Liddell Battery and Bayswater Ancillary Works Project

Appendix C – Traffic and Transport Assessment

Liddell Battery and Bayswater Ancillary Works Project

Traffic and Transport Assessment

| Final

February 2021

AGL Macquarie Pty Ltd

Contents

1. Introduction

1.1 Project background

AGL Macquarie Pty Limited (**AGLM**) own and operates Bayswater Power Stations (**Bayswater**), Liddell Power Stations (**Liddell**), and the Hunter Valley Gas Turbines and associated ancillary infrastructure systems that operate to produce around 23,000 gigawatt hours (**GWh**) annually, or approximately 35 per cent (**%**) of New South Wales' (**NSW**) electricity supply.

AGLM is seeking approval for the Liddell Battery and Bayswater Ancillary Works Project (**the Project**). As a State Significant Development (**SSD**) under the *State Environmental Planning Policy (State and Regional Development) 2011* (**SEPP SRD**) the Project is subject to Part 4, Division 4.7 of the *Environmental Planning and Assessment Act 1979* (**EP&A Act**) which requires the preparation of Environmental Impact Statement (**EIS**) in accordance with Secretary's Environmental Assessment Requirements (**SEARs**).

This traffic and transport assessment has been developed in support of the EIS for the Project.

1.2 Purpose of this report

This traffic and transport assessment has been prepared in accordance with the SEARs issued for the Project on 29 September 2020, by the Planning Secretary of the NSW Department of Planning, Industry and Environment (**DPIE**).

The SEARs relevant to traffic and transport assessment are summarised in **Table 1-1**, along with a reference to where these requirements have been addressed.

Table 1-1 SEARS – Traffic and transport

Environmental Assessment Requirement	Where addressed
Details of traffic types and volumes likely to be generated by the Project	**Section 4.1**
Details of the proposed transport routes, site access, safety issues and requirements for road works or upgrade	**Section 4.1.5** **Section 4.5** **Section 1**
An assessment of the likely impacts of the Project on the capacity, condition, safety and efficiency of the road network, in particular heavy vehicles and oversize/over-mass vehicles	**Section 4.3** **Section 4.4** **Section 4.5**
Details of measures to mitigate and/or manage potential impacts during construction, developed in consultation with the relevant road and rail authorities (if required)	**Section 5**

1.3 Project location

Liddell and Bayswater are located approximately 15 kilometres (**km**) south-east of Muswellbrook, 25 km north-west of Singleton and approximately 165 km north-west of Sydney in NSW (shown in **Figure 1-1)**. The total area of the AGLM landholding is approximately 10,000 hectares (**ha**), including the Ravensworth rehabilitation area, Lake Liddell and surrounding buffer lands.

The Project is located within an area dominated by mining and power generation. The landscape local to Liddell and Bayswater is heavily influenced by industrial activity. Local land use is dominated by large-scale infrastructure associated with Bayswater and Liddell and open cut mining activities at Ravensworth Mine Complex, Mount Arthur Coal, Hunter Valley Operations, Liddell Coal Mine and the former Drayton Mine.

Agricultural clearing for the purposes of grazing is also present within and surrounding the AGLM landholding.

The nearest residential receiver is the Lake Liddell Recreation Area's owner's residence, located approximately 2.5 km north of the Liddell Battery (**the Battery**) and Decoupling areas. While the nearest sensitive receiver to the Bayswater Ancillary Works (**BAW**) footprint is along at Jerrys Plains, approximately 700 metres (**m**) to the south of the Project.

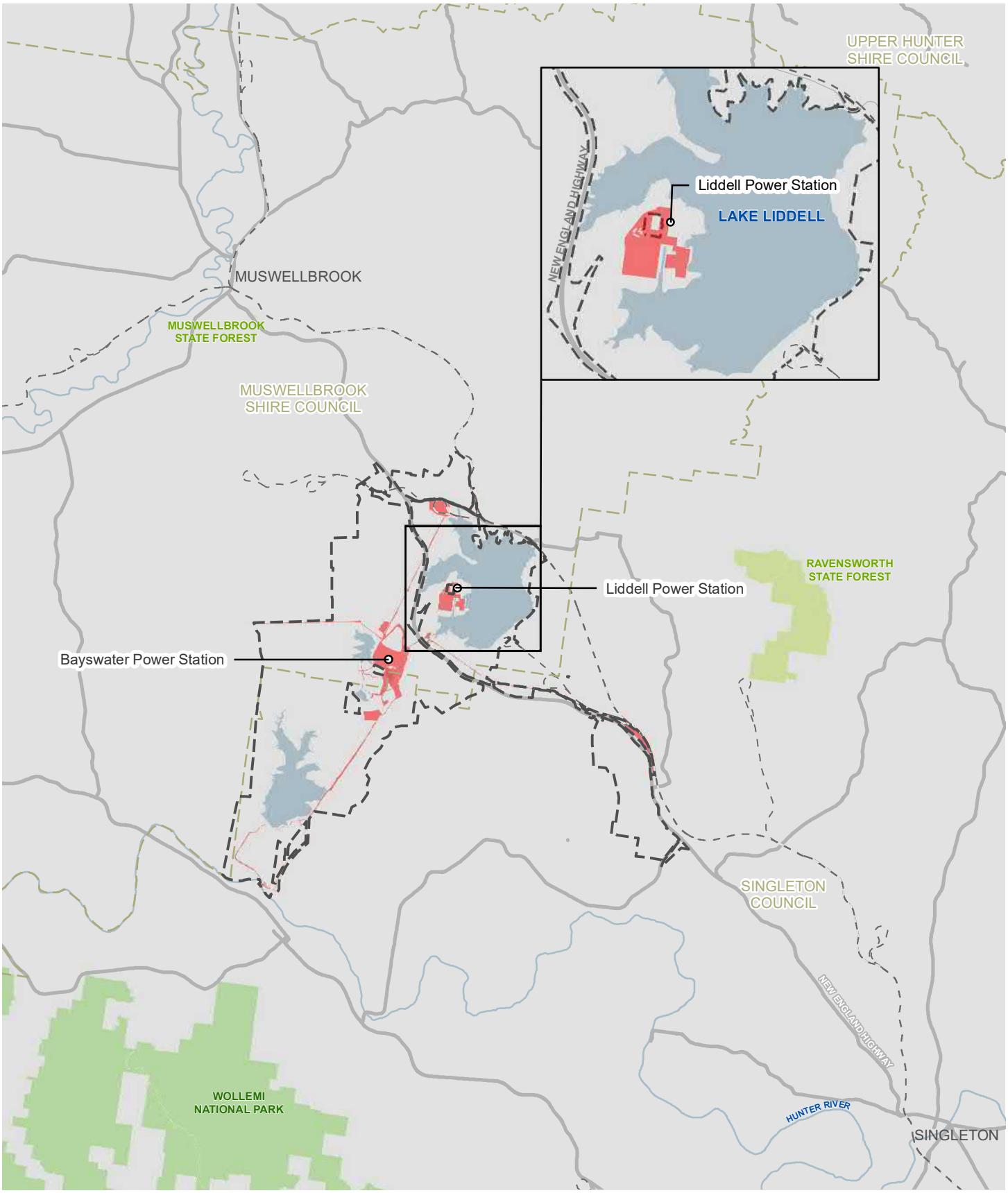
The New England Highway runs between Liddell and Bayswater, with access from the highway provided by means of a dedicated road interchange designed to service the power stations. The Northern Railway Line runs to the east of the AGLM landholding.

The majority of the AGLM landholding has been previously disturbed during the construction and operation of Liddell and Bayswater.

1.4 Report structure

The report structure is as follows:

- **Section 2** defines the existing conditions and access arrangements
- **Section 3** provides a description of the proposed works
- **Section 4** describes the expected traffic generation and assesses the impact of the proposed works
- **Section 5** outlines the proposed mitigation and management measures
- **Section 6** summarises the study findings and recommendations.



Legend

- Project area
- AGL owned land
- LGA boundary
- Railway
- Road
- Waterway
- Waterbody
- State forest
- National park

0 5 10 km

1:200,000 at A4

N

Data sources

Jacobs 2020
©Department of Finance, Service and Innovation Aug 2020
AGL 2019
GDA94 MGA56

Figure 1-1 Project location

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2. Project description

2.1 Project overview

AGLM are progressing plans to facilitate the efficient, safe and reliable continuation of electricity generating works from Bayswater and Liddell. The Project would consist of the following:

- **The Battery**: A grid connected Battery Energy Storage System with capacity of up to 500 megawatt (**MW**) and 2 GWh
- **Decoupling works**: Alternative network connection arrangements for the Liddell 33 kilovolt (**kV**) switching station that provides electricity to infrastructure required for the ongoing operation of Bayswater and associated ancillary infrastructure and potential third-party industrial energy users
- **Bayswater Ancillary Works** (BAW): Works associated with Bayswater which may include upgrades to ancillary infrastructure such as pumps, pipelines, conveyor systems, roads and assets to enable maintenance, repairs, replacement or expansion
- **Consolidated consents:** A modern consolidated consent for the continued operation of Bayswater through the voluntary surrender and consolidation into this application of various existing development approvals required for the ongoing operation of AGLM assets.

Construction works associated with the Battery and Decoupling would likely involve the following:

- Installation and maintenance of environmental controls including temporary and permanent water management infrastructure
- Establishment of a new access from the existing Liddell access road
- Establishment of a hardstand pad and construction laydown areas
- Cut and fill to Battery compound, transformer compounds, footings and construction laydown area
- Trenching and installation of cable from the Battery to 330 kV/33 kV transformer compounds
- Structural works to support Battery enclosures, inverters, transformers, buildings and transformer compounds
- Delivery, installation and electrical fit-out of the Battery
- Delivery installation and fit out of transformers and ancillary equipment for Decoupling works
- Testing and commissioning activities
- Removal of construction equipment and rehabilitation of construction areas.

The key components of the Project are shown on **Figure 2-1**, respectively. A detailed description of the Project and each component is provided in Chapter 2 of the EIS.

