except for the most sensitive receivers in Casula, where cumulative construction noise levels may exceed NML by up to 2dB. This is considered a negligible exceedance.

Operation

The cumulative operational noise levels ($L_{eq,\ period}$) were calculated and assessed against amenity criteria at various times throughout the day (day, evening and night) at key selected noise receivers, as shown in Section 8.4.2 of this EIS. The results show that the cumulative operational noise levels at sensitive receivers, due to the concurrent operation of the Proposal site and the MPE Stage 1 site, would comply with the relevant amenity criteria at all times of the day.

As is also noted in Section 8.4.2 of this EIS, the Glenfield Waste Services are proposing to develop a Materials Recycling Facility on a parcel of land south-west of the Proposal.

This facility is understood to operate during working hours only, for which the cumulative assessment of the Proposal operation was more than 10 dB below the relevant daytime amenity criteria at all sensitive receivers. It is therefore considered unlikely that this would contribute to any exceedance of daytime amenity criteria.

19.4.3 Air Quality

Construction

The cumulative construction scenario for the Proposal included emissions generated from Proposal construction, combined with the adopted ambient air quality concentrations (refer to Table 9-14 of this EIS) and emissions generated from the adjacent MPE Stage 1 Proposal. As air quality goals established for the Proposal are measured against the cumulative construction scenario, these results are included within Section 9.4.1 of this EIS. Selected cumulative results are reiterated below in Table 19-7.

Table 19-7: Summary of dust and particulate matter modelling predictions at most affected sensitive receptors for the cumulative construction scenario

Pollutant	Period	Air quality goal criteria	Receptor maximum
PM_{10} (µg/m^3)	24 hour maximum	50 µg/m^3	48.5 µg/m^3
	Annual average	30 µg/m^3	20.9 µg/m^3
$PM_{2.5}$ (µg/m^3)	24 hour maximum	25 µg/m^3	24.5 µg/m^3
	Annual average	8 µg/m^3	8.8 µg/m^3
TSP (µg/m^3)	Annual average	90 µg/m^3	50.4 µg/m^3
Dust deposition	Annual average	4g/m^2/m	3.0 g/m^2/m

The modelling results indicate that dust, TSP, PM_{10} and $PM_{2.5}$ emissions at sensitive receivers around the Proposal comply with all relevant impact assessment criteria. The annual average background concentrations of $PM_{2.5}$ already exceeds the NEPM AAQ reporting standard, meaning that cumulative predictions are also above the standard at all receptors. It is noted, however, that the incremental increases in $PM_{2.5}$ emissions created from the Proposal and MPE Stage 1 result in relatively minor increases to the annual average (<0.4 µg/m^3 at all sensitive receptors), when compared to background concentration levels.

Operation

The cumulative operational scenario included the cumulative operation of the Proposal combined with the MPE Stage 1 Proposal operation, incorporating a total of 750,000 TEU (500,000 TEU for the IMT and 250,000 TEU for the MPE site). The key pollutants assessed were those primarily resulting from diesel engine use, including:

- PM_{10} and $PM_{2.5}$
- Oxides of nitrogen (NO_x)
- Sulphur dioxide (SO_2)
- Carbon monoxide (CO)
- Speciated HC/VOCs – benzene, 1-3-butadiene and PAHs.

Key assumptions, detailed activity data, equipment types, emissions factors and fuel usage estimates used to predict emissions levels for the Proposal outlined in Section 9.4.2 of this EIS were used for the cumulative operational assessment. Modelling results for air pollutants PM_{10} and $PM_{2.5}$ are provided in Table 19-8 below[63]. As shown, predicted concentrations of PM_{10} and $PM_{2.5}$ for the operational cumulative scenario are compliant with air quality goals, except for the annual average $PM_{2.5}$ concentrations, which, as earlier discussed are already in exceedance of criteria and are not significantly influenced as a result of incremental cumulative emissions generated by both Proposals.

Table 19-8: Summary of cumulative PM_{10} and $PM_{2.5}$ modelling predictions at most affected sensitive receivers

Pollutant	Period	Air quality goal criteria	Receptor maximum
PM_{10} (µg/m^3)	24 hour maximum	50 µg/m^3	48.4 µg/m^3
	Annual average	30 µg/m^3	19.9 µg/m^3
$PM_{2.5}$ (µg/m^3)	24 hour maximum	25 µg/m^3	24.3 µg/m^3
	Annual average	8 µg/m^3	8.8 µg/m^3

As demonstrated below in Table 19-9, all predicted concentrations of air pollutants investigated were well below the impact assessment criteria at the most affected receivers.

Table 19-19-9: Summary of cumulative NO_2, CO and SO_2 modelling predictions at most affected sensitive receivers

Pollutant	Period	Air quality goal criteria	Receptor maximum
NO_2 (µg/m^3)	1 hour maximum	246 µg/m^3	160.5 µg/m^3
	Annual average	62 µg/m^3	36.1 µg/m^3
CO (mg/m^3)	1 hour maximum	30 mg/m^3	5.1 µg/m^3
	8 hour maximum	10 mg/m^3	3.1 µg/m^3
SO_2 (µg/m^3)	1 hour maximum	570 (µg/m^3)	75.0 µg/m^3
	24 hour maximum	228 (µg/m^3)	13.7 µg/m^3
	Annual average	60 (µg/m^3)	2.7 µg/m^3

In summary, the modelling results shown in Table 19-8 and Table 19-9 suggest that the cumulative operation of the Proposal would comply with relevant assessment criteria. Modelling predictions indicate that the risk of adverse air quality impacts generated by the Proposal are low.

19.4.4 Human Health

The evaluated increase in annual health endpoints for cumulative exposure to air quality parameters PM_{10}, $PM_{2.5}$, NO_2, SO_2, and CO for each suburb are presented in Table

[63] For cumulative 24-hour average PM_{10} and $PM_{2.5}$ concentrations, the results exclude days where the background is already in exceedance of the criteria.

19-10, Table 19-11, Table 19-12, Table 19-13 and Table 19-14. These results are based on the background data, emission receptors, assumptions and exposure-response functions outlined in Section 10.2.1 of this EIS.

Table 19-10: Summary of increased annual incidence associated with exposure to PM_{10} from the cumulative Proposal

Health endpoint	Exposure period	Increased annual incidence (case per year)			
		Casula	Glenfield	Moorebank	Wattle Grove
All-cause mortality 30+ years	Annual Average	0.07	0.03	0.06	0.06
All-cause mortality all ages	24-Hour Average	0.03	0.01	0.03	0.03
Mortality cardiovascular disease all ages	24-Hour Average	0.01	0.004	0.007	0.01
Hospital admissions respiratory disease 65+ years	24-Hour Average	0.04	0.02	0.04	0.02
Hospital admissions cardiac disease 65+ years	24-Hour Average	0.06	0.03	0.06	0.03
Hospital admissions pneumonia and bronchitis 65+ years	24-Hour Average	0.005	0.003	0.005	0.003
Hospital admissions respiratory disease 15-64 years	24-Hour Average	0.06	0.02	0.04	0.06
ED visits asthma 1-14 years	24-Hour Average	0.09	0.03	0.06	0.1

Abbreviations: ED: Emergency Department. PM: Particulate Matter

The above tables demonstrate that the combined incremental impacts to community health for selected end points for air quality parameters are generally low and within regulatory guidelines. The increased annual incidences for the health endpoints evaluated due to the cumulative Proposal related to PM_{10} and $PM_{2.5}$ exposure were all well below one case per year. Table 19-10 shows that the most sensitive health end point for PM_{10} emissions is asthma, and the cumulative Proposal could be expected to contribute an additional 0.1 asthma-related emergency department visits per year among 1-14 year olds in the most sensitive suburb (Wattle Grove). $PM_{2.5}$ emissions could be expected to result in an additional 0.1 incidence of premature mortality per year due to all causes or cardiopulmonary disease among 30+ year-olds in Casula and Moorebank (equivalent to one additional incidence of premature mortality every 10 years).

Table 19-11: Summary of increased annual incidence associated with exposure to $PM_{2.5}$ from the cumulative Proposal

Health endpoint	Exposure period	Increased annual incidence (case per year)			
		Casula	Glenfield	Moorebank	Wattle Grove
All-cause mortality 30+ years	Annual Average	0.1	0.05	0.09	0.08
Cardiopulmonary mortality 30+	Annual Average	0.1	0.05	0.1	0.09
Mortality ischemic heart disease 30+ years	Annual Average	0.02	0.01	0.02	0.02
Mortality lung cancer 30+ years	Annual Average	0.007	0.004	0.007	0.006
All-cause mortality all ages	24-Hour Average	0.04	0.01	0.03	0.04
Mortality cardiovascular disease- all ages	24-Hour Average	0.006	0.002	0.005	0.006
Hospital admissions respiratory disease 65+ years	24-Hour Average	0.06	0.03	0.05	0.03
Hospital admissions cardiac disease 65+ years	24-Hour Average	0.1	0.07	0.1	0.07
Hospital admissions cardiovascular disease 65+ years	24-Hour Average	0.09	0.04	0.08	0.04
Hospital admissions ischemic heart disease 65+ years	24-Hour Average	0.04	0.02	0.04	0.02
Hospital admissions COPD 65+ years	24-Hour Average	0.02	0.009	0.02	0.009
Hospital admissions pneumonia and bronchitis 65+ years	24-Hour Average	0.02	0.01	0.02	0.009
Hospital admissions respiratory disease 15-64 years	24-Hour Average	0.06	0.02	0.04	0.05
ED visits asthma 1-14 years	24-Hour Average	0.008	0.003	0.006	0.009

Abbreviations: COPD: Chronic Obstructive Pulmonary Disease. ED: Emergency Department. PM: Particulate Matter

Table 19-12: Summary of increased annual incidence associated with exposure to NO_2 from the cumulative Proposal

Health endpoint	Exposure period	Increased annual incidence (case per year) (values in brackets assume ambient ratio of NO_2 to NO_x of 0.7)			
		Casula	Glenfield	Moorebank	Wattle Grove
All-cause mortality 30+ years	Annual Average	1.3 (0.9)	0.7 (0.5)	1.2 (0.9)	1.1 (0.8)
Cardiovascular mortality 30+ years	Annual Average	0.4 (0.3)	0.2 (0.1)	0.3 (0.2)	0.3 (0.2)
Respiratory mortality 30+ years	Annual Average	0.06 (0.04)	0.03 (0.02)	0.06 (0.04)	0.05 (0.04)
All-cause mortality all ages	24-Hour Average	0.5 (0.3)	0.2 (0.1)	0.4 (0.3)	0.4 (0.3)
Mortality respiratory disease	24-Hour Average	0.1 (0.07)	0.04 (0.03)	0.08 (0.06)	0.09 (0.07)
Mortality cardiovascular disease all ages	24-Hour Average	0.14 (0.1)	0.05 (0.04)	0.11 (0.07)	0.13 (0.07)
Hospital admissions respiratory disease 65+ years	24-Hour Average	1.2 (0.9)	0.6 (0.5)	1.2 (0.8)	0.6 (0.4)
Hospital admissions cardiovascular disease 65+ years	24-Hour Average	1.2 (0.8)	0.6 (0.4)	1.1 (0.8)	0.5 (0.4)
Hospital admissions respiratory disease 15-64 years	24-Hour Average	0.5 (0.4)	0.2 (0.1)	0.4 (0.3)	0.5 (0.4)
ED visits asthma 1-14 years	24-Hour Average	0.1 (0.07)	0.03 (0.02)	0.07 (0.05)	0.1 (0.07)

Abbreviations: ED: Emergency Department, NO_2: Nitrogen Dioxide

Regarding NO_2 exposure outlined in Table 19-12, the increased incidences for the cumulative Proposal were slightly above one case per year for three health end points in Casula and Moorebank, as well as one health end point in Wattle Grove. The most sensitive health end point was all-cause mortality 30+ years that may cause an additional 1.4 incidences of premature mortality per year. It is however noteworthy to point out that calculations made were based on the conservative assumption that all NO_x is converted to NO_2. Based on monitoring data from the Liverpool Air Monitoring station, the ratio of NO_2 to NO_x is 0.7 (i.e. NO_2 is 70% of the monitored NO_x levels (Pacific Environment 2015)). When applied to the data presented in Table 19-12, increased annual incidence would be reduced to <1.0 cases per year for the most sensitive end point.

Table 19-13: Summary of increased annual incidence associated with exposure to SO_2 from the cumulative Proposal

Health endpoint	Exposure period	Increased annual incidence (case per year)			
		Casula	Glenfield	Moorebank	Wattle Grove
All-cause mortality all ages	24-Hour Average	0.0011 3	0.0003	0.0007	0.0008
Mortality respiratory disease- all ages	24-Hour Average	0.0002	0.00005	0.0001	0.0002
Mortality cardiovascular disease- all ages	24-Hour Average	0.0004	0.0001	0.0003	0.0003
Hospital admissions respiratory disease 65+ years	1- Hour Maximum	0.004	0.001	0.003	0.003
ED visits asthma 1-14 years	24-Hour Average	0.005	0.001	0.003	0.004

Abbreviations: ED: Emergency Department. SO_2: Sulfur Dioxide

The annual increased incidence of selected health endpoints for the cumulative proposal for SO_2 related emissions were all well below one case per year, as shown above in Table 19-13. For the most sensitive endpoint in Casula, the cumulative Proposal can be expected to contribute to 0.005 asthma-related emergency department visits per year among 1-14 year olds (equivalent to five additional emergency department visits per 1,000 years).

Table 19-14: Summary of increased annual incidence associated with exposure to CO from the cumulative Proposal

Health endpoint	Exposure period	Increased annual incidence (case per year)			
		Casula	Glenfield	Moorebank	Wattle Grove
All-cause mortality 30+ years	8-Hour Average	0.0003	0.0001	0.0002	0.0002
Hospital admissions cardiac disease 65+ years	8-Hour Average	0.001	0.0006	0.001	0.0007
Hospital admissions cardiovascular disease 65+ years	8-Hour Average	0.00009	0.00004	0.00008	0.00004

Abbreviations: CO: Carbon Monoxide. ED visits asthma 1-14 years

Table 19-14 below outlines that for the most sensitive health end point for CO related emissions generated by the cumulative Proposal, hospital admissions relating to cardiac disease for people aged 65+ years, it is expected that the cumulative Proposal would contribute to the equivalent of one hospital admission every one thousand years.

Based on the estimated increased annual incidence for multiple health endpoints contributing to mortality and morbidity shown above, there are no significant adverse health effects expected in relation to short-term exposure to PM_{10}, $PM_{2.5}$, NO_2, SO_2 or CO from the cumulative Proposal in the surrounding local area.

A review of noise impacts for the cumulative Proposal on noise at sensitive receivers, as shown in Table 19-15, indicates that hazard quotients for annoyance, sleep disturbance and cognitive impairment were less than or equal to one (1) at all residential and educational receivers, indicating that the operational noise from the cumulative Proposal does not pose an unacceptable risk to the health of these communities.

Table 19-15: Hazard quotients for cumulative operational noise from the cumulative Proposal

Receiver/Suburb	Annoyance	Sleep Disturbance		Cognitive Impairment
	$LA_{eq, period}$	$LA_{eq, period}$	L_{Amax}	$L_{Aeq, period}$
Casula	0.7	0.9	0.8	0.7
Glenfield	0.4	0.5	0.4	0.3
Wattle Grove	0.6	0.9	0.4	0.6
All Saints Senior College (S1)	0.5	N/A	N/A	0.5
Casula Powerhouse (S2)	0.5	N/A	N/A	0.4
DJLU (I2)	1.3	N/A	N/A	1.3
ABB (I3)	1.2	N/A	N/A	1.2

19.4.5 Biodiversity

The development of the three adjoining sites (MPW, MPE and Glenfield Waste facility) will reduce or remove a range of biodiversity values, including available fauna habitat (roosting, nesting and foraging habitat), potential threatened fauna habitat, threatened plant species, *Threatened Species Conservation Act* 1995 *(TSC Act)* listed Threatened Ecological Communities (TECs), local provenance plant species and potential seedbanks.

All of the plant community types (PCT) identified on the MPW site were also recorded within the MPE Stage 1 site. One additional PCT, Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion, was recorded within Anzac Creek in the MPE Stage 1 site. The total impacts to native vegetation, including TECs, are detailed in Table 19-16. The Early Works do not require clearing of native vegetation communities.

Table 19-16: Cumulative impacts to native vegetation from the Proposal and MPE Stage 1

Plant Community Type	Equivalent TEC	Conservation status	Area impacted by the Proposal	Area impacted by MPE Stage 1	Total area of impact
Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin	Castlereagh Scribbly Gum Woodland in the Sydney Basin bioregion	Vulnerable (TSC Act) Endangered (EPBC Act)	15.51 ha	0.74 ha	16.25 ha

Plant Community Type	Equivalent TEC	Conservation status	Area impacted by the Proposal	Area impacted by MPE Stage 1	Total area of impact
Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin	Castlereagh Swamp Woodland	Endangered (TSC Act)	0.92 ha	0.05 ha	0.97 ha
Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin	River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions	Endangered (TSC Act)	30.62 ha	0.42 ha	31.04 ha
Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion	Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions	Endangered (TSC Act)	0	0.03 ha	0.03 ha
Total area of native vegetation cleared			**47.05 ha**	**1.21 ha**	**48.26 ha**

The Glenfield Waste Facility proposal requires clearing of 9.5 hectares of the PCT Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion, which forms part of the Critically Endangered Ecological Community (CEEC) Cumberland Plain Woodland, listed under the *Environmental Protection and Biological Conservation Act* 1999 (EPBC Act) and TSC Act. As the Proposal does not impact on Cumberland Plain Woodland, cumulative impacts on this TEC as a result of the Proposal are not predicted.

Two threatened plant species listed under the EPBC and TSC Acts were recorded on both the MPW and MPE sites: the Endangered species *Persoonia nutans* (Nodding Geebung) and the Vulnerable species *Grevillea parviflora* subsp. *parviflora* (Small-flowered Grevillea). No threatened flora species were recorded on the Glenfield Waste Facility site. The total impacts to threatened plant species are detailed in Table 19-17.

Table 19-17: Cumulative impacts to native vegetation from the Proposal and MPE Stage 1

Threatened Flora Species	Conservation status	Number to be cleared for the Proposal	Number to be cleared for MPE Stage 1	Total number to be cleared
Persoonia nutans	Endangered (EPBC Act, TSC Act)	10 individuals	11 individuals	21 individuals
Grevillea parviflora subsp. parviflora	Vulnerable (EPBC Act, TSC Act)	16 mature plants with many suckers	20 stems	16 mature plants with many suckers plus 20 stems.

Threatened fauna species recorded on the Proposal site as well as the MPE Stage 1 site and Glenfield Waste Facility site were the Grey Headed flying-fox (*Pteropus policephalus*) and a suite of microbat species including Southern Myotis (*Myotis adversus*), East-coast Freetail-bat (*Mormopterus norfolkensis*) and Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*). Hollow-bearing trees would be reduced as a result of the proposals and habitat connectivity would be impacted across the landscape through clearing and vegetation in the Georges River riparian corridor. Furthermore, concurrent construction activities, particularly instream works, have the potential to exacerbate impacts to aquatic habitats. There would be a cumulative loss of fauna habitat within the landscape from vegetation removal at the Glenfield Recycling Facility, the MPE Stage 1 site and the Proposal site.

All proposals considered in the cumulative impact assessment are SSD, and therefore impacts to native vegetation would require biodiversity offsets under the Framework for Biodiversity Assessment. All proposals include mitigation measures to minimise impacts and provide offsets for the loss of biodiversity values.

19.4.6 Hazard and Risk

Potential impacts relevant for the Proposal relating to Hazards and Risks include gas leaks (natural gas and LNG), loss of containment of flammable/combustible or corrosive liquids, vehicle accidents, flooding as a result of extreme weather, and inappropriate waste disposal. All dangerous goods present on the Proposal site would be stored in locations and quantities below the risk levels under SEPP 33. It is therefore considered that the Proposal would not pose an unacceptable level of risk to the surrounding community, negating the need for a Preliminary Hazard Analysis (PHA) for the Proposal. As no major effects would be felt outside of the Proposal site, it is considered unlikely that any cumulative impacts would arise as a result of the construction or operation of the Proposal, as key impacts for both the Proposal and MPE Stage 1 Proposal would be managed and controlled locally in accordance with appropriate management plans.

19.4.7 Visual Amenity

Both the MPE and MPW sites are effectively screened from surrounding sensitive receivers by existing vegetation to the west, south and east, and existing Defence and industrial areas to the north. Landscaping proposed on the Proposal site would also assist in reducing any visual impacts. In addition, the Proposal and the MPE Stage 1 Proposal are both in keeping with the existing industrial nature of both sites. Therefore it is not anticipated for the cumulative scenario to result in any visual impacts above what was assessed for the Proposal in isolation.

19.5 Mitigation measures

Across the issues assessed for cumulative impacts, most did not identify significant additional impacts or exceedances of criteria and no additional mitigation measures were identified. As such, the mitigation measures identified for the Proposal would also effectively mitigate the cumulative impacts identified within this section. The mitigation measures for each of the key issues assessed are presented in following sections of this report:

- Traffic and Transport: refer to Section 7 of this EIS
- Noise and Vibration: refer to Section 8 of this EIS
- Air Quality: refer to Section 9 of this EIS
- Human Health: refer to Section 10 of this EIS
- Biodiversity: refer to Section 11 of this EIS
- Hazard and Risk: refer to Section 14 of this EIS.

20 OTHER ISSUES

20.1 Waste management

Arcadis has undertaken an assessment of waste to be generated and disposed of for the Proposal to address the SEARs. The SEARs which are addressed in this Section are provided in Table 20-1.

Table 20-1: SEARs for the Proposal relating to Waste

Section/ Number	Requirement	Where addressed in this EIS
16. Waste	An assessment of liquid and/or non-liquid waste generated on the site, how it will be identified, quantified, classified, documented and disposed of. The assessment shall also include a description of measures to be implemented to manage waste in accordance with the waste hierarchy. This assessment shall include waste management measures to ensure that the proposal considers the aims, objectives and guidelines in the NSW Waste Avoidance and Resource Recovery Strategy 2014-2021.	Sections 20.1.4 and 20.1.4 of this EIS

This Section summarises the studies undertaken previously for the Concept Plan Approval and, more recently, for the Proposal. This Section identifies, classifies and quantifies waste generated during the construction and operational phases of the project. Measures to mitigate the impacts of waste generated are explored in Section 20.1.5 of this EIS.

20.1.1 MPW Concept Approval

In October 2014, a Concept Plan Environmental Impact Statement was prepared for the MPW Project. The report identified likely waste streams associated with the different phases of the MPW Project. According to the investigation, the following waste streams are likely to arise during the early works and construction phase of the MPW Project:

- Demolition waste from the removal of Department of Defence (Defence) buildings and structures, including potential asbestos material
- Green waste from vegetation removal
- Hazardous solid waste, restricted solid waste, unsuitable excavated material and unexploded ordnance (UXO) during remediation and earthworks activities.

The report identified that the following waste streams would arise from project operations:

- Green waste from landscaped areas
- Waste associated with maintenance of plant and equipment (e.g. old parts, packaging waste and cleaning waste)
- Office and administration waste such as paper and food waste.

Mitigation measures were proposed for the management of waste and efficient use of resources.

The report noted that the waste flows associated with the Project would be quantified during detailed design and subsequent future approvals. The scope of works detailed in the report has since been separated into two approval phases; Early Works and the

MPW Stage 2 Proposal (the Proposal). This investigation therefore excludes waste generating activities associated with Early Works including:

- The demolition of existing buildings and structures
- Service utility terminations and diversion/relocation
- Removal of existing hardstand/roads/pavements and infrastructure associated with existing buildings
- Rehabilitation of the excavation/earthmoving training area (i.e. 'dust bowl')
- Remediation of contaminated land and hotspots, including areas known to contain asbestos, and the removal of:
  - Underground storage tanks (USTs)
  - Unexploded ordnance (UXO) and explosive ordnance waste (EOW) if found
  - Asbestos contaminated buildings
- Archaeological salvage of Indigenous and European sites
- Establishment of a conservation area along the Georges River
- Establishment of construction facilities (which may include a construction laydown area, site offices, hygiene units, kitchen facilities, wheel wash and staff parking) and access, including site security
- Vegetation removal, including the relocation of hollow-bearing trees, as required for remediation/demolition purposes

20.1.2 Methodology

The following legislation and plans have been considered to guide the waste strategy for the Proposal, namely:

- *National Waste Policy: Less Waste, More Resources*
- *Product Stewardship Act 2011 (Commonwealth)*
- *Waste Avoidance and Resource Recovery Act 2001* (NSW) (WARR Act)
- *Waste Avoidance and Resource Recovery Strategy 2014* (WARR Strategy)
- *Protection of the Environment Operations Act 1997* (NSW)
- *Protection of the Environment Operations (Waste) Regulation 2014* (Proximity Principle)
- *Protection of the Environment Operations (Waste) Regulation 2014* (The pasteurised organics order 2014)
- The Macarthur WARR Strategy 2014-2017
- Campbelltown City Council's Community Strategic Plan 2013-2023
- Campbelltown (Sustainable City) Development Control Plan 2014

The methodology for this quantitative and qualitative assessment involved:

- Reviewing previous waste assessments
- Studying MPW Project documentation and design to date
- Review of relevant waste legislation, strategies and policy
- Waste generating activity assessment
- Identification of waste streams
- Quantification of waste streams
- Waste management solutions for construction and operations.

This particular investigation will assess waste generation associated with:

- Pre-construction stockpiling
- Site preparation

- Bulk earthworks
- Construction and/or modifications to Moorebank Avenue and internal road works
- Construction and operation of the IMT Facility and Rail Link connection
- Construction and operation of the warehouses.

20.1.3 Existing environment

For the purpose of this assessment, existing environmental conditions are assumed to be those that exist upon completion of the Early Works (assessed in the MPW Concept EIS). Subsequent to Early Works being undertaken, the Proposal site would comprise a cleared site with the exception of some areas of remaining vegetation (i.e. the vegetation exclusion zone and EECs presented in Figure 1-3). It is anticipated that all construction waste generated by the Early Works would be managed as part of the MPW Concept Approval, and therefore not form part of the waste management assessment for this Proposal.

