



**PROJECT SEA DRAGON
STAGE 1 LEGUNE GROW-OUT FACILITY
DRAFT ENVIRONMENTAL IMPACT STATEMENT**

**VOLUME 5 - APPENDICES
APPENDIX 23 -TRAFFIC ASSESSMENT**



PROJECT SEA DRAGON
Legune Grow-out Facility EIS
Traffic and Transport Impact Assessment

July 2016

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1. Introduction

1.1 Overview

Project Sea Dragon Pty Ltd (PSD), a wholly owned subsidiary of Seafarms Group Limited (Seafarms), engaged GHD to undertake a traffic and transport assessment of the construction and operation of the Project Sea Dragon Stage 1 Legune Grow-out Facility in the Northern Territory.

Stage 1 is part of a wider integrated prawn production system. The proposed development comprises 1,080 hectares of production ponds and associated settlement and storage ponds, intake and discharge channels and water, sewerage, power and transport infrastructure, and facilities for people to live and work on the site.

The proposed development is located approximately 100 km north of Kununurra. The development itself is in the Northern Territory (NT) but it relies on roads through both the NT and Western Australia (WA).

During the planned project construction period from May 2017 to December 2019 the site will require consumables, construction materials, equipment, contractors and staff to travel between the project site and the nearest township of Kununurra as well as Perth¹ and Darwin. The commencement and duration of construction will be heavily influenced by wet season constraints and the provision of road infrastructure by the WA and NT Governments outside of the project footprint.

Once operational in Quarter 4 2019, the site will import fuel and feed from the port at Wyndham and prawn larvae from a purpose-built facility in the Darwin environs via road transport. Some workers will travel to and from Kununurra by bus and light vehicles. Harvested prawns will be transported to a processing facility at Kununurra and then exported from Wyndham Port.

During 2017, construction of the Grow-out Facility will require the construction traffic associated with the project to traverse the road construction activities associated with the extension and upgrading of Moonamang Road/Cave Spring Road and Legune Access Road to 2 lane sealed road standard. After 2017, construction and operations of the Grow-out Facility will be enabled by the proposed upgraded transport route which connects the site to the Weaber Plain Road and beyond to the Victoria, Great Northern and Stuart Highways.

1.2 Purpose of this report

This report analyses the construction and operational impacts of the PSD Stage 1 Grow-out Facility on the public road network, and provides recommendations for mitigation where required.

This report has been prepared to satisfy the terms of reference for the preparation of an Environmental Impact Statement (EIS) for the Stage 1 Legune Grow-out Facility issued by the NT EPA in November 2015. The terms of reference state that the traffic and transport impact assessment should:

¹ Impacts outside NT are not assessed in this report however out-of-State destinations are discussed as they are relevant to what routes vehicles will take through NT. Some WA traffic data is also referenced, where it is the closest relevant count site.

- Outline traffic management requirements during construction, including:
 - operating times and scheduling
 - vehicle types, numbers and frequency
 - the estimated volumes, tonnage, composition, origin, destination and proposed routes of traffic generated by the proposal
 - hazardous or dangerous material that may be transported
 - traffic flow management, including site access and signage
 - construction workforce transport requirements.
- Provide relevant information in respect of operational aspects of the road network and transport requirements, including:
 - routes for operational transport and estimated frequency and times of Project vehicle use on public infrastructure
 - type, size and number of vehicles required
 - ongoing provisions for road maintenance, including source and extraction of maintenance inputs and materials.

The traffic impact assessment / traffic management plan (detailing access, vehicle types, volumes of existing vehicles and increased traffic and other relevant matters, including a risk assessment) should:

- Assess the adequacy of the existing road network for the project development during the construction and operational phases of the Project, and any recommended improvement measures.
- Identify potential safety risks associated with road users, associated with increased traffic and use of the existing road networks.
- Recommend mitigation measures to be adopted to minimise the identified risks.
- Recommend detailed Construction Traffic Management Plans to be prepared prior to commencement of construction and upgrade of public roads where currently there is insufficient information available to develop a plan.

1.3 Methodology

The following tasks have been completed as part of this study:

- Review of existing conditions including road, rail, air and sea transport networks where relevant.
- Review of the proposed development in terms of location, access, and its material and workforce transport needs during construction and operations.
- Assessment of impacts on the road network and identification of potential safety risks associated with increased traffic on the public road network. This includes analysis of the amount of traffic expected and how it will use the road network. Impacts are described in terms of capacity and suitability of the transport network.
- Selection of mitigation measures to offset or reduce the identified impacts.

The Legune Grow-out facility operations spans both the NT and WA. This assessment covers the impacts on roads in the NT only.

1.4 Assumptions

- The traffic data has been provided by Project Sea Dragon and Government, and is assumed to be the best available at the time of writing the report.
- Impacts outside NT are not assessed in this report however out-of-State destinations are discussed as they are relevant to what routes vehicles will take through NT. Some WA traffic data is also referenced, where it is the closest relevant count site.
- The Western Australia Government (WAG) will be funding and managing the extension and upgrading of Moonamang Road to a 2 lane sealed standard road from the end of the existing sealed road to the WA/NT border. Construction will be undertaken in conjunction with the Project, and WAG will prepare a Construction Traffic Management Plan for this section of road.
- The Northern Territory Government (NTG) will be funding and managing the upgrading of Cave Spring Road to a 2 lane sealed standard road from the WA/NT border (end of Moonamang Road) to Legune Access Road at the property boundary of Legune Station. Construction will be undertaken in conjunction with the Project and NTG will prepare a Construction Traffic Management Plan for the construction of Cave Spring Road.

2. Existing conditions

2.1 Road network

The proposed development is located on Legune Station in the NT, approximately 100 km north of Kununurra in WA. It is near the boundary of NT and WA and as such, relies on the public road network in both states (Figure 1).

Kununurra is a small town of some 8,400 people (as recorded in the 2011 Census) located on the Victoria Highway in WA. It is approximately 106 km east of Wyndham (via the Great Northern Highway) and 830 km west of Darwin (via the Stuart and Victoria Highways).

2.1.1 Key roads within the study area

Legune Access Road

Legune Access Road is an internal property road that connects the proposed Central Facilities (and nearby Marralum Community, which is outside the Project boundary) to the southern boundary of Legune Station. This gravel road is 20.8 km long and within a Government gazetted corridor. Construction works will be required to bring it to the required road standard (i.e. a two-lane sealed rural road to match the proposed upgrading of Cave Spring Road).