2.2 Construction program

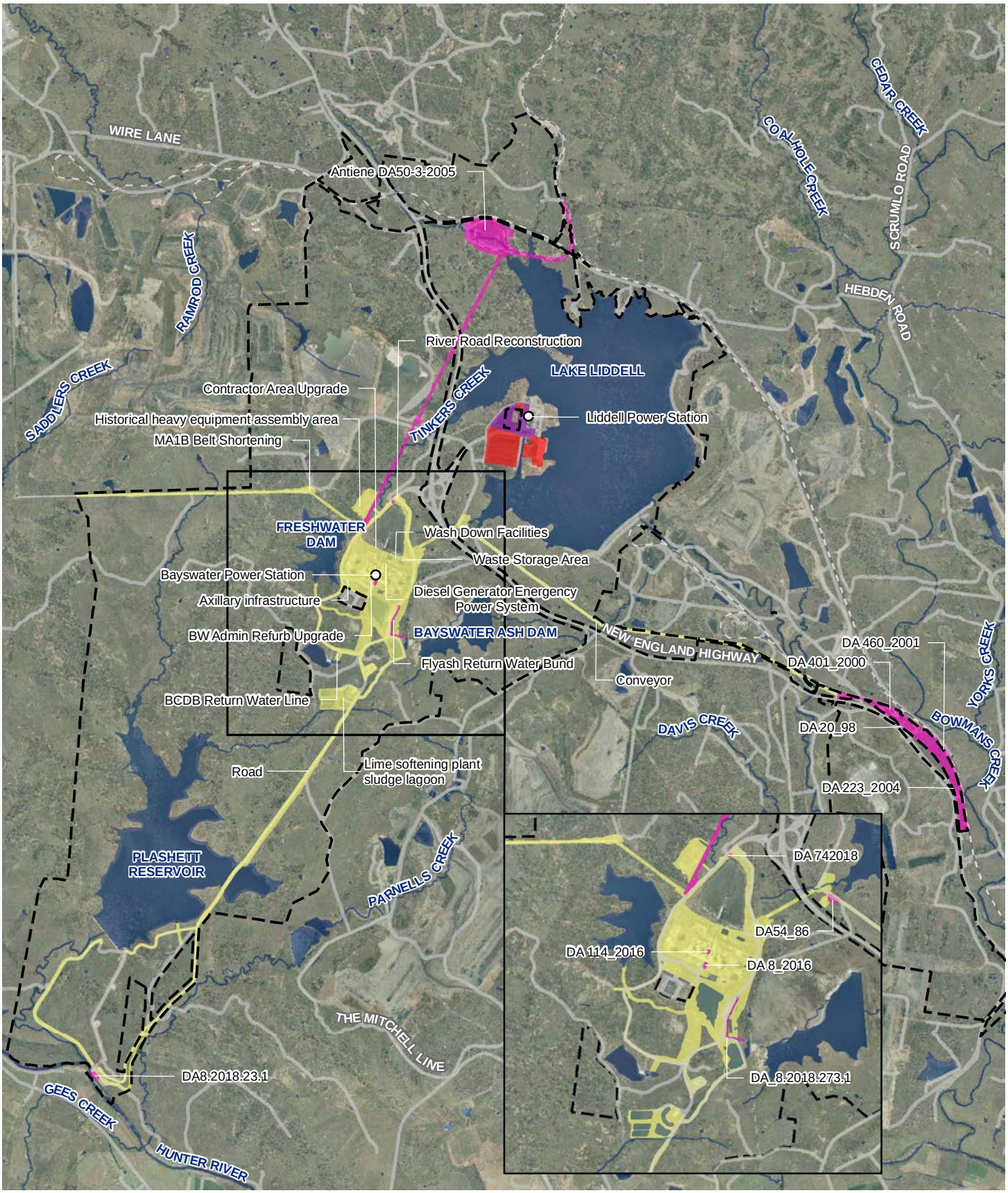
The development of the Battery may be staged to respond to market demand. AGLM anticipates the construction occurring over multiple stages. These stages could potentially be:

- Stage 1 consisting of 150 MW and 150 MWh targeting construction commencement in 2021
- Stage 2 consisting of 150 MW and 150 MWh targeting construction commencement in 2023
- Stage 3 consisting of 200 MW and up to 1700 MWh targeting construction in 2025 with storage capacity being added in response to the needs of the National Energy Market (**NEM**).

The construction of each Battery stage is anticipated to take up to 12 months consisting of the civil works component, mechanical and structural component, electrical works and testing and commissioning. Stage 3 may be further divided into smaller stages subject to market demand and be delivered on a progressive basis.

The Decoupling works are proposed to be undertaken prior to 2024, to facilitate the planned closure and decommissioning of Liddell. Decoupling works are anticipated to take up to 12 months.

The BAW component would be undertaken at any time up to the planned retirement of Bayswater. For the traffic and transport assessment purposes, a reasonable worst-case assumption has been made that a number of BAW components could occur at one time and coincide with the worst case traffic generation for the Battery, Decoupling and ongoing and currently anticipated works outside of the Project.



Legend

Project area:

- Bayswater Ancillary Works
- Battery energy storage system
- Decoupling area
- Consolidated consent
- AGL owned land

- Railway
- Road
- Waterway
- Waterbody

0 2 4km

1:90,000 at A4

Data sources

Jacobs 2021
AGL 2020
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Imagery:
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Figure 2-1 Project overview

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3. Existing conditions

3.1 Road network and access

The AGLM landholding is connected to the surrounding road network via an access road and grade-separated interchange to and from the New England Highway, as shown in **Figure 3-1**. The key surrounding roads are:

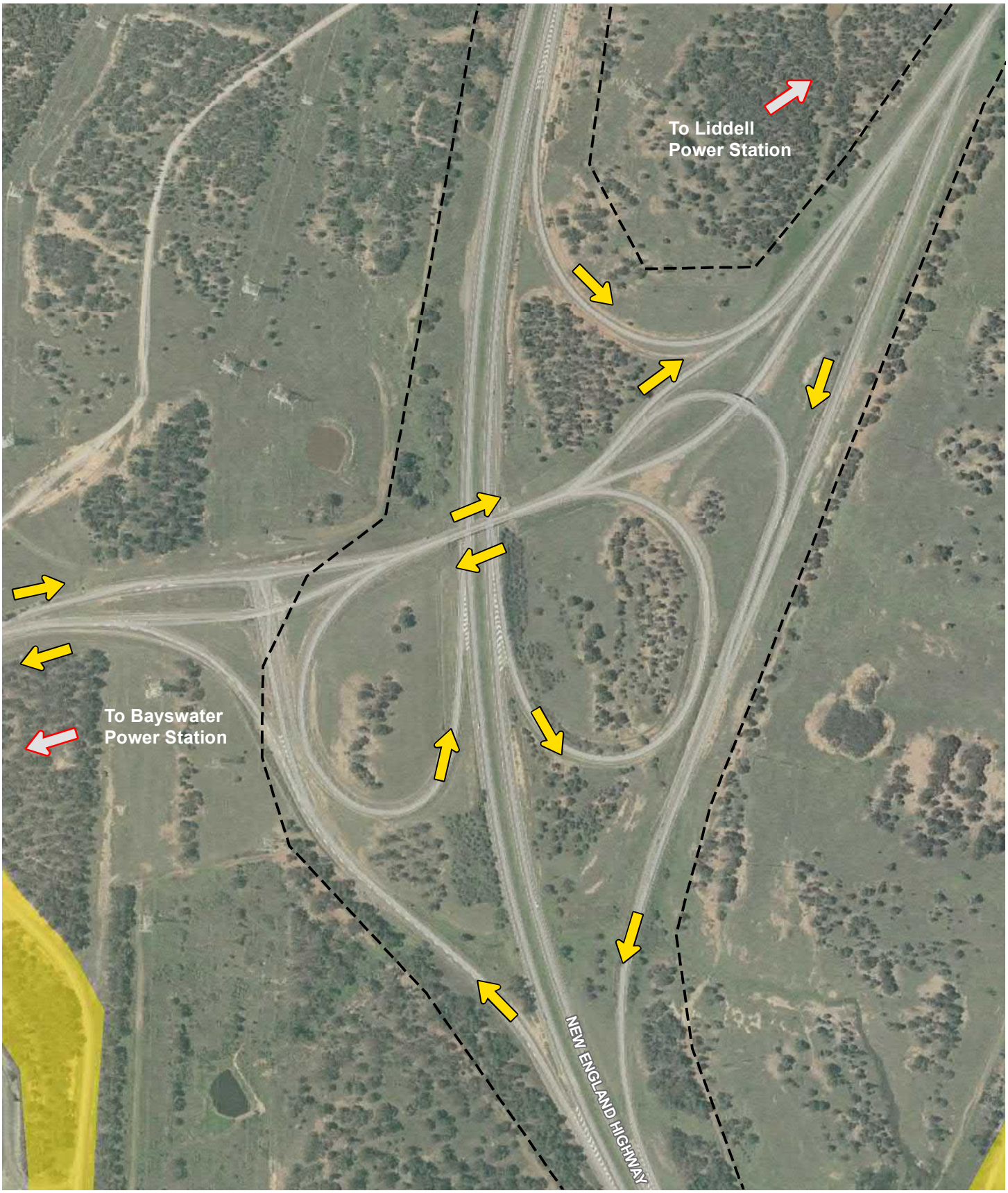
- **New England Highway –** The New England Highway is an 878 km highway that links Newcastle to Brisbane. The highway also provides connections with the Pacific Highway and the D'Aguilar Highway, facilitating access to Sydney and Queensland, respectively. Near the Project site, the New England Highway is dual carriageway with two lanes in each direction and a central median. The posted speed limit is 100 kilometres per hour (**km/h**) in the section of road near the power stations.
- **Liddell and Bayswater Interchange and Access Road** – Liddell and Bayswater are accessible from the New England Highway via an interchange with an unnamed east-west access road. The interchange consists of one northbound entry ramp, one northbound exit ramp, one southbound entry ramp and two southbound exit ramps which generally provide grade-separated access to Liddell and Bayswater. The access road is a single carriageway road with one lane in each direction. The road has no sign posted speed limit; therefore, the speed limit defaults to the rural default speed limit of 100 km/h (NSW Government, 2014).