20.1.4 Potential impacts

Construction

Waste generating activities during the construction phase are listed in Table 20-2 with the types of waste these activities are likely to generate being listed in Table 20-3.

It should be noted that all building demolition and remediation of known contamination 'hot-spots' on the Proposal site would be assessed as part of the Early Works for the MPW Concept Approval and therefore is not included within this assessment.

Table 20-2: Waste generating activities during construction

Construction Phase	Waste Generating Activity	Waste/Resource Types
Works period A - Pre-construction stockpiling	Earthworks associated with the installation of temporary erosion and sediment controls	▪ Virgin Excavated Natural Material and Excavated Natural Material (VENM and ENM) ▪ Controls may include sediment fences and hay bales
	Minor clearing and grubbing	Vegetation
	Earthworks associated with establishment of temporary stockpiling pad and associated temporary access roads	VENM/ENM
	Installation of temporary construction compound, including amenities and office for bulk earthworks	▪ Surplus building materials ▪ Packaging
	Office administration, lunch room and other activities	▪ Residual waste ▪ Recyclable waste (containers and paper/cardboard)

Construction Phase	Waste Generating Activity	Waste/Resource Types
Works period B - Site preparation	Establishment of construction compound fencing and hoardings	Surplus building materials
	Earthworks associated with the installation of temporary sediment and erosion control measures	▪ VENM/ENM ▪ Controls may include sediment fences and hay bales
	Vegetation clearing	Vegetation
	Installation of temporary site offices and amenities	▪ Surplus building materials ▪ Packaging
	Construction of hardstands for staff parking and laydown areas	VENM/ENM
	Establishment of temporary batch plant sites and installation of batch plant	▪ Concrete ▪ Surplus building materials
	Construction of access roads, site entry and exit points and security (N.B. preference is to use existing access where practicable)	VENM/ENM
	Relocation of utilities	VENM/ENM
	Office administration, lunch room and other activities	▪ Residual waste ▪ Recyclable waste (containers and paper/cardboard)
Works period C – Bulk earthworks, drainage and utilities	Removal of residual existing road pavements, as required. The majority of this will be undertaken during Early Works	▪ Concrete ▪ Asphalt
	Installation of onsite detention basins (OSD)	VENM/ENM
	Bulk Earthworks and raising of site to final level	VENM/ENM
	Drainage and utilities installation	▪ Surplus materials from drainage installation ▪ Surplus material from extension of sewer and telephone lines ▪ VENM/ENM
	Establishment of a concrete batching plant	▪ Concrete ▪ Surplus building materials

Construction Phase	Waste Generating Activity	Waste/Resource Types
	Office administration, lunch room and other activities	▪ Residual waste ▪ Recyclable waste (containers and paper/cardboard)
Works period D - Moorebank Avenue intersection works and internal road network	Relocation, adjustment and/or protection of all affected utilities, services and signage, as required	VENM/ENM
	Installation of erosion and sediment controls	▪ VENM/ENM ▪ Controls may include sediment fences and hay bales
	Stripping and stockpiling of topsoil by excavators and trucks	VENM/ENM
	Drainage works	▪ Surplus materials from drainage installation ▪ VENM/ENM
	Forming of new kerbs, gutters, medians and other structures	Surplus building materials - concrete
	Construction of asphalt and concrete pavement	Surplus building materials – concrete and asphalt
	Landscaping of exposed earthworks areas	Vegetation
	Office administration, lunch room and other activities	▪ Residual waste ▪ Recyclable waste (containers and paper/cardboard)
Works period E – IMT facility and Rail link connection construction	Establish formwork and reinforcement for sidings and bridge infrastructure	Surplus building materials
	Placement of concrete, curing and sealing	Surplus building materials – concrete
	Installation of permanent ways and rail systems	Surplus building materials
	Installation of permanent access gates, security gatehouse and permanent fencing	Surplus building materials
	Installation of the connection between the Rail link and the IMT facility sidings	Surplus building materials
	Erection of IMT facility structure – excavation foundation and floor slab construction, structural wall and roof framework, and roofing	▪ Surplus building materials ▪ VENM/ENM

Construction Phase	Waste Generating Activity	Waste/Resource Types
	Internal fit-out of building with control room, office, workshops, loco-shifter and staff amenities	Surplus building materials
	Office administration, lunch room and other activities	▪ Residual waste ▪ Recyclable waste (containers and paper/cardboard)
Works period F – Construction and fit-out of warehousing	Establishment of construction compound, temporary fencing/ hoardings and temporary sediment and erosion control	▪ Surplus building materials ▪ Controls may include sediment fences and hay bales ▪ VENM/ENM
	Installation of temporary site offices and amenities	Surplus building materials
	Excavation, foundation and floor slab installation	VENM/ENM
	Erection of framework and structural walls	Surplus building materials
	Installation of roof	Surplus building materials
	Internal fit out	Surplus building materials
	Landscaping and surrounds	Vegetation
	Preparation of warehouse access road subgrade	Surplus building materials
	Forming of new kerbs, gutters, medians and other structures	Surplus building materials - concrete
	Construction of asphalt and concrete pavement	Surplus building materials – concrete and asphalt
	Office administration, lunch room and other activities	▪ Residual waste ▪ Recyclable waste (containers and paper/cardboard)
Works period G – Miscellaneous structural construction and finishing works	Decommissioning/demobilisation of the construction area	Construction and demolition waste
	Landscaping	Vegetation
	Office administration, lunch room and other activities	▪ Residual waste ▪ Recyclable waste (containers and paper/cardboard)

Table 20-3: Estimated quantities of waste generated during construction

Waste Type	Estimated Quantity of Waste Generated	Estimated Quantity Suitable For:		
		Onsite Re-use	Offsite Recycling or Reprocessing	Offsite Disposal
Demolition				
Vegetation	[64]470,500 m^2	[65] 47,050m^2	423,450 m^2	
Concrete/asphalt roads and pavement	Concrete and asphalt pavements will be removed during Early Works. There may however be some residual pavements to be removed through the Proposal.			
Construction and demolition waste from decommissioning/demobilisation of the construction area (MPW Stage 2)	Dependent upon construction planning methodology			
Residual waste from lunch rooms and offices[66]	150L/day	N/A	N/A	150L/day
Recyclable waste from lunch rooms and offices[67]	150L/day	N/A	150L/day	N/A
Construction				
Excavated material	540,800[68] m^3	There is demand for onsite re-use of excavated material as 2,171,300m^3 of fill is required. Given the prevalence of noxious weeds onsite, a significant portion of the top soil will be contaminated and require appropriate treatment and/or disposal. However it is likely that a portion of this material may be able to be re-used on-site, however this will not be able to be fully determined until construction.		
Temporary sediment and erosion control	Sediment fences, hay	Where feasible, temporary sediment and erosion controls may be reused or		

[64] Sourced from Section 11

[65] It has been estimated that approximately 5-10% of this waste stream will be suitable for onsite re-use. In accordance with the mulch exemption 2016, this material must pose minimal risk of the presence of physical and chemical contaminants.

[66] This will be determined by the construction contractor. For the purpose of this report, it has been assumed that the waste generation rate for the demountable offices and lunch rooms is equivalent to the waste generation rate for standard offices. To estimate waste generation the City of Melbourne's Guidelines for Preparing a Waste Management Plan – 2015 has been utilised. According to this report, 10L of residual waste and 10L of recycling is generated per 100m^2 of office floor area (for standard daily operating hours). These generation rates were applied to the Building Code of Australia floor area/personnel design ratio of 10m^2/person floor area, 50 people and a 24 hour working day.

[67] As above.

[68] Stripped topsoil – 294,200 m^3. Sourced from Drawing C-MIC2-SSD-111-AA003760-04.

Waste Type	Estimated Quantity of Waste Generated	Estimated Quantity Suitable For:		
		Onsite Re-use	Offsite Recycling or Reprocessing	Offsite Disposal
	bales, mesh and gravel inlet filters, construction exit/wash down, sand bags, geotextile inlet filters, pipes and site fences.	re-processed off-site when no longer required.		
Spill kit consumables	As needs basis	N/A	N/A	As needs basis
Surplus building materials from construction, internal fit-out, utilities extension, drainage installation, pavements, new kerbs, gutters, medians and other structures	Dependent upon construction planning methodology. Indicative waste margins are as follows: ▪ Timber 5-7% ▪ Plasterboard 5-20% ▪ Concrete 3-5% ▪ Bricks 5-10% ▪ Tiles 2-5%[69]			
Construction Packaging	Dependent upon construction planning methodology and purchasing policies. Paper and cardboard packaging typically represents 1.1% and plastic typically represents 1% by weight of the total construction and demolition waste stream.			
Residual waste from lunch rooms and offices[70]	784 L/day	N/A	N/A	784 L/day
Recyclable waste from lunch rooms and offices[71]	784 L/day	N/A	784 L/day	N/A

[69] Construction Waste Management Plan Guidelines, WALGA and the Waste Authority, 2014.

[70] This will be determined by the construction contractor. For the purpose of this report, it has been assumed that the waste generation rate for the demountable offices and lunch rooms is equivalent to the waste generation rate for standard offices. To estimate waste generation the City of Melbourne's Guidelines for Preparing a Waste Management Plan – 2015 has been utilised. According to this report, 10L of residual waste and 10L of recycling is generated per 100m^2 of office floor area (for standard daily operating hours). These generation rates were applied to the Building Code of Australia floor area/personnel design ratio of 10m^2/person floor area, 570 people and an 11 hour standard working day.

[71] As above.

Operations

Waste generating activities during the operational phase are listed in Table 20-4, with the types and estimated quantities of waste these activities are likely to generate being listed in Table 20-5.

Table 20-4: Waste generating activities during operations

Operations Phase	Waste Generating Activity	Waste/Resource Types
IMT Facility	▪ Maintenance and hazard prevention ▪ Administration, amenities, engineers' workshop and lunchrooms	▪ Used spill kit consumables ▪ Residual waste ▪ Recyclable waste (containers and paper/cardboard)
Rail Link Connection	Maintenance and hazard prevention	▪ Used spill kit consumables ▪ Residual waste ▪ Recyclable waste (containers and paper/cardboard)
Warehousing	▪ Administration, amenities, engineers' workshop and lunchrooms ▪ De-stuffing and packing containers	▪ Waste generated from de-stuffing: – Cardboard – Flexible Plastic – Pallets ▪ Residual waste ▪ Recyclable waste (containers and paper/cardboard) ▪ Used spill kit consumables

Table 20-5: Estimated quantities of waste generated during operations

Waste Type	Estimated Quantity of Waste Generated	Estimated Quantity Suitable For:		
		Onsite Re-use	Offsite Recycling or Reprocessing	Offsite Disposal
IMT Facility				
Residual waste[72] (office / lunchroom / amenities)	177 L/day	N/A	N/A	177 L/day
Recyclables[73] (office / lunchroom / amenities)	177 L/day	N/A	177 L/day	N/A
Residual waste (Engineers' Workshop)	Dependent upon maintenance scheduling and plans	N/A	N/A	Dependent upon maintenance scheduling and plans
Recyclables (Engineers' Workshop)	Dependent upon maintenance scheduling and plans	N/A	Dependent upon maintenance scheduling and plans	N/A
Used oil	Dependent upon maintenance plans and whether waste oil will be generated on site	N/A	Dependent upon maintenance plans and whether waste oil will be generated on site	N/A
Spill Kit Consumables	As needs basis	N/A	N/A	As needs basis
Rail Link Connection				
Residual waste (maintenance activities)	Dependent upon maintenance scheduling and plans	N/A	N/A	Dependent upon maintenance scheduling and plans

[72] The estimated volume of waste generated was based on the commercial waste generation rate for an
Office, published in City of Melbourne's Guidelines for Preparing a Waste Management Plan – 2015. According
to this report, 10L of residual waste and 10L of recycling is generated per 100m^2 of office floor area (for standard daily operating hours). These generation rates were applied to a floor area of 590 m^2 and a 24 hour working day.

[73] As above.

Waste Type	Estimated Quantity of Waste Generated	Estimated Quantity Suitable For:		
		Onsite Re-use	Offsite Recycling or Reprocessing	Offsite Disposal
Recyclables (maintenance activities)	Dependent upon maintenance scheduling and plans	N/A	Dependent upon maintenance scheduling and plans	N/A
Spill Kit Consumables (maintenance activities)	As needs basis	N/A	N/A	As needs basis
Warehousing				
Residual waste[74] (Offices)	1,706 L/day	N/A	N/A	1,706 L/day
Recyclables[75] (Offices)	1,706 L/day	N/A	1,706 L/day	N/A
Residual waste (Precinct Amenities / Services Area)[76]	1,950 L/day	N/A	N/A	1,950 L/day
Recyclables (Precinct Amenities / Freight village)[77]	1,950 L/day	N/A	1,950 L/day	N/A
Spill Kit Consumables	As needs basis	N/A	N/A	As needs basis
De-stuffing waste	Approximately 95% of expected containers will be Full Container Loads (FCL) and contents will be transferred directly to the consumer (generating the destuffing waste outside the boundary of the project). The remaining 5% will be classified as Freight All Kind (FAK) and Less Than A Container Load (LCL) - these containers will be de-stuffed in the warehouse. Goods will come in the form of loose			

[74] The estimated volume of waste generated was based on the commercial waste generation rate for an
Office, published in City of Melbourne's Guidelines for Preparing a Waste Management Plan – 2015. According
to this report, 10L of residual waste and 10L of recycling is generated per 100m^2 of office floor area (for standard daily operating hours). These generation rates were applied to a floor area of 7,584 m^2 and an 18 hour working day.

[75] See above.

[76] The precinct amenities/freight village will function as a takeaway/café area. The estimated volume of waste generated was based on the commercial waste generation rate for a takeaway/café, published in City of Melbourne's Guidelines for Preparing a Waste Management Plan – 2015. According to this report, 150L of residual waste and 150L of recycling waste is generated per 100m^2 of floor area (for standard daily operating hours). These generation rates were applied to a floor area of 1,300 m^2 and an 8 hour working day.

[77] As above.

Waste Type	Estimated Quantity of Waste Generated	Estimated Quantity Suitable For:		
		Onsite Re-use	Offsite Recycling or Reprocessing	Offsite Disposal
	cartons or disposable pallets, with a proportion of these wrapping materials transported to the consumer. Assuming 50% of the waste to be de-stuffed in this warehouse are disposable pallets, it is estimated 250,000 disposable pallets will be generated per annum[78]. Other waste likely to be generated include flexible plastics and cardboard. However, the quantity of these streams is variable subject to the contents of the containers.			

20.1.5 Mitigation measures

This Section outlines mitigation measures to address the impacts of waste management during the construction and operational phases as described in Section 20.1.4 of this EIS.

Construction

Measures to mitigate the effect of the construction waste streams would be incorporated into the Proposal's CEMP (post approval), including the following:

- Characterisation of construction waste streams in accordance with the *NSW Waste Classification Guidelines*
- Management of any identified hazardous waste streams
- Procedures to manage construction waste streams, including handling, storage, classification, quantification, identification and tracking
- Mitigation measures for avoidance and minimisation of waste materials
- Procedures and targets for re-use and recycling of waste materials

Operations

Measures to mitigate the effect of waste arising during operation of the facility would be incorporated into the OEMP prior to commencement of operations. This policy would include measures to encourage recycling behaviour and increase the diversion of waste into recycling streams. These would include requirements such as:

- Addressing waste management requirements and goals in staff inductions
- Providing staff access to documentation outlining the facility's waste management requirements
- Locating recycling bins in kitchen areas beside general waste bins to prevent contamination of recycling
- Positioning paper recycling bins close to printer / photocopying equipment
- Establishing bays or containers for recyclable waste generated through de-stuffing
- Minimising general waste bins at desks but providing adequate container and paper recycling to encourage sorting of recyclables

[78] Assuming 2 rows of 10 standard sized disposable pallets per container.

- Providing adequate bin storage for the expected quantity of waste.
- Waste management planning incorporating principles of the waste hierarchy
- Selection of materials used in operations with recycled content, low embodied energy and durability
- Appropriate areas shall be provided for the storage of waste and recyclable material
- Standard signage on how to use the waste management system and what materials are acceptable in the recycling would be posted in all waste collection and storage areas
- All waste shall be collected regularly and disposed of at licensed facilities
- An education programme and on-going monitoring for training personnel to properly sort and transport waste into the right components and destinations.
- Container disposal units would be provided in the area around the diesel re-fuelling station to dispose of used spills kits. These containers will be taken for disposal at an appropriately licensed facility.

20.2 Bushfire

A *Bushfire Protection Assessment* has been prepared by Australian Bushfire Protection Planners Pty Ltd (ABPP) and is included at Appendix W of this EIS. This report provides an assessment of the potential bushfire threat associated with the development of the Proposal.

Table 20-6 sets out the Secretary's Environment Assessment Requirements (SEARs) as they relate to bushfire protection, and where these have been addressed.

Table 20-6: SEARs for the Proposal relating to Bushfire protection

Section/Number	Requirement	Where addressed in this EIS
17. Bushfire	An assessment against the *Planning for Bushfire 2006* (NSW Rural Fire Service).	Section 19.2.4 of this EIS

This Section summarises the studies undertaken previously for the MPW Concept Approval and, more recently, for the Proposal. This Section provides an assessment of potential bushfire protection measures required for the Proposal as assessed in the Bushfire Protection Assessment (ABPP, 2016). Measures to mitigate bushfire risks have been identified where they are required.

20.2.1 MPW Concept Approval

The Hazard and Risks Assessment prepared for the MPW Concept EIS assessed the potential hazards and risks associated with development of the MPW Project, including the spread and management of bushfire. The assessment involved a desktop literature review and site visit.

This assessment identified that the MPW site contains and adjoins bushfire prone land to the east, south and west and that the threat of bushfire on the MPW site would remain if no vegetation within the MPW site was cleared.

Based on the recommendations of the Hazards and Risk Assessment (PB, 2014), the REMMs, included in the Supplementary Response to Submissions, committed to the measures included in Appendix A of this EIS.

Conditions of Approval

The Conditions of Approval for the MPW Concept Approval relevant to the Proposal are shown in Table 20-7. These conditions of approval have been taken into account while developing the methodology for the Bushfire Protection Assessment for the Proposal.

Table 20-7: MPW Concept EIS Conditions of Approval

Conditions of Approval		Where addressed in this EIS
Schedule 4- Conditions to be met in future development applications		
E24.	All future Development Application shall be accompanied by an assessment against the Planning for Bushfire 2006 (NSW Rural Fire Service).	Section 20.2 and Appendix W of this EIS

20.2.2 Methodology

The methodology for the Bushfire Protection Assessment undertaken for the Proposal includes:

- Document review, including but not limited to; the Liverpool LEP, Liverpool Council Certified Bushfire Prone Land Map and *Planning for Bushfire Protection 2006* (NSW Rural Fire Service)
- Site inspection on 18 December 2015 to assess topography, vegetation and land use within and surrounding the Proposal site
- Visual inspection of the Proposal site to determine likely fire runs, influence of terrain on wind patterns within the bushfire prone vegetation and an assessment of the access and egress to the Proposal site
- Preparation of a Bushfire Protection Assessment, which incorporated a summary of the information obtained from the above activities and an assessment of the Proposal against the aims and objectives of *Planning for Bushfire Protection* 2006.The aim of the Bushfire Protection Assessment is to determine bushfire protection strategies that address the following:
  - The provision of building setbacks (Defendable Space) from vegetated areas and the siting of buildings to minimise the impact of radiant heat and direct flame contact
  - Firefighting water supplies
  - Access requirements for customers/staff and emergency service vehicles
  - Construction standards to be used for the future building within the proposed development to minimize the vulnerability of the building to ignition from radiation and ember attack
  - Land management responsibilities
  - Evacuation management.

20.2.3 Existing environment

The existing environment relevant to the Bushfire Protection Assessment comprises the following, and are detailed in Table 20-8:

- Topography, including an assessment to determine the effective slope of the land on and surrounding the Proposal site as the slope of the land will influence fire behaviour
- Vegetation on and surrounding the Proposal site in accordance with the vegetation classification system contained in Planning for Bushfire Protection 2006.
  - The definition of bushfire vegetation categories is as follows:
    - Bushfire Vegetation Category 1 refers to forest, woodlands, heath, wetlands
    - Bushfire Vegetation Category 2 refers to moist rainforests, shrublands, open woodlands, mallee and grasslands
    - Buffer was created based on the bushfire vegetation, with the buffering distance being 100 metres for vegetation category 1, and 30 metres for category 2.
- Surrounding land uses, which provides the context for the Proposal site and enable an accurate assessment of bushfire risks.

Figure 20-1 shows an extract of the Certified Liverpool Bushfire Prone Land Map showing the Proposal site and the surrounding vegetation mapping.

Table 20-8: Existing environment – Bushfire

Parameter	Existing Environment
Land use adjoining the Proposal site	▪ The MPE site and vacant undeveloped Commonwealth land to the north and east ▪ The East Hills Railway Line and vacant undeveloped Commonwealth land to the south ▪ The Georges River riparian corridor to the west.
Topography	The land within the Proposal site is level with a gradual fall towards George River to the west, the surrounding land is also level.
Vegetation	▪ To the east of the Proposal site is managed land on the MPE site and to the south east is Dry Sclerophyll Low Open Forest (managed Category 1 Bushfire Prone Vegetation) ▪ The vegetation on the land to the south of the Proposal site consists of slashed grassland and Dry Sclerophyll Low Open Forest (unmanaged Category 1 Bushfire Prone Vegetation) ▪ To the west of the Proposal site is the rehabilitated riparian corridor containing bushfire prone vegetation along the Georges River.

The above existing environment information was then used to undertake a precinct level assessment to determine those aspects of the Proposal deemed to be prone to bushfire threat and therefore subject to the provision of Asset Protection Zones/Defendable Spaces.

The bushfire hazard assessment produced a ‘Bushfire Hazard Score’ and ‘Bushfire Hazard Rating’ which considers the predominant vegetation within 140 m of the Proposal site and the effective slope of the land, in accordance with Planning for Bushfire Protection 2006 (NSW Rural Fire Service).

The vegetation, to the east and south of the Proposal site, and the riparian corridor to the west, present potential bushfire threat to the Proposal. The Bushfire Hazard Score and Bushfire Hazard Rating for the land to the east, south and west is as follows:

- The conservation area to the west of the Proposal site contains forest vegetation (vegetation index score of 2.8) and an effective slope of less than five degrees (slope index score of 2.0). The vegetation index and slope index are multiplied to produce a Hazard Score of 5.6 which results in a Bushfire Hazard Rating of high
- A Bushfire Hazard Rating of high also applies to the vegetation to the east and south of the Proposal site, however this hazard is mitigated by the separation provided by the Moorebank Avenue corridor to the east and the East Hill Railway Line to the south.

The bushfire threat to the Proposal site from the vegetation in the conservation area is deemed to be high due to the potential of this vegetation to be involved in a fire event which occurs under a northwest, west or southwest wind influence. The threat would involve high levels of ember attack, radiant heat and possible flame contact.

The separation provided by Moorebank Avenue and the East Hills Railway Line to the south reduces the threat from these directions to moderate. The threat from the east and south would involve moderate levels of ember attack and radiant heat. It is not likely that flame contact will occur.

Overall, the existing environment identifies that the potential bushfire threat to the Proposal would come from the rehabilitated forest vegetation within the conservation area, along the western part of the Proposal site, adjacent to the Georges River. A potential threat also exists from the forest vegetation on the Commonwealth Land to the east of Moorebank Avenue and to the south of the East Hills Railway Line.

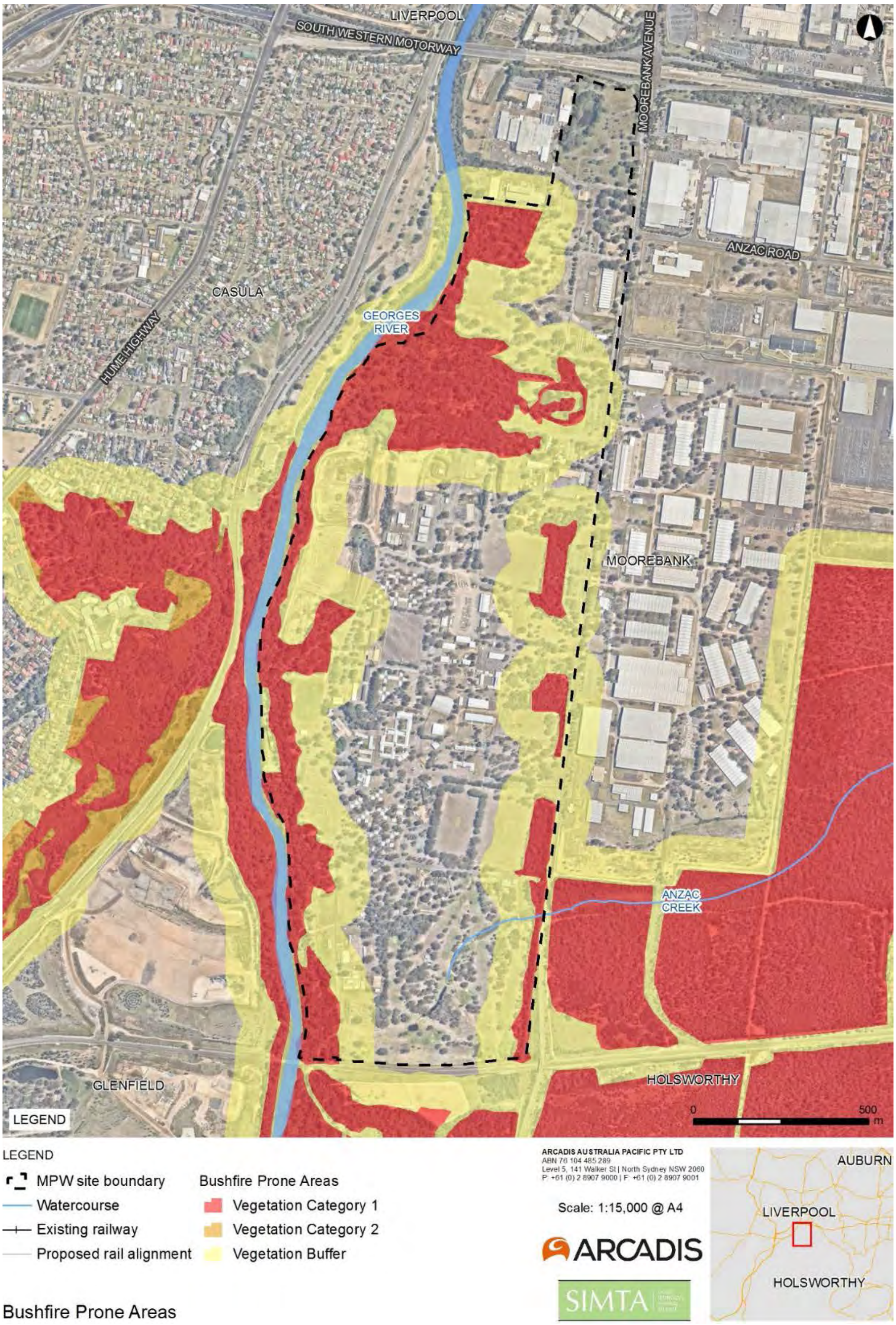

Figure 20-1: Extract of Certified Liverpool Bushfire Prone Land Map

20.2.4 Potential impacts

Construction

Construction compounds during the construction phase of the Proposal, would include:

- IMT facility compound, located directly south of Bapaume Road in the northern portion of the Proposal site
- Rail compound, located in the central portion of the Proposal site within the footprint of the proposed IMT facility site
- Earthworks compound, located in the southern portion of the site directly south of Chatham Avenue
- Warehouse compounds, located within the warehousing area in the central portion of the Proposal site.