Upgrades to the Legune Access Road will follow the existing Government gazetted corridor (road reserve) for nearly all of its length, except for the first 2 km where a deviation is proposed to bypass the Marralum Community. It is understood the NTG will address the land tenure issues associated with establishing a new road reserve over the deviation and closing the existing road reserve. Legune Access Road reserve is expected to be vested in the pastoral lease as a result of the Project.

Cave Spring Road

Cave Spring Road is an unsealed road section that is approximately 30 km long and connects Legune Access Road at the southern boundary with the WA border. It is currently restricted to dry-season use only due to two major waterway crossings (and numerous smaller crossings) without bridges. It is planned that the NT government will upgrade this road. Discussions with the NT Department of Transport are taking place to finalise the final upgraded road alignment so that the Marralum Community is not impacted by the increased traffic that the road will carry as a result of the Project.

Moonamang Road

Moonamang Road is approximately 27 km long and connects Cave Spring Road and the northern reaches of Kununurra via the local road network. It is currently sealed over a distance of approximately 19.6 km that provides about 40 km of sealed road from Kununurra. On this section the road has a single carriageway providing one lane in each direction. The remaining section of Moonamang Road from the end of the seal to the WA/NT border (7.4 km) is a low standard, unsealed road requiring upgrade to facilitate the project and future stage 3 of the Ord River Scheme. The upgrade of this section of the road is planned to undertaken by the WAG in conjunction with the Project.

Weaber Plain Road

Weaber Plain Road connects Moonamang Road to the Victoria Highway in Kununurra at a priority-controlled T-intersection. There are right and left turn auxiliary lanes on the Victoria Highway and a splitter island on the Weaber Plain Road approach. The first approximately 750

metres operates under a posted 50 km/h speed limit. This increases to 60 km/h and then 80 km/h as the road leaves the township and increases to 110 km/h beyond the town limits.

Ivanhoe Road

Ivanhoe Road runs approximately parallel to Weaber Plain Road between Kununurra and Ethel River. It is a good, standard two-lane, two-way sealed road with sealed shoulders. The speed limits are similar to Weaber Plain Road with 50 km/h in the town and then 80 km/h as the road leaves the township and increases to 110 km/h beyond the town limits.

Mills Road

Mills Road is a two-lane two-way road running east-west between Ivanhoe Road and Weaber Plain Road. The road is sealed and the speed limit is 90 km/h.

Research Station Road

Research Station Road is a two-lane two-way road running approximately parallel to Weaber Plain Road. It connects to Ivanhoe Road at the western/southern end and to Stock Route Road at the northern end. The road is sealed and the speed limit is 110 km/h.

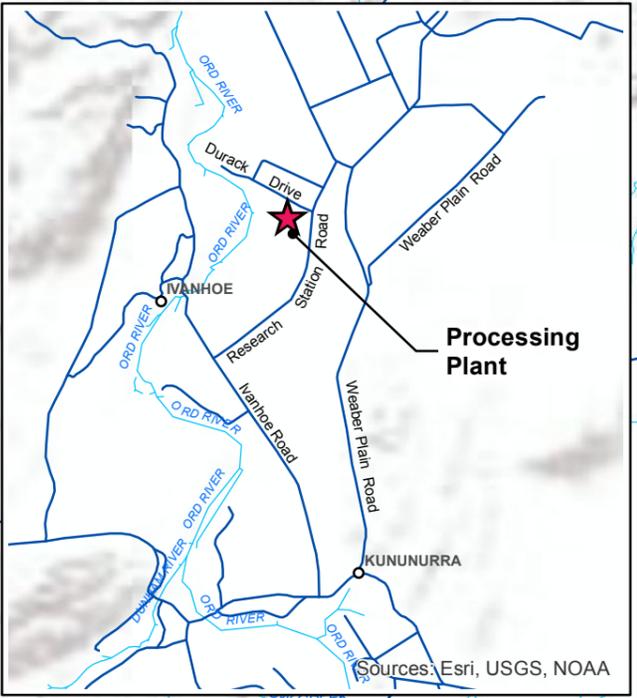
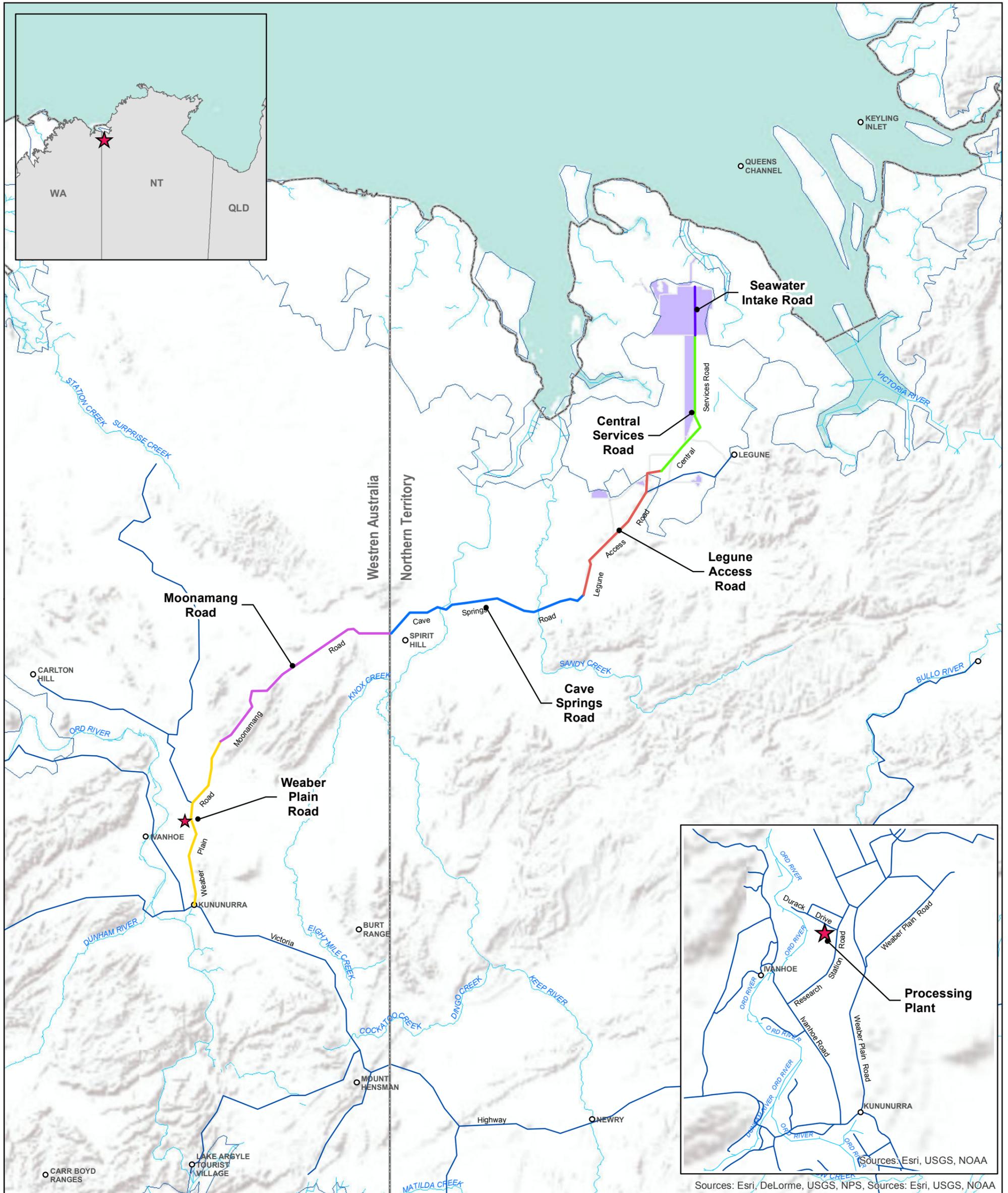
Victoria Highway