Between the Project site and Port of Newcastle, the road network also consists of a number of motorways and state roads including Maitland Road, John Renshaw Drive and Hunter Expressway. These roads carry moderate volumes of traffic, including heavy vehicles from Port of Newcastle throughout the Hunter Region, and form part of the approved 25/26m B-double network and oversized overmass (**OSOM**) load carrying vehicle networks.

No public transport services operate on the road network near the Project. No formal off-road pedestrian or cycling facilities are provided on the road network near the Project.

3.2 Heavy vehicle access routes

The approved 25/26m B-double routes in the vicinity of the Project are shown in **Figure 3-2** and include the New England Highway and the east-west access road.



Legend

Project area

Bayswater Ancillary Works

AGL owned land

0 100 200m

1:5,000 at A4

N

Data sources

Jacobs 2020
© Department Finance, Services and Innovation 2019
AGL 2019

Aerial:
© Department of Customer Service 2020

GDA94 MGA56

Figure 3-1 Liddell and Bayswater interchange with the New England Highway

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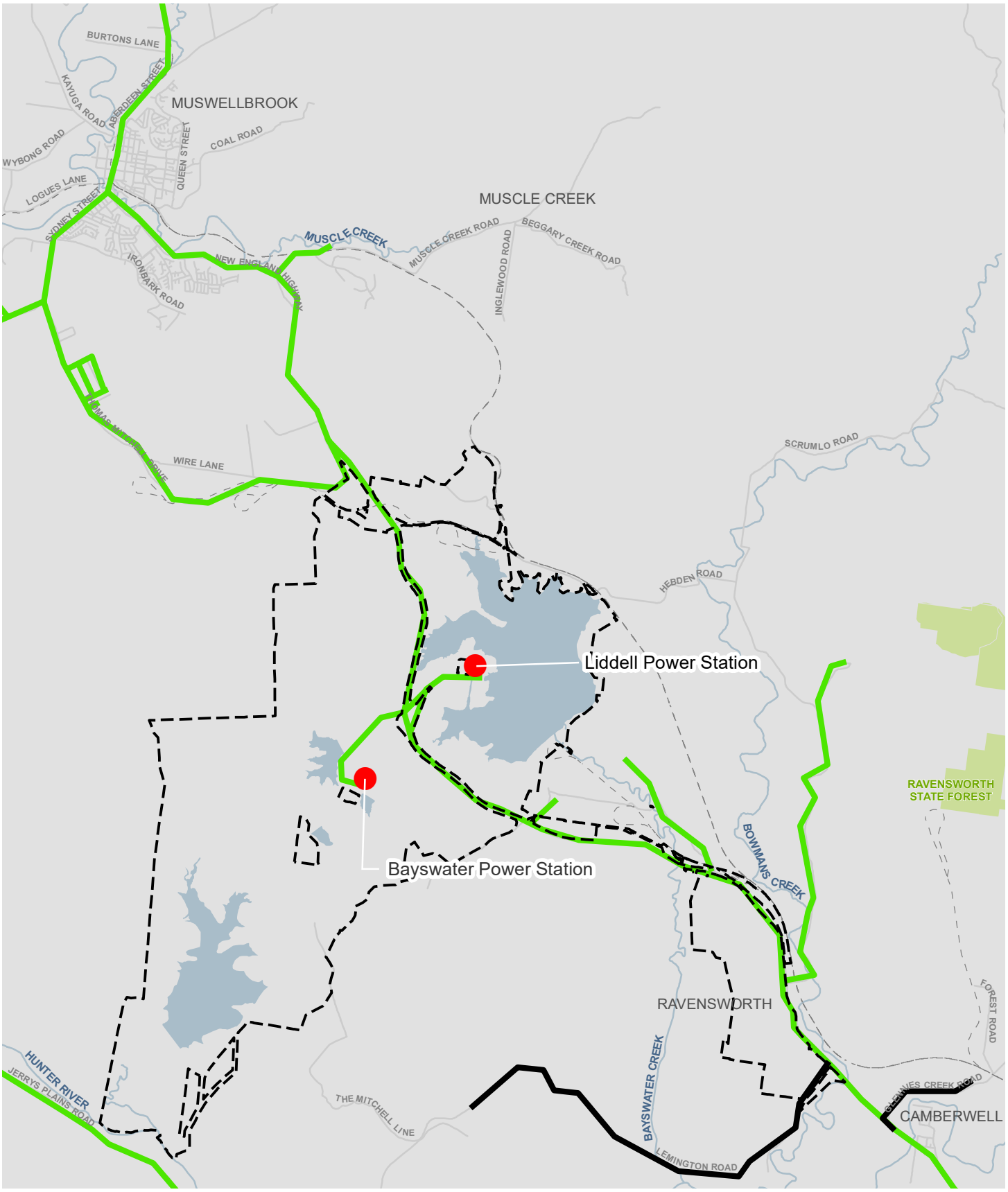

Legend

- Project site
- AGL owned land
- 25/26m B-double routes
- Approved routes with travel conditions
- Railway
- Road
- Waterway
- Waterbody
- State Forest
- National Park

0 2.5 5 km

1:125,000 at A4

N

Data sources

Jacobs 2020
NSW Spatial Services 2019
Transport for New South Wales 2020

GDA94 MGA56

Figure 3-2 25/26m B-double routes

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3.3 Traffic volumes and generation

3.3.1 New England Highway

Classified traffic volumes for the New England Highway were obtained from the Transport for NSW (TfNSW) permanent count station (ID 6153) located to the south of the Project, approximately 200 m north of Rix's Creek Lane, Rix's Creek. The average annual weekday traffic volumes are shown in **Table 3-1**.

Table 3-1: Average annual weekday total traffic volumes

	2018	2019	2020
Northbound	6,936	7,152	6,789
Southbound	7,138	7,360	6,986
Total	14,074	14,512	13,775

Source: TfNSW Traffic Volume Viewer (November 2020)

In 2019, the average weekday traffic volumes were approximately 14,500 vehicles per day with 24 % of this volume being heavy vehicles. The hourly traffic volume profile for an average weekday in 2019 is shown in **Figure 3-3**. The data indicates that peak traffic hours occurred in the hours starting 5:00am and 5:00pm for the morning and evening peaks respectively.

A breakdown of the peak hour trips is shown in **Table 3-2**.

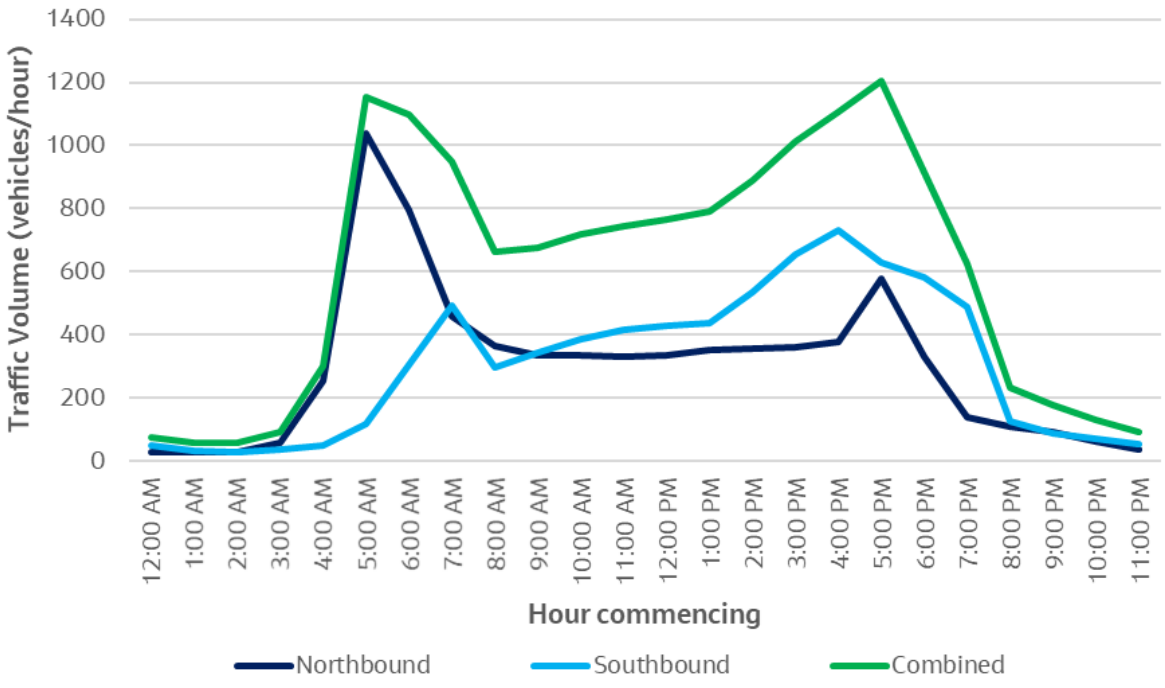


Figure 3-3: Hourly traffic volumes (2019) average weekday

Source: TfNSW Traffic Volume Viewer (November 2020)

Table 3-2: Peak hour traffic volumes on the New England Highway (2019)

	Morning peak hour 5:00am – 6:00am	Evening peak hour 5:00pm – 6:00pm
Northbound	1,037	576
Southbound	118	630
Total	**1,155**	**1,206**

Source: TfNSW Traffic Volume Viewer (November 2020)

3.3.2 Interchange and access road

Traffic volumes for the Liddell and Bayswater interchange and access road were obtained from traffic surveys which were undertaken on Tuesday 22 May 2018. At this time, Bayswater was operating during its annual maintenance shutdown period where an additional 400 staff were on site. It has been conservatively assumed for the purposes of this assessment that the recorded traffic volumes are indicative of typical operations at Bayswater. In addition, consultation with AGLM identified that typical staff numbers at Liddell increased between 2018 and 2020 to approximately 560 staff in 2020. Therefore, the 2018 traffic surveys were scaled up to match Liddell staff traffic generation in 2020.

At the interchange, the morning peak hour was 6:00am – 7:00am and the evening peak hour was 5:30pm – 6:30pm. **Figure 3-4** to **Figure 3-6** show the daily traffic, morning peak hour and evening peak hour traffic volumes, respectively. The majority of the traffic generated by the site travels to and from the south, with only a small volume of traffic travelling between Bayswater and Liddell.