These construction compounds would contain varying numbers and sizes of site offices, car parking, workshops, materials crushing areas etc., all of which are classified as non-habitable i.e. don't meet the requirements of Class 1, 2 or 3 structures under Australian Standard: 3959 Construction of buildings in bushfire-prone areas 2009 (AS3959).

All proposed construction compounds, site office locations and construction parking areas would be located outside vegetated and bushfire prone areas. Consequently, the bushfire threat to the fixed assets (construction compounds) during construction is considered to be low.

Operation

The operation of the Proposal has been considered in relation to the provisions of Planning for Bushfire Protection 2006 (NSW Rural Fire Service). Chapter 1, Section 1.3 of *Planning for Bushfire Protection 2006* states that the construction of Class 5 – 8 and Class 10 buildings (identified in the *Building Code of Australia* (ABCB, 1996)), which the Proposal site would consist of, on bushfire prone land, or land impacted by bushfire prone vegetation, must only meet the aims and objectives of the document, rather than the deemed to satisfy provisions.

The Proposal, is therefore a building class that is not required to comply with any bushfire specific performance requirements. Notwithstanding this, the Proposal would incorporate an IMT facility, workshop, offices and warehousing area that would be subject to occupation. For the purpose of providing a risk averse assessment, the Proposal site has therefore considered the bushfire risk and any appropriate setbacks for the Proposal site with a particular focus on habitable areas.

The Rail link connection does not fall within a building class that would require setbacks for bushfire, and would not contain any buildings. Consequently, a bushfire risk assessment is not required for the Rail link connection. Notwithstanding this, consideration has been given to elements of the Rail link connection, including the rail sidings which are a fixed asset, to fully understand any potential bushfire risks associated with the Proposal.

The compliance of the Proposal with the objectives of *Planning for Bushfire Protection 2006* is summarised in Table 20-9.

Table 20-9: Compliance with the objectives of Planning for Bushfire Protection 2006

Objective	Compliance with deemed-to-satisfy provisions
Afford occupants of any building adequate protection from exposure to a bushfire.	The separation between the fixed assets and the bushfire prone vegetation are as follows: ▪ IMT facility – 100 m ▪ Warehousing area – 25 m These distances exceed the defendable space widths required by *Planning for Bushfire Protection 2006* and remove the risk of flame contact, high levels of radiant heat and ember attack.
Provide for a defendable space to be located around the building.	A defendable space greater than 400 m is provided to the west of the IMT facility (including the office and engineers workshop) and 25 m to the west of the warehousing area.
Provide appropriate separation between a hazard and buildings, which, in combination with other measures, prevent direct flame contact and material ignition.	The width of the defendable space provided between the fixed assets and the bushfire prone vegetation removes the possibility of flame contact and high levels of radiant heat impact on the proposed buildings and site areas.
Ensure that safe operational access and egress for emergency service personnel and residents is available.	**Public roads**: The MPW site is accessed from Moorebank Avenue, which is a local road that provides safe operational access/egress for emergency service personnel and occupants of the facility. **Fire trail access**: No fire trail access is required, however the Proposal provides a fire service access within the Defendable Space located between the warehousing area and the proposed conversation area (i.e. along the internal road) **Emergency response access/egress:** Fire service access is provided via the main site access of Moorebank avenue and along the western boundary of the Proposal site, i.e. along the internal road.
Provide for ongoing management and maintenance of bushfire protection measures, including fuel loads in Asset Protection Zones.	The landscaping within the Proposal site would consist of the provision of an approximately 18 m wide landscaped area along the Moorebank Avenue frontage. This vegetation would be maintained to reduce the combustible ground fuels (leaf litter, bark and twigs). The Defendable Space located between the warehousing area and the conservation zone would be maintained as an Inner Protection Area and managed to the standards as required by *Planning for Bushfire Protection* 2006 and the NSW Rural Fire Service's document 'Standards for Asset Protection Zones'. The remainder of the Proposal site would be managed to maintain minimum dry fuels loads.

Objective	Compliance with deemed-to-satisfy provisions
Ensure that utility services are adequate to meet the needs of fire-fighters and others assisting in bushfire fighting.	An existing reticulated water supply, with hydrants, is located within Moorebank Avenue. An onsite fire-fighting water supply would to be installed to comply with A.S. 2419.1 - 2005, providing a satisfactory fire-fighting water supply to the complex. Refer to the Utilities Strategy Report (Appendix H).

The objectives of *Planning for Bushfire Protection 2006* generally apply to buildings included within the Proposal, and consequently are not applicable to the Rail link connection.

The bushfire threat to the fixed assets (rail sidings) is considered to be low however there is a risk that ignition of adjoining bushfire may occur from sparks given off by rail cars. The width of the Rail link connection would therefore be maintained in a low fuel state, as required, with protocols developed for the monitoring of train access/egress during high – catastrophic fire weather days.

20.2.5 Mitigation measures

Construction

The following actions would be considered for implementation, where reasonable and feasible, for mitigation of bushfire risk during construction:

- A bushfire management strategy, or equivalent, would be prepared as part of the CEMP for the construction phase. The plan would include:
  - Emergency response plans and procedures
  - All site offices and temporary buildings would have a minimum setback of 10 m to bushfire prone areas
  - All site offices would be accessible via access roads suitable for firefighting appliances similar to NSW Rural Fire Service category 1 tankers.

Operation

The following mitigation measures would be implemented during the operation of the Proposal:

- A bushfire management strategy, (including a fire safety and evacuation plan) or equivalent, would be prepared as part of the OEMP
- Management of the landscaped areas within the Proposal site would be undertaken to maintain minimum dry fuels loads
- The width, as required, of the Rail link connection would be maintained in a low fuel state
- Protocols would be developed for the monitoring of train access/egress during high – catastrophic fire weather days, if required and in accordance with the bushfire management strategy.

20.3 Property and infrastructure

A number of reports have been prepared to provide an assessment of the Proposal having regards to property and infrastructure impacts. The majority of reports prepared for this EIS address impacts on property and infrastructure, however of particular relevance are the Utilities Strategy Report and Building Service Strategy Brief (Appendix H).

Table 20-10 sets out the Secretary's Environmental Assessment Requirements (SEARs) as they relate to property and infrastructure, and where these have been addressed.

Table 20-10: SEARs for the Proposal relating to Property and Infrastructure

Section/Number	Requirement	Where addressed in this EIS
18. Property and Infrastructure	a) Assessing the impacts on affected properties and land uses, including impacts relating to access, land use, business activities, future development potential, and property acquisition; and	Sections 20.3.4 and 20.3.5 of this EIS
	b) Assessing the service demand, capacity and augmentation of existing and proposed utilities and infrastructure, including any relocation as a result of the development.	Section 20.3.4 and Appendix H of this EIS
7. Infrastructure Upgrades/Contributions		
a)	an assessment of the impacts of the project on local infrastructure, demonstrating that satisfactory arrangements are in place to support and mitigate any impacts of Stage 2 of the Concept Proposal including applicable costs, timing, TEU thresholds and approval pathways for such measures;	Sections 7.4, 7.5 and 7.6 of this EIS
b)	Consideration of any relevant Council's Developer Contributions Plan (or equivalent document requiring developer contributions), including the contributions plan for Prestons Industrial Area; and	Section 20.3.4 of this EIS
c)	Consideration of the need to extend the Route 901 bus service.	Sections 7.3.7 and 7.5 of this EIS

This Section summarises the studies undertaken previously for the MPW Concept Approval and, more recently, for the Proposal. This Section provides an assessment of the property and infrastructure impacts that have the potential to be encountered during the construction and operation of the Proposal, in accordance with the relevant SEARs. Measures to mitigate impacts have also been identified where they are required.

20.3.1 MPW Concept Approval

The MPW Concept EIS included a number of technical specialist studies and information to provide an assessment on the potential impacts of the MPW Project on affected properties, utilities and infrastructure.

The MPW Project is located on the MPW site, which is on Commonwealth Land. The MPW Project also involves work on portions of Anzac Road, the Commonwealth

Hourglass land and Bootlands, Moorebank Avenue and Bapaume Road, which are RMS, Commonwealth and council-owned roads respectively. Consultation with all of these land owners was undertaken as part of the preparation of the MPW Concept EIS.

Section 7.11 of the MPW Concept EIS provides details on the existing utility services for the MPW site and the potential for augmentation and/or adjustments to deliver the necessary utility servicing to support the MPW Project. The report identified that the MPW Project would require connection to a number of key utilities.

Table 20-11 provides a summary of the utility connections required and the potential impacts associated with these connections. Consultation was also undertaken with each of the service providers during the preparation of the MPW Concept EIS.

Table 20-11: Utility requirements for the MPW Project

Utility	Capacity potential
Electricity Supply (Endeavour Energy)	Endeavour Energy advised that supply would be able to be provided for the MPW Project from the Anzac Village Substation.
Gas (Jemena)	Natural gas would be available to the Project site from the existing gas main located along Moorebank Avenue.
Water (Sydney Water)	The water supply main (DN200 water main) servicing the terminals, administration, maintenance and repair and warehousing buildings would enter the MPW site from Moorebank Avenue near Anzac Road. A water supply main would be sufficient to meet the operational demands of the MPW Project. A separate water main would be provided for fire-fighting requirements.
Sewer	Sydney Water advised that a sewer line would need to be constructed for the MPW Project to connect to the existing Sydney Water network.
Telecommunications (Telstra)	The site would be able to receive connection to telecommunications.

The MPW Concept EIS concluded that existing infrastructure is suitable to service the estimated demands of the MPW Project either with augmentation or in its current condition.

A Rail Access Report (AECOM, 2015) was prepared for the MPE Stage 1 Proposal to identify enabling works and service alterations proposed within the Rail Corridor, for the construction of the Rail link. These enabling works and service alterations would be relevant to the MPW Project as the Rail link connection joins the MPE Stage 1 Rail link before connecting to the SSFL. The report identifies that the following enabling works would be required within the East Hills Rail Corridor and the SSFL/Main Southern Line Corridor:

- Protection and/or relocation of services, including potable water, sewer, telecommunications and gas
- Relocation of signalling cables
- Relocation of a signalling hut within the East Hills Rail Corridor
- Alterations to the existing ARTC Glenfield SSFL passing loop
- Establishment of protection barriers to allow for construction works of the Rail link to be undertaken concurrently with the operation of existing rail lines.

Conditions of Approval

The Conditions of Approval for the MPW Concept EIS do not include any requirements for property or utilities for the Proposal (i.e. Schedule 4 of the CoA). However, the CoAs committed to the following actions applicable to the Early Works (Schedule 3 of the CoA):

- B16 Utilities, services and other infrastructure potentially affected by construction and operation shall be identified prior to construction to determine requirements for access to, diversion, protection, and/or support. Consultation with the relevant owner and/or provider of services that are likely to be affected by the Early Works shall be undertaken to make suitable arrangements for access to, diversion, protection, and/or support of the affected infrastructure as required. The cost of any such arrangements shall be borne by the Applicant, or as otherwise agreed between the parties
- B17 The Applicant shall prepare dilapidation surveys and reports on the condition of local roads, footpaths, services and utilities affected by Early Works. The Applicant shall carry out rectification work at the Applicant's expense and to the reasonable requirements of the owners for damage resulting from the completion of Early Works
- B18 The Applicant shall ensure that the construction and operation of the proposed development will not prevent the existing use of Moorebank Avenue as a public road to a standard commensurate to its current use prior to the development. Note: temporary closures or part closures and changes to operation of Moorebank Ave may occur for limited periods during construction as detailed in the CTMP.

These conditions of approval have been taken into account while assessing the property and infrastructure impacts from the Proposal.

20.3.2 Methodology

The assessment of property and infrastructure impacts from the Proposal involved a review of the following technical assessments:

- Traffic and Transport (refer to Section 7 and Appendix M of this EIS)
- Noise and Vibration (refer to Section 8 and Appendix N of this EIS)
- Air Quality (refer to Section 9 and Appendix O of this EIS)
- Health (refer to Section 10 and Appendix P of this EIS)
- Socio-economic (refer to Section 20.5 of this EIS)
- Utilities Strategy Report and Building Service Strategy Brief (refer to Appendix H of this EIS).

The results of these above assessments were then considered in terms of the resultant property and infrastructure impacts, which are detailed below. The impact assessment provided discusses potential impacts on both affected properties (those which are included within the Proposal site) and also surrounding properties (those which are located around, however outside of the Proposal site).

20.3.3 Existing environment

For the purpose of this assessment, existing environmental conditions are assumed to be those that exist upon completion of the Early Works (assessed in the MPW Concept EIS).

Property ownership and land use

A summary of the affected (within the Proposal site) and surrounding properties and land uses is provided in Figure 20-2.

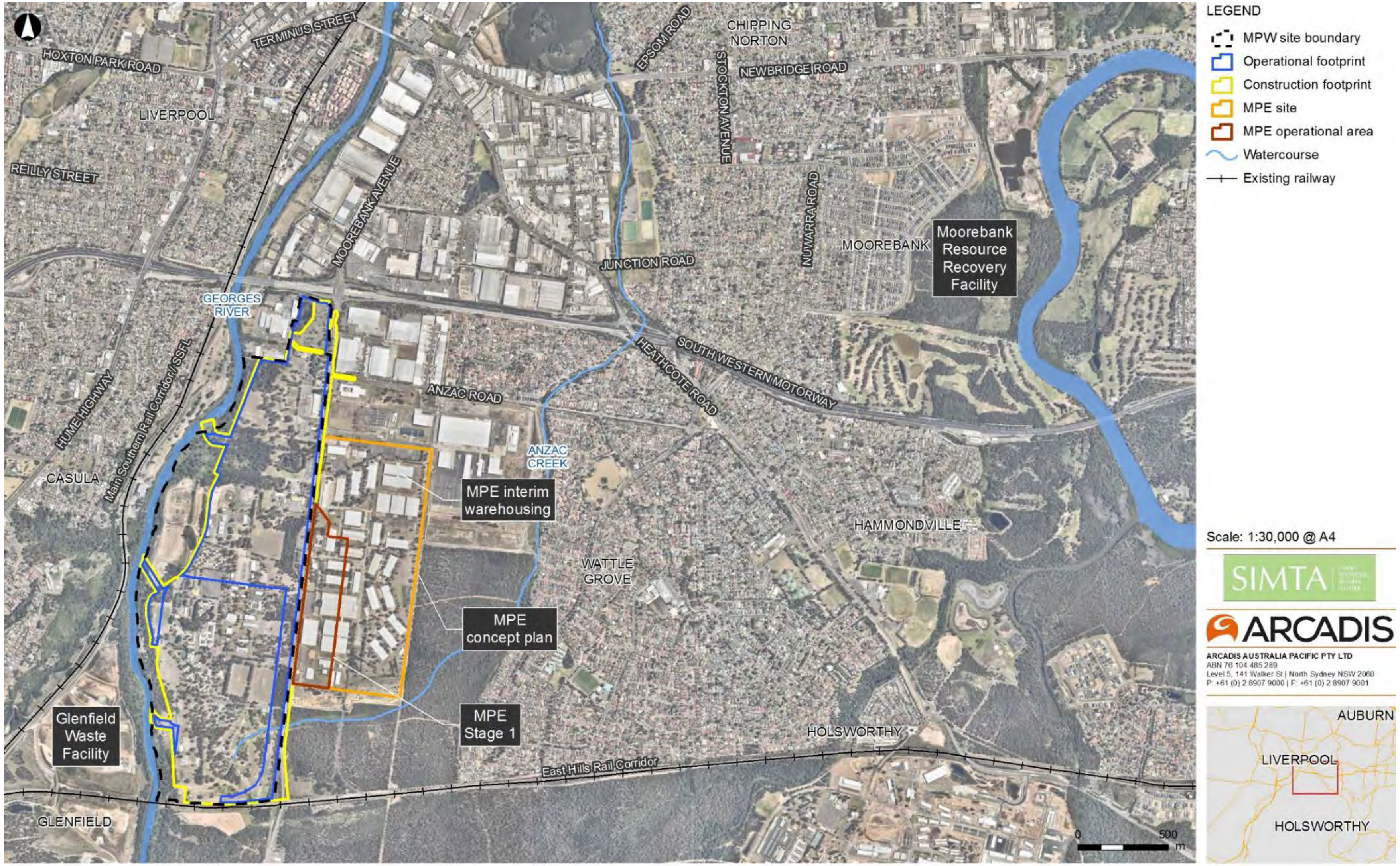

Figure 20-2: Affected (within the Proposal site) and surrounding properties and land uses

Affected properties

A summary of the current and future ownership and land uses for the Proposal site is included in Table 20-12.

These properties are subject to the MPW Concept Approval (SSD 5066) (and/or a modification to this approval), directly affected, and are properties on which an IMT facility, warehousing area, and associated Rail link connection and road upgrades are to be undertaken.

Table 20-12: Current property ownership and land use for the Proposal site

Site	Legal description	Ownership	Land use description
MPW site	Lot 1, DP 1197707, Lots 100 and 101 DP1049508	Commonwealth of Australia (owned by the Commonwealth and leased by SIMTA)	The MPW site was previously occupied by the Department of Defence for the purpose of training and housing and is known as the School of Military Engineering (SME). The site also includes the RAE Golf Course, located to the south, on which the Rail link connection is proposed. The site has now been vacated by the Department of Defence. The MPW site includes a riparian vegetation corridor (known as the 'conservation areas') along the eastern bank of the Georges River which mainly comprises River Flat Eucalypt Forest. Concept Plan Approval (SSD 5066) was granted on 3 June 2016 and EPBC Approval (No. 2011/6086) is anticipated to be granted in late 2016 for the development of an IMT, including rail and associated warehousing and Early Works on the MPW site. This EIS seeks approval for the second stage (MPW Stage 2, the Proposal) of development of the MPW Project, including the construction and operation of an IMT, warehousing area and Rail link connection.
Moorebank Avenue	Lot 2, DP 1197707	Commonwealth of Australia	Moorebank Avenue is currently a two lane undivided road (one lane

Site	Legal description	Ownership	Land use description
	Public road reserve of Moorebank Avenue to the north of Anzac Road		on each direction) between Cambridge Avenue and the M5 Motorway (adjacent to and traversing the MPW site) and a four lane undivided road (two lanes on each direction) north of the M5 Motorway. This road provides a north-south link between Liverpool and Glenfield. Moorebank Avenue between the M5 Motorway and Anzac Road is owned and maintained by Liverpool City Council. Moorebank Avenue between Anzac Road and Cambridge Avenue (adjacent to the Proposal site) is a private road on Commonwealth land.
Anzac Road	Public road reserve	Liverpool City Council	Anzac Road is an east-west local road that connects Moorebank Avenue and Heathcote Road. It provides access to Moorebank Business Park and the residential area of Wattle Grove. This is generally a two-lane undivided road.
Bapaume Road	Public road reserve	Liverpool City Council	Bapaume Road, is an east-west local road that connects the ABB site to Moorebank Avenue. It is a two-lane road which has a speed limit of 60 kilometres per hour (km/h) and is owned by Liverpool City Council.
Georges River	Georges River	Crown Lands (Department of Trade and Investment)	Includes areas of undeveloped land located on and primarily within the Georges River. This property also includes banks located on the eastern and western side of the Georges River which contains native vegetation including Hinterland Flats Eucalypt Forest and Forest Red Gums. It is located to the immediate north of the existing East Hills Rail Line railway bridge and to the west of the MPW site.

Site	Legal description	Ownership	Land use description
Commonwealth Hourglass land	Lot 4, DP 1130937	Commonwealth of Australia	Includes a patch of land (in an hourglass shape) located to the immediate east and north of the Glenfield Waste Facility, on the eastern bank of the Georges River. The land is owned by the Commonwealth, is undeveloped and includes Riparian Forest.
Bootlands	Lot 4, DP 1197707	Commonwealth of Australia	Undeveloped land, containing native vegetation including Cooks River Castlereagh Ironbark Forest, Castlereagh Scribbly Gum Woodland and Castlereagh Swamp Woodland. Small pockets of land have been cleared for past rail-related activities. This land is traversed by Anzac Creek, which flows to the north, discharging to the Georges River. The land includes a disused railway spur which connects into the East Hills Railway Line.

Surrounding properties

A number of residential suburbs are located in proximity to the Proposal site, as shown in Table 20-13. The closest residential sensitive receivers are approximately 300 m west of the Proposal site, and west of the SSFL.

Table 20-13: Distance from the closest residential receivers

Suburb	Distance[79] from:		
	Proposal site	Rail link connection	Rail link
Wattle Grove	1,000 m	1,000 m	1,260 m
Moorebank	630 m	1,400 m	2,500 m
Casula	330 m	1,200 m	290 m
Glenfield	820 m	1,100 m	750 m

A number of other sensitive properties and land uses which have been identified in the surrounding area include, but are not limited to:

- MPE site, located adjacent to the Proposal site on the eastern side of Moorebank Avenue

[79] Distance is measured from the closest residential receiver within this suburb.

- All Saints Senior College located approximately 400 m from the Proposal site to the west
- Casula Powerhouse located approximately 370 m from the Proposal site to the north-west
- Glenfield Farm (listed on the State Heritage Register) located approximately 650 m from the Proposal site to the west
- Holsworthy Military Area located approximately three kilometres from the Proposal site to the east.

In addition to this the key commercial and industrial sites which surround the Proposal site include:

- DJLU (a recently constructed site) located adjacent to the Proposal site on the eastern side of Moorebank Avenue and north of the MPE site
- The ABB site located to the northwest of the MPW site on the eastern side of Georges River, directly adjacent to the Proposal site
- The Moorebank Business Park (currently including companies such as Toyota, Electrolux and BMW warehousing and showroom facilities) located adjacent to the Proposal site on the eastern side of Moorebank Avenue to the north of the DJLU site and Anzac Road.

A number of additional sensitive receivers have also been identified in the greater surrounding area including residential, educational, commercial and industrial uses (refer to the Air Quality (Section 9 and Appendix O), Noise and Vibration (Section 8 and Appendix N) and Human Health (Section 10 and Appendix P) sections of this EIS).

Utilities

The Proposal site is currently serviced from public utility networks through connections that are Commonwealth owned assets. A number of existing public utilities are available in close proximity to the Proposal site including:

- Potable water – Water main north of Anzac Road on Moorebank Avenue
- Sewer - Moorebank Avenue gravity sewer near Bapaume Road
- Electricity - Anzac Village Substation on Anzac Road
- Communications - Existing assets along Moorebank Avenue and Anzac Road
- Natural Gas - Existing assets along Moorebank Avenue.

20.3.4 Potential impacts

A detailed description of the works for the Proposal, including necessary property rights alterations, are provided in Section 4 of this EIS.

A detailed assessment of the impacts of the Proposal (for both construction and operation) on both affected and surrounding properties (as identified above) has been provided in Sections 7 to 19 of this EIS. This has considered the following potential environmental impacts associated with the use of certain properties (included within the Proposal site) and an assessment of the impacts on surrounding properties. These assessments relate to the following.

- Traffic and transport
- Air quality
- Noise and vibration
- Human health
- Surface water
- Indigenous Heritage
- Non-Indigenous Heritage
- Contamination
- Bushfire
- Flora and Fauna

- Visual Amenity, Urban Design and Landscape
- Rail Access

This assessment section summarises, and provides reference to the assessment sections provided for each technical speciality, as relevant.

These properties are subject to the MPW Concept Approval (SSD 5066) (and/or a modification to this approval), which facilitates their use for the purposes of an IMT facility, warehousing area and associated Rail link connection.

Construction

Property ownership and land use

Affected properties (the Proposal site)

The potential impacts of the construction work included in the Proposal, relating to property ownership and land use and contained within the Proposal footprint, is provided in Table 20-14.