The Victoria Highway (National Route 1) is a national highway that links the Stuart Highway at Katherine in the NT to the Great Northern Highway (National Route 1) in WA. It has a single carriageway with one lane in each direction. The posted speed limit is generally 110 km/h in WA and 130 km/h in NT, with lower limits applying over the Ord River dam and through the built up areas of Kununurra.

Great Northern Highway (Victoria Highway to Wyndham)

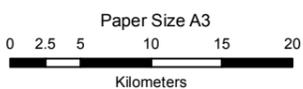
The Great Northern Highway links the Victoria Highway with Wyndham and its port. It has a single carriageway with one lane in each direction. The posted speed limit is generally 110 km/h with lower limits applying in Wyndham.

These roads are shown in Figure 1.



- LEGEND**
- Localities
 - Roads
 - Watercourse
 - Works Footprint

DRAFT



Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 52

Project Sea Dragon Pty Ltd
Project Sea Dragon

Job Number 43-22380
Revision A
Date 12 Jul 2016

Existing Road Network

Figure 1

2.1.1 Traffic volumes

The nearest traffic count site monitored by the NT Department of Transport (DoT) is located on the Victoria Highway, 24 km west of Timber Creek (RKVDP010). This site carried an average annual daily traffic volume (AADT) of 232 vehicles per day (vpd) in 2014. Since 2005, the volume has varied from 192 to 249 vpd, with an average linear growth rate of 2% per annum (5 vpd per year).

The pattern throughout the year is seasonal, as illustrated in Figure 2. The average daily volume (ADT) in each month varies from around 100 vpd (40% of the AADT) in January and February, up to 412 vpd (178% of the AADT) in July.

Data from count sites monitored by Main Roads WA is summarised in Table 1.

Figure 3 is a map of the count data in WA. Data for Weaber Plain Road/Moonamang Road is not available, but is likely to be in the range of 300 to 1,000 vpd, based on the data in Table 1.

The rural sections of both the Victoria Highway and the Great Northern Highway carry volumes in the order of 300 to 700 vpd including around 70-100 heavy vpd. Traffic volumes increase in the built up area of Kununurra, which reflects more intense land use and a greater degree of local trip making.

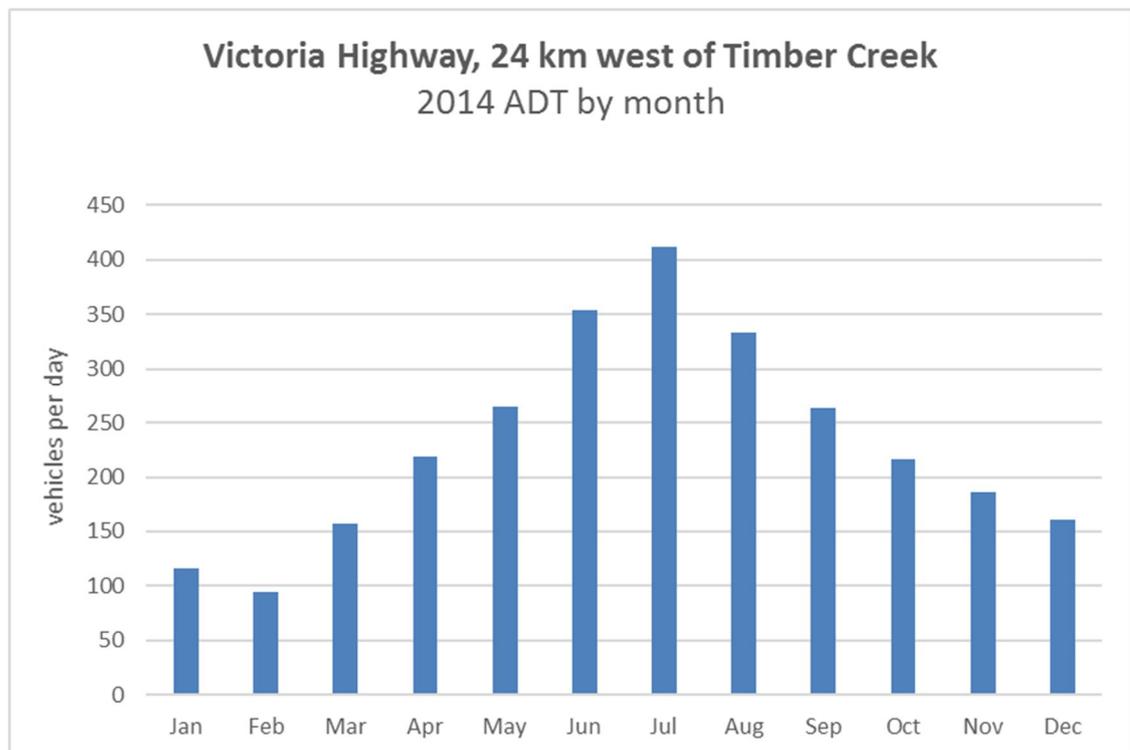


Figure 2 Seasonal traffic pattern

Table 1 Traffic count data (WA)

Site no.	Count Site	2015 AADT (vpd)	% Heavy vehicles (heavy vpd)
1	Great Northern Highway, south of Gibb River - Wyndham Road	304	24 (73)
2	Great Northern Highway, south of Victoria Highway	397	30 (120)
3	Great Northern Highway, west of Foreshore Road	602	16 (96)
4	Victoria Highway, east of Great Northern Highway	705	15 (106)
5	Victoria Highway, east of Messmate Way	2,781	15 (417)
6	Victoria Highway, north of Lake Argyle Road	349	23 (80)

2.1 Rail network

The nearest rail line to the site connects Darwin to South Australia via Alice Springs, more than 450 km from Kununurra. Rail is not a feasible transport option for this project and hence, this assessment does not consider rail further.