Heavy vehicle volumes at the interchange make up between 5 and 10 % of the total volume of traffic.

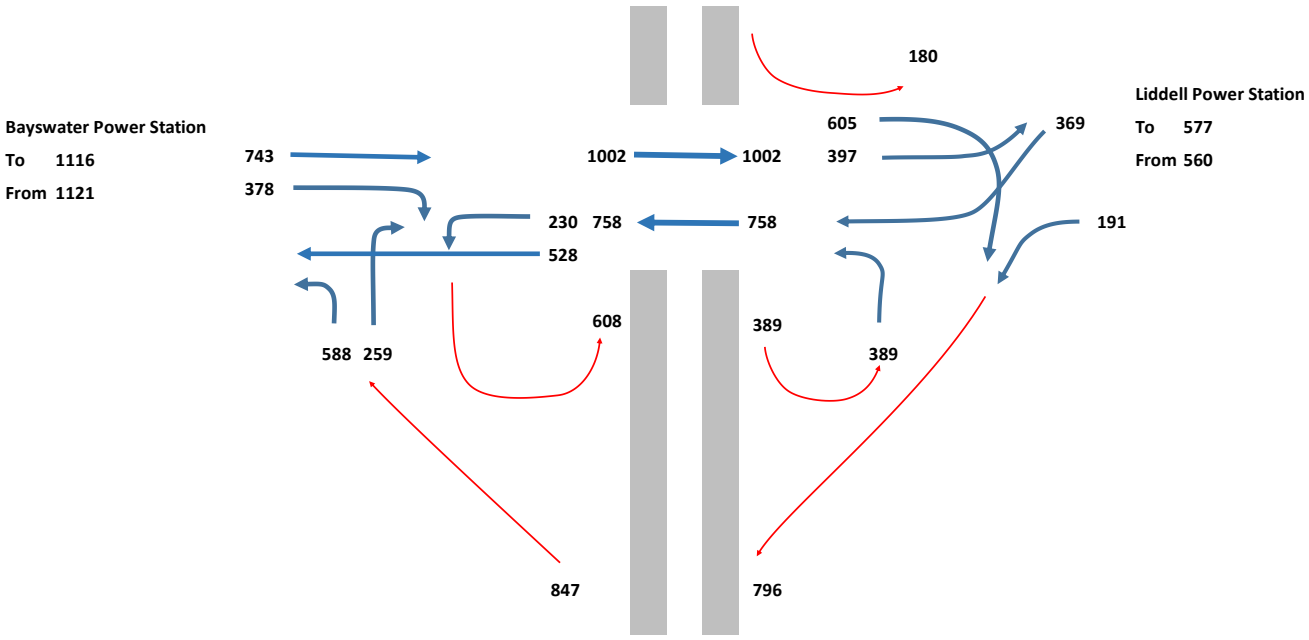


Figure 3-4: Liddell and Bayswater access road daily traffic volumes

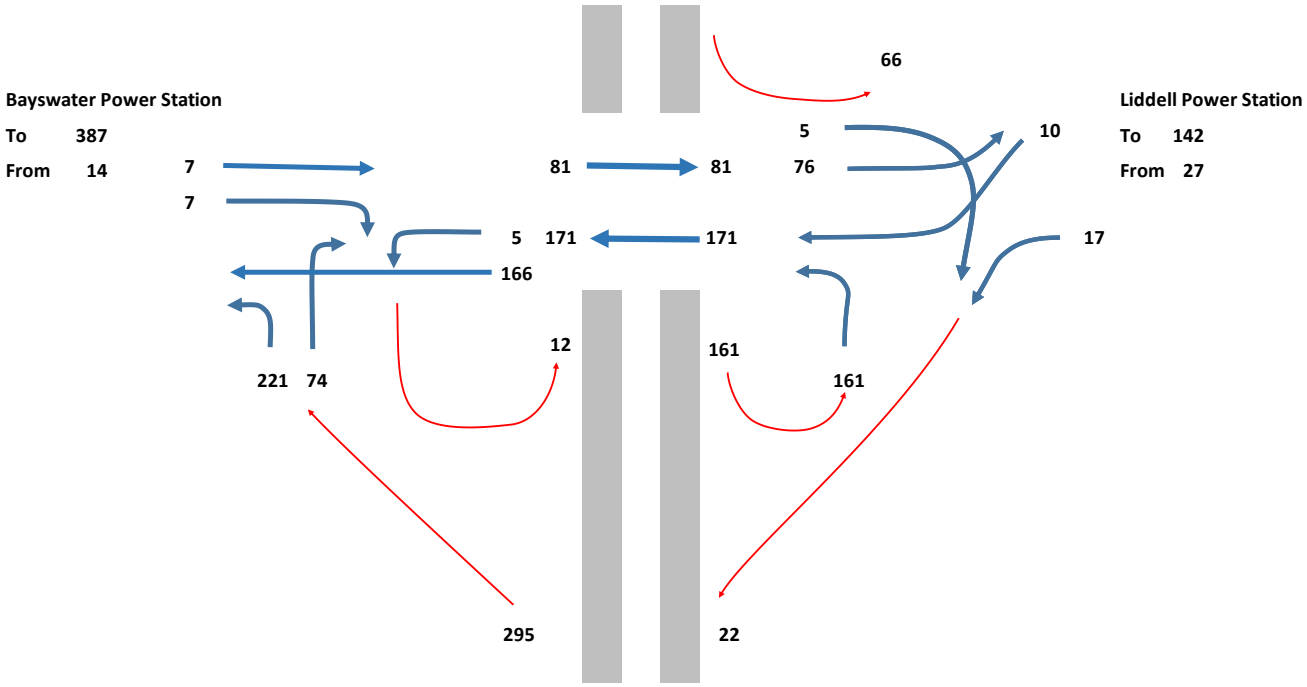


Figure 3-5: Liddell and Bayswater access road morning peak hour traffic volumes (6:00am - 7:00am)

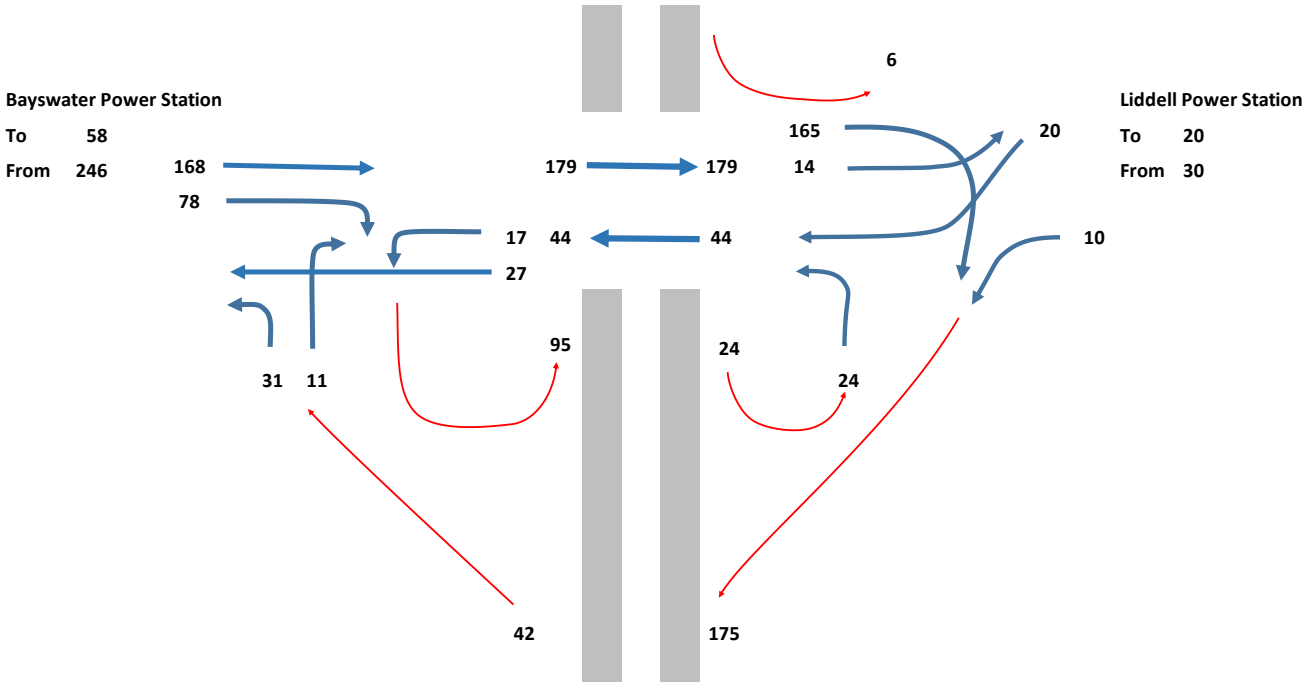


Figure 3-6: Liddell and Bayswater access road evening peak hour traffic volumes (5:30pm - 6:30pm)

The existing traffic generated by Liddell and Bayswater during the morning and evening peak hours is summarised in **Table 3-3**.