Table 20-14: Construction impacts on property ownership and land use (affected properties)

Site	Potential impact
MPW site	The Proposal would not change the current landownership of the MPW site. The construction of the Proposal would involve physical construction works over the majority of the MPW site, part of which would have been previously disturbed by Early Works undertaken under the MPW Project (refer to Section 1 of this EIS). A number of private easements are proposed over the Proposal site to maintain access and provide for electrical, water, sewer and telecommunication services. In addition, services corridors within the road verge standard allocation are proposed to remain unutilised to provide access for services authorities. The Proposal involves clearing of the Proposal site which is located within the MPW site. This clearing would be offset through a Biodiversity Offset Strategy, which comprises the establishment of a conservation area (approximately 6.8 ha) on the eastern bank of the Georges River, on the western side of the MPW site, rehabilitation of the Hourglass land on the western side of the Georges River and the Bootlands to the south-east of the Proposal site, in accordance with the both the *NSW Biodiversity Offsets Policy for Major Projects* (OEH, 2014) and the *Framework for Biodiversity Assessment* (OEH, 2014) (refer to Section 11 and Appendix Q of this EIS). The establishment of part of the MPW site as a biodiversity offset site would not have an impact on the proposed land use of the site. This is generally considered a positive impact and ensures the preservation of this existing vegetation in perpetuity. The biodiversity offset areas may be subject to indirect impacts from the adjoining development, including edge effects, weed invasion, sedimentation and erosion, noise impacts on fauna, dust and light pollution. These potential impacts would be

Site	Potential impact
	managed through implementation of mitigation measures in accordance with the CEMP. The Proposal also involves the construction of three OSD drainage channels from the Proposal site, through the conservation area and into the Georges River. Whilst these channels would change the land use of these areas from bushland to drainage channels, they would be designed to maintain fauna connectivity along the conservation area (e.g. vegetation gabions), thereby minimising any potential impacts. Overall, the construction of the Proposal would facilitate for a change in land use of the Proposal site from Defence uses to an IMT facility. Mitigation measures would be implemented to reduce the impact of this land use change on the immediately surrounding environment.
Moorebank Avenue	The Proposal would not change the current landownership of Moorebank Avenue. Subject to further discussions with services and infrastructure providers, there is the potential for necessary property rights to be granted along Moorebank Avenue to accommodate infrastructure (including utility services and road augmentation) to service the Proposal. A number of works would be undertaken during construction within Moorebank Avenue to accommodate drainage works, intersection upgrades including signalling works (both temporary and permanent) and car and truck entrances to the Proposal site (construction of the new site access and also establishment of temporary construction entrances), proposed utility servicing (along Moorebank Avenue) and alterations to the Moorebank Avenue/Anzac Road intersection. These works would involve temporary closures (in part and full) of Moorebank Avenue during certain works periods as part of the construction of the Proposal. Moorebank Avenue would be used by construction and light vehicles travelling to and from the Proposal site. The impact of these works and construction traffic movement on Moorebank Avenue has been considered in Section 7 and Appendix M of this EIS. These impacts would be mitigated through the preparation of a CTMP, in accordance with the PCTMP, included in Appendix M to this EIS, which would be implemented during construction of the Proposal. In summary, the Proposal may result in temporary disturbances during construction, however, would not result the on-going land use of the Moorebank Avenue as a publicly accessible private road.
Anzac Road and Bapaume Road	The Proposal would not change the current landownership of either Anzac Road or Bapaume Road. A number of works would be undertaken during construction within Anzac Road and Bapaume Road to accommodate intersection works and the new site access, which would involve temporary closures of both roads during certain works periods of the construction of the Proposal. These construction works would require potential road diversions, however access to properties within these areas would be maintained. Access to the ABB site would be maintained throughout construction via Bapaume Road. The impact of these works and construction traffic movement on both these roads has been considered in Section 7 and Appendix M of this

Site	Potential impact
	EIS. These impacts would be mitigated through the preparation of a CTMP, in accordance with the PCTMP, included in Appendix M to this EIS, which would be implemented during construction of the Proposal. In summary, the Proposal may result in temporary disturbances, however, would not result in any change to the on-going land use of Anzac Road and Bapaume Road as council-operated local roads.

Surrounding land uses

As discussed above, detailed environmental impact assessment has been undertaken to minimise the impacts of the construction of the Proposal on surrounding land uses. Particular consideration has been given to sensitive surrounding land uses including residential (Wattle Grove, Moorebank, Casula and Glenfield) and educational, commercial and industrial uses.

Of particular importance to the land uses in the surrounding area are impacts related to traffic and transport, air quality, noise and vibration, visual and socio-economic. A summary of how these impacts are to be mitigated during the construction of the Proposal is provided in Table 20-15.

Table 20-15: Potential construction impacts and mitigation on surrounding properties

Concern	Mitigation	Where addressed
Traffic	The key potential impacts would be associated with the use of construction vehicles (cars and trucks) accessing the site via Moorebank Avenue from the M5 Motorway. To a significantly lesser extent Anzac Road would also be used by construction vehicles. The following would be prepared and implemented during construction to minimise impacts on surrounding properties: ▪ A community information and awareness strategy would be included in the CEMP ▪ Road Safety Audit would be undertaken of Moorebank Avenue to identify the traffic safety risk and its findings and recommendations included in the CTMP ▪ CTMP would be prepared in accordance with the PCTMP included in Appendix M, and included in the CEMP.	Section 7 and Appendix M of this EIS
Air Quality	The principle air emissions during the construction phase of the Proposal would be dust from construction activities. Overall, the modelling results indicate that the construction phase of the Proposal complies with all relevant impact assessment criteria. The Air Quality Management Plan (provided in Appendix O of this EIS), would be further progressed and incorporated into the CEMP for the Proposal.	Section 9 and Appendix O of this EIS.
Noise and Vibration	Works included within the construction phase of the Proposal have the potential to impact on surrounding sensitive receivers. The modelling results indicate that	Section 8 and Appendix N of this EIS.

	construction noise emissions are expected to comply with the EPA's ICNG noise management levels during all works periods at all receivers, with the exception of Casula for bulk earthworks, which is predicted to exceed the established NML by up to 1 dBA. This exceedance is considered negligible and does not warrant mitigation. A Construction Noise and Vibration Management Plan, or equivalent, would be developed for the Proposal in accordance with the ICNG.	
Visual	Areas such as Moorebank Avenue, the nearby passenger rail lines and nearby residential areas of Casula and Glenfield may have the potential to view the construction area and associated construction equipment. These visual impacts would generally be localised and temporary in nature. A Visual Impact Assessment has been prepared as part of this EIS. A number of mitigation measures would be considered for implementation to further reduce visual impacts on surrounding land uses.	Section 15 and Appendix T of this EIS.
Socio-economic	Construction impacts that would affect the socio-economic environment would be temporary and include the employment of a construction workforce, generation of additional customers for local businesses. There may be potential disruptions to businesses as a result of the impacts listed above. The majority of the impacts are positive, however there may also be some short term negative impacts. A community information and awareness strategy would be included in the CEMP and would outline measures to maintain communication with the community (including surrounding businesses) and all relevant stakeholders throughout the construction process of the Proposal.	Section 20.5 of this EIS.

Overall, the Proposal includes a number of measures which would reduce the impact of the construction works on the surrounding area. Impacts would be temporary and are not considered to significantly impact on surrounding land uses.

Utilities

The construction works for the Proposal would include connection to existing utilities. The Utilities Strategy Report and Building Service Strategy Brief (Appendix H) and Section 4 of this EIS, provide further detail on the utilities works to be undertaken.

A summary of the demand requirements, for each utilities connection, for the Proposal site includes:

- Water – 50 L/s (peak) and 350 kL (daily)
- Sewer – 40 L/s (peak) and 270 kL (daily)
- Electricity – 9.75 MVA
- No additional gas demand is expected from the Proposal.

The Proposal site has historically been connected to nearby public utility networks through Commonwealth owned assets. These connections would be disconnected and redundant infrastructure would be decommissioned as part of the Early Works. Utilities installation across the Proposal site would be completed as part of the Proposal, refer to Section 4 and Appendix H of this EIS for details.

There is likely to be some temporary impacts on surrounding utilities during construction, however these would be avoided where possible, and if unavoidable would be for short duration. All of these works would be undertaken in consultation with relevant land owners and infrastructure and service providers to further minimise impacts of the construction works included in the Proposal.

Operation

Property ownership and land use

Affected properties (the Proposal site)

The potential impacts of the operation of the Proposal, in relation to property ownership and land use for affected properties within the Proposal footprint, is provided in Table 20-16.

Table 20-16: Operational impacts on property ownership and land use (affected properties)

Site	Potential impact
MPW site	The Proposal would not change the current landownership of the MPW site. The Proposal would result in a permanent land use change to the majority of the MPW site, from a Defence site to an IMT facility with associated warehousing. This land use change would be facilitated by the planning proposal to amend the site zoning (PP_2012_LPOOL_004_00) detailed in Section 1.4.3 and 5.4.1 of this EIS. The Proposal has been specifically designed to minimise impacts on the surrounding land uses. The establishment of part of the MPW site as a biodiversity offset site (on the eastern bank of the Georges River) would support the current land use on this part of the site. This is considered a positive impact and ensures the preservation of this existing vegetation in perpetuity (refer to Section 11 and Appendix Q of this EIS). The proposal also involves the establishment of stormwater management systems across the site comprising of three OSDs with drainage channels that pass through the conservation area and into the Georges River. Whilst these channels would change the land use of these areas from bushland to drainage channels, fauna connectivity along the conservation area would be maintained, thereby any potential impacts would be minimised. The Proposal would result in a change of land use to the MPW site, however this change would retain and support the use of the MPW site for industrial purposes, as is intended by the Planning Proposal (PP_2012_LPOOL_004_00))
Moorebank Avenue	The Proposal would not change the current landownership of Moorebank Avenue. Subject to further discussions with infrastructure

Site	Potential impact
	providers, there is the potential for necessary property rights to be granted along Moorebank Avenue to accommodate necessary infrastructure (including utility services and road augmentation) to service the Proposal. Moorebank Avenue would include upgraded traffic signalling and drainage works as a result of the Proposal, particularly for the upgraded Moorebank Avenue/Anzac Road intersection and the new site access. Construction works are also required on Bapaume Road and Anzac Road as discussed below. The use of Moorebank Avenue (to the south of the M5 Motorway) for access to the Proposal would be managed through the implementation of a number of mitigation measures during operation of the Proposal (refer to Section 7 and Appendix M of this EIS). The Proposal would result in a visual change to the streetscape of Moorebank Avenue, however, the Proposal would be in keeping with the industrial character of this streetscape and includes landscaping to minimise impacts on the visual amenity of Moorebank Avenue (refer to Section 15 and Appendix T of this EIS). In summary, the Proposal would support and facilitate for the on-going land use of Moorebank Avenue as a publicly accessible road.
Anzac Road and Bapaume Road	The Proposal would not change the current landownership of either Anzac Road or Bapaume Road. Both roads would require intersection upgrades as part of the Proposal, however the use of both of these roads would be managed through the implementation of a number of mitigation measures during operation of the Proposal (refer to Section 7 and Appendix M of this EIS). After construction, Bapaume Road would have a left-in and left-out only arrangement and access to the ABB site would be via the new site access. In summary, the Proposal would support and facilitate for the on-going land use of Anzac Road and Bapaume as publicly accessible roads.
Georges River	The proposal involves the operation of three OSD drainage channels from the Proposal site, through the conservation area and into the Georges River. The operation of these channels would not change the existing land use of the Georges River. In addition, the Proposal would not impact on public access to the river or change the recreational uses of the Georges River.
Commonwealth Hourglass land and Bootlands	The Proposal involves the development and implementation of a Biodiversity Offset Strategy, which includes the Hourglass land on the western side of the Georges River and the Bootlands to the south-east of the Proposal site as offsets, The establishment of these areas as biodiversity offsets would not have an impact on the existing land use of the areas. This is considered a positive impact and ensures the preservation of this existing vegetation in perpetuity.

Surrounding land uses

As has been discussed above, detailed environmental impact assessment has been undertaken to minimise the impacts of the operation of the Proposal on surrounding land uses. Particular consideration has been given to sensitive surrounding land uses including residential (Wattle Grove, Moorebank, Casula and Glenfield) and educational, commercial and industrial uses.

Of particular importance to the land uses in the surrounding area are impacts related to traffic and transport, air quality, noise and vibration, human health, visual and socio-economic. A summary of how these impacts are to be mitigated during the operation of the Proposal is provided in Table 20-17.

Table 20-17: Potential operational impacts and mitigation on surrounding properties

Concern	Mitigation	Where addressed
Traffic	Potential traffic impacts would be generated by site access off Moorebank Avenue particularly by heavy vehicle movements (and to a lesser extent cars) on the surrounding road network. The potential impacts associated would relate to the performance of the surrounding road network, use of, and disruption to, pedestrian and cyclist networks and the potential for increased traffic accidents. The following would be prepared and implemented during operation to minimise the traffic impacts on the surrounding properties: ▪ Heavy vehicle movements would be managed through a Vehicle Booking System to regulate and manage truck arrivals to/from the site and to prevent trucks queuing and waiting on Moorebank Avenue as identified in the Preliminary Operational Traffic Management Plan ▪ Preparation of a Preliminary Operational Traffic Management Plan (or equivalent), including a driver code of conduct. Improvements to the proposed site entry and exits to facilitate safe access for vehicles, and pedestrians (at these locations) during the progression of the design of the Proposal.	Section 7 and Appendix M of this EIS
Air Quality	Overall, the modelling predictions indicate that the risk of adverse air quality impacts from the Proposal are low. The incremental increase in key pollutants (PM_{10} and $PM_{2.5}$) at the surrounding residential areas would be largely indistinguishable from the existing background and the Proposal. The implementation of Best Practice, identified in the Air Quality Best Practice Review would further reduce the operational impacts of the Proposal (refer to Section 9 and Appendix O of this EIS). The Air Quality Management Plan (provided in this EIS), would be further progressed and incorporated into the OEMP for the Proposal.	Section 9 and Appendix O of this EIS

Concern	Mitigation	Where addressed
Noise and Vibration	The noise modelling has predicted that operation of the IMT facility and road traffic associated with the Proposal may exceed the relevant noise assessment criteria, hence the construction of a noise wall along the western boundary of the Proposal site has been proposed. The modelling has predicted that noise generated by the operations of the Rail link connection would exceed the applicable noise criteria at Casula and Glenfield. Based on the INP amenity levels, these locations are already subject to significant levels of rail noise from the existing network rail lines (SSFL and the Main Southern Line). The existing numbers of rail movements due to both passenger and freight trains travelling along network rail lines in the vicinity of the sensitive receivers are significantly higher than the additional movements associated with the Proposal. Therefore, it is expected that the existing $L_{Aeq,\ period}$ levels of rail noise at the most affected receivers within Casula and Glenfield are unlikely to noticeably increase due to the Proposal. The implementation of Best Practice, identified in the Noise Best Practice Review would further reduce the operational impacts of the Proposal (refer to Section 8 and Appendix N of this EIS).	Section 8 and Appendix N of this EIS
Human Health	With regards to air quality, the increase in risk due to air pollution from the operations at the Proposal site are low and in most cases are negligible. The cancer risk from the air toxics are well below acceptable risk level set by international agencies. The implementation of best practice measures, as outlined in Section 9 of this EIS, would lead to further reductions in air pollution levels and the associated health risks. The assessment undertaken for noise indicated that the Proposal operation meets the WHO community noise guidelines at most sensitive receivers. Exceedances occur for annoyance, sleep disturbance and cognitive impairment in the local communities from predicted operational rail noise. However, since it was also indicated that the existing ambient noise levels already exceed the WHO guidelines, the additional noise created as a result of the Proposal is anticipated to have minimal impacts on noise related health effects in the local area The implementation of the best practice measures outlined in Section 8 and captured in Appendix N of this EIS would further reduce this impact.	Section 10 and Appendix P of this EIS
Visual	The extensive native bushland areas, the MPE site and the general pattern of industrial type development surrounding the Proposal site screen the Proposal from much of the greater sensitive surrounding areas. Furthermore, the landscape and urban design features described above, would further screen the Proposal as well as integrate the Proposal	Section 15 and Appendix T of this EIS

Concern	Mitigation	Where addressed
	with surrounding land uses, minimising the visual impact. Overall impacts are considered low or moderate with mitigation measures included to further reduce this impact. The lighting to be used for the operation of the IMT facility and warehousing area would have minimal effect on adjacent properties and on the environment as a result of the appropriate selection of light source, luminaire, luminaire mounting height and luminaire aiming.	
Socio-economic	There is potential for positive and negative socio-economic impacts associated with the operation of the Proposal. Positive impacts are likely to be felt more at a regional level while the direct impact (positive and negative) of the development would possibly be experienced at the local level. Of particular importance is that the Proposal would have a positive long term impact on economy through employment and investment in the local and regional area. The OEMP would also include measures to engage with stakeholders and to manage and respond to feedback received during operation of the Proposal. A number of mitigation measures are proposed (in the sections above) to reduce the operational impacts of the Proposal on the surrounding social and economic community.	Section 20.5 of this EIS

Overall, the Proposal includes a number of measures which would reduce its operational impact on the surrounding area.

Utilities

The Utilities Strategy Report and Building Service Strategy Brief (refer to Appendix H of this EIS) and Section 4 of this EIS, provide further detail on the utilities works to be undertaken.

These utility connections provided for the operation of the Proposal have been determined through an assessment of the service demand requirements for the Proposal available in the surrounding area. The assessment provided within the Utilities Strategy Report (refer to Appendix H of this EIS) concludes that the existing infrastructure is suitable to service the estimated demands of the Proposal either with augmentation or in its current condition. The report also indicates that consultation and applications have been made to service and infrastructure providers including Sydney Water, Telstra, Jemena and Endeavour Energy to facilitate for the necessary utilities connections (refer also to Section 4 of this EIS).

Further consultation with infrastructure and service providers would continue during the progression of the design for the Proposal, prior to and during construction.

Developer contributions

Section 7.6 of this EIS provides a summary of the potential traffic impacts of the operation of the Proposal and concludes that developer contribution discussions to address these impacts would be undertaken with Roads and Maritime subsequent to the finalisation of the Precinct Model[80]. The apportionment of developer contributions would be subject to the outcomes of the Precinct Model and would be discussed further, and as necessary an agreement determined, between MIC, SIMTA and the relevant government agencies (Roads and Maritime and Liverpool City Council, as relevant).

Liverpool City Council does not currently have a Section 94 Contributions Plan which relates to industrial development on the Proposal site. In the absence of a relevant contributions plan for the Proposal site and the Proposal, SIMTA has considered the principles of the Liverpool Contributions Plan 2009, in particular in relation to the Preston's Industrial Release Area (Section 1.1 of the plan). It is noted that there are considerable differences between the Preston's Industrial Release Area and its location to surrounding development, drainage infrastructure, need for transport infrastructure and ownership arrangements, which form, amongst other aspects, the basis for developer contributions. Notwithstanding this, Table 20-18 provides a summary of the general considerations of the Preston's Industrial Release Area contributions and the benefits proposed by the Proposal.

Table 20-18: Considerations of the Preston's Industrial Release Area contributions

Principle	Proposal comments
Transport	Section 7 and Appendix M of this EIS provides a summary of the potential traffic impacts of the Proposal. The analysis has identified a number of intersections, which are in part impacted by the Proposal, and require upgrade. It is considered acceptable that developer contributions, from SIMTA, would be provided to assist with the development of these intersections, however this would need to be confirmed through discussions with Roads and Maritime.
Drainage	Sections 4, 12 and Appendix R of this EIS identify the stormwater strategy and potential impacts of the Proposal. In particular, the Proposal includes an integrated stormwater strategy comprising pits and pipes draining to OSD, which filter run-off and then periodically discharge. The Proposal's drainage strategy considers other surrounding site's and historic drainage flows. In particular, the Proposal includes retention of the existing Amiens wetland, which is understood to be utilised by the M5 Motorway (i.e. Roads and Maritime).
Landscaped Buffer Areas	Sections 4, 11 and Appendix E and Q of this EIS provide further detail on the landscaped (or otherwise) buffers proposed to be established for the Proposal site. In particular, buffers are to be provided along Moorebank Avenue and also as part of a biodiversity offset on the western part of the MPW site, fronting Georges River.

The above aspects are considered to provide benefits to the Proposal, the Moorebank Precinct, and the surrounding area, and therefore may form part of the developer contributions discussions.

[80] Currently under preparation by MIC to highlight all potential traffic impacts of the Proposal (as a part of the Moorebank Precinct), the need for upgrades to the road network, and the timing and triggers for those upgrades. This Precinct Model is envisaged to be available towards the end of 2016.

20.3.5 Mitigation measures

A number of mitigation measures would be implemented during both the construction and operation of the Proposal to minimise impacts on affected and surrounding land uses, as provided in Section 22 of this EIS.

Further assessment of services demand, infrastructure requirements and augmentation works, in consultation with relevant infrastructure and service providers would be undertaken during the progression of the design for the Proposal, prior to and during construction.

20.4 Ecologically Sustainable Development

An assessment of the Proposals' consistency with the principles of ecologically sustainable development (ESD) is provided in this Section of the EIS. The SEARs which are addressed in this Section are provided in Table 20-19.

Table 20-19: SEARs for the Proposal relating to ESD

Section number	Requirement	Where addressed in this EIS
21. Ecologically Sustainable Development	The EIS shall detail how the development will incorporate ESD principles in the design, construction and ongoing operation phases of the development.	Section 20.4 of this EIS

20.4.1 MPW Concept Approval

The MPW Concept Approval includes an outline of the MPW Project's sustainability, which is relevant to the Proposal as it outlined the sustainability framework and principles that guide the development of the MPW Project, and a summary of its key sustainability objectives and benefits.

The review of the MPW Project's sustainability, included:

- Identification of the relevant principles of Ecological Sustainable Development (ESD)
- Assessment of the MPW Project against a range of relevant sustainability policies and rating tools
- Identification of the economic benefits of implementing ESD
- Identification of ESD objectives and initiatives for the MPW Project.

20.4.2 Methodology

The Proposal has been assessed against the principles of ESD, as described in Schedule 2 of the EP&A Regulations:

- **Precautionary principle**, namely, that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, public and private decisions should be guided by:
  - (i) Careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment
  - (ii) An assessment of the risk-weighted consequences of various options
- **Inter-generational equity**, namely, that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations
- **Conservation of biological diversity and ecological integrity**, namely, that conservation of biological diversity and ecological integrity should be a fundamental consideration
- I**mproved valuation, pricing and incentive mechanisms**, namely, that environmental factors should be included in the valuation of assets and services, such as:

- (i) Polluter pays, that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement
- (ii) The users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste
- (iii) Environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, which enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems.

20.4.3 Potential impacts

Precautionary principle

The precautionary principle requires evaluation of the risks of serious or irreversible environmental damage associated with a proposed development. The Proposal has been assessed with the purpose of reducing the risk of serious and permanent impacts on the environment.

A precautionary principle approach has been applied throughout the preparation of the design of the Proposal and all technical studies associated with the Proposal; with intent to minimise environmental impacts. The MPW Concept Approval for the MPW Project defined the extent of the project and included a number of environmental investigations which identified its potential impacts. It is the intention of the Proposal to further the progress provided in the MPW Concept EIS and to minimise environmental damage to the Proposal site and surrounds.

Technical specialist studies were undertaken to provide accurate information to assist with the evaluation and development of the Proposal, including:

• Air quality	• Non-Indigenous Heritage
• Noise and vibration	• Bushfire
• Human health	• Surface water
• Flora and Fauna	• Visual Amenity, Urban Design and Landscape
• Contamination	• Rail Access

Where a level of uncertainty was identified in the data used for the assessments, a conservative worst-case scenario analysis was undertaken. Where these assessments identified potential impacts to the environment, mitigation measures have been proposed to be implemented. The technical specialist studies provided a detailed analysis of both the construction and operational phases of the Proposal, to consider the environmental impacts, having regard to the precautionary principle.

Subject to the implementation of mitigation measures, these specialist studies did not identify any issues that may cause serious and irreversible environmental damage as a result of the Proposal. The detailed assessment of each of these potential impacts is provided throughout this EIS (refer to Sections 7-19 of this EIS). Further, the mitigation measures provided in Section 22 of this EIS identify how the Proposal will minimise environmental damage throughout its various phases (construction and operation).

Intergenerational equity

Inter-generational equity is concerned with ensuring that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations.

The Proposal has been designed to benefit both existing and future generations through the provision of an IMT that contributes to improving the standard of existing freight management, which will remove significant numbers of freight vehicles from the M5 Motorway, easing congestion on this arterial road, and will reduce average delivery distances and support more efficient use of road transport. This is a high growth area for a wide variety of activities. In the absence of any alleviating measures the cumulative effects of traffic congestion would significantly reduce amenity and regional accessibility for local communities.

Reducing the freight traffic volume would have direct and flow-on economic, social and wider environmental benefits, including but not limited to improved inter-regional access, reduced freight and transport costs for industry and businesses and job creation during construction. While the Proposal would have some adverse impacts during both construction and operation, as outlined elsewhere in this assessment, they are assessed as being of a nature or extent that would not trigger investigation thresholds or inequitably disadvantage any sector of the community or future generations. Mitigation measures have also been identified during both construction and operation, which will result in there being no significant adverse environmental impacts associated with the Proposal.

Further, the development of an IMT at Moorebank was identified in NSW 2021, the State Infrastructure Strategy, the Plan for Growing Sydney, and other State strategies (refer to Section 3 of this EIS), as a key element of the wider IMT network required to meet long term projected freight demand across the Sydney Greater Metropolitan Area. The Proposal forms an integral part of the overall IMT strategy of Sydney, servicing the increased Port Botany throughput and the future capacity of Sydney ports. This would, in turn, result in an increase in jobs into the future.

Overall, the design of the Proposal has incorporated the ESD principle of intergenerational equity through ensuring that the IMT can be constructed and operated sustainably to ensure that there is no significant on-going impacts on the surrounding community and future generations. The mitigation measures provided in Section 22 of this EIS, in particular those for Air Quality, Health and Noise identify the Proposal's commitment to minimising impacts on the surrounding area (both during construction and operation).

Conservation of biological diversity and ecological integrity

This principle stipulates that biological diversity and ecological integrity should be fundamentally considered when assessing the impacts of a Proposal.

A comprehensive assessment of the existing local environment at the Proposal site has been undertaken to recognise any potential impacts of the Proposal on local biodiversity. A detailed biodiversity assessment, and associated proposed mitigation measures have been outlined in Section 11 of this EIS.

Habitat values on the Proposal site include scattered patches of native vegetation including Forest Red Gum and Hard-leaved Scribbly Gum vegetation communities. Given the location and nature of the Proposal and its context with regard to existing road and rail infrastructure, there is limited scope for using alternative locations to entirely avoid impacts on biodiversity. The Proposal has generally minimised the area of clearing and habitat loss to those areas of disturbed and fragmented patches of vegetation within the centre and east of the MPW site, further consolidating the existing and proposed future industrial development area.