2.2 Sea transport

The nearest port facilities are located at Wyndham, approximately 100 km west of the Legune Central Facilities site, and some 830 km east of the Darwin environs. Sea transport demand for the construction and operational phases of the Project will only have a minor impact on the Wyndham and will not be considered further.

2.3 Air transport

The nearest airport to the site is East Kimberley Regional Airport at Kununurra. Two airlines offer flights from here to Broome, Darwin, and Perth.

Legune Station currently has a 1000 m long x 23 m wide unsealed airstrip for light planes only. This may be upgraded to a 1600 m x 30 m wide airstrip, plus navigational aids, to allow up to Beechcraft 1900D aircraft size to utilise it for some passenger and freight transfer between Darwin and Legune and any emergency services.

Air transport demand for the construction and operational phases of the project will only be related mostly to passenger transport and will be able to be catered for by air services and the existing airport facilities.

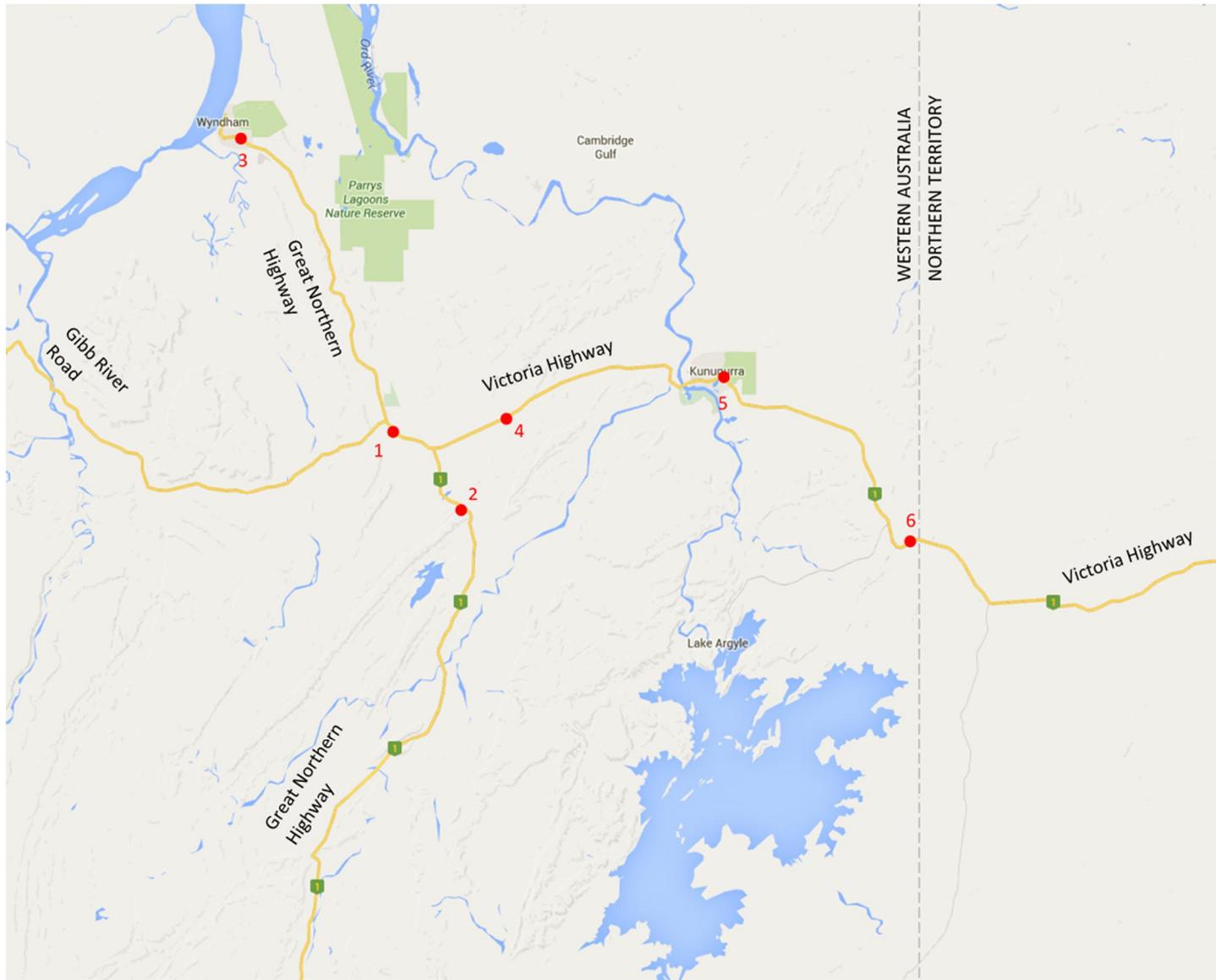


Figure 3 Traffic Volume Map

3. Proposed development

3.1 Overview

The Stage 1 Legune Grow-out Facility (herein referred to as “the Grow-out Facility”) is part of an integrated Black Tiger prawn production system. The proposed development at Legune comprises:

- Three prawn farms occupying 1,080 hectares (ha) of productive pond area
- Sea and fresh water canals, intake structures, a pump station, treatment ponds and wetlands
- Power generation facilities
- Gas and fuel storage
- A central accommodation village and distributed on-farm accommodation
- The Central Facilities area, where harvested prawns will be transferred to highway trucks for transport to Kununurra
- A network of sealed and unsealed access roads

Production of approximately 12,000 tonnes per annum of prawns is expected when Stage 1 reaches full capacity.