Table 3-3: Existing traffic generation

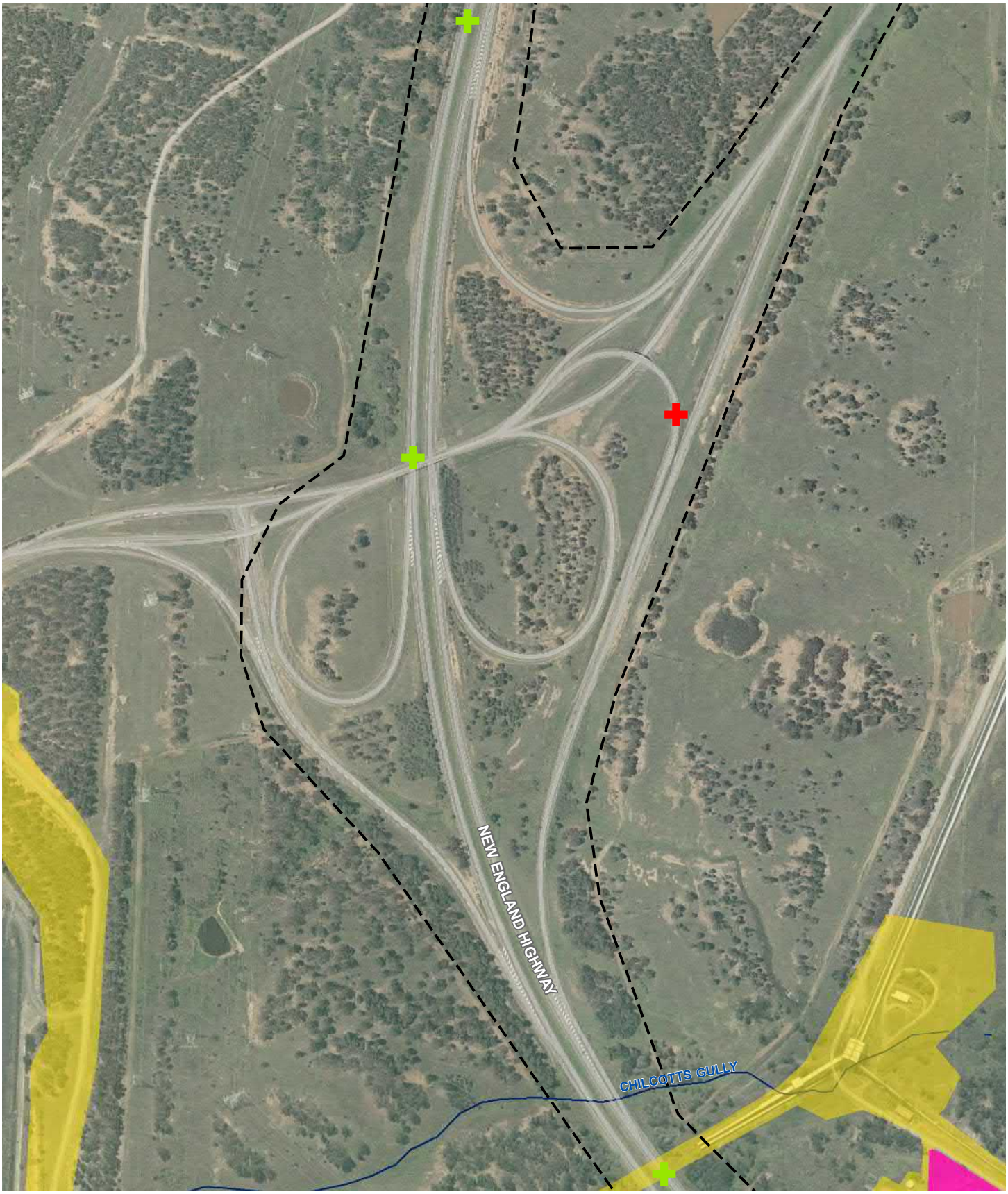
Period	Liddell		Bayswater		
	To the site (vehicles)	From the site (vehicles)	To the site (vehicles)	From the site (vehicles)	Total
Daily	577	560	1,116	1,121	3,374
Morning peak hour (6:00am – 7:00am)	142	27	387	14	570
Evening peak hour (5:30pm – 6:30pm)	20	30	58	246	354

3.4 Crash history

Crash data was provided by TfNSW for NSW in November 2020 for the most recent full five-year period of available data from January 2015 to December 2019. During this period, four crashes occurred near the site and are shown in **Figure 3-7**.

Key findings include:

- Three crashes occurred on the New England Highway and one crash occurred at the interchange
- The most common crash type, with two crashes, involved striking a kangaroo or straying stock
- Two crashes occurred in darkness and while raining.



Legend

Project area
- Bayswater Ancillary Works
- Consolidated consents
- AGL owned land
- Waterway

Crash location and type
- Moderate Injury
- Non-casualty (towaway)

0 100 200m

1:6,000 at A4

N

Data sources
Jacobs 2020
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AGL 2019
Transport for New South Wales 2020

Aerial:
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Figure 3-7 Five-year crash history at the Liddell and Bayswater interchange

4. Traffic impact assessment

4.1 Traffic generation and distribution of the Project

4.1.1 Construction working hours

The majority of works would be undertaken during the standard construction hours shown below:

- Monday to Friday 7:00am – 6:00pm
- Saturday 8:00am – 1:00pm
- No Sunday or public holiday work.

Traffic generated by the Project was confirmed in consultation with AGLM in November 2020 and would involve transportation of personnel, plant, equipment and materials. As a worst-case scenario, it is assumed that all light vehicle movements would occur within one hour before shift start and one hour after shift end. The majority of heavy traffic movements would occur between 6:00am to 7:00pm. It is assumed that heavy vehicle movements would be distributed evenly throughout the day across standard construction hours.

4.1.2 Liddell Battery

Between the commencement of the Project and 2023, Stage 1 and 2 construction of the Battery would include an additional 100 workers travelling to Liddell, generating an expected 100 two-way light vehicle movements per day (i.e. 100 inbound movements and 100 outbound movements). Furthermore, an additional 20 two-way heavy vehicle movements are expected to be generated per day.

Between 2024 and 2026, Stage 3 construction of the Liddell Battery would also include an additional 100 workers travelling to Liddell, generating an expected 100 two-way light vehicle movements per day. Furthermore, an additional 20 two-way heavy vehicle movements are expected to be generated per day.

4.1.3 Decoupling Works

Between the commencement of the Project and 2023, Decoupling works would include an additional 50 workers travelling to Liddell, generating an expected 50 two-way light vehicle movements per day. Furthermore, an additional 10 two-way heavy vehicle movements are expected to be generated per day.

4.1.4 Bayswater Ancillary Works

The BAW would include an additional 100 workers travelling to Bayswater, generating an expected 100 two-way light vehicle movements per day. Furthermore, an additional 50 two-way heavy vehicle movements are expected to be generated per day.

Construction traffic generation associated with the BAW has been assumed to occur between commencement of the Project and 2035 as a worst-case scenario. In reality, construction is not expected to occur for the entirety of this period.

4.1.5 Traffic distribution

The traffic distribution of vehicles generated by the Project is assumed to be similar to the existing proportion of vehicles travelling to the site each day. As shown in **Figure 3-4**, 847 vehicles (approximately 60 %) accessed the site from the south and 569 vehicles (approximately 40 %) accessed the site from the north. All light and heavy vehicles would travel to the Project site via the New England Highway and the Liddell and Bayswater interchange.

4.2 Nearby concurrent developments

Several developments near Bayswater and Liddell would operate concurrently with the various stages of the Project. The traffic generation associated with these developments has been considered cumulatively alongside the Project in the traffic impact assessment.

As with the Project, as a worst-case scenario, it is assumed that all light vehicle movements would occur within one hour before shift start and one hour after shift end. The majority of heavy traffic movements would occur between 6:00am to 7:00pm. It is assumed that heavy vehicle movements would be distributed evenly throughout the day across standard construction hours.

The general activities, location, timing, duration and traffic generation of these developments are described below.

4.2.1 Bayswater Water and Other Associated Operational Works Project

The Bayswater Water and Other Associated Operational Works Project (Bayswater WOAOW) includes a range of upgrades to Bayswater aimed at improving the environmental performance of ash, salt and water management infrastructure and associated rehabilitation outcomes. Traffic generation associated with construction and operation of Bayswater WOAOW has been assumed to occur concurrently between 2021 and 2035 as a worst-case scenario. In reality, construction and operation are not expected to occur concurrently. Traffic generation associated with decommissioning and rehabilitation is expected to occur from 2035 to up to 2040.

4.2.1.1 Construction

During peak construction, Bayswater WOAOW would provide employment for up to 90 workers, generating an expected 90 two-way light vehicle movements per day to Bayswater. Furthermore, an additional 25 two-way heavy vehicle movements are expected to be generated per day. The traffic distribution of heavy vehicles associated with Bayswater WOAOW construction works is expected to be to and from the south.

As per the *Bayswater Water and Other Associated Operational Works Project Appendix J – Traffic and Transport Assessment report* (AGLM, 2019), these volumes are conservative as it assumes that construction of all project elements would be undertaken concurrently. Construction works are expected to be staged, which would result in a reduction of cumulative construction-related traffic impacts.

4.2.1.2 Operation

During operation of Bayswater WOAOW, an additional 25 operational personnel are expected at Bayswater. Personnel are expected to travel to and from Bayswater using personal light vehicles, generating approximately 25 two-way light vehicle movements per day. Furthermore, an additional 180 two-way heavy vehicle movements are expected to be generated per day for the transportation of ash. The traffic distribution of heavy vehicles associated with Bayswater WOAOW operation works is assumed to be 40 % and 60 % to and from the north and south, respectively.

4.2.1.3 Decommissioning and rehabilitation

During decommissioning and rehabilitation, delivery of materials would be required from the Ravensworth Composting Facility for the remediation of the proposed Ash Dam at Bayswater. It is estimated that approximately 15 two-way heavy vehicle movements per day would be required from 2035 until rehabilitation works are completed (up to 2040).

In addition, there would be up to 15 two-way heavy vehicle movements a day associated with the delivery of over 150,000 tonnes of organics required for progressive rehabilitation works of other elements of Bayswater WOAOW. These progressive works would continue over the life of the Project from 2021 until the

rehabilitation works are completed in 2040. For the purposes of this assessment it is assumed that these progressive works would occur concurrently with rehabilitation works between 2035 and 2040 as a worst-case scenario. However, in reality, these works may not occur simultaneously.

The traffic distribution of heavy vehicles associated with Bayswater WOAOW decommissioning and rehabilitation works is expected to be to and from the south.

4.2.2 Bayswater Turbine Efficiency Upgrade

The Bayswater Turbine Efficiency Upgrade involves the replacement of four turbines over a four-year period commencing in 2019. One turbine will be replaced per year with works over 50 days per year. These works commenced in August 2019 and are expected to be undertaken during the annual shut down periods of Bayswater. During the upgrade, the following traffic generation and distribution is expected:

- Seventy light vehicles arriving and leaving Bayswater during the morning and evening peak hours, respectively. This will generate 70 two-way traffic movements per day. As discussed in **Section 4.1.5**, 40 % and 60 % of these vehicles are assumed to travel to and from the north and south, respectively
- An assumed five heavy vehicles arriving and leaving Bayswater during the morning and evening peak hours. These vehicles are assumed to travel to and from the south
- Ten over-sized and over-mass deliveries to and from Newcastle Port to Bayswater during the off-peak period. These vehicles are assumed to travel to and from the south.