The proposal would therefore result in the clearing of threatened ecological communities, threatened species and their habitat; however, the majority of this vegetation/habitat is made up of small, highly fragmented and disturbed patches of vegetation. A proposed conservation area, up to 250 m wide, located adjacent to the Georges River running along the western boundary of the Proposal site, has been selected to maintain higher native vegetation values than those areas proposed for clearing, while maintaining fauna connectivity and a buffer for the protection of soil stability, water quality and aquatic habitats.

All areas mapped as Plant Community Types (PCTs) to be impacted under the Proposal are to be offset in accordance with the *Framework for Biodiversity Assessment* (FBA) from the *NSW Biodiversity Offsets Policy for Major Projects*. Endangered Ecological Communities (EECs)/Threatened Species occurring within the Proposal construction boundary include:

- Castlereagh Scribbly Gum Woodland of the Sydney Basin bioregion (VEC)
- *Persoonia nutans*
- *Grevillea parviflora subsp. Parviflora*
- River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions (EEC).

The Georges River is at least a 6th order stream. The area within 50 m of the Georges River is defined as a state biodiversity link under the FBA, and several sections of this area would be subject to impacts from the Proposal. The Georges River riparian corridor state significant biodiversity link would be impacted by the removal of vegetation for construction of sediment basin outlets in three locations. Vegetation would be removed to the water's edge, creating a temporary barrier to habitat connectivity along the riparian corridor.

The vegetation within the basin outlet locations is currently disturbed, with high abundance and cover of exotic species including invasive weedy species such as *Lantana camara*, *Ligustrum* spp., *Cardiospermum grandiflorum* and *Arundo donax.* The existing drainage infrastructure in the location of the proposed basin outlet 5 has catastrophically failed, resulting in an incised and scoured drainage line on the steep slope down to the Georges River, and there is dense cover of *Lantana camara* on the slope.

The areas to be disturbed would be recontoured and partially revegetated upon completion of construction of the basin outlets to restore habitat connectivity. While there would be a considerable temporary and short term impact during construction of the outlets, the permanent impacts would be unlikely to significantly impede fauna movement provided that connectivity is enhanced using strategic revegetation and other fauna habitat features, such as rocks and hollow logs to provide cover in these areas. The gaps in the riparian corridor vegetation as a result of the proposed basin outlets would range from 50 to 70 m during construction, and from 20 to 40 m following revegetation.

It was initially anticipated that four basin outlets would be required within the Georges River riparian corridor, however following discussions with the design team, the number of proposed basins, and corresponding outlets, has been reduced to three. The design of the basin outlets has incorporated features to facilitate fauna passage and outlets would be revegetated as far as is practicable while still maintaining functional flows.

The impacts to the Georges River Riparian Corridor are considered unlikely to fall into the category of impacts requiring further consideration as they:

- Would not result in a gap greater than 100 m between two areas of moderate to good condition native vegetation with a patch size greater than 1 ha
- Would not remove over-storey cover and mid-storey cover vegetation within the state significant biodiversity link to create a gap in over-storey cover vegetation greater than 100 m
- Will not create a hostile barrier within the state significant biodiversity link.

Improved valuation, pricing and incentive mechanisms

This principle requires that costs to the environment are incorporated or internalised in terms of the overall project costs, ensuring that decision making takes into account the environmental impacts.

While it is often difficult to place a reliable monetary value on the residual, environmental and social effects of the Proposal, the value placed on environmental resources within and around the Proposal is evident in the extent of environmental investigations, planning and design of impact and mitigation measures undertaken to inform assessments and to minimise, if not prevent, adverse environmental impacts during construction and operation of the Proposal.

As outlined in Sections 8 and 9 of this EIS, the EIS incorporates a comprehensive review of IMTs best practice in design, emission control and management measures that might feasibly and reasonably be applied to the Proposal during operation and potentially in subsequent stages. As such a detailed evaluation of feasible and reasonable mitigation and management measures has been prepared, including consideration of environmental and sustainability outcomes, including air pollutants and noise emissions that will be generated by the Proposal. These have resulted in the preparation of mitigation measures that result in SIMTA investing, through infrastructure and procedures, to minimise environmental impacts throughout the operation of the Proposal.

In addition to this, the Proposal proposes the implementation of a Biodiversity Offset Package to offset the impacts of the Proposal on species listed under the EPBC Act and TSC Act and TECs listed under the TSC Act. A key part of the biodiversity offset process, under the FBA, involves the identification of an ‘ecological value’ for the flora and fauna to be impacted by the Proposal. The offsetting to be undertaken for the Proposal would result in a cost, thereby ensuring that this environmental impact has been considered as an overall cost to the Proposal, which is consistent with this ESD principle.

This EIS has examined the environmental consequences of the Proposal and identifies mitigation measures for areas where adverse environmental impacts may occur. The implementation of mitigation measures represents a capital and or operational cost for the Proposal, acting as a valuation in economic terms of environmental resources.

20.4.4 Mitigation measures

The Proposal would implement a number of key environmental controls and initiatives. The mitigation measures provided for each technical speciality (Section 22) are considered suitable to ensure that ESD principles are integrated into the Proposal.

20.5 Socio-economic

Neither the SEARs nor CoAs include requirements for assessment of socio-economic impacts. However in order to provide a complete and robust assessment of the Proposal, a desktop assessment of socio-economic impacts has been undertaken by Arcadis.

This section summarises the studies undertaken previously for the MPW Concept Approval and, more recently, for the Proposal. This Section provides a desktop assessment of potential socio-economic impacts resulting from construction of the Proposal. Measures to mitigate impacts have also been identified where they are required.

20.5.1 MPW Concept Approval

A *Social Impact Assessment Report and Economic Assessment* (2014) was undertaken by PB to inform the MPW Concept EIS. The assessment identifies the social and economic implications of the Proposal at a local and regional level, and also provides a cumulative assessment to predict the level of impact of these implications when viewed in conjunction with other surrounding developments.

Construction phase impacts were assessed for the Early Works period, while operational impacts were assessed at the “full build” scenario. Findings from the assessment are summarised below:

- Both Early Works construction and full build operation will have a positive impact on employment, many of which would support the local skills base. These employment opportunities may also be linked to wider socio-economic benefits, including financial security, and improvements to health and well-being
- The Early Works construction and operational full build would not significantly modify the demographics of the local area, or result in a shift in demand for essential community infrastructure services, such as education or healthcare
- Social amenity impacts, relating to traffic, air quality and noise and vibration to surrounding suburbs, although minor are expected during construction of Early Works, for which mitigation strategies will be required
- No significant direct impacts on local businesses are predicted as a result of Early Works activities or full build operation
- The MPW Project at full build is expected to boost freight transport efficiency, thereby contributing towards benefits for the regional and national economy.

In summary, social and economic implications arising from Early Works are considered to have a minor effect on the surrounding environment, limited to a minor temporary change in existing conditions relating to noise, traffic and visual amenity and negligible impacts to the local population or demand for community services. Similarly, operational socio-economic impacts are anticipated to be localised along Moorebank Avenue and the MPW site and considered unlikely to impact on the surrounding neighbouring suburbs.

Environmental conditions assessed for the Proposal are assumed to be those that remain following completion of the Early Works (MPW Concept Approval).

20.5.2 Existing environment

Population profile and demographics

The Proposal is located wholly within the Liverpool LGA, surrounded by the suburbs of Casula, Moorebank, Wattle Grove and Glenfield. At the time of the last census (2011) the population the Liverpool LGA was 180,143. This represents a population rise of 8% over the preceding five-year period, exceeding the general growth average of Sydney over the same time-period (6%). The population of the Liverpool LGA for the month of June 2016, according to the Australian Bureau of Statistics (ABS), is estimated to be 204,594. The population of the Liverpool LGA is expected to grow significantly over the course of the Proposal construction, with ABS figures predicting the local population of Liverpool to reach 288,959 people by 2031.

The relative socio-economic disadvantage of the Liverpool LGA has been calculated based on a tool developed by the ABS known as the Socio Economic Indexes for Areas (SEIFA). The tool is based on information provided during the last census (2011) including income, educational attainment, unemployment and occupation type and is commonly used for determining areas requiring funding, services or additional resources. The tool can highlight areas that may be more vulnerable to changes in social or economic conditions, and may assist in understanding the priorities of communities. In 2011, Liverpool LGA ranked 103 out of the 153 LGAs in NSW for disadvantage[81]. Looking more locally, Moorebank, Glenfield and Wattle Grove have higher levels of socio-economic advantage than the NSW and Australian average, while Casula was slightly below the NSW average.

Employment levels in Casula, Moorebank and Wattle Grove neighbouring the Proposal range between 93-95% and are slightly above the average for Greater Sydney (93%). The three top professions within the area are:

- Clerical and administration
- Professional
- Technical and trade services.

As demonstrated above, the region upon which the Proposal is situated is characterised by a higher than average population growth. Employment figures suggest that levels are approximately consistent with the Greater Sydney region, and the area generally has a higher level of social advantage when compared to the remainder of NSW.

Community consultation

Chapter 6 of this EIS outlines the consultation activities that have been undertaken to date within the surrounding community and affected stakeholders regarding the MPW Project.

Consultation activities undertaken during the MPW Concept EIS included communication with stakeholders to the Proposal relative to their level of interest. Targeted consultation and engagement activities included:

- One-on-one meetings and briefings with key regulators
- Telephone and email communication.

Further information regarding the abovementioned correspondence is provided in Section 5 of the MPW Concept EIS.

[81] This score indicates that it is above the median socio-economic level of advantage for NSW.

Consultation has also been undertaken with key stakeholders and agencies for this EIS, in accordance with the SEARs (refer to Section 6 of this EIS). This consultation includes discussions and correspondence with government agencies and local councils, the community and Aboriginal Heritage Representatives. This consultation has been undertaken via a range of mediums including emails, telephone conversations, face to face meetings and letter submissions.

20.5.3 Potential impacts

Construction

Construction impacts created by the Proposal would be temporary (constructed over 36 months) and mainly localised to the construction area and neighbouring suburbs. Aspects potentially impacted (both positively and negatively) by the Proposal include:

- Employment
- Changes to access
- Economic development
- Community perception
- Ambient noise and air conditions
- Visual amenity
- Traffic conditions
- Health.

Further detail regarding the likelihood and extent of each impact as a result of construction of the Proposal is outlined below in Table 20-20. Detailed assessments of traffic, noise and vibration, air and visual amenity associated with the construction of the Proposal are presented in Sections 7, 8, 9 and 15 of this EIS respectively.

Table 20-20: Social and Economic benefits and impacts generated by construction of the Proposal

Impact (including benefits)	Description	Unmitigated Impact
Economic		
Employment	It is anticipated that 570 construction personnel would be required during the Proposal's peak construction period, with positions to be filled locally where possible.	Positive
Changes to access	Construction works associated with the Proposal, would be accessed at various stages via four access points located along Moorebank avenue. Some minor disruptions are anticipated during the construction of intersections facilitating site usage, however these are expected to be temporary in nature and managed through mitigation measures presented in Section 7 of this EIS.	Slight short-term negative impact.
Economic development	There is potential that some nearby businesses may experience increased trade due to the presence of additional construction workers or to meet the demand for construction related goods arising from construction of the Proposal.	Positive

Impact (including benefits)	Description	Unmitigated Impact
Social		
Community perception	Local residents and businesses are likely to have perceived concerns regarding disruption and disturbances resulting from construction of the Proposal.	Short-term negative impact
Air quality	The removal of vegetation and import of fill to the MPW site has the potential to generate dust and other emissions to the local environment, while the operation of diesel powered plant and equipment will result in an increase in NO_x emissions. Modelling results for construction of the Proposal (refer to Section 9 of this EIS) indicate that all activities would comply with relevant impact assessment criteria. In summary, consistent with previous air quality assessments for the MPW Concept Approval, the potential air quality impacts are expected to be low risk and the proposed mitigation measures outlined within Section 9 of this EIS are considered sufficient to ensure off-site impacts from the Proposal are effectively managed.	Short-term negative
Noise	Construction activities, particularly, materials crushing and demolition activities, have the potential to generate increased levels of noise and vibration at nearby residential sensitive receivers, including Casula and North Glenfield and Wattle Grove. Modelling undertaken for the Proposal (refer to Section 8 of this EIS) indicates that Construction noise levels during all Proposal works periods are anticipated to comply with the established Noise Management Levels (NML) at most sensitive receivers. At the most affected receivers in Casula, construction noise levels during bulk earthworks may exceed the NML by 1 dBA, which is considered a negligible exceedance. Construction noise levels during all proposed out of hours works periods are predicted to comply with the NML at all times. Given the setback distances to nearby receivers, any ground vibrations created by construction activities would be well below the relevant guideline criteria for human comfort and structural damage.	Short-term negative
Visual amenity	During construction, equipment including piling rigs and cranes are likely to be visible from Moorebank Avenue, nearby passenger railway lines and residential and recreational areas in the	Short-term negative

Impact (including benefits)	Description	Unmitigated Impact
	neighbouring suburb of Casula. However given the low rise nature of construction works, and the retention of the conservation area along the western extent of the Proposal (adjacent to the Georges River), it was considered unlikely that these works would have an overly obtrusive visual impact compared to existing conditions (refer to Section 15 of this EIS).	
Traffic and transport	Access to the Proposal site would be via Moorebank Avenue. Construction activities would involve up to 740 truck movements (round trip) per day during the peak construction period. As demonstrated in Section 7 of this EIS, the level of service at key intersections around the Proposal site would not be significantly impacted. Analysis suggests through traffic along major roads servicing the Proposal site would not be significantly impacted by construction activities	Short-term negative impact
Cumulative Impacts	The construction of the Proposal in conjunction with the MPE Stage 1 Proposal and other planned or Proposed developments in the local area may have a cumulative impact on the surrounding community. Most cumulative impacts assessed would not result in significant additional impacts or exceedance of relevant criteria. Hence no additional mitigation measures have been identified.	Negligible

In general, construction related socioeconomic impacts generated by the Proposal relating to noise, air, visual amenity and traffic would be temporary in nature, confined locally and managed through the implementation of management and mitigation measures outlined throughout this EIS. The construction of the Proposal would include the employment of a construction workforce and potentially benefit businesses in the local area.

Operation

The operation of the Proposal has the potential to generate both positive and negative impacts. The long-term positive impacts are generally more likely to be received at the regional level, while the short-term direct impacts (both positive and negative) are likely to be felt locally.

Potential social and economic impacts during operation of the Proposal are summarised in Table 20-21 below.

Table 20-21: Social and Economic benefits and impacts generated by Operation of the Proposal

Impact (including benefits)	Description	Level of Impact (unmitigated)
Economic		
Employment	The Proposal would provide employment opportunities associated with the operation and maintenance of the IMT, warehouse and distribution facilities, of both skilled and unskilled nature. It is estimated the Proposal will result in the provision of approximately 1,200 jobs per year, mostly associated with warehouse operations. It is anticipated that the majority of employees and contractors would live in the local and regional area. A range of indirect impacts associated with employment (such as improved health and additional jobs generated through the supply of goods and services) would occur as a result of increased employment of the Proposal.	Long-term positive
Local and Regional development	Local businesses within close proximity to the Proposal site may experience increased trade to meet the demands of operational workers. In particular, the proposed freight village would provide only a small number of services to support the employees on the Proposal site, as a result of its nature and size, and would not compete with surrounding local centres. The Proposal will encourage a greater proportion of freight movement by rail, reducing the cost of rail transported containers for Import/Export, Intrastate or Interstate usage. This reduction would improve productivity, reduce operating costs, increase reliability, reduce costs associated with road damage, congestion and accidents, and lead to other environmentally beneficial outcomes resulting in economic savings. The warehousing component of the Proposal would serve to support the function of the IMT and would also serve to integrate into the surrounding industrial area.	Long-term positive
Social		
Community perception	Social stress and anxiety may be created through uncertainty surrounding the nature of the Proposal and the efforts implemented to mitigate residual impacts. A community engagement plan (CEP) is to be prepared for the Proposal to outline community involvement and consultation	Negative

Impact (including benefits)	Description	Level of Impact (unmitigated)
	activities during construction and operational phases, and is to ensure all relevant stakeholders are kept informed and aware of Proposal activity. Further detail of the CEP is outlined in Section 6 of this EIS.	
Air quality	Air quality impacts during operation of the Proposal would mainly be generated by material handling (dust and particulates) from diesel powered vehicles around the site. Modelling predictions indicate that the incremental increase in key pollutants (PM_{10} and $PM_{2.5}$) at the surrounding residential areas would be largely indistinguishable from the existing background levels (refer to Section 9 of this EIS).	Negligible
Noise	Operational noise impacts generated by the Proposal have been assessed as relatively low, and within acceptable noise criteria at all relevant times at monitoring locations. Predicted noise levels comply with sleep disturbance screening levels at all relevant receivers. L_{Aeq} and L_{Amax} rail noise levels at the most sensitive residential receivers near the Rail link connection are predicted to exceed the established noise goals. However, due to the proximity of these receivers to the Southern Sydney Freight Line, rail movements associated with the Proposal are not expected to result in a noticeable change to the existing L_{Aeq} and L_{Amax} rail noise levels. A range of	Slight long-term negative
Visual amenity and light spill	The Proposal is expected to generate additional views of the Proposal site along Moorebank Avenue and where topography provides some elevation above potential obstructions to views, such as from Casula to the west of the Georges River. The retention of extensive native bushland areas, Department of Defence facilities on neighbouring lands, and the general pattern of development surrounding the Proposal site, Proposal operations are adequately screened from much of the greater sensitive surrounding areas (primarily residential). Overall, the Proposal would retain the existing character in the area, however there would remain some relatively high, bulky structures which may create some degree of minor visual impact. Urban design principles are incorporated to help break down the bulk and scale of the operational site	Slight long-term negative

Impact (including benefits)	Description	Level of Impact (unmitigated)
	features so as to create a cohesive visual landscape.	
Traffic and transport	The operation of the Proposal would result in a future reduction of road traffic locally and regionally through facilitating an increase in freight movement by rail between the Proposal site and Port Botany that would otherwise be transported by other means to meet the demand for future growth. Overall, the results of the modelling identified that the traffic impacts, and the required improvements to mitigate them, would not have any detrimental impact on the safety and operation of the adjacent road network.	Slight long-term positive
Locational issues	The Proposal has been identified at both State and National levels as a preferred location for an IMT to service a defined catchment in South-Western Sydney. The Proposal site is located within proximity to a dedicated rail freight line and the major road network, and is currently zoned for industrial purposes. Furthermore, there are sufficient buffers surrounding the Proposal site to offset impacts to nearby sensitive receivers, and the Proposal site is adequately sized for its purpose.	Positive long-term
Crime	The Proposal would be self-contained, enclosed and secure. Natural and electronic surveillance would be installed throughout the facility, and a security fence would restrict unauthorised access. Crime within or involving the Proposal would therefore be prevented to the greatest extent possible.	Negligible
Health Impacts	The overall health impacts incurred by the Proposal are anticipated to be low. Short-term and long-term exposure to PM_{10} and $PM_{2.5}$ generated as part of the Proposal result in low health impacts to surrounding communities. Short-term and long-term exposure to NO_x emissions also results in low health impacts, while short-term exposure to SO_2 and CO created by the operation of the Proposal would result in negligible impacts to the surrounding communities. The noise generated by the operation of the Proposal is anticipated to be within WHO community noise guidelines at all residential	Slight long-term negative/negligible

Impact (including benefits)	Description	Level of Impact (unmitigated)
	receivers. Although rail noise and total noise exceed WHO community noise guidelines, the existing ambient noise levels alone are already above these guidelines and on this basis the Proposal related noise is expected to have a minimal impact on the local residential area.	
Cumulative Impacts	The Proposal in conjunction with the MPE Stage 1 Proposal and other planned or Proposed developments in the local area may have a cumulative impact on the surrounding community. Most cumulative impacts assessed would not result in significant additional impacts or exceedance of relevant criteria. Hence no additional mitigation measures have been identified.	Negligible

There is potential for both positive and negative socio-economic impacts to occur as a result of Proposal operation, however it is anticipated that the overall effect will be positive. Positive impacts are anticipated to be predominately economic at both the local and regional scales. Social impacts are predicted to be minor, and will be managed and minimised further through ongoing community consultation to provide the community with information and opportunities for feedback. Individual assessments investigating traffic, noise and vibration, air and visual amenity have generally concluded that residual impacts potentially affecting the community would be low, and managed through mitigation measures outlined in each of the respective sections within this EIS (summarised in Section 22 of this EIS).

20.5.4 Mitigation measures

Construction

A community information and awareness strategy would be included in the CEMP and would outline measures to maintain communication with the community and all relevant stakeholders throughout the construction process of the Proposal.

Stakeholders would have opportunities to provide formal feedback on the Proposal during public exhibition periods, as part of the statutory planning process. SIMTA would consider and respond to issues raised in submissions received.

Feedback can also be provided to SIMTA at any time via:

- The MPW Project website (www.simta.com.au) which has been updated and continues to be accessible
- The email feedback system (SIMTA@elton.com.au)
- The free-call information line (1800 986 465) which is available 24 hours a day.

SIMTA is committed to continuing to consult with stakeholders, including the community throughout the planning of the Proposal.

Operation

The Operational Environmental Management Plan (OEMP) would include measures to engage with stakeholders and to manage and respond to feedback received during the operation of the Proposal.

A range of measures to mitigate the operational impacts associated with air quality impacts, noise and vibration, visual amenity and health impacts are proposed and included in this EIS. Furthermore, a best practice review has been undertaken by WMPL and Ramboll Environ to determine, and where suitable implement, best practice operational management within the IMT. This would further reduce the overall impacts on the surrounding community. A summary of mitigation measures is provided in Section 22 of this EIS.

21 ENVIRONMENTAL RISK ANALYSIS

An environmental risk analysis (ERA) has been undertaken to identify the key environmental impacts associated with construction and operation of the Proposal, as identified in Sections 7 to 20 of this EIS, and assign a risk ranking to each issue before and after the application of the mitigation measures identified. The ERA has been undertaken to address the SEAR in relation to environmental risk, which is shown in Table 21-1.

Table 21-1: SEARs for the Proposal relating to environmental risk

Section/Number	Requirement	Where addressed in this EIS
General Requirements	Notwithstanding the key issues specified below, the EIS must include an environmental risk assessment to identify the potential environmental impacts associated with the development (construction and operation), proposed mitigation measures and potentially significant residual environmental impacts after the application of proposed mitigation measures. Where additional environmental impacts are identified through this risk analysis, an appropriately detailed impact assessment of the additional environmental impacts shall be included as part of the Development Application.	Section 21 of this EIS

This Section summarises the ERA undertaken for the MPW Concept Approval and contains the ERA undertaken for the Proposal.

21.1 MPW Concept Approval

An ERA was undertaken for the MPW Concept Approval, which identified:

- Potential environmental impacts associated with the MPW Project
- Control measures and any significant residual impacts
- The nature and extent of environmental impacts likely to remain after the implementation of control measures.

The ERA identified and assessed the potential environmental impacts associated with the MPW Project and assigned a risk ranking to each of the impacts identified. Each of the potential environmental impacts was initially ranked between low and very high based on the environmental impacts that could potentially result if the issue was un-mitigated.

Mitigation measures to ameliorate the risks, as identified in the specialist studies undertaken for the MPW Concept Approval, were applied to each impact and a residual risk ranking was assigned. The ERA found that, with the application of the proposed mitigation measures, no environmental impact was High or Very High. No additional environmental impacts were identified through the ERA and therefore no additional assessments were deemed necessary.

21.2 Methodology

An assessment of environmental risk associated with the Proposal has been undertaken to identify the residual environmental risk, once the mitigation measures identified for each environmental issue have been applied. The ERA aims to assign a qualitative environmental risk category to each issue. For consistency, the methodology used for the ERA is based on the methodology used in the MPW Concept Approval.

Risk category is determined on the basis of consideration of the likelihood of an impact occurring and the consequences of the impact occurring. The criteria for evaluating likelihood and consequence are identified in Table 21-2 and Table 21-3 respectively.

Table 21-4 shows the determination of the risk rating through the combination of likelihood and consequence levels.

Table 21-2: Criteria for evaluating likelihood

Level	Descriptor	Description	Frequency Of Occurrence
A	Almost Certain	Expected to occur in the course of most normal circumstances	Once per month
B	Likely	Could occur in the course of most normal circumstances	Between once a month and once a year
C	Possible	May occur in the course of normal circumstances	Between once a year and once in five years
D	Unlikely	Is possible, but not likely to occur in the course of normal circumstances	Between once in five years and once in 20 years
E	Rare	May occur in exceptional circumstances	Once in more than 20 years

Table 21-3: Criteria for evaluating consequence

Level	Category	Safety	Financial	Operational	Environmental	Community
1	Not Significant	No medical control	<$250,000	< 6 hours track closure or disruption to facility operations	Release to the environment immediately contained. No impact on native vegetation/fauna species.	No community or stakeholder complaints
2	Minor	Lost time injury occurs or medical control required	≥ $250,000 but less than $2,000,000	≥ 6 hours but less than 24 hours track closure or disruption to facility operations	Release to environment contained with internal assistance. Short term impact on PCT vegetation/fauna habitat – no threatened species or community impacted.	Several community or stakeholder complaints. Complaints rectified within adequate timeframes.

Level	Category	Safety	Financial	Operational	Environmental	Community
3	Moderate	Serious injury occurs	≥ $2M but less than $10M	≥ 24 hours but less than 48 hours track closure or disruption to facility operations	Release to the environment contained with external assistance. Impact to PCT vegetation/fauna habitat requiring action to correct OR minor impact on threatened species or communities.	Multiple and sustained community or stakeholder complaints. Complaints addressed after an interval. Limited media coverage of issues raised.
4	Major	Single fatality occurs	≥ $10M but less than $50M	≥ 2 days but less than 5 days track closure or disruption to facility operations	Pollution event with short –term detrimental effect. Short term impact on threatened species or communities requiring action to correct.	Widespread community and stakeholder concern. Sustained failure to address complaints. Extensive media coverage.
5	Severe	Multiple but localised fatalities occur	≥ $50M	≥ 5 days track closure or disruption to facility operations	Pollution event with long-term detrimental effect. Long term impact on threatened species or communities requiring action to correct; possibly requiring the provision of offsets.	Ongoing and widespread community and stakeholder concern, culminating in litigation. Inability to address complaints. Extensive and sustained negative media coverage.