The wider prawn production project includes ancillary facilities located elsewhere in NT and WA. These facilities and the transport relationships between them at the Grow-out Facility are:

- A core breeding centre (CBC) and broodstock maturation centre (BMC) at Bynoe Harbour, south-west of Darwin
- A commercial hatchery (HAC) in Darwin Environs supplying prawn larvae (PL) to the central grow-out facility at Legune
- A processing plant at Kununurra to take harvested prawns from the grow-out facility
- A port at Wyndham and / or Darwin to take processed prawns to market

Temporary facilities during construction are proposed including a temporary accommodation village at Kununurra to house construction workers before the accommodation facilities at Legune are established.

This traffic and transport assessment relates to the traffic generated by the Stage 1 Grow-out Facility only. Other facilities and future stages of development beyond the estimated production for stage 1 are subject to separate approval processes.

Construction is proposed to start in May 2017 and be complete by December 2019. The first delivery of prawn larvae would be November 2019 and the first harvest would follow in March 2020.

3.2 Location and vehicle access

3.2.1 External vehicle access

Weaber Plain Road, Moonamang Road, Cave Spring Road and the Legune Access Road form the route between Legune station and Kununurra, as shown on Figure 1. The NT Government has proposed to upgrade the Cave Spring Road.

The proposed standard is understood to be:

- Two 3.5 m wide traffic lanes
- Sealed width of 8.0 m
- Carriageway width of 9.0 m
- Design speed of 110 km/h
- Design vehicle A-triple

Together with the upgrading of Legune Access Road to a similar standard (i.e. carriageway width of 8 m and sealed width of 7.5 m), this will create a sealed, rural, secondary, local road standard corridor between Kununurra and the Central Facilities area on site.

Ivanhoe Road and Mills Road will be used to bypass the town to ensure that heavy truck traffic does not enter the town itself.

3.2.2 Internal vehicle access

A network of link roads and farm roads will connect Central Facilities to the various activities on the grow-out facility site. The central service road forms the spine of this network. The traffic on this road will be harvest trucks; feed trucks; fuel supplies; trucks carrying PL stock, and light vehicles for personnel, maintenance, supplies and consumables.

The total length of the central service road will be 32.4 km long when measured from the Central Facilities to the northern end of the seawater intake channel on Forsyth Creek.

It will be a two-lane, two-way carriageway from Central Services to the northern-most farm entry. From there to the northern end of the seawater intake channel it may reduce to a single lane access road.

The design of any one-lane section will consider safe stopping sight distance for heavy vehicles. If the carriageway is not wide enough for two vehicles to pass, then intermittent passing bays will be provided. As the one-lane roads will be used for construction, maintenance and periodic inspection only, access will be controlled by radio and GPS tracking.

The two-way carriageway sections will have the same carriageway provisions as the Legune Access Road but will have an 80 km/h operating speed limit. The design vehicle for this road, up to each farm gate, will be B-Double trucks, principally for feed and fuel distribution.

B-Doubles will be provided with an off-loading bay outside each farm gate, a parking area and a turning circle.

Inside the farm gate, minor roads will connect the farm services area, the ponds, pump stations and all areas requiring operations and maintenance access. These will be unsealed all-weather roads with the following design criteria:

- Largest vehicle type: triple road train
- Trafficable widths: 3.0 m for minor bunds (on 5 m crest width); 4.0 m for feed delivery and harvest access (on 6 m crest width);
- Maximum axle loading: will be to the statutory load limits; and
- Design speed: 80 km/h.

4. Impacts on the road network

4.1 Traffic generation

4.1.1 Construction phase

Materials, equipment, and people will require transport to and from the site to enable construction of the on-site village and facilities, buildings, ponds and channels, access roads, structures and other service infrastructure.

Construction is expected to commence in the dry season 2017 and be complete by December 2019. The upgrades of Moonamang Road (by the WAG) and Cave Spring Road (by the NTG) are expected to start around the same time, in June 2017. The timeframes and construction sequencing of these two projects is not known at this point in time. The new roads will not be ready in time for the start of the Project's construction phase. The Construction Traffic Management Plan (discussed further later in this report) will need to demonstrate how access to the site will be achieved using the existing network and/or purpose-built construction access tracks.

The Proponent has provided information about the number, type, origin and destination of vehicle movements expected during the construction phase. These relate only to construction activities associated with Project Sea Dragon. Separate assessments are expected to be prepared by the NTG and WAG for their road construction projects.

In total, some 10,880 vehicle movements (5,440 inbound and 5,440 outbound) are expected over the 32-month construction period. The composition of construction traffic by vehicle type is summarised in Table 2.

Figure 4 summarises how these total monthly vehicle movements vary over the 32-month construction period. The majority of construction activities will occur during the dry season from May to October.

Table 2 Total construction vehicle movements by vehicle type

Vehicle Type	Vehicle Movements	%
Light Vehicle	5,810	53
Bus (26 or 53 seater)	1,228	12
10 T truck	100	1
20 T truck	880	8
Semi-Trailer	1,614	15
Double Semi-Trailer	40	0.4
Dump Truck	8	0.1
Low-Loader	788	7
Triple Train	408	3.5
Rigid Truck	4	0.04
TOTAL	10,880	100
TOTAL LIGHT	5,810	53