4.2.3 Ravensworth Composting Facility

AGLM currently host the Ravensworth Composting Facilities. These facilities are located at Ravensworth and supply composted materials to AGLM lands in addition to off-site third parties. The facilities process up to a combined 126,000 tonnes of compost materials a year. Vehicle movements associated with the ongoing operation of these facilities are approved under the development consents for the facilities (DA140/2016 and DA173/2016).

Composted material is transferred to other AGLM sites, including the Liddell Ash Dam. The facilities are is approved for a maximum allowable 35 two-way heavy vehicle movements per day from the Ravensworth Composting Facility, south of the site.

4.2.4 Liddell Power Station closure and rehabilitation

Liddell is expected to commence closure works in April 2023. The expected heavy vehicle traffic generation during closure works is 50 to 100 two-way heavy vehicle movements per day for approximately two years.

Rehabilitation works will be dependent on the proposed future land use of the site and is yet to be agreed upon. Rehabilitation works are expected to generate 35 two-way heavy vehicle movements per day for approximately two years following completion of closure works.

The traffic distribution of heavy vehicles associated with the Liddell closure and rehabilitation works is expected to be to and from Ravensworth, south of the site.

4.2.5 Liddell minor shutdowns

Minor maintenance shutdowns at Liddell are required over a three-week period each year. During this period, an additional 250 workers are expected to travel to and from Liddell, generating an expected 250 two-way light vehicle movements per day.

4.2.6 Cumulative additional traffic generation

The cumulative traffic generation, in passenger car units (**pcu**), of the Project and nearby developments is shown in **Figure 4-1**. It is noted that this assessment is conservative as it assumes that the Project and nearby developments in a given year would all occur concurrently.

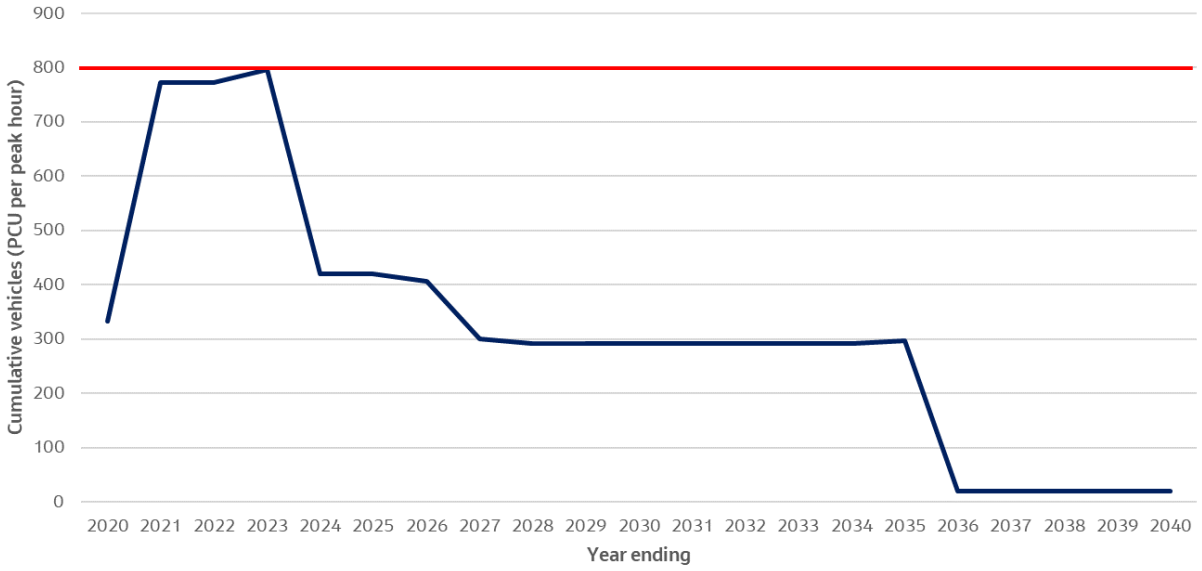


Figure 4-1 Cumulative traffic generation of the Project and nearby developments[1]

Based on a peak of 796 pcu in 2023, the expected cumulative traffic generation of the Project and nearby developments in 2023 is:

- 285 light vehicles and 28 heavy vehicles to or from Bayswater during the morning and evening peak hour, respectively
- 400 light vehicles and 19 heavy vehicles to or from Liddell during the morning and evening peak hour, respectively.

The distribution of light and heavy vehicles is shown in **Figure 4-2** and **Figure 4-3.**

[1] A pcu factor of 2.4 has been assumed to convert heavy vehicles to passenger car units

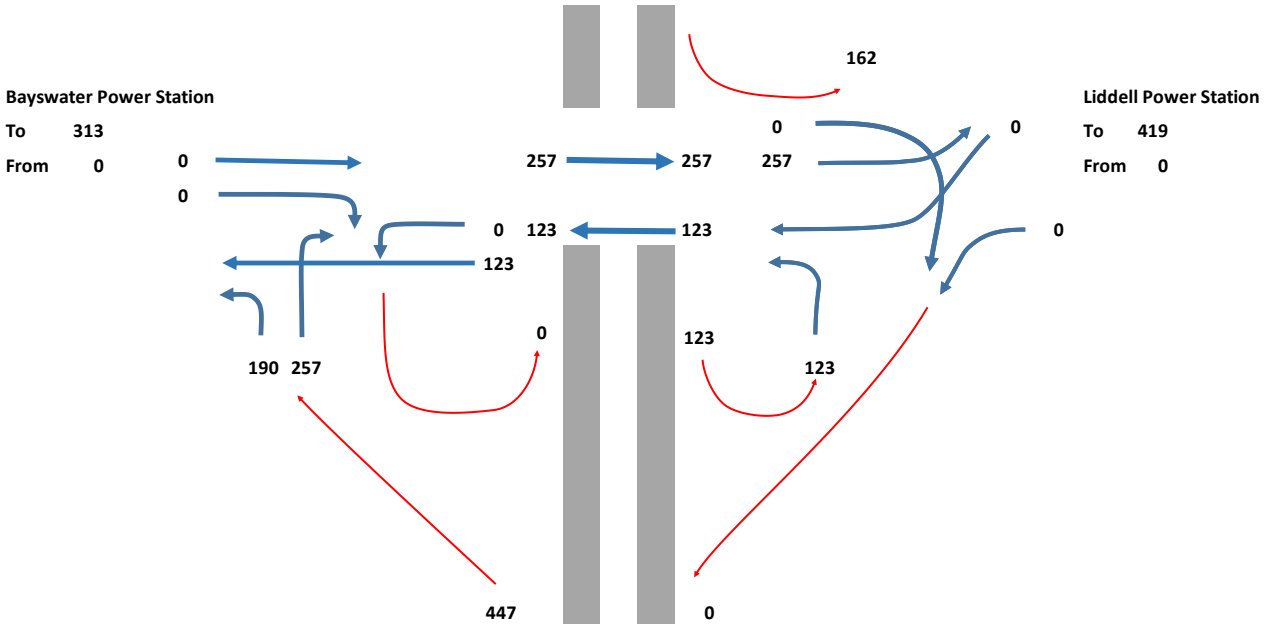


Figure 4-2 Bayswater access road cumulative morning peak hour traffic generation volumes (6:00am – 7:00am)

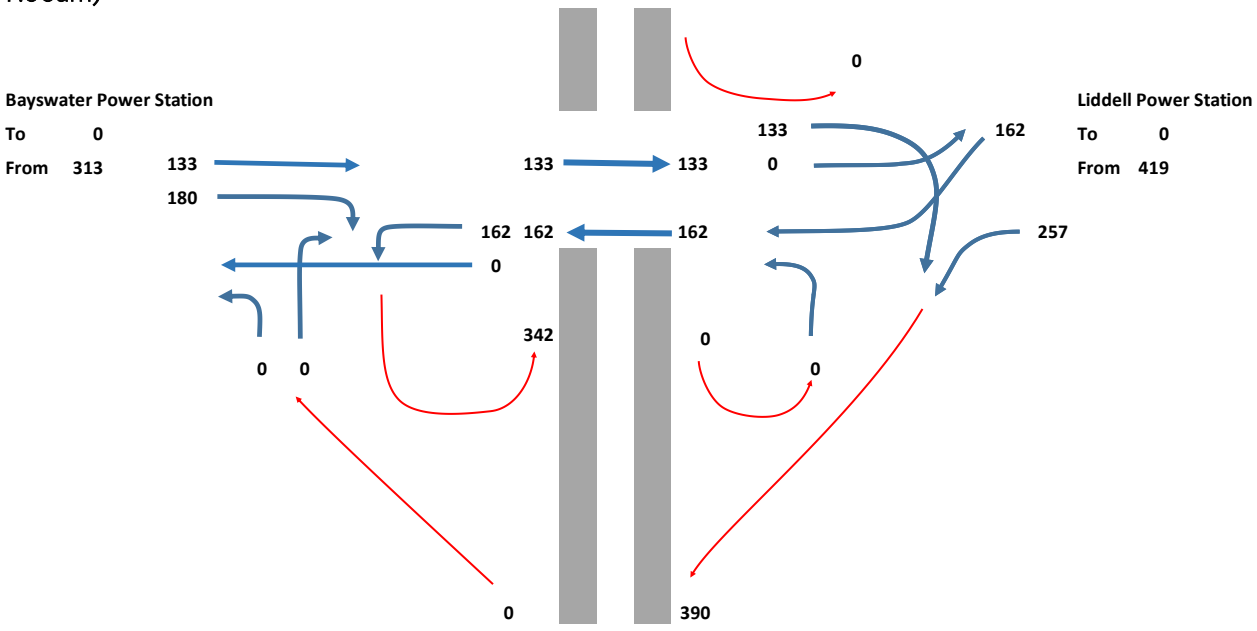


Figure 4-3 Bayswater access road cumulative evening peak hour traffic generation volumes (5:30pm – 6:30pm)

4.3 Impacts on road network performance

4.3.1 Desired level of service criteria

The criteria for evaluating the operational performance of intersections is defined in **Table 4-1** and comes from the *Guide to Traffic Generating Developments (*Roads and Maritime, 2002). For priority (sign-controlled) intersections, the criteria for evaluating the performance of intersections is based on the worst delay across all legs of the intersection during the peak hour. This average vehicle delay is equated to a corresponding level of service (**LoS**) from A (best) to F (worst). For rural roads, the desired LoS is LoS C.