Table 21-4: Risk analysis categories and criteria for risk rating

Likelihood	Consequence				
	1 – Not significant	2 – Minor	3 – Moderate	4 – Major	5 – Severe
A – Almost certain	Moderate	Moderate	High	Very High	Very High
B – Likely	Low	Moderate	High	High	Very High
C – Possible	Low	Moderate	Moderate	High	High
D – Improbable	Low	Low	Moderate	Moderate	High
E – Rare	Low	Low	Low	Moderate	High

Each potential environmental impact was initially rated between low and very high based on the environmental impacts that could potentially result if the issue was unmitigated.

Subsequent to this initial risk rating, the environmental issues identified were assigned a second risk rating (residual risk) to indicate the risk following design development (refer to Sections 4 and 6 of this EIS) and the implementation of the control measure/s that have been identified within this EIS (refer to Section 22 of this EIS).

21.3 Risk assessment

Issue	SEARs /Key Issue?	Potential impacts	Risk ranking – Pre-mitigation	Mitigation	Risk ranking – Post-mitigation	Reference
Air Quality	Yes	Increased air pollution (PM, NO_2 and CO) from the construction of the Proposal resulting in impacts on the environment and community.	M	The measures outlined in the Air Quality Management Plan, included in Appendix O of this EIS, would be implemented during the construction of the Proposal to control dust and other air emissions.	L	Section 9 Air Quality Impact Assessment Appendix O Air Quality Impact Assessment
		Increased air pollution (PM, NO_x, SO_2, CO and VOCs) from the operation of the Proposal resulting in impacts on the environment and community.	L	The measures outlined in the Air Quality Management Plan, included in Appendix O of this EIS, would be implemented during the operation of the Proposal to minimise the generation of air emissions.	L	
Greenhouse gas and climate change	Yes	Increase in greenhouse gas emissions as a result of construction and embodied emissions in materials used.	M	Mitigation measures identified for the management of Greenhouse Gas (GHG) emissions during construction would be incorporated into the CEMP.	L	Section 18 Greenhouse Gas Assessment Appendix O Air Quality Impact Assessment
		Potential net increase in direct and indirect greenhouse gas emissions as a result of operation.	L	The total annual emissions of the Proposal amount to 0.01% of Australia's total annual GHG emissions and 0.07% of Australia's total transport emissions. Implementation of the measures outlined in the Air Quality Best Practice Review, as feasible for the	L	

Issue	SEARs /Key Issue?	Potential impacts	Risk ranking – Pre-mitigation	Mitigation	Risk ranking – Post-mitigation	Reference
				Proposal would assist to reduce these anticipated GHG emissions. Mitigation measures identified for the management of GHG emissions during operations would be incorporated into the OEMP.		
		Increased extreme weather events, including heat waves and flooding impacting the proposal	H	Incorporation of adaptation responses into the final design and operational procedures.	M	
Transport and access	Yes	Increased traffic on local and regional roads resulting in decreased level of service at key intersections and increased risk of traffic incidents during construction.	M	Prior to construction, a road safety audit would be undertaken of proposed construction access and haulage routes to identify appropriate measures to mitigate any safety risks identified. A Construction Traffic Management Plan (CTMP) and Operational Traffic Management Plan (OTMP) would be developed for the Proposal, in accordance with the measures outlined in the Preliminary Construction Traffic Management Plan (PCTMP) and Preliminary Operational Traffic Management Plan (POTMP), included in Appendix M of this EIS. The recommended intersection improvements (to mitigate the traffic impacts of the Proposal) would	L	Section 7 Appendix M Traffic and Transport Impact Assessment Construction Traffic Impact Assessment PCTMP POTMP
		Increased traffic on local and regional roads resulting in decreased level of service at key intersections and increased risk of traffic incidents during operation.	M		L	

Issue	SEARs /Key Issue?	Potential impacts	Risk ranking – Pre-mitigation	Mitigation	Risk ranking – Post-mitigation	Reference
				perform within an acceptable LoS with no-worsening of the performance without the Proposal.		
Rail	Yes	Impact from the operation of the Rail link connection on the community and rail network.	M	Consultation with relevant rail network owners has been undertaken and the Rail link connection has been designed to reduce potential impacts on the surrounding environment and community.	L	Section 6 Appendix F Rail Access Report
Noise and vibration	Yes	Increased noise and vibration levels upon adjoining receivers during construction (including nearby residential areas of Moorebank, Wattle Grove, Glenfield and Casula and sensitive land uses), impacting on the community.	M	A Construction Noise and Vibration Management Plan would be prepared and implemented to include the appropriate control measures to avoid, reduce and manage noise emissions and vibration.	L	Section 9 Appendix N Noise and Vibration Impact Assessment
		Increased noise and vibration caused by operation of container handling equipment, locomotives and truck movements during operation of the Proposal, impacting on the community.	M	An Operational Noise and Vibration Management Plan, or equivalent, would be prepared and implemented to include the appropriate control measures to avoid, reduce and manage noise emissions and vibration. A noise wall (approximately five metres high) would be constructed along a portion of the western Proposal site boundary to reduce potential noise	L	

Issue	SEARs /Key Issue?	Potential impacts	Risk ranking – Pre-mitigation	Mitigation	Risk ranking – Post-mitigation	Reference
				impacts during operation of the Proposal on surrounding sensitive receivers. The MPE Stage 1 Proposal would involve the installation of a lubrication system at locations on the Rail link likely to generate rail squeal. Attended monitoring would be undertaken to confirm the effectiveness of the lubrication system. These measures would mitigate operational rail noises from the Proposal along the Rail link.		
Soil and Water	Yes	Regional and local hydrological impacts including: Effects on flood characteristics on and off the Proposal site Loss of operations of the Proposal due to flooding Resulting in impacts on the environment and surrounding land.	H	On-site detention basins (OSDs) have been sized to limit peak discharges for the 100 year ARI event from the Proposal site to no greater than under existing conditions. The Proposal site has been designed for, and would be located above the 1% Annual Exceedance Probability (AEP) flood level.	L	Section 12 Appendix R Stormwater and Flooding Environmental Assessment
		Reduced surface water and stormwater quality resulting in impacts to the environment.	M	Water Sensitive Urban Design (WSUD) measures have been identified to ensure that the Proposal would have a neutral or beneficial effect on the quality of stormwater leaving the site.	L	

Issue	SEARs /Key Issue?	Potential impacts	Risk ranking – Pre-mitigation	Mitigation	Risk ranking – Post-mitigation	Reference
		Increased erosion during construction (on and off the Proposal site) resulting in impacts to the environment.	H	An Erosion and Sediment Control Plan (ESCP) would be developed and implemented to include the appropriate control measures to minimise impacts upon water quality.	L	
		Inappropriate disposal of waste materials excavated from the Proposal site and handling of material to be reused on the site, resulting in impacts on the environment and safety for site workers.	M	The Bulk Earthworks Strategy would be progressed by the construction contractor and would outline material handling processes and stockpiling areas. Material requiring disposal to be subject to waste classification under the *Waste Classification Guidelines 2014* (NSW EPA, 2014) and would be disposed of at an appropriate licensed facility.	L	Sections 13 and 20.1 Appendix R Stormwater and Flooding Environmental Assessment
Indigenous heritage	Yes	Damage and/or destruction of Indigenous heritage items of significance.	M	A management strategy for Indigenous heritage would be developed and include appropriate control measures during the construction phase, including the management of scarred trees MA6 and MA7, and the salvage excavation of MA10, MA14, the MPW Stage 2 Terrace PAD and the tertiary terrace. This would include an unexpected finds procedure and consideration of consultation requirements and process for managing any identified Indigenous items uncovered during construction and operation.	L	Section 16 Appendix U Aboriginal Heritage Impact Assessment

Issue	SEARs /Key Issue?	Potential impacts	Risk ranking – Pre-mitigation	Mitigation	Risk ranking – Post-mitigation	Reference
Non-Indigenous heritage	Yes	Damage and/or destruction of Non-Indigenous heritage items of significance.	L	No known Non-Indigenous heritage items of significance would be impacted. An unexpected finds procedure would be included in the CEMP.	L	Section 17 Appendix V Non-Indigenous Heritage Assessment Section 15 Appendix T Visual Impact Assessment
		Visual impacts on Glenfield Farm, the Casula Power Station and Kitchener House, altering the views and setting of the site.	L	Landscaping on the eastern and western boundaries of the Proposal site would provide screening and minimise visual impacts from the Proposal.	L	
Visual amenity, urban design and landscape	Yes	Negative change in visual character of the Proposal site, impacting the community.	M	The Proposal would be developed in accordance with a landscape management plan that reinforces the surrounding natural context and integrates the site with its broader environment.	L	Section 15 Appendix T Visual Impact Assessment Appendix E Landscape Design Statement and Plans
Biodiversity	Yes	Environmental impacts resulting from the permanent loss of riparian vegetation and habitat connectivity due to installation	H	Implementation of construction and operational management plans for maintenance of structures (i.e. OSD drainage channels) in riparian areas would be in accordance with the Biodiversity Assessment	M	Section 11 Appendix Q

Issue	SEARs /Key Issue?	Potential impacts	Risk ranking – Pre-mitigation	Mitigation	Risk ranking – Post-mitigation	Reference
		of infrastructure (e.g. OSD drainage channels).		Report (BAR) prepared for the Proposal (Appendix Q of this EIS).		Biodiversity Assessment Report
		Environmental impacts resulting from the permanent loss of threatened flora and fauna species habitat and threatened communities due to vegetation clearance and the installation of infrastructure on the Proposal site.	H	The Proposal would require clearing of all vegetation within the development site, including threatened ecological communities and threatened flora species. Construction and operational activities would be undertaken in accordance with the measures identified in the BAR (Appendix Q of this EIS) that would form part of the CEMP and OEMP for the Proposal. Offsets would also be provided for vegetation removal required for the Proposal (refer to Appendix Q of this EIS).	M	
		Environmental impacts resulting from the inadvertent removal and/or modification of areas containing populations, endangered ecological communities and/or habitat for threatened species, e.g. the conservation area.	M	High visibility fencing would be installed where relevant to clearly define the limits of the construction area so as to not encroach on vegetated areas outside of the Proposal site. Works would be undertaken in accordance with the measures identified in the BAR (Appendix Q of this EIS).	L	
		Environmental impacts resulting from the collective loss of vegetation and fauna habitat across the landscape, as a	VH	All vegetation removal works and works within riparian areas would be undertaken in accordance with the methods prescribed in the BAR (Appendix Q	M	

Issue	SEARs /Key Issue?	Potential impacts	Risk ranking – Pre-mitigation	Mitigation	Risk ranking – Post-mitigation	Reference
		result of removal and/or modification of native vegetation and fauna habitat. Vegetation clearing (including riparian areas) and loss and fragmentation of foraging, nesting and roosting areas.		of this EIS), including provision of offsets and fauna habitat connectivity measures.		
		Environmental impacts resulting from the loss of hollow bearing trees and fauna habitat.	H	Clearing of hollow bearing trees would be undertaken in accordance with the BAR. Fauna microhabitat such as logs would be removed from areas to be cleared and relocated to suitable nearby bushland areas (where practicable) in the presence of an ecologist.	M	
		Environmental impacts resulting from the permanent loss of biodiversity due to changes in hydrological function of the Proposal site and lowering of water quality, including potential impacts to groundwater dependent ecosystems.	M	Design of on-site water retention to facilitate discharges to receiving waterways would match pre-construction discharges. Installation of appropriate drainage infrastructure (OSDs), sediment and erosion controls would occur, to manage surface waters. Gross Pollutant Traps and Rain gardens (bio-retention systems) would be installed in the base of the OSDs proposed to capture and store stormwater.	L	Section 11 Appendix Q Biodiversity Assessment Report Appendix R Stormwater and Flooding

Issue	SEARs /Key Issue?	Potential impacts	Risk ranking – Pre-mitigation	Mitigation	Risk ranking – Post-mitigation	Reference
				This would consist of bio-filtration layers, planting and subsoil collection and drainage.		Environmental Assessment
		Environmental impacts resulting from the impacts on aquatic biodiversity due to changes in hydrological function of the Proposal site and lowering of water quality during construction.	M	Installation of sediment basins and sediment fences as per the Stormwater and Flooding Environmental Assessment (Appendix R of this EIS). Development of an Erosion and Sediment Control Plan (ESCP) and Soil and Water Management Plan (SWMP) for management of construction activities. Development of spill management and incident response measures.	L	
		Environmental impacts resulting from the loss of biodiversity due to weed infestation.	H	The CEMP would include requirements for washdown of equipment prior to entering the construction area to remove seed and plant material. Erosion and sediment controls to be installed in accordance with ESCPs and SWMP. A weed control program would be implemented as part of the conservation management of the retained vegetation. Ongoing monitoring for identification of weed outbreaks and treatment where required. Any imported soils or earth materials to site would be classified and certified as weed free prior to acceptance on site.	L	Section 11 Appendix Q Biodiversity Assessment Report

Issue	SEARs /Key Issue?	Potential impacts	Risk ranking – Pre-mitigation	Mitigation	Risk ranking – Post-mitigation	Reference
				Works within the riparian areas would be undertaken in accordance with the methods prescribed in the BAR (Appendix Q of this EIS) to control weed infestations in these areas.		
Contamination	Yes	Migration of contamination offsite as a result of the Proposal, resulting in impacts on the environment and community. Exposure of site workers to contamination resulting in safety incidents.	H	Works identified in the Contamination Summary Report (and the associated reference documents, e.g. the Remediation Action Plan - RAP) would be undertaken prior to or concurrently with construction of the Proposal to remediate identified contamination on the Proposal site to the greatest extent practicable. A Construction Environmental Management Plan (CEMP) would be prepared prior to commencement of construction that would identify processes to be followed in the event of an unexpected find of contamination.	L	Section 13 Contamination Summary Report
		Contamination of soils and groundwater due to spills during operation of the Proposal, resulting in impacts to the environment.	M	The Operational Environmental Management Plan (OEMP) would include an Emergency Response Plan (ERP), including a Pollution Incident Response Management Plan (PIRMP), and a refuelling procedure that would specify procedures to follow in the event of a spill and refuelling, to prevent contamination.	L	Section 13

Issue	SEARs /Key Issue?	Potential impacts	Risk ranking – Pre-mitigation	Mitigation	Risk ranking – Post-mitigation	Reference
Hazards and risks	Yes	Environmental and community impacts from the release of hazardous materials and dangerous goods.	H	All goods at the Proposal site would be managed in accordance with the Code of Practice for storage and handling of dangerous goods (WorkCover NSW, 2005) and Model Code of Practice - Labelling of Workplace Hazardous Chemicals (Safe Work Australia 2011), as a minimum.	L	Section 14 Hazards and Risks Assessment
Waste	No	Construction waste production.	H	Measures to minimise waste would be included within the CEMP and OEMP for the Proposal, in accordance with the recommendations in this EIS.	M	Section 20.1
		Operational waste production.	L		L	
Bushfire	No	Risk of bushfire impacting the Proposal site and construction compounds, posing safety risk to workers.	M	Design of the Proposal conforms to the management principles identified in *Planning for Bushfire Protection* (NSW RFS, 2006). A Bushfire Management Strategy would be developed for both the construction and operational phases of the Proposal as part of the CEMP and OEMP. Appropriate buffer zones would be established and maintained.	L	Section 20.2 Appendix W Bushfire Protection Assessment
		Increased risk of bushfire ignition from construction activities and operation of the Proposal.	M		L	
Property and infrastructure	No	Increase on service demand, capacity and augmentation of existing and proposed utilities and infrastructure as a result of the Proposal.	M	The existing infrastructure would have sufficient capacity to service the estimated increase in utility demands for the Proposal, either with augmentation or in its current condition (refer to Section 4 and Appendix H of this EIS).	L	Section 4 Section 20.3 Appendix H Utilities Strategy Report

Issue	SEARs /Key Issue?	Potential impacts	Risk ranking – Pre-mitigation	Mitigation	Risk ranking – Post-mitigation	Reference
Socio economic	No	Disruption to the community during construction.	M	A community information and awareness strategy would be included in the CEMP, which would provide for maintaining communication with the community and all relevant stakeholders throughout the construction process.	L	Section 6 Appendix L Community and Stakeholder Consultation Outcomes Report Appendix P Health Risk Assessment Appendix O Air Quality Impact Assessment Appendix N Noise and Vibration Impact Assessment Section 20.5
		Community concern over impacts on environmental and health impacts associated with operation of the Proposal.	H	A community information and awareness strategy would be included in the OEMP, which would enable community members to access information and provide feedback regarding the operation of the Proposal. Measures identified in the Compilation of Mitigation Measures (Section 22 of this EIS), and in particular the Best Practice Reviews, would be implemented.	M	
		Employment generation and injection of significant capital into local and regional economy.	L	Employment of local people and use of goods and services from local and regional suppliers would be prioritised.	L	
Human health	No	Increase in morbidity and mortality.	M	Measures outlined in the Best Practice Reviews for air quality and noise would be implemented where reasonable and feasible for the Proposal, to minimise air quality and noise impacts.	L	Section 10 Appendix P Health Risk Assessment

Issue	SEARs /Key Issue?	Potential impacts	Risk ranking – Pre-mitigation	Mitigation	Risk ranking – Post-mitigation	Reference
						Appendix O Air Quality Impact Assessment Appendix N Noise and Vibration Impact Assessment
Cumulative impacts	No	Cumulative impacts on the environment and community as a result of works associated with the construction and operation of the MPE Stage 1 Proposal and the Proposal.	L	Assessments on the cumulative impacts of traffic, air quality, noise and health for the scenario whereby the construction/operation of the MPE Stage 1 Proposal occurs concurrently with the construction/operation of the Proposal identified only minor cumulative impacts, therefore no additional mitigation measures are proposed.	L	Section 19 Appendix O Air Quality Impact Assessment Appendix N Noise and Vibration Impact Assessment Appendix P Health Impact Assessment Appendix M Transport and Traffic Impact Assessment

Issue	SEARs /Key Issue?	Potential impacts	Risk ranking – Pre-mitigation	Mitigation	Risk ranking – Post-mitigation	Reference
		Environmental impacts resulting from the loss of biodiversity on both the Proposal site and the MPE site.	VH	A Biodiversity Offset Strategy would be required for the Proposal as detailed in the BAR (Appendix Q).	M	Section 19 Section 11 Appendix Q Biodiversity Assessment Report

22 COMPILATION OF MITIGATION MEASURES

The EIS for the Proposal has identified a range of environmental impacts and recommended management and mitigation measures to avoid, remedy or mitigate these impacts (refer to Sections 7 – 19 of this EIS). This compilation of mitigation measures has been provided to satisfy Schedule 2, Part 3, clause 7(1)(e) of the EP&A Regs 2000.

This Section presents a summary of the measures which would be implemented, either prior to construction, during construction or during operation. These draft mitigation measures may be revised in response to public submissions to the EIS and/or design changes following the public exhibition of this EIS. The final Compilation of Mitigation Measures would form part of a post submissions response for the Proposal.

The draft Compilation of Mitigations Measures for the Proposal is provided in Table 22-1.

The ‘implementation stage’ column of Table 22-1 details the timing as to when the specific mitigation measures would be implemented. For example, a CEMP may be prepared prior to construction, but would not be ‘implemented’ until the construction phase.

For the purpose of this Compilation of Mitigations Measures, the following definitions apply to the terms used in the implementation phase column:

- Detailed design - works and design progression prior to construction of the associated permanent physical works for the Proposal
- Pre-construction phase – initial stage of physical works for the Proposal, which are not included within the definition of construction and within Works period A
- Construction phase – during construction of all permanent physical works for the Proposal (Works periods B - G)
- Operation phase - either prior to, or during, operation of the Proposal.

Table 22-1: Consolidated list of mitigation measures

No.	Mitigation measures	Implementation stage	Applicability		
			IMT	Rail link connection	Warehousing
0.	**General environmental management**				
0A	Pre-construction works would be undertaken subject to the preparation of an Environmental Work Method Statement (EWMS) or equivalent. Pre-construction works include works within Works period A (Section 4 of the EIS) and the following: ▪ survey; acquisitions; or building/ road dilapidation surveys; fencing; investigative drilling, excavation or salvage ▪ minor clearing or translocation of native vegetation that does not comprise any EECs ▪ establishment of site compounds and construction facilities ▪ installation of environmental mitigation measures ▪ utilities adjustment and relocation that do not present a significant risk to the environment, as determined by the Environmental Representative ▪ other activities determined by the Environmental Representative to have minimal environmental impact ▪ All works as described in Works period A in section 4 of this EIS	Pre-Construction	Y	Y	Y
0B	The Construction Environmental Management Plan (CEMP), or equivalent, for the Proposal would be based on the PCEMP (Appendix I of this EIS), and include the following preliminary management plans: ▪ Preliminary Construction Traffic Management Plan (PCTMP) (Appendix M of this EIS) ▪ Air Quality Management Plan (Appendix O of this EIS)	Construction	Y	Y	Y

No.	Mitigation measures	Implementation stage	Applicability		
			IMT	Rail link connection	Warehousing
	▪ Erosion and Sediment Control Plans (ESCPs) and Bulk Earthworks Plans, within the Stormwater Drainage Design Drawings (Appendix R of this EIS) As a minimum the CEMP would include the following sub-plans: ▪ Construction Traffic Management Plan (CTMP) ▪ Construction Noise and Vibration Management Plan (CNVMP), prepared in accordance with the *Interim Construction Noise Guideline* ▪ Cultural Heritage Assessment Report/Management Plan ▪ Construction Air Quality Management Plan ▪ Construction Soil and Water Management Plan (SWMP), prepared in accordance with Managing Urban Stormwater, 4th Edition, Volume 1, (2004). ▪ Erosion and Sediment Control Plan ▪ Flood Emergency Response and Evacuation Plan ▪ UXO, EO, and EOW Management Plan ▪ Acid Sulfate Soils Management Plan ▪ Bushfire Management Strategy ▪ Community Information and Awareness Strategy.				
0C	The Operational Environmental Management Plan (OEMP), or equivalent, for the Proposal would be based on the following preliminary management plans ▪ Preliminary Operational Traffic Management Plan (POTMP) (Appendix M of this EIS) ▪ Air Quality Management Plan (Appendix O of this EIS)	Operation	Y	Y	Y

No.	Mitigation measures	Implementation stage	Applicability		
			IMT	Rail link connection	Warehousing
	▪ Erosion and Sediment Control Plans (ESCPs) and Bulk Earthworks Plans, within the Stormwater Drainage Design Drawings (Appendix R of this EIS) As a minimum the OEMP would include the following sub-plans ▪ Operational Traffic Management Plan (OTMP) ▪ Operational Noise and Vibration Management plan (ONVMP) ▪ Air Quality Management Plan ▪ Flooding and Emergency Response Plan (FERP) ▪ Groundwater Monitoring Program ▪ Long term Environmental Management Plan ▪ Incident Response Plan, including a Spill Management Procedure. ▪ Fire Safety and Evacuation Plan ▪ Community Information and Awareness Strategy.				
OD	The construction and/or operation of the Proposal may be delivered in a number of stages. If construction and/or operation is to be delivered in stages a Staging Report would be provided to the Secretary prior to commencement of the initial stage of construction and updated prior to the commencement of each stage as that stage is identified.	Construction and operation	Y	Y	Y
1.	**Traffic and Transport**				
1A	A Construction Traffic Management Plan (CTMP) would be prepared based on the Preliminary Construction Traffic Management Plan (Appendix M of this EIS), detailing management controls to be implemented to avoid or minimise impacts to traffic,	Construction	Y	Y	Y

No.	Mitigation measures	Implementation stage	Applicability		
			IMT	Rail link connection	Warehousing
	pedestrian and cyclist access, and the amenity of the surrounding environment. The following key initiatives would be included in the CTMP: ▪ Review of speed restrictions along Moorebank Avenue and additional signposting of speed limitations ▪ Restriction of haulage routes through signage and education to ensure, where possible, that construction vehicles do not travel through nearby residential areas to access the Proposal site, in particular Moorebank (Anzac Road) or the Wattle Grove residential areas ▪ Inform local residents (in conjunction with the Community Information and Awareness Strategy) of the proposed construction activities and road access restrictions that the construction traffic must adhere to and establish communication protocols for community feedback on issues relating to construction vehicle driver behaviour and construction related matters ▪ Installation of specific warning signs at entrances to the construction area to warn existing road users of entering and exiting construction traffic ▪ Establishing pedestrian walking routes and crossing points ▪ Distribution of day warning notices to advise local road users of scheduled construction activities ▪ Installation of appropriate traffic control and warning signs for areas identified where potential safety risk issues exist ▪ The promotion of car-pooling for construction staff and other shared transport initiatives during the pre-construction phase				

No.	Mitigation measures	Implementation stage	Applicability		
			IMT	Rail link connection	Warehousing
	▪ Management of the transportation of materials to maximise vehicle loads and therefore minimise vehicle movements ▪ Minimising the volumes of construction vehicles travelling during peak periods ▪ Maintaining access to neighbouring properties, in particular the ABB site ▪ Monitoring of traffic on Moorebank Avenue during peak construction periods to ensure that queuing at intersections does not unreasonably impact on other road users.				
1B	A Road Safety Audit would be undertaken on Cambridge Avenue to identify potential traffic safety risks from the Proposal (in consideration of background traffic) and determine appropriate mitigation.	Construction	Y	Y	Y
1C	Moorebank Avenue/Anzac Road/Proposal site intersection would be upgraded to include a four leg intersection as shown in Appendix G of this EIS. The funding of this intersection upgrade would be clarified through discussions with SIMTA and Roads and Maritime.	Operation	Y	Y	Y
1D	The Operational Traffic Management Plan would be prepared based on the Preliminary Operational Traffic Management Plan (Appendix M of this EIS) and include the following key initiatives: ▪ Heavy vehicle route management ▪ Safety and amenity of road users and public ▪ Congestion management on Moorebank Avenue ▪ Road user delay management ▪ Information signage, distance information and advance warning systems	Operation	Y	Y	Y