TOTAL BUS	1,228	12
TOTAL HEAVY	3,842	35

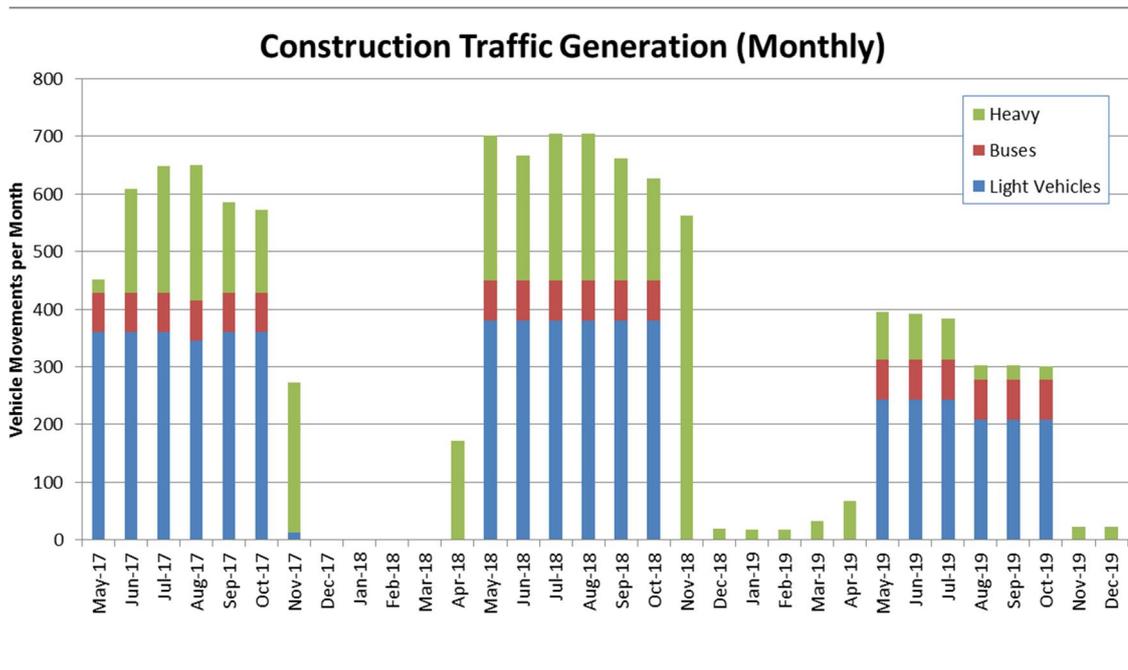


Figure 4 Monthly traffic generation by vehicle type

The graph shows that total construction traffic and total heavy traffic peak in the second year (2018), when a maximum of 700 vehicle movements per month is expected. There is one month (November 2018) when heavy vehicle volumes alone reach 560 vehicle movements per month. A concentration of demobilisation activities associated with road building and earthworks causes this one-off peak. More typically, heavy vehicle volumes reach 250 movements per month during the busiest year.

Figure 5 below converts these monthly movements into average daily totals. This takes account of the proposed six-day working week, with no activities other than staff recreation trips on Sundays. The resulting average daily traffic generation during the busiest year is up to 30 vpd during the dry season 2018. Typically, this comprises up to 10 heavy vpd. During the one-off heavy vehicle peak in November 2018 this reaches 22 heavy vpd.

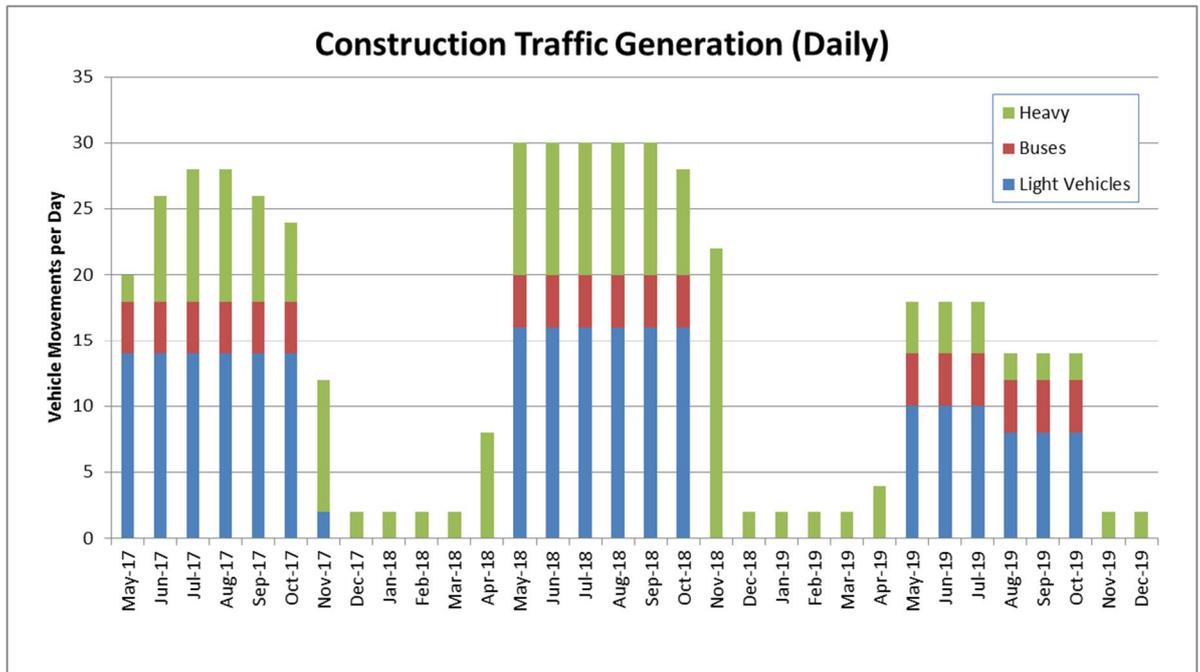


Figure 5 Daily traffic generation by vehicle type

All traffic would use the Weaber Plain Road - Moonamang Road - Cave Spring Road route and Legune Access Road (or an alternative network of construction access tracks) to connect with the grow-out facility and return, and then distribute to or from the wider network at that point. Travel from the point of origin includes travel on the public road network to and from Darwin, Perth, Queensland, the Pilbara and Kununurra and therefore requires assessment.

The vast majority (99%) of light vehicle and bus movements (associated with contractor mobilisation, contractor travel, and staff travel) will be between Legune and Kununurra only.

The distribution of heavy vehicle movements is wider and is summarised in Table 3. The main origin and destinations of heavy vehicle construction movements are Darwin (45%), Kununurra (24%) and Perth (19%). The incremental traffic volumes on different sections of the road network are summarised in Section 4.1.4.

Table 3 Total heavy vehicle construction movements by origin/destination

Origin/Destination	Total Heavy Vehicle Movements	% of Total
Darwin	1,740	45
Perth	730	19
Pilbara	376	10
Stuart Highway (South)	16	0.5
Kununurra	928	24
Not known	52	1.5
TOTAL	3,842	100

4.1.2 Operational phase

Post-larval prawns which weigh less than 0.01 grams will be transported from the commercial hatchery, located in the Darwin environs, to Legune by truck. The juvenile prawns are transported in self-contained tanks. Each 5000 L tank holds approximately 2.7 million PLs which is the requirement to stock a single pond.

Prawns are fed a formulated feed diet. Bulk bags of feed will be transferred from Wyndham to Legune using Tautliners of road train (75 bulk bags with 80 tonne payload) or B-Double (40 bulk bags with 80 tonne payload) depending on the transport market. The annual tonnage of feed to be transported to Legune will be approximately 20,000 t.