Table 4-1: Level of service definitions

LoS	Average delay (seconds/vehicle)	Give way and stop signs
A	Less than 15	Good operation
B	15 to 28	Acceptable delays and spare capacity
C	29 to 42	Satisfactory, but accident study required
D	43 to 56	Near capacity and accident study required
E	57 to 70	At capacity, requires other control mode
F	Over 70	Extreme delay, traffic signal or other major treatment required

Source: Guide to Traffic Generating Developments (RMS, version 2.2, 2002)

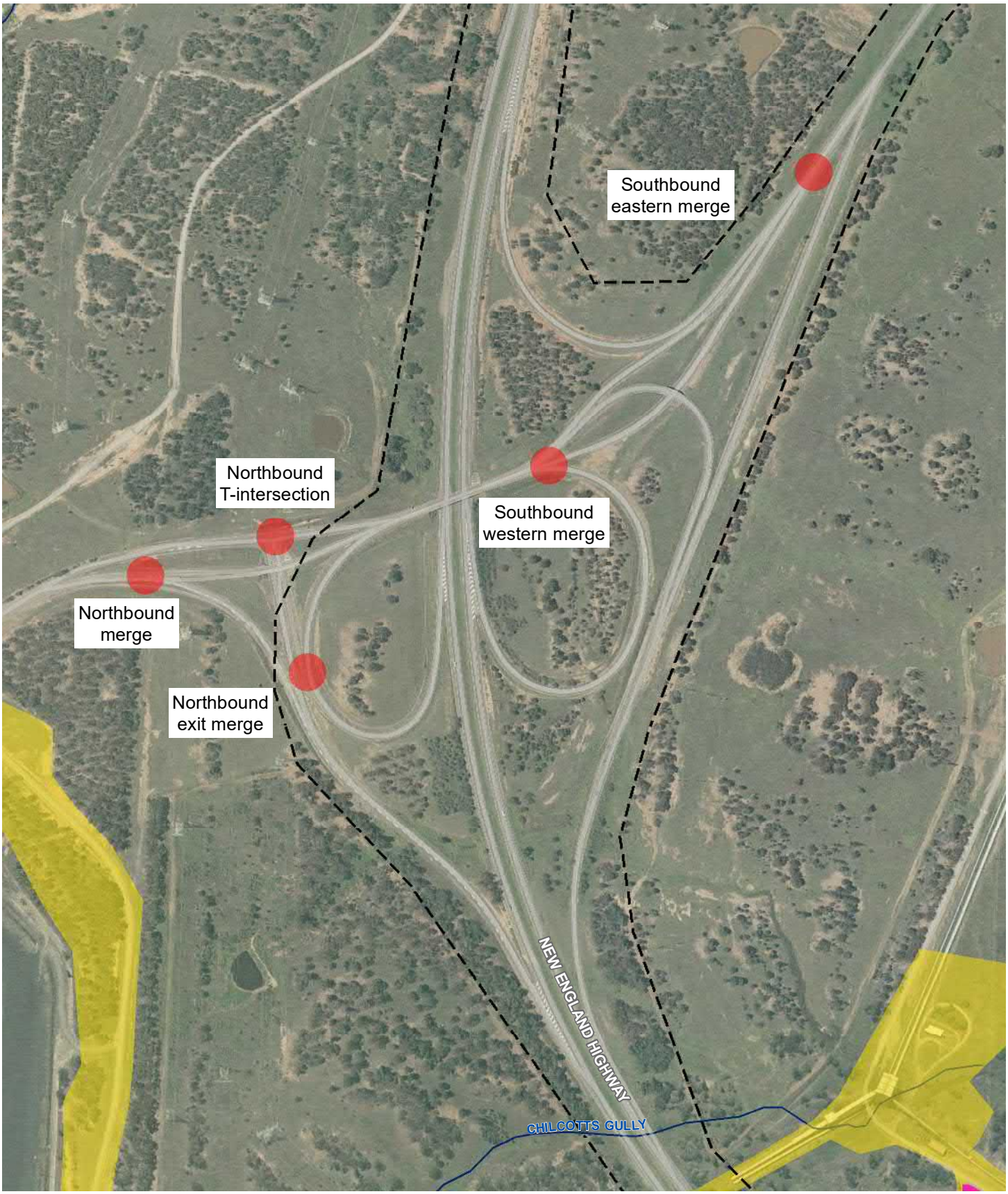
4.3.2 Intersection level of service and queue length

SIDRA Intersection 8 software was used to model the existing and project scenarios of the four key constraint intersections on the New England Highway exit ramps at the interchange. These intersections were selected to assess any potential road network performance issues at the exit ramps which had the potential to cause queue spillback onto the New England Highway. A target LoS of C was adopted for the modelled intersections as consistent with Section 4.2.4 of the *Guide to Traffic Generating Developments* (RTA, 2002).

It should be noted that this assessment is conservative as it assumes that:

- The Project and nearby developments in a given year would all occur concurrently
- All light vehicle movements would occur within one hour before shift start and one hour after shift end
- Construction traffic generation associated with the BAW would occur between commencement of the Project and 2035 as a worst-case scenario. In reality, construction is not expected to occur for the entirety of this period
- Traffic generation associated with construction and operation of Bayswater WOAOW would occur concurrently between 2021 and 2035 as a worst-case scenario. In reality, construction and operation are not expected to occur concurrently
- Traffic generation associated with progressive rehabilitation works of Bayswater WOAOW would occur concurrently with decommissioning and rehabilitation works to occur between 2035 and 2040 as a worst-case scenario. In reality, these works may not occur simultaneously.

The modelled locations are shown in **Figure 4-4** and the existing and future peak year traffic modelling results are shown in **Table 4-2**. The modelling indicates that the interchange currently operates at LoS A with abundant spare capacity. In the future peak year, the cumulative impact of the Project and nearby developments is not expected to have a large impact the operation of the interchange. This is mostly due to the grade separation of most conflicting movements and the provision of low angle merges.



Legend

Project area

Bayswater Ancillary Works

Consolidated consents

AGL owned land

Model Location

0 100 200m

1:6,000 at A4

Data sources

Jacobs 2020
© Department Finance, Services and Innovation 2019
AGL 2019

Aerial:
© Department of Customer Service 2020

GDA94 MGA56

Figure 4-4 Intersection model locations

Table 4-2: Modelled SIDRA intersection performance

Scenario	Intersection	Peak period	Degree of Saturation	Intersection delay (seconds)	LoS	Maximum queue length (m)
Existing scenario	Northbound merge	Morning peak	0.13	7.6	A	0
		Evening peak	0.02	7.7	A	0
	T-intersection	Morning peak	0.06	8.3	A	1.4
		Evening peak	0.09	9.1	A	0.2
	Western southbound merge	Morning peak	0.11	7.4	A	3.2
		Evening peak	0.02	7.7	A	0.6
	Eastern southbound merge	Morning peak	0.04	7.6	A	0
		Evening peak	0.01	7.6	A	0
Future peak year scenario	Northbound merge	Morning peak	0.24	7.7	A	0
		Evening peak	0.02	7.7	A	0
	T-intersection	Morning peak	0.28	8.5	A	8.6
		Evening peak	0.17	10.8	A	0.4
	Western southbound merge	Morning peak	0.19	7.4	A	6.4
		Evening peak	0.10	8.3	A	0.7
	Eastern southbound merge	Morning peak	0.19	7.6	A	0
		Evening peak	0.01	7.6	A	0

4.3.3 New England Highway exit ramp queue length

The length of the exit ramps from the New England Highway to the Liddell and Bayswater interchange are shown in **Table 4-3**.

Table 4-3 Exit ramp lengths

Exit ramp	Length (m)
Northbound exit ramp to merge	800
Northbound exit ramp to T-intersection	730
Southbound exit ramp to western merge	750
Southbound exit ramp to eastern merge	700

As shown in **Table 4-2**, modelled future year peak scenario queue lengths are expected to be very low and are not expected to extend into nor impact motorway operation.

4.3.4 New England Highway capacity

To assess the capacity of the motorway, Exhibit 12-4 of the *Highway Capacity Manual* (Transportation Research Board, 2010) specifies the base capacity of a freeway based on the free-flow speed and is shown in **Table 4-4**.

Table 4-4: Base capacity of a freeway

Free flow speed (km/h)	Base capacity (pcu/hour/lane)
120	2,400
113	2,400
105	2,350
97	2,300
89	2,250

Source: Highway Capacity Manual 2010

The New England Highway has two lanes in each direction. As shown in **Figure 3-3**, the peak hour traffic volume on the highway is approximately 1,037 vehicles per hour in each direction across the two lanes.

For a free flow speed of 100 km/h, the base capacity of the New England Highway is approximately 4,600 pcu per hour in each direction. This indicates that there is excess capacity to accommodate the cumulative additional traffic generation on the New England Highway without having a large impact on the operation of the highway.

4.3.5 Merge and diverge analysis

To assess the capacity of the entry ramp from the Bayswater access road to the New England Highway in the northbound and southbound directions, the *Highway Capacity Manual* specifies the LoS criteria for merge segments on a freeway. Merge LoS is defined in terms of density with a target LoS of C for rural roads and are shown in **Table 4-5**.

Table 4-5: Level of service definitions

LoS	Density (pcu/km/lane)	Comments
A	Less than 6.2	Unrestricted operations
B	6.2 to 12.4	Merging and diverging manoeuvres noticeable to drivers
C	12.4 to 17.4	Influence area speeds begin to decline
D	17.4 to 22.7	Influence area turbulence becomes intrusive
E	Over 22.7	Turbulence felt by virtually all drivers
F	Demand exceeds capacity	Ramp and freeway queues form

Source: Highway Capacity Manual 2010

As discussed in **Section 4.2.6**, as a result of the Project and nearby developments, the following total vehicles are expected to merge from the interchange to the New England Highway in the evening peak hour:

- 423 light vehicles and 14 heavy vehicles in the northbound direction
- 525 light vehicles and 40 heavy vehicles in the southbound direction.