No.	Mitigation measures	Implementation stage	Applicability		
			IMT	Rail link connection	Warehousing
	▪ Driver code of conduct ▪ Incident management ▪ Traffic monitoring.				
1E	Consultation with TfNSW would be conducted regarding the provision for active transport to/from the Proposal site and along the internal perimeter road, as part of detailed design for the Proposal.	Operation	Y	Y	Y
1F	Bicycle and end of trip facilities would be provided in accordance with the *City of Sydney Section 3 – General Provisions.*	Operation	Y	Y	Y
1G	Consultation would be undertaken with relevant bus provider(s) regarding the potential to extend the 901 bus service (or equivalent) and additional bus stops with the aim of maximising public transport accessibility to and within the Proposal site.	Operation	Y	Y	Y
2.	**Noise and Vibration**				
2A	A Construction Noise and Vibration Management Plan (CNVMP), or equivalent, would be prepared for the Proposal in accordance with the *Interim Construction Noise Guideline* (or equivalent), and would give consideration to Revised Environmental Mitigation Measures (REMMs) 5A – 5B (of the MPW Concept Plan Approval (SSD 5066)).	Construction	Y	Y	Y
2B	The ambient noise monitoring surveys undertaken within Casula, Wattle Grove and Glenfield would be continued throughout the construction and operation of the Proposal (with annual reporting of noise results up to two years beyond the completion of the Proposal).	Construction and operation	Y	Y	Y

No.	Mitigation measures	Implementation stage	Applicability		
			IMT	Rail link connection	Warehousing
2C	In the event of any noise or vibration related complaint or adverse comment from the community, noise and ground vibration levels would be investigated. Remedial action would be implemented where feasible and reasonable.	Construction and operation			
2D	A noise wall would be installed along a portion of the western boundary of the Proposal site in the general location identified in Figure 7-1 of the Noise Impact Assessment (Appendix N of this EIS). The height, extent, and staged implementation of the noise wall would be confirmed, based on further noise modelling undertaken during detailed design.	Operation	Y	N	Y
2E	Best practice noise mitigation measures would be implemented for the operational phase of the Proposal including: ▪ Noise monitoring (refer to mitigation measures 2B and 2C above) ▪ A gate appointment system would be implemented to minimise truck loading/unloading wait times and resultant queueing. Trucks would be turned away from facility if arriving too early ▪ Truck marshalling lanes would be included to minimise congestion and queueing ▪ The provision of information signs and communication of MPW idle reduction policy.	Operation	Y	Y	Y
3.	**Air Quality**				
3A	A Construction Air Quality Management Plan would be prepared based on the Air Quality Management Plan (Appendix O of this EIS) and include the following key initiatives: ▪ Procedures for controlling/managing dust ▪ Roles, responsibilities and reporting requirements	Construction	Y	Y	Y

No.	Mitigation measures	Implementation stage	Applicability		
			IMT	Rail link connection	Warehousing
	▪ Contingency measures for dust control where standard measures are deemed ineffective.				
3B	Vehicle movements would be limited to designated entries and exits, haulage routes and parking areas.	Construction	Y	Y	Y
3C	Best practice air quality mitigation measures would be implemented for the operational phase of the Proposal including: **Locomotives** ▪ Ensure locomotives are well maintained in accordance with the manufacturer's specification or relevant operational plan. Update maintenance plans to include a requirement to consider air emissions and where possible improve air emission performance at next overhaul/upgrade (for SIMTA operational fleet) ▪ Ultra Low Emitting Switch Locomotives would be considered during the procurement process, having regard to technical, logistical and financial considerations ▪ Anti-idle policy and communication / training for locomotive operators ▪ Unnecessary idling avoided through driver training and site anti-idle policy ▪ Driver training for fuel efficiency.	Operation	Y	Y	N
	Container Handling ▪ New reach stackers to achieve emissions performance equivalent to US EPA Tier 3 / Euro Stage IIIA standards ▪ Unnecessary idling avoided through driver training and site anti-idle policy		Y	N	N

No.	Mitigation measures	Implementation stage	Applicability		
			IMT	Rail link connection	Warehousing
	▪ Equipment with smoky exhausts (more than 10 seconds) should be stood down for maintenance.				
	Trucks ▪ Gate appointment system, truck marshalling lanes and rejection of trucks that arrive early to minimise wait times and queuing ▪ Development of an anti-idle policy and communication through the provision of information signs ▪ Unnecessary idling avoided through driver training and site anti-idle policy ▪ Loading and unloading coordinated to minimise truck trip distances as they travel through site.		Y	Y	Y
3F	The *Air Quality Management Plan* (Appendix O of this EIS), would be further progressed and incorporated into the OEMP for the Proposal. In accordance with the AQMP the following key aspects would be addressed in the OEMP: ▪ Implementation and communication of anti-idling policy for trucks and locomotives ▪ Complaints line for the community to report on excessive idling and smoky vehicles ▪ Procedures to reject excessively smoky trucks visiting the site based on visual inspection.	Operation	Y	Y	Y
4.	**Biodiversity**				
4A	Following detailed design and before construction, detailed flora and fauna mitigation measures would be developed and presented as part of the CEMP. These detailed measures would incorporate the measures listed below.	Construction	Y	Y	Y

No.	Mitigation measures	Implementation stage	Applicability		
			IMT	Rail link connection	Warehousing
	The CEMP would address: ▪ general impact mitigation ▪ staff/contractor inductions ▪ vegetation clearing protocols including identification of exclusion zones ▪ pre-clearing surveys and fauna salvage/translocation ▪ rehabilitation and restitution of adjoining habitat ▪ weed control ▪ pest management ▪ monitoring. The CEMP would include clear objectives and actions for the Proposal including how to: ▪ minimise human interferences to flora and fauna ▪ minimise vegetation clearing/disturbance ▪ minimise impact to threatened species and communities ▪ minimise impacts to aquatic habitats and species ▪ undertake flora and fauna monitoring at regular intervals.				
4B	Vegetation clearing would be restricted to the construction footprint with sensitive areas, outside of this footprint, clearly identified as vegetation exclusion zones.	Pre-construction and Construction	Y	Y	Y
4C	The vegetation exclusion zones would be marked on maps, which would be prepared by the contractor/s, and would also be marked on the ground using high visibility fencing (such as barrier mesh).	Pre-construction and Construction	Y	Y	Y

No.	Mitigation measures	Implementation stage	Applicability		
			IMT	Rail link connection	Warehousing
4D	A suitably qualified ecologist would accompany clearing crews to ensure disturbance is minimised and to assist in relocating any native fauna to adjacent habitat.	Construction	Y	Y	Y
4E	The following procedures would be implemented to minimise fauna impacts from vegetation clearance: ▪ A staged habitat removal process would be developed and would include the identification and marking of all habitat trees in the area ▪ Where reasonable and feasible, clearing of hollow-bearing trees would be undertaken in March and April when most microbats are likely to be active (not in torpor) but are unlikely to be breeding or caring for young, and when threatened hollow-bearing tree dependent birds in the locality are also unlikely to be breeding ▪ Pre-clearing surveys would be conducted 12 to 48 hours before vegetation clearing to search for native wildlife (e.g. reptiles, frogs, Cumberland Land Snail) that can be captured and relocated to the retained riparian vegetation of the Georges River corridor ▪ Vegetation would be cleared from a 10 m radius around habitat trees to encourage animals roosting in hollows to leave the tree. A minimum 48 hour waiting period would allow animals to leave ▪ After the waiting period, standing habitat trees would be shaken (where safe and practicable) under the supervision of an ecologist to encourage animals roosting in hollows to leave the trees, which may then be felled, commencing with the most distant trees from secure habitat	Construction	Y	Y	Y

No.	Mitigation measures	Implementation stage	Applicability		
			IMT	Rail link connection	Warehousing
	▪ Felled habitat trees would either be immediately moved to the edge of retained vegetation, or left on the ground for a further 24 hours before being removed from the construction area, at the discretion of the supervising ecologist ▪ All contractors would have the contact numbers of wildlife rescue groups and would be instructed to coordinate with these groups in relation to any animal injured or orphaned during clearing.				
4F	Within areas of high quality intact native vegetation proposed to be removed: Topsoil (and seedbank) would be collected from native vegetation that are to be permanently cleared and used in the revegetation of riparian areas Where feasible and reasonable native plants in areas that are to be permanently cleared would be relocated and transplanted in riparian areas identified for rehabilitation	Construction	Y	Y	Y
4G	Relocation of fauna to adjacent retained habitat would be undertaken by a suitably qualified ecologist during the supervision of vegetation removal.	Construction	Y	Y	Y
4H	An ecologist would supervise the drainage of any waterbodies on the Proposal site and would relocate native fish (e.g. eels), tortoises and frogs to the edge of the Georges River and/or the existing pond at the northern end of the Proposal site.	Construction	Y	Y	Y
4I	The design of temporary site fencing and any overhead powerlines would consider the potential for collision by birds and bats and minimise this risk where practicable.	Detailed design & Pre-construction	Y	Y	Y
4J	The potential for translocation of threatened plant species as individuals or as part of a soil translocation process would be considered during the detailed development of the EWMS and CEMP.	Detailed design, construction and construction	Y	Y	Y

No.	Mitigation measures	Implementation stage	Applicability		
			IMT	Rail link connection	Warehousing
4K	Important habitat elements (e.g. large woody debris) would be moved from the construction area to locations within the conservation area which would not be cleared during the Proposal, or to stockpiles for later use in vegetation/habitat restoration.	Pre-construction and Construction	Y	Y	Y
4L	Winter-flowering trees would be preferentially planted in landscaped areas of the Proposal site to provide a winter foraging resource for migratory and nomadic nectar-feeding birds and the Grey-headed Flying-fox.	Detailed design, Pre-construction and Construction	Y	Y	Y
4M	Erosion and sediment control measures such as silt fencing and hay bales would be used to minimise sedimentation of streams and resultant impacts on aquatic habitats and water quality.	Pre-construction and Construction	Y	Y	Y
4N	Opportunities for planting of detention basins with native aquatic emergent plants and fringing trees would be explored in the detailed design of the Proposal and, if practicable, implemented so that they would provide similar habitat in the medium term to that lost through the removal of existing basins.	Detailed design and construction	Y	Y	Y
4O	The CEMP (or equivalent) would include detailed measures for minimising the risk of introducing weeds and pathogens.	Construction	Y	Y	Y
4P	The CEMP and OEMP for the Proposal would consider and have reference to the weed removal and riparian vegetation restoration undertaken within parts of the Georges River corridor under the MPW Concept Approval (identified within the Biodiversity Offset Package for the MPW Project).	Construction and operation	Y	Y	Y
4Q	The detailed design process would consider the potential groundwater impacts on groundwater-dependent ecosystems. In most cases, these impacts, if evident, would be mitigated at the design phase.	Detailed design and construction	Y	Y	Y

No.	Mitigation measures	Implementation stage	Applicability		
			IMT	Rail link connection	Warehousing
4R	The OEMP would include a biodiversity monitoring program designed to detect operational impacts of the Georges River riparian corridor (within the offset site).	Operation	Y	Y	Y
4S	Ongoing monitoring of macroinvertebrate communities would be undertaken prior to, during and following construction upstream and downstream of the potential impacts at the proposed basin outlets in the Georges River and reference locations to assist in identifying any changes in aquatic communities.	Pre-construction, construction and operation	Y	Y	Y
4T	The proposed stormwater basin outlets would be designed to minimise biodiversity impacts by incorporating native revegetation and fauna habitat features as far as possible.	Detailed design	Y	Y	Y
4U	The native vegetation and connectivity values in the proposed basin outlets would be monitored to ensure that fauna passage is maintained.	Construction and operation	Y	Y	Y
5.	**Stormwater and Flooding**				
5A	A Soil and Water Management Plan (SWMP) and Erosion and Sediment Control Plan (ESCP), or equivalent, would be prepared for the Proposal. The SWMP and ESCPs would be prepared in accordance with the principles and requirements of the *Blue Book* and based on the Preliminary ESCPs provided in the Stormwater and Flooding Assessment Report (refer to Appendix R of this EIS). The following aspects would be addressed within the SWMP and ESCPs: ▪ Minimise the area of soil disturbed and exposed to erosion ▪ Priority should be given to management practices that minimise erosion, rather than to those that capture sediment downslope or at the catchment outlet	Construction	Y	Y	Y

No.	Mitigation measures	Implementation stage	Applicability		
			IMT	Rail link connection	Warehousing
	▪ Divert clean water around the construction site or control the flow of clean water at non-erodible velocities through the construction area ▪ Provision of boundary treatments around the perimeter of construction areas to minimise the migration of sediment offsite ▪ Permanent or temporary drainage works (in particular OSDs) would be installed as early as practical in the construction program to minimise uncontrolled drainage and associated erosion ▪ Stockpiles would be located away from flow paths on appropriate impermeable surfaces, to minimise potential sediment transportation. Where practicable, stockpiles would be stabilised if the exposed face of the stockpile is inactive more than ten days, and would be formed with sediment filters in place immediately downslope ▪ Disturbed land would be rehabilitated as soon practicable ▪ The wheels of all vehicles would be cleaned prior to exiting the construction site where excavation occurs to prevent the tracking of mud. Where this is not practical, or excessive soil transfer occurs onto paved areas, street cleaning would be undertaken when necessary. ▪ A requirement to inspect all permanent and temporary erosion and sedimentation control works prior to and post rainfall events and prior to closure of the construction area. Erosion and sediment control structures must be cleaned, repaired and augmented as required. ▪ Where required, sediment basins and their outlets would be designed to be stable in the peak flow from at least the 10-year ARI time of concentration event. Sediment basins should be sized to accommodate the 5 day, 80th percentile storm event, with sufficient size and capacity to manage Type F soils. Sediment basins must be				

No.	Mitigation measures	Implementation stage	Applicability		
			IMT	Rail link connection	Warehousing
	regularly cleaned to maintain the design capacity. Prior to discharge from sediment basins, water would be tested for the following parameters to identify construction impacts: – pH – Turbidity / TSS – Oil and grease. ▪ Sediment fences are to be provided around the perimeter of the site to ensure no untreated runoff leaves the site, and around the existing and proposed drainage channels to minimise sediment migration into waterways and sediment basins ▪ The following management measures would be implemented during works in and adjacent to Georges River to mitigate potential impacts on water quality during OSD channel construction: – All reasonable efforts would be taken to program construction activities during periods when flood flows are not likely to occur – The construction site, on completion of construction works, would be left in a condition that promotes native revegetation – The management principles outlined in Managing Urban Stormwater (Landcom 2004) for sites with high erosion potential would be implemented.				
5B	Proposal site exits would be fitted with hardstand material, rumble grids or other appropriate measures to limit the amount of material transported offsite.	Construction	Y	Y	Y
5C	The following measures would be considered during the development of construction methodology for the Proposal to mitigate flooding impacts:	Construction	N	N	Y

No.	Mitigation measures	Implementation stage	Applicability		
			IMT	Rail link connection	Warehousing
	▪ For all site works, provide temporary diversion channels around temporary work obstructions to allow low and normal flows to safely bypass the work areas ▪ Locate site compounds, stockpiling areas and storage areas for sensitive plant, equipment and hazardous materials above an appropriate design flood level, outside of the PMF extent at the northern section of the construction area, to be determined based on the duration of the construction work.				
5D	To minimise potential flood impacts during construction of the Proposal, the following measures would be implemented and documented in the SWMP: ▪ The existing site catchment and sub-catchment boundaries would be maintained as far as practicable ▪ To the extent practicable, site imperviousness and grades should be limited to the extent of existing imperviousness and grades under existing development conditions ▪ Smaller detention storages that provide adequate rainfall runoff mitigation during partial construction/site development would be considered. ▪ Temporary structures used to convey on site run-off during construction would be designed to accommodate flows during prolonged or intense rainfalls. The existing stormwater conduit conveying flows from Moorebank Avenue to the Georges River would be assessed to ensure it is adequate to accommodate run-off from the construction area.	Construction	N	N	Y
5E	A Flood Emergency Response and Evacuation Plan, or equivalent, would be prepared and implemented for the construction phase of the Proposal to allow work sites to be safely evacuated and secured in advance of flooding occurring at the Proposal site.	Construction	N	N	Y

No.	Mitigation measures	Implementation stage	Applicability		
			IMT	Rail link connection	Warehousing
5F	Stormwater quality improvement devices would be designed to meet the performance targets identified in the *Stormwater and Flooding Environmental Assessment* (Appendix R), and civil design drawings. Maintenance of the bio-retention structures would be in accordance with the maintenance requirements set out in Gold Coast City Council's *Water Sensitive Urban Design Guidelines* 2007 and would be included in the OEMP.	Operation	Y	Y	Y
5G	Operational water quality monitoring is to be carried out and included in the OEMP with the objective of maintaining or improving existing water quality.	Operation	Y	Y	Y
5H	A Flood Emergency Response Plan (FERP) would be prepared and implemented for the operational phase of the Proposal. The FERP would take into consideration, site flooding and broader flood emergency response plans for the Georges River floodplains and Moorebank area. The FERP would also include the identification of an area of safe refuge within the Proposal site that would allow people to wait until hazardous flows have receded and safe evacuation is possible.	Operation	Y	Y	Y
6.	**Geology, Soils and Land Contamination**				
6A	The CEMP would identify the actions to be taken should additional contamination be identified during the development of the site (i.e. an unexpected finds protocol), and will address REMM items 8H, 8T, 8U, 8V and 8W (of the MPW Concept Plan Approval (SSD 5066)).	Construction	Y	Y	Y
6B	A site specific Remediation Action Plan (RAP) is not considered to be required for the Proposal. The following documentation would be utilised for the purposes of remediating the site: ▪ The Preliminary Remediation Action Plan (PB, 2014a)	Construction	Y	Y	Y

No.	Mitigation measures	Implementation stage	Applicability		
			IMT	Rail link connection	Warehousing
	▪ The Validation Plan – Principles (Golder, 2015b) ▪ The Demolition and Remediation Specification (Golder 2015c) ▪ Any other contamination documentation prepared for the remediation activities undertaken for MPW Early Works (Stage 1).				
6C	The CEMP would include the preparation of a site-wide UXO, EO, and EOW management plan (or equivalent) based on the UXO Risk Review and Management Plan (G-Tek, 2016). This plan would be implemented to address the discovery of UXO or EOW during construction, to ensure a safe environment for all staff, visitors and contractors.	Construction	Y	Y	Y
6D	An Asbestos in Soils Management Plan (AMP) is to be implemented as part of the CEMP in accordance with the Safe Work NSW requirements, including but not limited to: ▪ the Guidelines for Managing asbestos in or on soil (2014), and ▪ Codes of Practice - How to Safely Remove Asbestos (2011) and How to Manage and Control Asbestos in the Workplace (2011).	Construction	Y	Y	Y
6E	An Acid Sulfate Soils Management Plan (or equivalent) would be prepared as part of the CEMP in accordance with the ASSMAC Assessment Guidelines (1998), for areas identified as being of low or high risk i.e. works within close vicinity of the Georges River (Figure 13-2 of this EIS). In addition, a risk assessment quantifying the risks associated with the volumes of soil to be disturbed, the laboratory results from ASS testing undertaken, the end use of the materials and the proximity to sensitive environments is to be undertaken.	Construction	Y	Y	Y

No.	Mitigation measures	Implementation stage	Applicability		
			IMT	Rail link connection	Warehousing
	All offsite disposal would be in accordance with the NSW Waste Classification Guidelines Part 4: Acid Sulfate Soils (2009).				
6F	The existing groundwater monitoring undertaken for the Proposal would continue. A groundwater monitoring program (GMP) would be developed at the conclusion of remediation activities for the Proposal and included as part a Long Term Environmental Management Plan (LTEMP) (to be prepared for approval by the Accredited Site Auditor and in association with the OEMP). The main purpose of the GMP would be to assist in the management of groundwater contamination (particularly PFAS impacts) at the site, and to minimise potential harm to human health and the environment. The GMP would achieve the following objectives: ▪ Establish whether the residual groundwater contamination plume is shrinking, stable, or increasing, and whether natural attenuation and/or migration is occurring according to expectations through line-of-evidence collection ▪ Provide appropriate groundwater investigation levels (GILs) for groundwater contaminants, in accordance with the *National Environment Protection (Assessment of Site Contamination) Measure 1999* (ASC NEPM). Should exceedances be identified, contingency plans for further investigations or remediation would be prepared. ▪ Provide appropriate trigger levels for key contaminants (where available), based on the receptor of interest and identified contaminants ▪ Serve as a compliance program, so that potential impacts to down-gradient receptors are identified before adverse effect occurs (relative to above objectives)	Pre-construction, construction and operation	Y	Y	Y

No.	Mitigation measures	Implementation stage	Applicability		
			IMT	Rail link connection	Warehousing
	▪ Detect changes in environmental conditions (e.g. hydrogeologic, geochemical or other changes) that may reduce the efficacy of any natural attenuation processes or that could lead to a change in the nature of impact ▪ Establish groundwater conditions (i.e. concentrations and/or trends) which indicated that groundwater monitoring could be reduced or ceased and the requirements of the GMP absolved. The monitoring program is to be undertaken for two years post operation of the Proposal to ensure a range of seasonal and river flow variations is assessed. At the completion of the two year period, subject to analysis of results, consideration would be given to whether this monitoring is required to continue.				
6G	Findings within the Geotechnical Interpretive Report (Golder, 2016 – Appendix S) regarding excavations, earthworks, pavements and structural footings are to be considered during detailed design.	Detailed design	Y	Y	Y
6H	At the conclusion of remediation works, a Remediation and Validation Report (RVR) is to be prepared for the Proposal to facilitate the Auditor's review of remediation and validation activities. The RVR is to document the remediation and validation activities completed within specific areas of the Proposal, including: ▪ Information relating to the materials used in the separation layers such as the soil types, geotextile materials, and sealant types etc. (if required) ▪ An as-constructed plan of the site showing the locations, depths and materials of the separation layers installed at the site.	Operation	Y	Y	Y
6I	The existing site-wide Long-Term Environmental Management Plan (LTEMP), such as the one established at the completion of Early Works, is to be revised at the completion	Operation	Y	Y	Y

No.	Mitigation measures	Implementation stage	Applicability		
			IMT	Rail link connection	Warehousing
	of the Proposal remediation activities to include protocols for ongoing maintenance and/or monitoring or any long term remedial/mitigation measures to be implemented following completion of the Site Audit Statement.				
7.	**Hazard and risk**				
7A	The following measures would be included in the CEMP (or equivalent) to minimise hazards and risks: ▪ Procedures for safe removal of asbestos ▪ Provision for safe operational access and egress for emergency service personnel and workers would be provided at all times ▪ An Incident Response Plan that would include a Spill Management Procedure.	Construction	Y	Y	Y
7B	To minimise the risk of leakages involving natural gas, LNG and flammable and combustible liquids to the atmosphere: ▪ Appropriate standards for a gas reticulation network, including AS 2944-1 (2007) and AS 2944-2 (2007), would be applied ▪ Correct schedule pipes would be used ▪ Fire protection systems would be installed as required ▪ Access to the Proposal site would be restricted to authorised personnel.	Operation	Y	Y	Y
7C	To minimise the risks of leakage of LNG and flammable liquids during transport: ▪ The transport of dangerous goods by road would comply with the *Dangerous Goods (Road and Rail Transport) Act 2008* and the Dangerous Goods (Road and Rail Transport) Regulation 2014	Operation	Y	Y	Y

No.	Mitigation measures	Implementation stage	Applicability		
			IMT	Rail link connection	Warehousing
	▪ Contractors delivering the gas would be trained, competent and certified by the relevant authorities.				
7D	To minimise hazards associated with venting of LNG: ▪ LNG storage would be designed to AS/NZS 1596-2008 standards ▪ Access to the Proposal site would be restricted to authorised personnel ▪ Adequate separation distances to residencies and other assets would be maintained.	Operation	Y	Y	Y
7E	Storage of flammable/combustible liquids would be undertaken in accordance with AS 1940, with secondary containment in place in a location away from drainage paths.	Operation	Y	Y	Y
7F	Intermodal terminal facility and warehousing staff involved in the transport and handling of dangerous goods would receive training in the contents of the dangerous goods provisions commensurate with their roles and responsibilities. Training is to be provided and records maintained in accordance with the appropriate competent authority (WorkCover NSW).	Operation	Y	Y	Y
7G	The 190 KL of diesel fuel (combustible liquids of class C) would be stored on site in a separate 97 KL self-bunded container and would be stored away from other flammable materials of class 3PGI, II or III. The manifest threshold quantity under this circumstance is 100 KL for each tank. Refuelling of locomotives is likely to occur on the locomotive shifter, which would catch any spills during the refuelling process. Spill kits would be located in the vicinity of the refuelling location and staff would be trained in the use.	Operation	Y	N	N

No.	Mitigation measures	Implementation stage	Applicability		
			IMT	Rail link connection	Warehousing
8.	**Visual Amenity, urban design and landscape**				
8A	The following mitigation measures would be implemented, where reasonable and feasible, to minimise the visual impacts of the Proposal: ▪ Existing vegetation around the perimeter of construction sites would be retained where feasible and reasonable ▪ The early implementation of landscape planting would be considered in order to provide visual screening during the construction of the Proposal ▪ Elements within construction sites would be located to minimise visual impacts as far as feasible and reasonable, e.g. setting back large equipment from site boundaries ▪ Construction lighting, on both ancillary facilities and plant and equipment, would be designed and located to minimise the effects of light spill on surrounding sensitive receivers, including residential areas and the proposed conservation area ▪ Design of site hoardings would consider the use of artwork or project information ▪ Regular maintenance would be undertaken of site hoardings and perimeter areas including the prompt removal of graffiti ▪ Re-vegetation/landscaping would be undertaken progressively ▪ Where required for construction works, cut-off and directed lighting would be used and lighting location considered to ensure glare and light spill are minimised.	Construction	Y	Y	Y
8B	The following mitigation measures would be implemented, where reasonable and feasible, for the landscaping of the Proposal: ▪ Use of species that are local to the area ▪ Use of trees to provide a uniform canopy cover within vegetated areas	Operation	Y	Y	Y