Prawn harvest involves draining each pond via the outlet structure before depositing the prawns into an ice slurry. The ice slurry preserves the prawns for transport to the Processing Plant in Kununurra. Harvests will be staggered in time across the different ponds and farms. This enables targeting of specific prawn sizes and smooths out the peak workforce, infrastructure and supply chain requirements. Terminal harvest (total drainage of the pond), partial harvest (up to 50% of the pond water being drained), or a combination will occur on 276 days of the year. Within the site, harvest trucks (8 tonne flatbed) will transport prawns between the ponds and central facilities. A fleet of refrigerated Pantech trucks will transport the harvest to the processing facility at Kununurra, from where they will leave for port at Wyndham.

The workforce is constant through the year and travels by bus from Kununurra. Diesel requirements for operations and for power generation will be transported from the Port at Wyndham via road train to site.

The traffic generation of harvest and non-harvest operational activities is summarised in Table 4.

Table 4 Annual operational traffic generation

Input / output	Annual volume required	Deliveries (one-way)	Round trips per annum	Annual vehicle movements (one-way)	Vehicle type
Diesel	19.5 million litres/year	3 per week	156	312	Quad road train, Wyndham-Legune
Feed	19,400 tonnes/year	243 per year	243	486	Triple Tautliner, Wyndham-Legune
Post larvae	505 M/year	1 every second day	156	312	Triple Tautliner, Darwin-Legune
Processed prawns	Not stated	222 per year	222	444	Triple road train, Kununurra to Wyndham
Workforce	Not stated	14 per week	728	1,456	10-seater bus, Kununurra-Legune
Harvested prawns	13,980 tonnes/year	3,177 loads per year	3,177	6,354	Refrigerated Pantech Legune-Kununurra

The expected average daily traffic generation from regular operations is:

- 1-2 vpd transporting processed prawns between Kununurra and Wyndham
- 6 vpd in bus movements to transport workers
- 4 vpd associated with regular operations not affected by harvest (i.e. diesel, feed, juvenile prawns).

Daily generation from harvesting activities is more variable. The peak is 32 vpd during a combination of partial and terminal harvests. This occurs on 108 days of the year. During terminal harvests (96 days each year) and partial harvests (72 days per year) there are 24 vpd and 8 vpd respectively. There is no harvesting activity on 88 days of the year.

4.1.3 Traffic generation summary

The expected operational traffic generation (excluding the 1-2 daily movements generated between the processing plant at Kununurra and the port at Wyndham) is summarised in Table 5.

Daily volumes have then been converted into hourly volumes using the generally accepted rule of thumb relationship that the peak hour volume is about 10 % of the daily volume. Construction and industrial activities typically differ as they can have more concentrated arrival and departures peak associated with the start and end of the working day. In this case, it is conservatively estimated that the peak hour of activity could be up to one third of the daily total.

Table 5 Daily and peak hour traffic generation summary

Phase	Light (vpd)	Bus (vpd)	Heavy (vpd)	Total (vpd)	Peak Hour (vph)
Construction	16	4	10	30	10
Operation – no Harvest	-	6	4	10	4
Operation – during Harvest	-	6	36	42	14

Note that the harvesting of prawns typically occurs at night.

4.1.4 Traffic generation by road section

Construction and operational traffic generation by road section is presented in Tables 6, 7 and 8 below.

Unlike operational traffic, construction traffic (Table 6 and Table 7) does not have a consistent composition and directional pattern. Table 7 presents the total construction loading on each route. Table 8 gives the peak traffic generation, by vehicle type, at any stage of operation. These individual peaks will not necessarily occur at the same time (i.e. the day on which there are 22 heavy vehicle movements will not also have the peak of 16 light vehicle movements) so these tables show the worst-case impact on each road section, at any time.

Table 6 Total construction traffic movements (in 32 months) by road section

Road	Section	Light	Bus	Heavy
Weaber Plain/Moonamang/Cave Spring/Legune Access Roads	Legune to Kununurra	5,810	1,228	3,842
Victoria H/way	East of Kununurra	-	-	1,756
Victoria H/way	West of Kununurra	80	-	1,106
Great Northern H/way	North of Victoria H/way	-	-	-
Great Northern H/way	South of Victoria H/way	80	-	1,106

Table 7 Daily construction traffic movement by road section in the busiest month (November 2018)

Road	Section	Light (vpd)	Bus (vpd)	Heavy (vpd)
Weaber Plain/Moonamang/Cave Spring/Legune Access Roads	Legune to Kununurra	16	4	22
Victoria H/way	East of Kununurra	-	-	18
Victoria H/way	West of Kununurra	2	-	10
Great Northern H/way	North of Victoria H/way	-	-	-
Great Northern H/way	South of Victoria H/way	2	-	10

Table 8 Daily operational traffic movements by road section

Road	Section	Light (vpd)	Bus (vpd)	Heavy (vpd)
Weaber Plain/Moonamang /Cave Spring/Legune Access Roads	Legune to Kununurra	-	6	36
Victoria H/way	East of Kununurra	-	-	2
Victoria H/way	West of Kununurra	-	-	6
Great Northern H/way	North of Victoria H/way	-	-	6
Great Northern H/way	South of Victoria H/way	-	-	-

The contribution to the road network as a result of the Project construction and operation is summarised below.

- 4-6 bus movements per day are expected on the route between Legune and Kununurra during the construction and operational phases.
- The proposal adds 16 light vpd to Weaber Plain/Moonamang/Cave Spring/Legune Access Roads during construction. During the operational phase, light vehicle demand is negligible.
- During construction, heavy vehicle volumes between Legune and Kununurra peak at 22 vpd, noting that this is a one-off peak month for heavy movements, and the regular average is 10 vpd).
- Construction activities add up 10-18 heavy vpd contribution to the Victoria and Great Northern Highways, associated with materials and equipment moving between Legune, Darwin and Perth/Pilbara.
- During the operational phase this increases to 36 heavy vpd contribution when harvesting activities are at their peak. Most of this is concentrated between Legune and Kununurra. Lower regular demands continue west to Wyndham (6 vpd) and east to Darwin (2 vpd).

4.2 Traffic impacts on the road network

4.2.1 Road Capacity

Table 9 presents an assessment of the capacity of the existing road network. Count sites 4, 5 and 6 from Table 1 and Figure 3 are used as they are the closest to the site, and they represent the range of traffic volumes carried by roads in the area.

The assumptions used in this assessment are:

- The ADT in the peak month of the year is 180% of the AADT (based on the analysis at Section 2.1.1).
- Peak hour volume (two-way) is 10% of the daily total
- Up to 65% of the peak two-way volume could be travelling in one direction in one lane
- The typical capacity of a one-way traffic lane in uninterrupted flow conditions is 1,800 vph (Austroads Part 2, Traffic Theory).