As per Chapter 14 *Freeway Merge and Diverge Segments* of the *Highway Capacity Manual*, the calculated density on the entry ramp influence area is 6.7 and 7.5 pcu per km per lane in the northbound and southbound directions respectively, which correspond to LoS B. This indicates that there is excess capacity on the entry ramp to accommodate the cumulative additional traffic generation without having a large impact on impacting the operation of the entry ramp.

4.4 Impacts of oversized overmass vehicles

The following OSOM vehicles are expected to be generated from Port of Newcastle throughout the Project:

- Stage 1: three one-way movements to transport one new transformer to the Project site and to transport one refurbished transformer from and to the Project site
- Stage 2 onwards: up to eight one-way movements to transport up to four transformers to the Project site.

Furthermore, an additional 32 OSOM deliveries may be required including:

- Six transformer component deliveries to end of 2023
- Six transformer component deliveries between 2024 -26
- 10 deliveries of 33 kV equipment to end of 2023
- 10 deliveries of 33 kV equipment between 2024 -26.

The proposed OSOM vehicle routes from Port of Newcastle have been assessed against the *NSW OSOM load carrying vehicles network map* (TfNSW, 2020c). The *NSW OSOM load carrying vehicles network map* displays the network for eligible vehicles operating under the following Heavy Vehicle National Law notices:

- Multi-State Class 1 Load Carrying Vehicles Mass Exemption Notice 2020, which authorises the use of class 1 load carrying vehicles that are up to 5.5 m wide, 35 m long and 5 m high
- Multi-State Class 1 Load Carrying Vehicles Dimension Exemption Notice 2020, which authorises the use of class 1 load carrying vehicles that are up to 115 tonnes.

The two proposed OSOM vehicle routes from Port of Newcastle and the relevant restrictions from the *NSW OSOM load carrying vehicles network map* are described in **Table 4-6** and shown on **Figure 4-5**. It is noted that physical constraints may exist on each route and would be determined via a detailed route survey as part of a traffic management plan; for example, a 5.4 m vertical height clearance exists along proposed route 2 at the Gowrie Gates Bridge at Singleton.

Table 4-6 Proposed OSOM vehicle routes

No.	Proposed routes	Distance (km)	Restrictions
1	From Port of Newcastle: Selwyn Street, George Street, Industrial Drive, Maitland Road, New England Highway, John Renshaw Drive, Hunter Expressway, New England Highway, Golden Highway via Jerrys Plains, Denman Rd, Thomas Mitchell Drive, New England Highway and Power Station Access Road to the site	168	▪ **New England Highway between Hexham and John Renshaw Drive**: vehicles or combinations exceeding 3.5 m wide or 25.0 m long are not permitted to travel between 8:30am and sunset on weekends or a state-wide public holiday ▪ **Hunter Expressway between John Renshaw Drive and New England Highway**: vehicles or combinations exceeding 3.2 m wide are not permitted to travel from Monday to Friday from 5:00am to 9:00am and from Monday to Friday from 4:00pm to 6:00pm (except on state-wide public holidays) ▪ **New England Highway between Hunter Expressway and Golden Highway**: vehicles or combinations exceeding 3.2 m wide are not permitted to travel from Monday to Friday from 5:00am to 9:00am and from

No.	Proposed routes	Distance (km)	Restrictions
			Monday to Friday from 3:00pm to 6:00pm (except on state-wide public holidays)
2	From Port of Newcastle: Selwyn Street, George Street, Industrial Drive, Maitland Road, New England Highway, John Renshaw Drive, Hunter Expressway, New England Highway and Power Station Access Road to the site	111	▪ **New England Highway between Hexham and John Renshaw Drive**: vehicles or combinations exceeding 3.5 m wide or 25.0 m long are not permitted to travel between 8:30am and sunset on weekends or a state-wide public holiday ▪ **Hunter Expressway between John Renshaw Drive and New England Highway**: vehicles or combinations exceeding 3.2 m wide are not permitted to travel from Monday to Friday from 5:00am to 9:00am and from Monday to Friday from 4:00pm to 6:00pm (except on state-wide public holidays) ▪ **New England Highway between Hunter Expressway and Singleton**: vehicles or combinations exceeding 3.2 m wide are not permitted to travel from Monday to Friday from 5:00am to 9:00am and from Monday to Friday from 3:00pm to 6:00pm (except on state-wide public holidays)

Legend

- Point of Interest
- Restricted Structures - Bridges
- Restricted Structures - Railway Level Crossings
- Restricted Structures with Conditional Access - Railway Level Crossings

OSOM Network

- NSW Oversize Overmass Load Carrying Vehicles Network Approved Roads

- Approved Routes with Travel Conditions
- Limited Access Locations
- Route 1
- Route 2

- Railway
- Road
- Waterway
- Waterbody
- National Park
- State Forest

0 10 20 km

1:610,000 at A4

Data sources

Jacobs 2020
NSW Spatial Services 2019
AGL 2019
Transport for New South Wales 2020

GDA94 MGA56

Figure 4-5 Proposed OSOM vehicle routes

Date: 10/12/2020 Path: \\jacobs.com\ANZ\IE\Projects\04_Eastern\IS334000\22_Spatial\GIS\Directory\Templates\Figures\EIS\TrafficTransport\IS334000_TRAFFIC_F006_OSOM_r1v2.mxd
Created by : NT | QA by : KM

To manage these OSOM vehicles, a permit will be sought from the National Heavy Vehicle Regulator (**NHVR**). This permit will undergo a separate approval process and a suitable contractor will be engaged for transportation. As part of the permit, the subcontractor would develop a traffic management plan and determine the suitable route based on the required OSOM vehicle dimensions and mass in consultation with AGLM and the NHVR. These traffic movements would be undertaken at night under police escort and in accordance with any OSOM permit conditions.

The traffic management plan for the movement of these OSOM vehicles would be undertaken to identify risks and minimise impacts to the wider road network. The plan would cover:

- Identification of route
- Measures to provide an escort for the loads
- Times of transporting to minimise impacts on the road network
- Communication strategy and liaising with emergency services and police.

Due to the low number of OSOM vehicle movements, combined with the fact that these OSOM vehicles would travel outside of peak periods, it is expected that the traffic impact of OSOM vehicles on the road network would be minimal.

4.5 Impacts on road safety

As outlined in **Section 3.4**, four crashes occurred near the site in the most recent full five-year period of available data from January 2015 to December 2019. The low frequency of crashes indicates that additional traffic generation is unlikely to have an impact on future crash frequency. However, it should be noted that several crashes involved striking an animal. To mitigate this risk, personnel should be notified of the risk of collisions, particularly with animals during rain or periods of low light.

As discussed in **Section 4.3.3**, modelled future year peak scenario queue lengths are expected to be very low and are not expected to extend into nor cause safety issues on the New England Highway.

5. Mitigation and management measures

Recommended safeguards and mitigation measures to manage traffic and transport impacts of the Project's construction and operation are summarised in **Table 5-1**.

Table 5-1 Summary of environmental management measures

Ref	Impact	Mitigation measures
Detailed design and pre – Construction		
TT1	Traffic, access and transport	The haulage contractor to prepare and implement a traffic management plan for oversize vehicle movements, which would include: ▪ Identification of the routes ▪ Measures to provide an escort for the loads ▪ Times of transporting to minimise impacts on the road network ▪ Communication of strategy and liaising with emergency services and police.
TT2	OSOM vehicles	An oversized vehicle permit will be sought for all OSOM vehicle movements where required. The OSOM movements would be in accordance with the permit requirements and be outside of peak traffic periods where possible..
Construction/operation		
TT3	Road safety	The Construction Environmental Management Plan and general site induction would inform construction and operational personnel of the risk of collisions, particularly with animals during rain or periods of low light.

6. Conclusion

Jacobs has been commissioned to undertake a traffic and transport assessment of the Project. Cumulative traffic generation by the Project and nearby developments, including Bayswater WOAOW, Bayswater Turbine Efficiency Upgrade, Ravensworth Composting Facilities, Liddell Power Station closure and rehabilitation and Liddell minor shutdowns is expected to generate an additional 635 light vehicles and 46 heavy vehicles during the morning and evening peak hours.

Modelling using SIDRA Intersection 8 indicates that the interchange currently operates at excellent LoS with abundant spare capacity. The cumulative impact of the Project and nearby developments would increase delay slightly but will not have a large impact the operation of the interchange. This is mostly due to the grade separation of most conflicting movements and the provision of low angle merges. Queue lengths are expected to be very low and would not extend into nor impact the operation of the New England Highway.

The New England Highway and the northbound and southbound entry ramps from the interchange have excess capacity to accommodate the additional cumulative traffic generation.

Up to 32 two-way oversized vehicle movements are expected throughout the duration of the Project works. Oversized vehicle permits would be sought for these movements and appropriate timing and escort arrangements would be in place for these transports. It is recommended that a detailed traffic management plan for the movement of these oversized vehicles be undertaken to identify risks and minimise impacts to the wider road network.

A crash assessment found that four crashes occurred near the site in the most recent five-year period. The low frequency of crashes indicates that additional traffic generation is unlikely to have an impact on future crash frequency, but it is recommended that personnel should be notified of the risk of collisions, particularly with animals during rain or periods of low light.

7. References

RTA 2002, *Guide to Traffic Generating Developments*

TfNSW (Transport for NSW) (2020a), viewed 21 November 2020, https://www.rms.nsw.gov.au/about/corporate-publications/statistics/traffic-volumes/aadt-map/

TfNSW (Transport for NSW) (2020b), viewed 30 November 2020, https://www.rms.nsw.gov.au/business-industry/heavy-vehicles/maps/restricted-access-vehicles-map/map/index.html

TfNSW (Transport for NSW) (2020c), viewed 30 November 2020, https://www.rms.nsw.gov.au/business-industry/heavy-vehicles/maps/nsw-load-carrying-network/map/index.html

Transportation Research Board 2010, *Highway Capacity Manual*