No.	Mitigation measures	Implementation stage	Applicability		
			IMT	Rail link connection	Warehousing
	▪ Use of local species as understory planting to support and enhance local habitat values ▪ Use of seeds collected within the local area for planting to reinforce the genetic integrity of the region, where possible.				
8C	The following initiatives would be implemented for mitigation of light spill: ▪ Lighting would be designed to minimise impacts on surrounding existing and future residents and the proposed conservation zone ▪ The use of shields on luminaire lighting to minimise brightness effects would be considered ▪ Asymmetric light distribution-type floodlights would be selected as part of the proposed lighting design (i.e. the light is directed specifically to the task with minimal direct light spill to the surrounding area) ▪ Low reflection pavement surfaces would be considered to reduce brightness ▪ The quantity of light and energy consumption in parts of the Proposal site that are not active would be minimised, while retaining safe operation.	Detailed design and operation	Y	Y	Y
9.	**Indigenous Heritage**				
9A	The scar portions of MA6 & MA7 would be removed by a qualified arborist and relocated to the TLALC property at Thirlmere, or a suitable area identified in consultation with Registered Aboriginal Parties (RAPs). The trees should be mounted and housed in a weather protected structure. All costs associated with the removal, relocation and housing of the trees would be covered by the Proponent. The relevant RAP would be responsible for the maintenance of the housing once established.	Construction	N	N	Y

No.	Mitigation measures	Implementation stage	Applicability		
			IMT	Rail link connection	Warehousing
9B	Staged salvage excavation of selected areas should be conducted as part of the Proposal, in consultation with RAPs. These stages include: ▪ Part 1 would involve dispersed pits placed along transects within the Terrace PAD and the tertiary terrace (between MA10 and MA14 – refer to Figure 16-2 of this EIS). ▪ Part 2 would involve open area salvage excavation, targeting the artefact concentrations identified by NOHC at MA10 and MA14, as well as any additional artefact concentrations identified during Part 1.	Construction	N	N	Y
9C	Where changes are made to the Proposal and areas not assessed by this report or previous reports (NOHC 2014, NOHC Sept 2014, AHMS 2015) are to be impacted, further Aboriginal heritage investigation and consultation should take place.	Construction	Y	Y	Y
9D	An Aboriginal Cultural Heritage Assessment Report (ACHAR) (also known as a Cultural Heritage Management Plan) would be prepared as part of the CEMP for the Proposal and would outline ongoing management/ mitigation measures relating to MA6 and MA7.	Construction	N	N	Y
9E	An unexpected finds procedure would be included in the ACHAR and in place for the construction phase of the Proposal.	Construction	Y	Y	Y
9F	If suspected human remains are located during any stage of the construction works, work would stop immediately and the NSW Police and the Coroner's Office should be notified. The Office of Environment and Heritage, RAPs and an archaeologist would be contacted if the remains are found to be Aboriginal.	Construction	Y	Y	Y
9G	Consultation with RAPs would continue throughout the life of the Proposal, as necessary. Ongoing consultation with RAPs would take place throughout the reburial of retrieved artefacts and in the event of the discovery of any unexpected Aboriginal objects.	Pre-Construction,	Y	Y	Y

No.	Mitigation measures	Implementation stage	Applicability		
			IMT	Rail link connection	Warehousing
		construction and operation			
10.	**Non-Indigenous Heritage**				
10A	Naming of roads would consider previous School of Military Engineering (SME) street names.	Detailed Design	Y	Y	Y
10B	Naming of buildings and roads (in addition to above) would consider commemoration of significant events and individuals related to the Moorebank Cultural Landscape.	Detailed Design	Y	Y	Y
10C	An unexpected finds protocol (or equivalent) would be included within the CEMP. If unexpected finds are identified during works, a suitably qualified archaeological consultant would be engaged to assess the significance of the finds and the NSW Heritage Council notified. In this instance, further archaeological work or recording may be required.	Construction	Y	Y	Y
11.	**Greenhouse Gas**				
11A	The following mitigation measures would be implemented, where reasonable and feasible, for management of GHG emissions as part the operation of the Proposal: ▪ Energy efficiency design aspects would be incorporated wherever practicable to reduce energy demand ▪ Fuel efficiency of the operation plant/equipment would be assessed prior to selection, and where practical, equipment with the highest fuel efficiency and which uses lower GHG intensive fuel (e.g. biodiesel) would be used	Detailed design	Y	Y	Y

No.	Mitigation measures	Implementation stage	Applicability		
			IMT	Rail link connection	Warehousing
	▪ Energy-efficient guidelines for operational work would be considered and implemented where appropriate and regular maintenance of equipment would be undertaken to maintain fuel efficiency ▪ Methods to reduce losses from industrial processes (refrigerants and SF6) would be investigated during detailed design ▪ Consideration would be given to undertake further investigation and implementation of cost negative abatement opportunities ▪ Investigate and, where possible, implement key performance indicators (KPIs) for plant efficiency and GHG intensity. The mitigation measures, management strategies and abatement opportunities presented in this report would be reviewed and considered where appropriate for incorporation into the OEMP.				
11B	The following initiatives would be implemented, where reasonable and feasible, for mitigation of GHG emissions during construction: ▪ Construction works would be planned to minimise double handling of materials ▪ Construction/transport plans would be incorporated within the CEMP to minimise the use of fuel during construction ▪ Fuel efficiency of the construction plant/equipment would be assessed prior to selection, and where practical, equipment with the highest fuel efficiency and which uses lower GHG intensive fuel (e.g. biodiesel) would be used ▪ On-site vehicles would be fitted with exhaust controls in accordance with the *Protection of the Environment Operations (Clean Air) Regulation 2010,* as required and appropriate.	Construction	Y	Y	Y

No.	Mitigation measures	Implementation stage	Applicability		
			IMT	Rail link connection	Warehousing
	▪ Regular maintenance of equipment would be undertaken to maintain good operations and fuel efficiency ▪ Where practicable, trucks removing waste from the site or bringing materials to the site would be filled to the maximum amount allowable, depending on the truck size and load weight, to reduce the number of traffic movements required ▪ The mitigation measures, management strategies and abatement opportunities (Section 18 of this EIS) would be reviewed and considered where appropriate for incorporation into the CEMP.				
12.	**Waste**				
12A	The following mitigation measures would be implemented as part of the CEMP (or equivalent) for waste management: ▪ Characterisation of construction waste streams in accordance with the *NSW Waste Classification Guidelines* ▪ Management of any identified hazardous waste streams ▪ Procedures to manage construction waste streams, including handling, storage, classification, quantification, identification and tracking ▪ Mitigation measures for avoidance and minimisation of waste materials ▪ Procedures and targets for re-use and recycling of waste materials.	Construction	Y	Y	Y
12B	The following mitigation measures would be implemented as part of the OEMP (or equivalent) for waste management: ▪ Addressing waste management requirements and goals in staff inductions	Detailed design	Y	Y	Y

No.	Mitigation measures	Implementation stage	Applicability		
			IMT	Rail link connection	Warehousing
	▪ Providing staff access to documentation outlining the facility's waste management requirements ▪ Locating recycling bins in kitchen areas beside general waste bins to prevent contamination of recycling ▪ Positioning paper recycling bins close to printer / photocopying equipment ▪ Establishing bays or containers for recyclable waste generated through de-stuffing ▪ Minimising general waste bins at desks but providing adequate container and paper recycling to encourage sorting of recyclables ▪ Providing adequate bin storage for the expected quantity of waste. ▪ Waste management planning incorporating principles of the waste hierarchy ▪ Selection of materials used in operations with recycled content, low embodied energy and durability ▪ Appropriate areas shall be provided for the storage of waste and recyclable material ▪ Standard signage on how to use the waste management system and what materials are acceptable in the recycling would be posted in all waste collection and storage areas ▪ All waste shall be collected regularly and disposed of at licensed facilities ▪ An education programme and on-going monitoring for training personnel to properly sort and transport waste into the right components and destinations.				
12C	Container disposal units would be provided in the area around the diesel re-fuelling station to dispose of used spills kits. These containers would be taken for disposal at an appropriately licensed facility.	Operation	Y	Y	Y

No.	Mitigation measures	Implementation stage	Applicability		
			IMT	Rail link connection	Warehousing
13.	**Bushfire**				
13A	The following actions would be considered for implementation, where reasonable and feasible, for mitigation of bushfire risk during construction: ▪ A bushfire management strategy, or equivalent, would be prepared as part of the CEMP for the construction phase. The strategy would include: – Emergency response plans and procedures – All site offices and temporary buildings would have a minimum setback of 10 m to bushfire prone areas – All site offices would be accessible via access roads suitable for firefighting appliances similar to NSW Rural Fire Service category 1 tankers.	Construction	Y	Y	Y
13B	The following mitigation measures would be implemented during the operation of the Proposal: ▪ A bushfire management strategy, (including a fire safety and evacuation plan) or equivalent, would be prepared as part of the OEMP ▪ Management of the landscaped areas within the Proposal site would be undertaken to maintain minimum dry fuels loads ▪ The width, as required, of the Rail link connection would be maintained in a low fuel state ▪ Protocols would be developed for the monitoring of train access/egress during high – catastrophic fire weather days, if required and in accordance with the bushfire management strategy.	Operation	Y	Y	Y

No.	Mitigation measures	Implementation stage	Applicability		
			IMT	Rail link connection	Warehousing
14.	**Socio-economic**				
14A	A community information and awareness strategy would be included in the CEMP and would outline measures to maintain communication with the community and all relevant stakeholders throughout the construction process of the Proposal.	Construction	Y	Y	Y
14B	The Operational Environmental Management Plan (OEMP) would include measures to engage with stakeholders and to manage and respond to feedback received during the operation of the Proposal.	Operation	Y	Y	Y

23 JUSTIFICATION AND CONCLUSION

The Proposal seeks approval on behalf of the Applicant, the Sydney Intermodal Terminal Alliance (SIMTA) for the construction and operation of the Proposal as part of the second stage of development under the MPW Concept Approval (SSD 5066).

The approval provided for the MPW Project, within the MPW Concept Approval and EPBC Approval, is considered recognition from state government, and authorities that the Proposal is justified and, subject to further assessment, is considered suitable for its location.

This EIS has provided considerable justification for the Proposal (refer to Section 3 of this EIS), in consideration of its consistency with national and state planning policy, its importance to the ongoing distribution of freight within Sydney and the number of options which have been considered to improve its operational efficiency and reduce its environmental impact.

A summary of the key outcomes for the environmental issues associated with the Proposal has also been provided within this EIS (refer to Sections 7-20 of this EIS). These sections conclude that no significant environmental impacts would result from the construction and/or operation of the Proposal. This EIS includes a number of mitigation measures, to further reduce the overall environmental impacts, which would be implemented for the construction and operation of the Proposal (refer to Section 22 of this EIS).

This section provides an overall summary of the justification for the Proposal and a conclusion of the potential environmental impacts associated with the Proposal.

23.1 Proposal justification

23.1.1 Proposal objectives

The objectives of the MPW Project are identified in the MPW Concept Approval. The objectives of the Proposal, which are generally consistent with those of the MPW Project, include:

- Australian Government objectives (2010):
  - Boost national productivity over the long term through improved freight network capacity and rail utilisation
  - Create a flexible and commercially viable facility and enable open access for rail operators and other terminal users
  - Minimise impact on Defence’s operational capability during the relocation of Defence facilities from the Moorebank site
  - Attract employment and investment to west and south-western Sydney
  - Achieve sound environmental and social outcomes that are considerate of community views
  - Optimise value for money for the Commonwealth having regard to the other stated Project objectives
- MIC constitutional objectives (2012):
  - To facilitate the development of an intermodal freight terminal at Moorebank, including an IMEX facility, an interstate freight terminal capable of catering for 1,800 metre trains and ancillary facilities by optimising private sector investment and innovation in the development, construction and operation of the intermodal terminal
  - To facilitate the operation of a flexible and commercially viable common user facility which shall be available on reasonably comparable terms to all rail operators and other terminal users

  - To ensure the intermodal terminal operates with the aim of improving national productivity through an efficient supply chain, increased freight capacity and better rail utilisation
  - To operate on commercially sound principles having regard to the Australian Government's long-term intention to sell its interest in the Company (MIC).

23.1.2 Need for the Proposal

The Proposal includes infrastructure which is critical to the on-going distribution of freight interstate, intrastate and throughout the Sydney Metropolitan Area. The Proposal also contributes considerably to a change in mode share (from road to rail) which would result in some positive benefits for the region.

Projected growth in trade volumes will lead to an increase in freight movements across the Sydney Greater Metropolitan Area. This will pose substantial challenges for the supply chain which is currently dominated by road transport. To meet these challenges and to allow for increased use of rail, it is necessary to invest in new intermodal terminal capacity, to develop dedicated freight rail lines, to widen the orbital motorway network and ideally to complete the missing linkages in the current orbital motorway network, and to improve the rail interface at Port Botany.

The Proposal is consistent with the MPW Concept Approval (SSD 5066) allowing for the development of an IMT facility with the capacity of 500,000 TEU per annum. The Proposal provides the necessary infrastructure to enable a throughput of 500,000 TEU including the Rail link connection, rail sidings, container storage, road access and 215,000 GFA of warehousing. The Proposal is considered an important step in achieving the set target for a transport modal shift to rail and would facilitate the development of the MPW site.

23.1.3 Proposal alternatives

The MPW Concept Approval established the framework for the design, construction and operation of the IMT Facility and warehousing. The Proposal represents the second stage of development approved within the MPW Concept Approval. A key goal of the Proposal was to, where possible, improve the operational efficiency of the IMT facility and warehousing area and further reduce the environmental impacts, previously presented in the MPW Concept Approval.

Consideration was given to a number of alternatives as part of the approach and design development for the Proposal.

The feasible alternatives considered for the Proposal, include:

- 'Do nothing' option: this option was rejected on account of not improving freight transit for outward or inward bound interstate, intrastate and port shuttle freight movements. Similarly, it would not deliver any improvements to general transit conditions on the M5 Motorway or reductions in greenhouse gas emissions from diesel trucks. Furthermore it would not provide temporary and long-term employment opportunities within the region.
- Consideration of other alternative sites: a number of alternate sites were considered as part of the MPW Concept Approval. The assessment found the MPW Project presents an ideal location for an intermodal facility in south-western Sydney due to the following factors:
  - It is located near to the South West Growth Centre
  - It is in proximity to major road and rail freight corridors (SSFL, M5 Motorway, near the M7 Motorway and Hume Highway)
  - There is a direct intersection linking the adjacent Moorebank Avenue to the M5 Motorway

  - It is zoned as industrial land for use as industrial warehousing
  - Buffer zones are provided between the facility and nearby residential areas
  - It is within the catchment for which there is a demand, resulting in shorter average delivery distances and more efficient use of road transport
  - The location has also been identified in both state and federal strategies as the best, and only location for an intermodal terminal to service this defined catchment in South- Western Sydney.
- Refining design for the Proposal site layout and operations: since the MPW Concept Approval, a number of design refinements have been undertaken to the Proposal. Design changes have been undertaken in response to advice and consultation with government authorities, service providers and the community, as well as additional data from more detailed environmental and social investigations. Where a refinement was likely to have wider implications, or where a range of constraints and alternatives were considered, design refinements were identified in the context of environmental considerations. Design refinements included a number of changes to the IMT facility, the warehousing area and the OSD drainage channels.

23.2 Consistency with relevant legislation and approvals

23.2.1 EPBC Approval

The EPBC Approval (No. 2011/6086) was granted in mid 2016 for the impact of the MPW Project on listed threatened species and communities and Commonwealth land. The EPBC Approval included a number of conditions which were to be implemented within the design, construction and operation of future stages of development of the MPW Project.

This EIS has considered the conditions provided in the EPBC Approval, and where relevant, integrated them into the design or mitigation measures for construction and operation of the Proposal. In particular the following has been prepared to satisfy the EPBC Approval conditions:

- An assessment of the impacts of the Proposal on threatened flora and fauna and a discussion on measures which have been made to reduce and minimise these impacts (refer to Section 11 and Appendix Q of this EIS)
- A Biodiversity Offset Strategy (refer to the Biodiversity Assessment Report - Appendix Q of this EIS) has been prepared to further mitigate the impact of vegetation removal
- A Preliminary Construction Environmental Management Plan (PCEMP) (refer to Appendix I of this EIS) which forms the basis of the Construction Environmental Management Plan (CEMP) to be prepared for the Proposal prior to construction
- A commitment has been made to the preparation of an Operational Environmental Management Plan (OEMP) which would consider these conditions, prior to the operation of the Proposal.

Section 5 of this EIS provides further discussion on the consistency of the Proposal with the EPBC Approval. Overall, it is concluded that the Proposal is consistent with the relevant conditions of the EPBC Approval.

23.2.2 Concept Plan Approval

The MPW Concept Approval (SSD 5066) was granted by the PAC on 3 June 2016 under Division 4.1, Part 4 of the *Environmental Planning and Assessment Act* 1979 (EP&A Act).

The Conditions of Approval (for the MPW Concept Approval) included a number of future assessment requirements to be undertaken for future stages of the MPW Project.

These Conditions of Approval formed the basis for the Secretary's Environmental Assessment Requirements (SEARs) (SSD 16-7709) which were issued by DP&E for the Proposal on 14 July 2016.

This EIS has been prepared to satisfy both the MPW Concept Approval, and more specifically, the SEARs provided for the Proposal. The environmental assessment included within this EIS provides all of the information required by the MPW Concept Approval and also the SEARs which focused particularly on the following key issues:

- Air quality
- Traffic and transport
- Rail
- Noise and vibration
- Infrastructure Upgrades/Contributions
- Soil and Water
- Heritage (Indigenous and Non-Indigenous)
- Visual Amenity, Urban Design and Landscape
- Biodiversity
- Contamination
- Hazard and Risk.

In addition to this a number of other issues have been addressed in this EIS as requested by the MPW Concept Approval (Conditions of Approval), the SEARs and the Revised Environmental Management Measures (REMMs) identified in the MPW Concept Approval.

Appendix A of this EIS provides details of where the MPW Conditions of Approval, REMMs and the SEARs have been addressed in this EIS.

The design prepared for the Proposal has been developed to be consistent with the design provided within the MPW Concept Approval and, where possible, further reduce environmental impacts.

Overall, it is concluded that this EIS, and the Proposal provided, is consistent with the MPW Concept Approval and the SEARs.

23.2.3 EP&A Act (Section 79C)

As discussed above, approval is sought for the Proposal under Part 4, Division 4.1 of the EP&A Act. As approval for the Proposal is via a Development Application (DA), and as reiterated in the SEARs, the Proposal EIS must comply with the 'matters for consideration' under Section 79C of the EP&A Act. Section 5 of this EIS provides a summary of the Proposal's consistency with Section 79C of the EP&A Act, which is reproduced in Table 23-1.

Table 23-1: Compliance with matters for consideration (Section 79 of the EP&A Act)

Section 79C(a)	Matter for consideration	Comments
a)	Relevant legislation, plans and policy	A detailed assessment of the Proposal having regard to relevant Acts (Federal and state), EPIs and planning policies has been provided within this EIS (refer to Sections 3 and 5 of this EIS). The Proposal is consistent with state planning policy in that it facilitates for the operation of an IMT facility and associated warehousing within Moorebank, which will lead to an increase in freight rail movements across the Sydney Greater Metropolitan Area. The Proposal is generally compliant with this legislation (refer to Section 3 and 5 of this EIS) and, as relevant, includes mitigation measures to ensure compliance is met during construction and operation.
b)	Likely environmental impacts	This EIS has undertaken a detailed assessment of the potential environmental impacts associated with the construction and operation of the Proposal (refer to Sections 7- 20 of this EIS). In summary, no substantial environmental impacts have been identified for the Proposal. Further, the environmental impacts identified would be mitigated through the implementation of measures for the construction and operation of the Proposal (refer to Section 22 of this EIS).
c)	Suitability of the site for the development	The EIS prepared for the MPW Concept Approval gave consideration to the suitability of the site for the development of an IMT facility. The MPW Concept Approval is considered recognition, by state government and authorities that, subject to mitigation measures, the MPW site is considered suitable for the development of the Proposal (refer to Section 3 of this EIS). Further, as discussed above, the MPW site is considered suitable in that: ▪ It is situated in close proximity to the SSFL ▪ There is a direct intersection linking the adjacent Moorebank Avenue to the M5 Motorway ▪ It is predominantly zoned as General Industrial land (IN1) for facilitating an IMT facility and industrial warehousing ▪ Buffer zones are provided between the facility and nearby residential areas ▪ The location has also been identified in both state and federal strategies as the best, and only location for an IMT facility to service this defined catchment in South-Western Sydney. The MPW site is therefore considered suitable for the development of the Proposal.
d)	Any submissions	A number of submissions were made by stakeholders (both private and public) during the public exhibitions of the MPW Concept EIS, RtS and MPW SRtS (8 October– 8 December 2014 and 28 May – 26 June 2015). These submissions, although for previous approval, have been considered in the

Section 79C(a)	Matter for consideration	Comments
		preparation of the design and EIS for the Proposal (refer to Section 6 of this EIS). Specific consultation has also been undertaken for the Proposal with both government stakeholders and the community. The comments received during this consultation have been considered and, as relevant, addressed in this EIS. Further, the design for the Proposal has been amended to specifically respond to comments provided by stakeholders during the preparation of this EIS, as outlined in Section 6 of this EIS. Additional consultation would be undertaken throughout the assessment of the Proposal, in particular with any potential submissions received during the public exhibition of this EIS. Response to these potential submissions, subsequent to the public exhibition of the EIS, is anticipated to be provided in the form of a Response to Submissions Report and/or a Preferred Project Report if necessary.
e)	The public interest	As discussed above, this EIS has been prepared based on consultation undertaken with government authorities, service and infrastructure providers, specialist interest groups (including Local Aboriginal Land Councils - LALCs) and the public. The design of the Proposal has been amended to, where possible, address concerns raised by stakeholders and reduce the environmental impact of the Proposal on the surrounding area (refer to Section 6 of this EIS). Positive impacts are likely to be experienced at a regional level while the direct impact (both positive and negative) of the development would potentially be experienced at the local level (refer to Section 20.5 of this EIS). The Proposal is consistent with state and regional planning policies and includes a number of benefits which would be experienced as a result of the proposed freight modal shift from road to rail. The resulting positive economic effects of the Proposal would be experienced at both a local and regional level (refer to Section 3 of this EIS). This EIS includes a number of mitigation measures which would further reduce the impact of the Proposal on the surrounding built, social and natural environment (refer to Section 22 of this EIS). Overall, the construction and operation of the Proposal is considered to be in the public interest.

In summary, the Proposal complies with the matters for consideration in Section 79C and therefore is considered suitable for approval under Part 4, Division 4.1 of the EP&A Act.

23.2.4 Ecologically Sustainable Development Principles

An assessment of the Proposal's consistency with the principles of ecologically sustainable development (ESD), identified in the *Environmental Planning and Assessment Regulation* 2000 (EP&A Regs), is provided in this EIS (refer to Section 20.4 of this EIS).

A summary is provided in Table 23-2.

Table 23-2: Consistency with ESD principles (EP&A Regs)

ESD Principles	Discussion
Precautionary principle	A precautionary principle approach has been applied throughout the preparation of the design of the Proposal and all technical studies associated with the Proposal with intent to minimise environmental impacts. Subject to the implementation of mitigation measures, these specialist studies did not identify any issues that may cause serious and irreversible environmental damage as a result of the Proposal (refer to Sections 7- 20 and 22 of this EIS).
Intergenerational equity	The Proposal has been designed to benefit both existing and future generations through the provision of an IMT facility and warehousing area, which will remove significant numbers of freight vehicles from the M5 Motorway, easing congestion on this arterial road, and will reduce average delivery distances and support more efficient use of road transport. Reducing the freight traffic volume through the provision of an IMT facility would have direct and flow-on economic, social and wider environmental benefits, including but not limited to improved inter-regional access, reduced freight and transport costs for industry and businesses and job creation during construction. Overall, the design of the Proposal has incorporated the ESD principle of intergenerational equity through ensuring that the IMT facility and warehousing area can be constructed and operated sustainably to ensure that there is no significant on-going impacts on the surrounding community and future generations.
Conservation of biological diversity and ecological integrity	A comprehensive assessment of the existing local environment at the Proposal site has been undertaken to recognise any potential impacts of the Proposal on local biodiversity. A detailed biodiversity assessment, and associated proposed mitigation measures have been outlined in Section 11 and Appendix Q of this EIS. A key element of this mitigation includes the preparation of on-going management plans and areas for biodiversity offset which would contribute to the conservation of the biological diversity and ecological integrity of the surrounding area.
Improved valuation, pricing and incentive mechanisms	While it is often difficult to place a reliable monetary value on the residual, environmental and social effects of the Proposal, the value placed on environmental resources within and around the Proposal is evident in the extent of environmental investigations, planning and design of impact and mitigation measures undertaken to inform assessments and to minimise, if not prevent, adverse

ESD Principles	Discussion
	environmental impacts during construction and operation of the Proposal. The Proposal has undertaken specific studies, namely Best Practice Reviews (Sections 8 and 9, and Appendices N and O of this EIS), a greenhouse gas assessment (Section 18 of this EIS), and a biodiversity assessment (Section 11 and Appendix Q) which aim to identify the value of environmental impacts associated with the Proposal and implement mitigation measures to reduce these impacts.

In summary, the Proposal is consistent with the principles of ecologically sustainable development, within the EP&A Regs.

23.3 Conclusion

The Proposal, identified as a State Significant Development, has been subject to an EIS in accordance with the *Environmental Planning and Assessment Act* 1979 and the SEARs. The potential environmental, social and economic impacts, both direct and cumulative, have been identified and thoroughly assessed as part of this EIS. No significant environmental impacts have been identified by the Proposal in preparing the EIS. The environmental impacts identified would be mitigated through the implementation of measures for the construction and operation of the Proposal (refer to Section 22 of this EIS).

The Proposal has been assessed against, and has been found to be consistent with, the priorities and targets adopted in relevant draft and published State plans, as well as Government policies and strategies. The Proposal provides regional benefits through the removal of freight trucks from the M5 Motorway, easing congestion on this arterial road, and by reducing average delivery distances and supporting more efficient use of road transport. It would provide capacity for an annual throughput of up to 500,000 TEU to meet the short-term demand for Western and South Western Sydney and make a significant contribution to achieving Federal and State land use, freight and logistics policies.

The Proposal meets the SEARs and is considered consistent with the MPW Concept Approval and EPBC Approval. The Proposal also complies with Section 79C of the EP&A Act and is consistent with the principles of ecologically sustainable development.

Overall the EIS concludes that the development proposed is in the public interest and approval is recommended.

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