This analysis shows that at the busiest times of the year, the roads around the site are currently operating at no more than 18% of their capacity (i.e. before the addition of Project traffic).

The analysis summarised in Table 5 shows that during the construction phase, the proposed development is expected to generate up to 10 vph. During the operational phase it is expected to generate up to 14 vph during harvest. Table 9 shows that there is more than adequate available capacity in the surrounding road network to accommodate this level of activity and no capacity mitigation is required.

Table 9 Road capacity assessment

Site	Road	Existing AADT	Peak Month ADT	Peak Hour (vph, two-way)	Peak Hour (vph, one-way)	% capacity used
4	Victoria Highway, east of Great Northern Highway	705	1,269	127	82	5%
5	Victoria Highway, east of Messmate Way	2,781	5,006	501	325	18%
6	Victoria Highway, north of Lake Argyle Road	349	6286	63	628	2%

4.2.2 Within Kununurra

The intersection of Weaber Plain Road and the Victoria Highway is on an established truck access route. It is of a suitable standard for heavy vehicle movement and has auxiliary turning lanes to minimise disruption to through traffic. The addition of up to 14 vph travelling through this intersection going to and from different directions would add 3-4 vph to the turning movements at this intersection, if all the development traffic travels through it (some may distribute to other parts of Kununurra). Such changes would create negligible impact. They would be within the normal day-to-day variation in traffic volumes and are not likely to materially affect delays and queue lengths for existing road users.

4.2.3 Victoria Highway

The Victoria Highway and connecting highways are established heavy vehicle routes. The addition of up to 10-18 vpd (Table 7) to routes that carry 350 vpd to 2,780 vpd (Section 2.1.1) and operate at no more than 18% (Table 9) of their capacity in peak season is not expected to have any material effect on safety, operational efficiency, or the performance of intersections along these routes.

It is noted that triple road trains currently use the intersection of Victoria Highway and Ivanhoe Road, so no upgrades will be necessary.

4.2.4 Kununurra to Legune Route

During construction, heavy vehicle volumes between Legune and Kununurra peak at 22 vpd (noting that this is a one-off peak month for heavy movements, and the regular average is 10 vpd). During operation, heavy vehicle volumes between Legune and Kununurra peak at 36 vpd.

This projected change is negligible. It would be within the normal day-to-day variation in traffic volumes and is not likely to materially affect delays and queue lengths for existing road users.

Upgrading and forming of new roads is proposed to ensure that the entire route from Kununurra to the Project Central Facilities is constructed to the NT DoT sealed rural secondary local road standard. This provides a corridor of appropriate standard and capacity to accommodate the operational needs of the proposed activity, and will mitigate the impacts of increased light and heavy vehicle demands on the route.

These projects are all planned to start construction around May/June 2017. Therefore, access to the Project site will be required before the roads are upgraded and will be via existing roads

and/or purpose-built construction tracks, Construction traffic will need to be addressed in the Construction Traffic Management Plans for each of the project along the transport route.

4.2.5 Other potential road impacts

Road surface conditions

The addition of 18 vpd on the National Highway network is not expected to have a material impact on the life of road pavement. It may have an effect on the lower level roads in the hierarchy, depending on what heavy vehicle loading their pavements have been designed to carry. It is recommended that the Construction Traffic Management Plan address the monitoring of pavement conditions and remediation of any damage that occurs as a result of additional heavy vehicle loading.

Access to emergency and other essential services

The upgrading of the Legune to Kununurra route to an all-weather and two-way carriageway significantly improves access to Legune for all vehicles including emergency and essential services. The traffic generation associated with the proposal is not expected to adversely affect the accessibility of the area for emergency and essential services.

Road closures

The upgrading of the Legune to Kununurra route and specifically the upgrading of bridges and culverts to create an all-weather route significantly reduces the frequency of road closures in this area. With the all-weather route in place, the proposed activity is not expected to impact or be impacted by road closures.

5. Mitigation of impacts

5.1 Access road

The only off-site transport mitigation identified is a suitable standard transport connection between Legune Station and the existing sealed section of Moonamang Road. Improvements to individual intersections to accommodate road trains may also be needed; and this will be addressed in the construction and operation traffic management plans but is unlikely due to traffic generated by the Project.

The NTG is proposing to upgrade Cave Spring Road from the NT/WA border to the Legune Access Road including access to Marralum Community. The Proponent will be responsible for the balance of the route (Legune Access Road) to the Central Facilities in the NT and this will be constructed to a suitable standard for the expected use.

The WAG is proposing to upgrade Moonamang Road from the end of the existing sealed road to the WA/NT border to the 2 lane sealed road standard.

The proposed 8.0 m sealed two-way carriageway will be adequate to carry the expected construction and operational traffic demands and protects the opportunity for future growth.

5.2 Traffic management plan

Detailed Construction Management Plans will be prepared for all sections of the transport route identified for upgrading from the current low standard unsealed road standard to the 2 lane sealed road standard following detailed design and prior to commencement of construction.

6. Conclusions

This report has analysed the impact of the proposed Project Sea Dragon Stage 1 Grow-out facility at Legune on the local and supporting national highway network.

The proposed development is located approximately 100 km north of Kununurra. The development itself is in the Northern Territory but it relies on roads through both Northern Territory and Western Australia.

Construction is expected to start in May 2017 and be complete by December 2019. The first harvest is anticipated in March 2020.

Access to the site is via single route made up of Weaber Plain Road, Moonamang Road, Cave Spring Road and Legune Access Road. This route is currently sealed for approximately the first 40 km from Kununurra but transitions to an unsealed track beyond that. The NTG, WAG and the proponent have proposed to upgrade the whole route to a two-lane sealed surface.

The proposed development will import prawn larvae from Darwin and fuel and feed from Wyndham via the Victoria Highway. Harvested prawns will be transported to Kununurra for processing and then exported via Wyndham.

Traffic generation estimates for the construction and operational phases have been made based on truck movement and production information provided by the Proponent. The forecast total generation of 30 vpd and 42 vpd during construction and operation respectively indicated that the proposed operation is likely to result in low impacts on the existing road network.

The existing public road network from the sealed section of Weaber Plain Road south is assessed as adequate to accommodate the proposed development traffic generation. No mitigation is proposed to Weaber Plain Road or the National Highway network.

A sealed two-way road is to be provided between this point and the site's central facilities, by a combination of the NTG, WAG and the Proponent. This connection in combination with the internal transport corridors and traffic management plan are assessed as adequately mitigating the transport impacts and risks of the proposal.

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